

**Artificial Bee Colony based Fisheye State Routing dissemination  
Technique**

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*Submitted in partial fulfillment of the requirements for the award of degree of*

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In

**Computer Science and Applications**

*Submitted By*

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## CERTIFICATE

I hereby certify that the work which is being presented in the thesis entitled, “*Artificial bee colony based Fisheye state routing dissemination technique*”, in partial fulfillment of the requirements for the award of degree of Master of Technology in *Computer Science And Applications* submitted in Computer Science and Engineering Department of Thapar University, Patiala, is an authentic record of my own work carried out under the supervision of *Dr. Rajesh Kumar* and refers other researcher’s work which are duly listed in the reference section.

The matter presented in the thesis has not been submitted for award of any other degree of this or any other University.



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This is to certify that the above statement made by the candidate is correct and true to the best of my knowledge.



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## ABSTRACT

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It is seen that in the few upcoming years, it is noticeable that road accidents are increasing. For this real time traffic information's like road accident notification, warning messages etc are disseminated by mobile vehicles. A possible way to prevent mis-happening is to use safety applications which exchange information using wireless networks. Each vehicle can thus actively participate in sharing the information with other nodes which involved in forming a infrastructure-less, self-organizing network. So, improving in road safety is a strong matter of analysis and interest. The use of VANETs for the dissemination of data flows has gained attention. For this vehicle-to-vehicle communication are employed. For the efficient networking of packet among vehicles on highways, it is necessary to implement efficient algorithm.

Main reason to disseminate safety message is to inform early, so that drivers can take effective decision. For efficiently disseminating safety messages an Efficient FSR(Fisheye State Routing) protocol is used. Fisheye State Routing (FSR) protocol improves conventional Link State routing in VANETs by adopting the idea of Artificial bee colony (ABC). In this paper, we proposed an effective ABC based Fisheye State Routing. This methodology is advantageous of less control message exchange by abandoning the exhausted food source. A next forwarder is elected on the basis of fitness value and that node is the node in the region which further disseminate the message to nodes of next region. Considerable amount of bandwidth can be saved using this methodology. Simulation Results shows that ABC based FSR is more effective and optimized than FSR, specially in high density network.

## LIST OF ACRONYMS

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VANET	Vehicular Ad hoc Network
ITS	Intelligent Transport System
OBU	On- Board Unit
TPD	Temper Proof Device
RSU	Road Side Unit
DSRC	Dedicated Short Range Communication
WAVE	Wireless Access Vehicular Environment
LSR	Link State Routing
FSR	Fisheye State Routing
LSP	Link State Packet
ABC	Artificial Bee Colony
TT	Topology Table
NT	Next Hop Table
DT	Discrete table

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# CHAPTER 1

## Introduction

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Improvement in road safety is a strong matter of analysis and interest. A possible way to prevent mishappening is to use safety applications which exchange information using wireless networks. The desire for in-vehicle entertainment is growing strong as more and more population is using cars. With recent progress in wireless communication technologies and computing, networks that support the requirements for this kind of approach can be visualized. The continuous moving system requires no or little infrastructure. Such systems support multi-hop topology. These ad-hoc networks have various features as restricted bandwidth, dynamic topology, and limited power constraint and so on. As MANET is an independent system therefore the mobile nodes involved in this system can be targeted on airplanes, trucks, ships or cars. So we can say, vehicle ad-hoc networks (VANETs) are the modified version of mobile ad hoc networks. They can be established within vehicles (V2V) communication or between vehicles and infrastructure (V2I) communication. As on roads, count of number of cars is always high. So, sometimes V2V communication is also known as car to car communication. For improving road safety issues, these VANETs provide a big platform.

VANETs have various features that differentiate it from MANETs. Highly movable nodes (vehicles) in VANETs, and there is no guarantee of point-to-point delay and no restriction on power and storage. However, even VANETs have dynamic topologies and are not fully arbitrary. The motion of vehicles is mostly known as it is confined to the road where the vehicle travels. This has various pros and cons. The predictability of the location of a vehicle permits an enhancement in transmission. The bandwidth problem also occurs due to crossings or junction, the existence of productions around the roadway, traffic jam especially in metropolitan scenarios. VANETs have the great capability to expand to a very huge scale of network. For example, a segment of highway having four lanes. In ordinary scenario, the distance between nodes (vehicles) is around 70 m, having approximately 50 nodes in a radius of 1 km around a particular node. While in a traffic jam condition, the distance between vehicles is

reduced to 7m which cost more than 500 vehicles within the same segment of road.

The innovations in mobile communications and on-going mode in ad-hoc networks which permits various classification of architectures for vehicular systems. On the basis of density like highways, urban have dense vehicular environment and rural has sparse vehicular environment to support many applications with distinct Quality of System requirements.

## **1.1 VANET Architecture**

In the few upcoming years, number of vehicles on roads is increasing very rapidly. Due to which number of accidents are also increasing. Key role to undertake VANET is to disseminate information to wide set of vehicles. On-Board Unit (OBU) is installed inside VANET vehicles which is responsible for communication. VANET consists of vehicles and Road Side Units (RSU). Each vehicle is equipped OBU. And this OBU is connected with Global Positioning System (GPS) and have synchronization with Temper-Proof Device (TPD) and Transmission System.

VANET architecture consists of:

- i. Authenticate messages
- ii. Temper Proof Device
- iii. Certificate Authority
- iv. Digital Signature
- v. Road side units

Authenticate message- constitutes safety message and cryptographic material. Safety message is of approximately of 100 bytes and is responsible for position, speed, direction etc. Whereas, cryptographic material is approximately of 140 bytes and is responsible for senders digital signature, senders public key.

Temper Proof Device- is the safety device established inside the vehicle. It consists of vehicles' safety information, a watch (for synchronization) and a battery. This device is only accessible by an authorized person. TPD also consists of Electronic Licence Plate.

Digital Signature - Every message must be authenticated with a tag of digital signature. It provides authentication and security. It is more appropriate for liability

related messages.

Road Side Units -are infrastructure for communication between vehicles. These fixed infrastructures are coupled to main network and should be in appropriate position to help in transmission. The count of RSUs and its scattering across area depends upon the communication protocol we are using. For example, some protocols requires RSUs only at region borders, some at intersection while some requires evenly distribution throughout the topology.

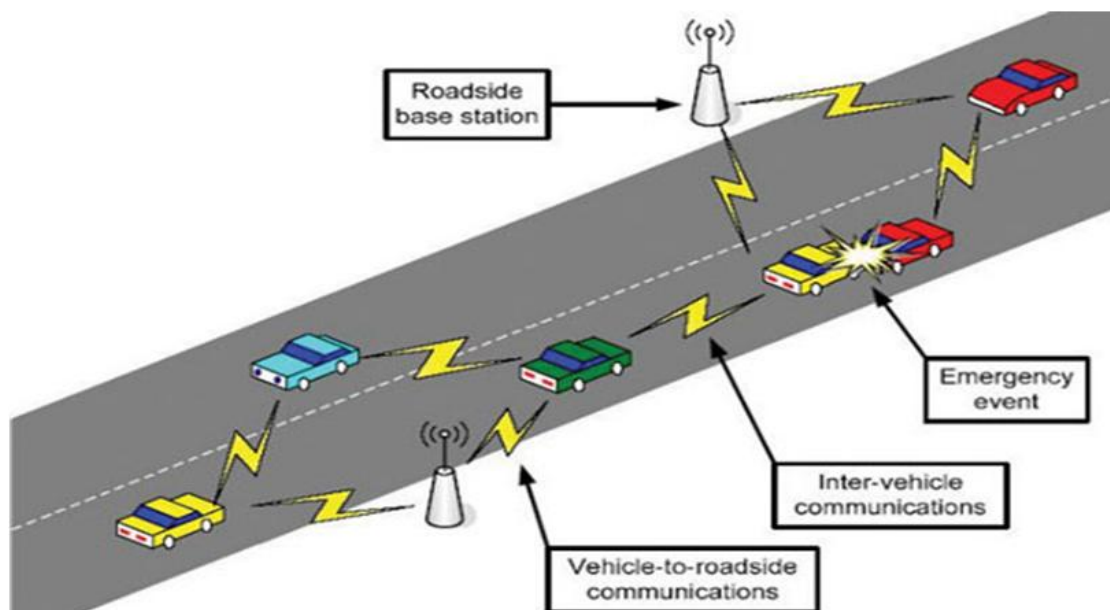


Figure 1: VANETs

The main aim of VANET architecture is enabling the transmission among vehicles, between dynamic vehicles and static infrastructure equipment (Road Side Units). Following are the types of communication modes:

- Vehicle-to-Vehicle (V2V) Communication: V2V communication type is also known as Car-to-Car (C2C) communication. It allows the direct communication between vehicles without depending on Road Side Units (RSU) assistance and is mostly used for dissemination of message and for safety purposes.
- Vehicle-to-Infrastructure (V2I) Communication: It enables the transmission between movable vehicles and fixed roadside infrastructures for statistics and data collection purposes.
- Hybrid Communication: It is the combination of both C2C and Car-to-Infrastructure

(C2I). In this, transmission with roadside units is done either in a single hop or multi-hop, based upon the separation between vehicles, i.e. if two vehicles are not in range of each other then they communicate with the help of road side unit.

## **1.2 Characteristics of VANETs**

VANET has distinct characteristics despite being a particular case of MANET and representing almost identical features like short transmission range, Omni-directional broadcast and low bandwidth [2].

- **Highly Dynamic Topology:** Topology of VANET system is constantly changing due to the given factors, properties of radio propagation and velocity of nodes (vehicles). Vehicles have comparatively high velocities like 60 KMPH in crowded environments to greater than 120 KMPH on highways. Also vehicles are moving in non-identical directions. Thus, nodes (vehicles) rapidly connect and disconnects in the network after a very small time period, leading to ceaseless and rapid changes in topology.

- **Continuous Disconnects:** The extremely changeable topology results in continuous alteration in connectivity and subsequently disappearing of link between two vehicles while in communication.

- **Restricted Mobility and Prediction:** VANET are based on high changeable topology, but nodes (vehicles) pursue a specified movability pattern restricted by ways and roads, traffic lights and traffic conditions and driving behaviour of driver's. Thus the further position of the node is easily predictable.

- **Communication Model:** VANETs works in three scenarios: highways, city and rural. In highway, the communication model normally assumed to be independent, but the radio signals suffer intrusion by reflection from the traffic signal panels along the roads.

In cities, communication become difficult due to presence of houses and constantly changing vehicle density, trees and many other obstacles which hinder the signal travel. Fading of signals occurs due to these Obstacles. In rural areas, because of compound graphic forms (like dense forests, fields), it's important to consider attenuation of signal distribution. Therefore, communication is done using largely deployed access points in such scenarios.

### 1.3 VANET Applications

Safety and effectiveness are the two main requirements which can use to categorize VANET applications [3]. Safety and effectiveness are not entirely different from each other. Whereas, other aspects must be taken in consideration together with the design of VANET application. For example, a car engine stops working or a mishap occurs, both involve two or more than two vehicles which may end to congestion in traffic. A warning text describing the incidence, reports a safety warning message which in turn will increase awareness. The similar message will simulate the calculation of another possible route for the vehicle that is going to pass nearby or from accident spot, as it's not near that point yet, so can change its path. In such case, the main objective is to increase the transportation efficiency of vehicles. In an event, an early warning can assist a driver or traveller to take a decision to adopt another route, use another mode of transportation or can stop at any location far away from a severe traffic problem. In the case, main objective is providing a person the required helpful information.

VANET applications will also consider different conditions like vehicle conditions, roads surrounding, weather conditions and surface of road to make the environment safer and efficient.

i. *Safety Applications*: The main objective of this application in VANETs is to provide protection by avoiding and decreasing the number of accidents that occurs on the roads. This application is very sensitive to any delay. Thus, in this type of applications V2V transmission is used to minimize the delay. Some other requirements are reliability; all the vehicles nearby to the accident area should have to be alerted about the hazard. In any case of mishap, there are two problems that need to be dealt with. The vehicles approaching the mishap position and the nearby areas. When an accident occurs, an event (for ex. opening of an airbag) provokes a notifying structure to broadcast urgent message to all the nearby vehicles. These updates can carry the location of GPS enabled OBU. This warns the driver or leads to stop the vehicle automatically as an emergency breaking system works when the vehicle approaches the accident area. It is highly advantageous to get emergency video, so emergency responder may know the traffic condition and vehicle where about before reaching the scene of the accident. The video data can easily be obtained from vehicles installed with video cameras and capabilities to store and forward images and videos. This application could also sense the consequences of collision so as to take appropriate

measures. Once a mishap takes place, the application gives suggestion to adopt alternative path according to the time and location of vehicle. An application designed so that it should be able to give early warning and notification to drivers to prevent accidents.

ii. *Efficiency Applications*: In this classification, all the applications need to be present all the times, because travellers require precise information to make appropriate decisions during travelling. The general transmission pattern formed among vehicles, and between vehicles and the road side units. Categorization of these applications can be done in two ways: applications to secure the crossroads or junctions, applications to avoid and decrease traffic congestions.

- **Intersections and Crossroads**: Controlling and managing traffic is a key area of research that can upgrade VANET. For example, vehicles crossing through intersections and those near should drive carefully since two or more roads crosses each other which raises the probability of collision. In such scenario, effective traffic lights can easily control and manage the flow of traffic at road crossings.
- **Traffic jam management**: A traffic jam application can assist drivers with the efficient path to their destinations. The main objective is to reduce congestion due to traffic from roads and to keep the traffic flow as smooth as possible. This can potentially improve the road capacity and prevent traffic jams.
- **Support for authorities**: if a vehicle is stolen then it can be easily traced by vehicle tracking system and each vehicle is equipped with electronic licence plate which provide authentication.

iii. *Comfort Applications*: In this classification, travellers can get useful data from vehicles that help the driver during the driving to make it more comfortable, relaxed and enjoyable. This application enhances the driving and traffic efficiency. Generally, the application need is to provide reliable information at the perfect time as per the need of driver. Such application type consists of: weather forecasting, location of gas station, tourist information, available space in parking lot, route navigation, advertisement or announcement broadcasting etc.

VANET applications	Purpose	Examples
i. Safety Applications	Danger due to collision	Warnings for <ul style="list-style-type: none"> <li>• Blind Spot</li> <li>• Lane change</li> <li>• Cross-roads and Junctions</li> </ul>
	Hazardous road features	Warnings for <ul style="list-style-type: none"> <li>• Low Bridge</li> <li>• Speed at Curves</li> <li>• Traffic light</li> </ul>
	Traffic and road condition	Road construction notification, Traffic jam ahead warning
ii. Efficiency Applications	Support for authorities	Electronic licence plate Stolen vehicle tracking
	Traffic management	Road congestion notification
iii. Comfort Applications	Traffic efficiency	Weather forecasting Route navigation Filling station
	Information broadcasting	Advertisement Announcement notification
iv. Business and entertainment Applications	Vehicle maintenance	Wireless Diagnostics Software updates Safety reminder notifications
	Mobile Services	Internet services Instant messaging
	E-payment	Toll collection Parking payment Fuel payment

*Table 1: Applications of VANET*

## **1.4 Basic Components in VANET**

i. *On- Board Unit (OBU)*: is a device installed inside each vehicle which processes the data. OBU helps to form short range Ad hoc wireless networks. Each vehicle is equipped with OBU. OBU is connected with hardware and have synchronization with TPD and Transmission System. This hardware device gives detailed information of location, speed, distance. Such devices can be GPS or DGPS.

ii. *Wireless Access in Vehicular Environment (WAVE)*: This is IEEE1609.4 standard which provide multi-channel communication.

iii. *Dedicated Short Range Communication (DSRC)*: This is IEEE802.11p standard which defines channel band and provide multi-hop communication.

iv. *Road Side Units (RSU)*: These are infrastructures for communication between vehicles. These static RSUs are synchronized to backbone network and must be in appropriate position to help in communication. The number of RSUs and its scattering depends upon the communication protocol we are using. For example, some protocols require RSUs only at region borders, some at intersection while some requires even distributed throughout the topology.

## **1.5 Standards in VANET**

### **1.5.1 IEEE 802.11p protocol**

IEEE 802.11p [4] works on the PHY (physical) layer and MAC (Medium Access Control) layer in WAVE protocol stack. IEEE 802.11p is a improved version in IEEE 802.11 to support ITS (Intelligent Transport System). Figure 2 shows the working of IEEE 802.11p protocol. IEEE 802.11p defines the DSRC (Dedicated Short Range Communication) band. The DSRC band is of 75MHz spectrum having 5.9GHz frequency band which is partitioned into seven 10MHz wide channels, out of which six are Service Channels (SCH) used to send infotainment messages and one is Control Channel (CCH) used to send safety related beacon messages. Control channels are also known as Channel 178 as shown in Figure 3.

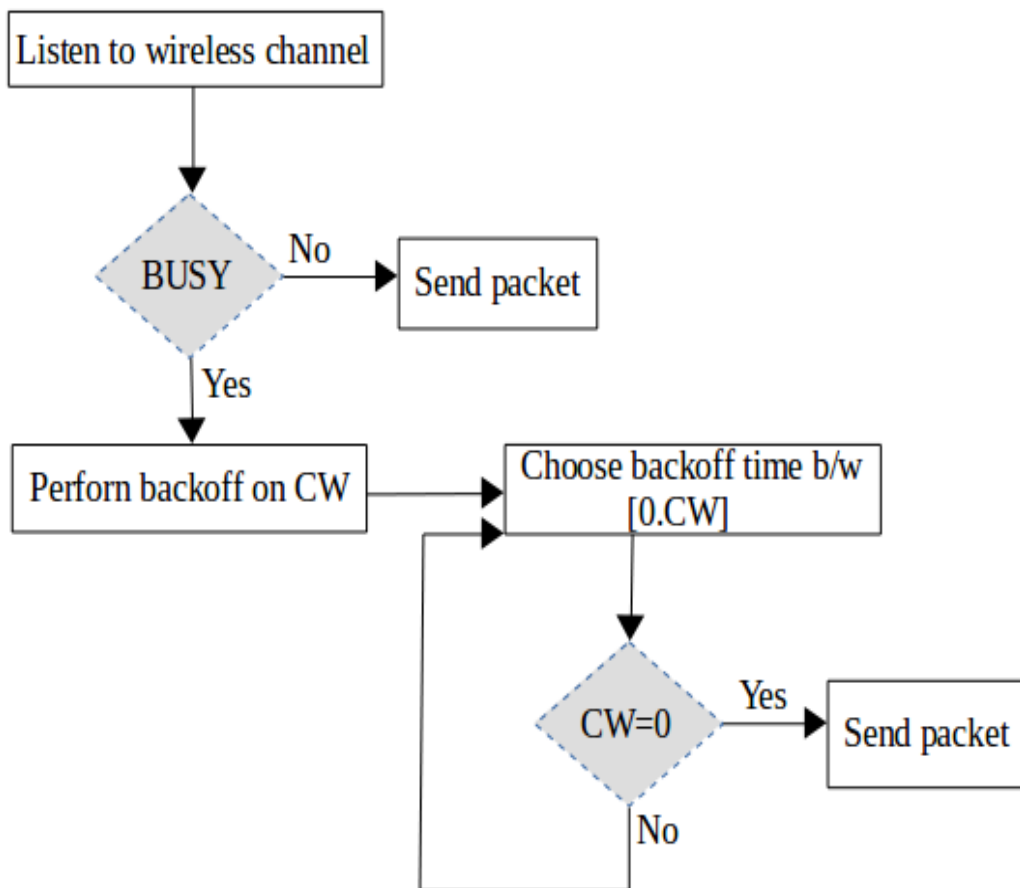


Figure 2: Working of 802.11p

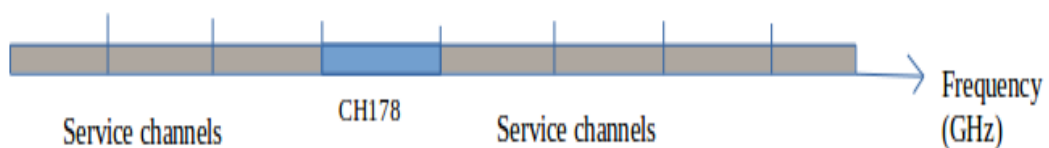


Figure 3: DSRC Spectrum

### 1.5.2 WAVE protocol stack

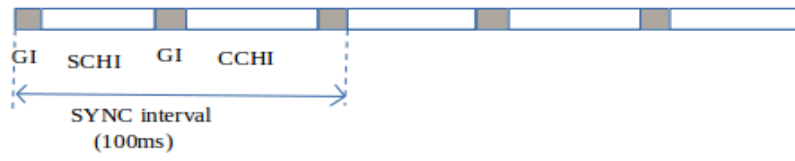
WAVE protocol stack consists of many protocols as shown in table. As we are using multichannel operation in single radio vehicle so we are using IEEE 1609.4 WAVE protocol [5].

The following table shows the comparison of OSI (Open Source Interconnection) model and WAVE architecture. It represents which layer is responsible for which feature.

<b>OSI Layers</b>	<b>WAVE arch.(1609.0)</b>			
Application Layer	Electronic fee collection (1609.11)			
Presentation Layer	Security (1609.2)			
Session Layer	Remote Management (1609.6/1609.1)			
Transport Layer	Transport Services (TCP/UDP + IPv6)			
Network Layer	Network Services (1609.3)			
Data Link Layer	<table border="1"> <tr> <td>LLC</td> </tr> <tr> <td>Upper MAC (IEEE 1609.4 (WAVE))</td> </tr> <tr> <td>MAC Layer (802.11e (EDCA))</td> </tr> </table>	LLC	Upper MAC (IEEE 1609.4 (WAVE))	MAC Layer (802.11e (EDCA))
LLC				
Upper MAC (IEEE 1609.4 (WAVE))				
MAC Layer (802.11e (EDCA))				
Physical Layer	Physical (802.11a)			

*Table 2: Comparison of OSI with WAVE architecture*

IEEE 1609.4 protocol sticks upon IEEE 802.11p MAC protocol to enable multichannel operations. To imitate multichannel action of IEEE 1609.4, this standard partition access time into 50ms intervals i.e. 50ms for Service Channel Interval (SCHI) and 50ms for Control Channel Interval (CCHI). In the beginning of each interval there is a Guard interval (GI) of 4ms which makes SCHI and CCHI of 46ms each. Guard interval is introduced because at the beginning of each partitioned interval, previous action is interrupted and next is started or resumed. At CCH interval each vehicle adapts to DSRC control channel and interchange safety related applications. While at during SCH interval vehicle adapt to any of six DSRC service channels and exchange infotainment information. SYN interval is of 100ms duration and equally partitioned into control channel interval and service channel interval as shown in figure 4.



*Figure 4: Multichannel operation of 1609.4*

## VANET Routing Protocols

Routing protocols of VANET can be categorized on the basis of inter vehicle communication or area. Here categorization is done on the basis of area. VANET routing protocols on the basis of area can be organised into five groups [3] as follows: Topology based routing protocol, Position based routing protocol, Cluster based routing protocol, Geo-cast routing protocol and Broadcast based routing protocol.

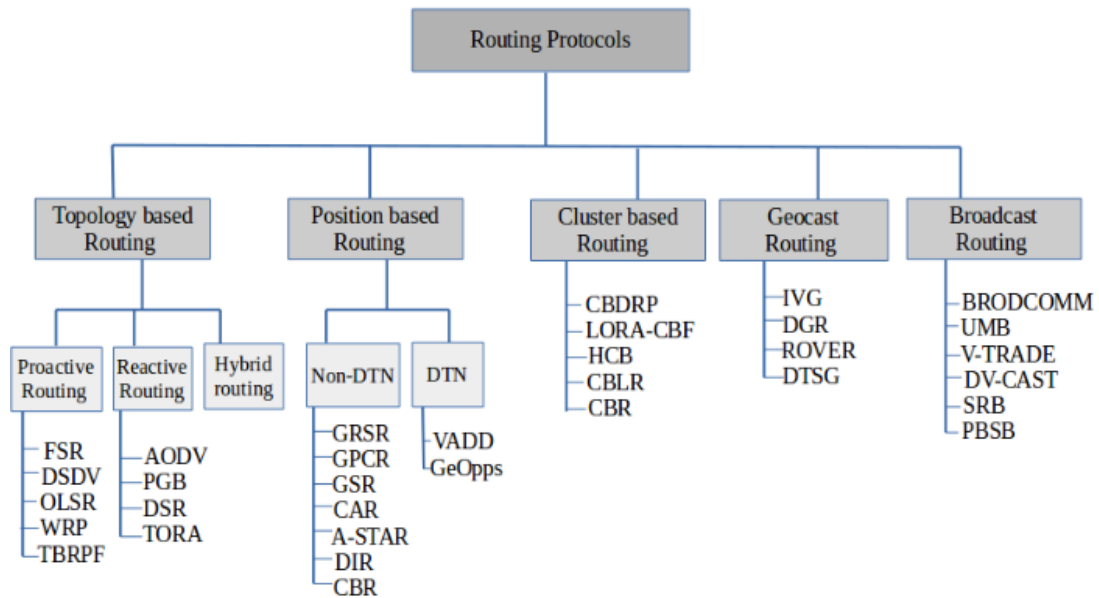


Figure 5: Categories of Routing Protocols

Various categories of routing protocols of VANET can be explained as follow:

### 2.1 Topology based Routing Protocols

For packet forwarding in this category of routing protocols, path information that exists in the system is used. In such protocols, sender finds the path and preserves it in a table before transmitting data i.e. two procedures are triggered named as Route Discovery and Route Maintenance. They are furthermore categorized as follow:

### 2.1.1 Proactive Protocol

The Proactive routing protocols are additionally called table driven routing protocol. They follow the phenomenon of interchanging the information about topology among nodes present in the network at particular interval of time. The upside of such routing protocols is that, initially route discovery process is not performed, as the path to destination is saved in the cache, but the downside of this protocol is that it consumption of bandwidth is high for updates at particular interval of time. There are different variants of proactive routing protocols:

a) *Fisheye State Routing (FSR)* [9]: It is same as LSR except the flooding property. Each node keeps up a topology table (TT) which depends upon the recent data received from neighbouring nodes. It makes use of various interchange periods for discrete nodes in routing table to minimize the magnitude of safety data packet in huge system. Fields of routing table for destination are updated periodically. There are various drawbacks of FSR routing, like, the magnitude of the link table grows as network size increases. Sometimes route discovery fails if the node we want to reach lies out of extent of source node. Because of high versatility in VANET, path to destination become less precise.

b) *Destination-Sequenced Distance-Vector Routing (DSDV)* [10]: This protocol is formed on the Bellman-Ford algorithm. It eliminates looping of routes, reduces message overhead, and improves convergence speed. In DSDV, every node keeps a one-hop table, which it interchanges with its neighbours. DSDV is a proactive protocol for discovering route. Whenever a path to another destination is needed, that path is already exist at source. Consequently, latency for route discovery is low. DSDV also ensures loop free paths.

c) *Optimized Link State Routing Protocol (OLSR)* [11]: It is an optimized pure LSR for MANETs. Each and every node belongs to the network choose a group of neighbouring nodes known as MPRs (multi-point relays), which in turn sends its data parcel again. The neighbouring nodes which do not belongs to MPR group can only visualize and interpret the data packet. This policy diminishes the retransmission count in a broadcasting scenario. OLSR is intended to work in a fully distributed environment and have no dependency on any focal entity. Each node sends control

messages at some interval of time, and can result in reducing a reasonable loss of messages. Such misfortune happens every now and again due to crashes in radio channel.

d) *Wireless Routing Protocol (WRP)* [12]: Objective of WRP protocol is to maintain link information in between all the nodes belong to the network. Every node in the system is responsible for preserving four tables named as -distance table, link-cost table, routing table and message retransmission list (MRL) table. A connection is considered between two nodes just if there is a network between them and is capable to upgrade messages dependably with a specific likelihood of success. At the point if a connection breaks, the corresponding distance entries in link table are assigned as infinity.

e) *Topology Dissemination Based on Reverse- Path Forwarding (TBRPF)* [13]: It is additionally a LSR based routing protocol intended specially for ad-hoc system. Each node forms a source tree by utilising topology table which comprises the ways to reach each node. Nodes are upgraded occasionally with the contrasts between the present and past system state by sending HELLO messages. TBRPF comprises of two principal modules: first for discovering neighbour's and second for routing to perform topology discovery and computation of routes.

### **2.1.2 Reactive Protocol**

These protocols are additionally called table-driven routing protocol. This sort of routing finds the path just when it is needed by a node to make transmission with each other. This routing comprises a stage of discovering route discovery by flooding the query parcels into the system for the discovery of path and this stage comes to end only when path to particular destination is found. The variants of reactive routing protocols are:

a) *Ad Hoc On Demand Distance Vector (AODV)* [14]: In AODV route discovery is done by control packets only when it required. AODV can organise low, direct, and generally high mobility rates, along with different data traffic levels. AODV is intended for systems where the nodes have faith on each other. AODV is intended to diminish the broadcasting of control traffic and expel the overhead on information

activity, so as to enhance execution performance. The origin node scatters RREQ (Route Request) packet to the greater part of neighbouring nodes. On receiving RREQ, each node finds the reverse way from destination point to source point. It contains packet from where packet is send, hop count to source node and life time field in routing table. This is also called Backward Learning and is useful to create path. These RREQ packets are disseminated till it reaches destination and once destination is reached, RREP (Route Reply) packet to source node is send through Backward Learning method.

b) *Preferred Group Broadcasting (PGB)* [15]: This is a dissemination mechanism whose objective is to diminish dissemination overhead connected with AODV's route discovery. AODV also provides path balance especially in VANETs where movement of vehicles is very high and are useful for wireless hosts. On the basis of signal received by receiving vehicle involved in broadcasting, receivers demonstrate whether they belongs to a preferred group or not.

c) *Dynamic Source Routing (DSR)* [5]: This protocol is a on-demand routing protocol which is based on a technique known as source routing. Source routing is outlined exceptionally for wireless multi-hop ad-hoc network to diminish the consumption of bandwidth. This can be done by eliminating the requirement of table updating at regular interval of time. This calculation creates the on-demand routes and sender node knows the complete data of destination. It comprises of two major stages: First stage is to discover routes and second is to maintain routes. Route information is reserved in route cache and whenever any node wants to send data packet, initially it check it in route cache. If route is found than packet will be send else route discovery process is triggered for finding another path in between origin node and destination node. Each request packet knows the address of origin node, a unique sequence number and an id for destination node. This convention lessens the data transfer capacity overhead.

### **2.1.3 Hybrid Protocol**

These protocols are formed by consolidating the properties of both protocols discussed above, that is, proactive and reactive. The hybrid type protocols are shaped

to overcome the drawbacks of both proactive and reactive protocols. These protocols diminish the control overhead of proactive routing protocol and reducing the delay encountered during path discovering process. ZRP is frequently used hybrid protocol :

a) *Zone Routing Protocol (ZRP)* [13]: In this routing, system is partitioned into overlapping sections called zones. These zones can be characterized as a accumulation of nodes which exists within the range of zone radius. The extent of a zone is chosen by a span of length, which can be determined as hop count in the zone. In ZRP, the responsibility of intra-zone communication is of proactive routing protocol and for inner-zone communication reactive routing protocol are utilised. Origin node sends data continuously to the destination node only if both belong to same routing zone otherwise IERP triggers a procedure for route discovery. Objective of ZRP is to find routes free from loops to the destination. For this it uses border casting method.

## **2.2 Position based Routing**

This protocol utilises geographic situating data to choose next sending hop if there is no worldwide path between source and destination. Then there is need to make and keep the path to the destination. Position based routing is partitioned into two sorts: Position based greedy V2V protocols and Delay Tolerant Protocols.

### **2.2.1 Position Based Greedy V2V**

In this, greedy methodology requires the middle node and this middle node knows the position of itself, its neighbouring nodes and destination position. This is additionally known as minimum delay routing. Different sorts of Position based greedy V2V protocols are:

a) *Greedy Perimeter Stateless Routing (GPSR)* [17]: In this, a data packet is send to a direct neighbour which is nearer to the destination node geographically which follow greedy mode of forwarding. A continuous broadcasting of safety data packet is done to all those neighbours having its id and location. If neighbouring node do not get beacon message in particular period of time, then GPSR router thinks that particular node is not in range and delete that node from its neighbour table. If somehow greedy forwarding is not possible then perimeter of the area strategy is utilised to find next sender node. In a urban conditions, greedy forwarding is not utilised because of the

fact that direct transmission is not possible due to presence of hurdles such as buildings and trees. When greedy forwarding is not possible, performance degrades while converting network topology into planarized graph.

b) *Greedy Perimeter Coordinator Routing (GPCR)* [17]: In this, the drawback of GPSC is eliminated. It comprises of two procedures: a procedure for Greedy Forwarding which is restricted and one Repair Strategy. These procedures are based on the topology of real world roads and crossovers and subsequently there is no necessity of planarization process. The GPCR takes advantage of the way that city streets and intersections frame a planar chart, without utilizing any static road map. A GPCR builds up destination based greedy forwarding procedure, it routes information to nodes at cross over. Since GPCR is not related to static road map, so junction node is hard to find. So this methodology uses heuristic method for finding junction nodes and these points of node is called coordinators. And these coordinators are responsible for making path decision. Two approaches can be used to find coordinates: Neighbour Table Approach, Correlation Coefficient Approach.

c) *Connectivity Aware Routing (CAR)* [18]: CAR keeps up the reserve of the effective paths between various source and destination set. It also assumes that as vehicle moves, location of destination also changes. CAR protocol intermittently sends HELLO signal message that contain their speed vector data. On accepting beacon, node will cache the sender position in its link state table and calculates its velocity vector. Signal message can likewise be piggybacked on sent information parcels to diminish wastage of data transfer capacity and to lessen blockage. It contains ID, TTL count and radius. CAR presents two forms of Guard i) Standard Guard and ii) Travelling Guard.

d) *Anchor-Based Street and Traffic Aware Routing (A-STAR)* [19]: This protocol guarantees a conclusion association regardless of the possibility that we have low traffic density. It utilizes data of one city transport route to find a feasible link with high network for parcel delivery. This protocol additionally provides a route recovery procedure. It assumes that if somehow data packet is lost, it requires resending the packet again. For this route recovery procedure is needed. It also makes assumption that more the number bus routes a road has, the more will be vehicle traffic it will get.

A-STAR routes can be classified into two types of maps: one is static and another is dynamic.

e) *Diagonal-Intersection-Based Routing (DIR)* [20]: DIR builds a progression of corner to corner crossing points (diagonal intersections) in-between the origin and destination vehicle. This protocol is related upon Geographic Routing convention, in which origin vehicle forward parcel towards first crossing point and then second crossing point and so on till geographically reached to the destination. DIR vehicle is auto- movable that is, dynamically select to forward data packet.

### **2.2.2 Delay Tolerant Protocol**

During day time or in urban scenario where vehicles density is high, finding a node to convey a notification is not an issue. But in less dense situation or in urban areas during night, vehicle density is very low and in such scenario setting up end-to-end link is difficult. Different variants of delay tolerant protocols are:

a) *Vehicle Assisted Data Delivery (VADD)* [20]: VADD utilizes a store, convey and forward procedure to permit parcel to be conveyed by vehicles every vehicle to confirm its own particular position furthermore require an outer static road map. In this each data packet has 3 modes: i) Intersection, ii) Straight way, iii) Destination.

All the modes are based on location of nodes. Intersection mode works when packet reaches an cross point at which road path decision can be made for data packet. When vehicle is moving on the road then there will be only two possible directions for data packet to travel that is called straight way mode. And when packet is close to the final point then it is destination mode.

b) *Motion Vector Routing (MOVE)* [20]: This routing is for sparse VANET scenario. MOVE predicts whether they will it shows some progress towards destination regarding forwarding message. In this every node knows about its own particular location, moving direction and destination. From these data the present vehicle hub can compute the closest separation amongst vehicle and the destination.

## 2.3 Cluster based Routing

This routing can be done in clusters. A cluster can be formed by gathering of nodes which distinguishes them to be a component of a particular family of cluster known as simple nodes and a node out of this simple node is nominated as cluster head. For communication, this cluster head will broadcast the packet to cluster head of other cluster, which then broadcast the message to the other nodes belong to his cluster . For large networks, good scalability is provided but it has a downside that network delays and message overhead increases while clusters are formed in highly dynamic VANET. The variants Clusters based routing protocols are:

a) *Cluster-Based Directional Routing Protocol (CBDRP)* [6]: This protocol partitions the nodes into clusters and to form a cluster, vehicles are assumed to flow in same direction. The origin node transmits the data packet to its cluster head and then it sends the data packet to cluster head of another cluster in the direction of destination. This procedure repeats till the destination is experienced. Finally the cluster header transmits the data packet to the node which is destination. The cluster head nomination and maintenance is similar to CBR but it also considers velocity along with direction of a vehicle which is ignored in CBDRP.

b) *Location Routing Algorithm with Cluster- Based Flooding (LORA-CBF)* [6]: In this, any node belongs to the cluster can be elected as cluster-head and remaining nodes are considered as cluster member. There is only one cluster-head for each cluster. There is a node named as gateway which is responsible to inter-connect two clusters or we can say which is communal in two clusters. The cluster-head node conserve cluster members and gateways information. In this greedy forwarding is used in data packet transmission. Only cluster head and gateway nodes have authority to convey out the Position Request (PREQ) packets when the position of the destination node is not approachable. The technique LORA-CBF shows highly diverse execution output results.

c) *Cluster Based Location Routing (CBLR)* [6]: This routing algorithm assumes all vehicles fetch their current position information via GPS. This algorithm partition the system into numerous groups. Every group elect a cluster head and group of nodes with in transmission scope of the cluster head. The cluster-head and individuals are

worked as follow: another node transmits a Hello Message. If the node gets an answer from the cluster head node of the group, the new vehicle would be approved to be added to the group which turns into an individual of the cluster. If not, the new node will turn into the cluster head.

d) *Cluster Based Routing (CBR)* [4]: In this protocol, the geographic area is partitioned into four rectangular grids. Each and every node evaluate most effective neighbour cluster head to send information to the following hop by using utilizing Nodes, secure Ring Nodes. Nodes pick some distance far from sender node whereas secure Ring Nodes selects on the basis of most desirable distance from originating node. It restricts retransmission to only secure ring nodes.

## **2.4 Geo-cast Routing**

Geo-cast is a multi cast position based routing. Its main objective of is to distribute the data packet from a particular origin to all the other nodes which belongs to a defined geographical region, that is, Area of Interest (AOI). The variants of Geo cast routing protocols:

a) *Inter-Vehicle Geo-cast (IVG)* [21]: It's purpose is to disseminate safety beacon messages to all nodes on expressway situation. This convention utilizes a clock based instrument for sending data packet and broadcasts it periodically. This protocol is used to overcome network fragmentation.

b) *Distributed Robust Geo-cast (DRG)* [21]: This routing protocol is used to improve feasibility of message broadcasting by defining the area to which data packet is to be transmitted or we can say Area of forwarding (AOF) which defines the area of interest (AOI). Vehicles which belong to Area of forwarding region can transmit the information to other node in the Region of Interest.

## **2.5 Broadcast Routing**

This category of routing protocols includes conventions used in dissemination of data packet to a particular region or area. Various variants of broadcast routing are:

a) *BRODCOMM*: This protocol follows the hierarchal structure. This is basically used for expressway scenarios. In this, the whole expressway is partitioned into digital cells whose movement is same as vehicles. These vehicles (nodes) within the freeway are

categorized into hierarchy of two levels: the primary one comprises all the nodes in a set, another one is proven by set reflectors. Cell reflectors are couple of nodes arranged close to global focal point of cell. Cell reflected go about as cluster head for certain time interval and control the emergency beacon data originating by similar individuals from the cell.

b) *Urban Multi-hop Broadcast (UMB)* [26]: This protocol is based on the handshaking principal. In this communication is done by RTB (Request to Broadcast) and the CTB (Clear to Broadcast) control data packets. The purpose of using this is to solve the issues like the black storm problem and the hidden node problems. Transmission will not be initiated until CTB data packet is received. Firstly, dissemination of RTB data packet is done by sender, after that all the receiving vehicles in communication range start sending black burst for specific interval of time. Black burst is nothing; it is just a jamming signal. Evaluation of this time is done by each vehicle in transmission range on the basis of distance separating it from the sender node. At the end of this, a forwarder car will hear to the medium once more and will reply through CTB packet whenever channel is free. Using this system, the furthest receiver car, will probably be randomly chosen by the origin as the subsequent sender. Allocating the longest waiting interval to the next sender vehicle will expand the point-to-point delay, which isn't appropriate to send safety related message.

c) *Vector Based Tracing Detection (V-TRADE)* [26]: It is a GPS situated data dissemination convention. The essential thought is same as unicast directing routing protocols. V-TRADE additionally works on principals of ZRP. This protocol category the link state into various dissemination set depending upon area and motion information. For every gathering just a little subset of vehicles is chosen to retransmit the message

d) *Distributed vehicular broadcast protocol (DV-CAST)* : This protocol utilizes native topology expertise via sending the HELLO beacon messages periodically for broadcasting the data packet. Each vehicle makes use of a flag tag to inspect either the data packet is a copy of previous one or not. This convention partition the vehicles into three slot in view of regional connectivity, that is, fully connected, moderately

connected, thoroughly disengaged neighbourhood.

		<b>Forwarding Method</b>	<b>Infrastructure Required</b>	<b>Recovery Strategy</b>	<b>Path Maintenance</b>	<b>Scenario</b>
<b>Protocols</b>						
Topology Based	Proactive	Wireless Multi-hop Forwarding	NO	Multi-hop Forwarding	Active	Urban
	Reactive	Wireless Multi-hop Forwarding	NO	Carry & Forward	Active	Urban
Position Based	Greedy V2V	Heuristic	NO	Carry & Forward	Active	Urban
	Delay based	Carry & Forward	NO	Multi-hop Forwarding	Passive	Sparse
Cluster (Group) Based		Multi-hop Wireless Forwarding	YES	Store, Carry & Forward	Passive	Urban
Geo-cast		Multi-hop Wireless Forwarding	NO	Store, Carry & Forward	Active	Highway
Broadcast		Multi-hop Wireless Forwarding	NO	Flooding	Active	Highway

*Table 3: Comparison of various routing protocols*

#### **3.1 Work related to Dissemination of Messages:**

**Y.H.Kwon and B.H.Rhee (2016)** proposed the cooperative Game Theoretic approach based on 802.11p which formulate a procedure for decision making. This process is done for nodes to broadcast a beacon packet. The beacon dissemination is required for staying transmission channel away from degradation in high vehicular density instances. Broadcasting of information is done by WAVE/IEEE 802.11p. In high vehicular density collision occurs, Due to which delay increases. For this drawback, Game theory is used on medium access control (MAC).

**Jai Mahabole et al. (2015)** proposed a Game approach for congestion avoidance technique around RSA in VANET. This paper defines the Basic parts of a Game model ie Players, Choice and Payoff and use methodology of Co-operative bidding game approach to minimize the signal collision and power consumption around RSA. The bidding game theory reduces bandwidth problem by connecting only specific nodes to RSA.

**Claudia Campolo et al. (2015)** proposed the cooperative intelligent Transportation System (C-ITS) and evolutionary path of Vehicular Network and development phases. In this we analyse the theme of vehicular systems with regards to C-ITS from a developmental perspective, checking early ideas and empowering advancements, current status and future possibilities. The author defines the four phases of C-ITS deployment as defined in Table below:

It defines the two main stages:

- a) First, referred as today, which surrounds the main regulations and architectures based on single-hop single-radio IEEE 802.11
- b) Second, referred as tomorrow, which include improvements to the baseline 802.11, aimed at issues of services under more crowded condition and multi-channel operation.

	Use Cases
Phase 1	Safety Message(Traffic Jam Warning)
Phase 2	Hard Safety Messages(Crash Notification)
Phase 3	Platooning
Phase 4	Autonomous Driving

*Table 4: Development Phases*

**Sofiane Zemouri et al. (2015)** proposed RCP (Road-Casting Protocol) design and its algorithm to pick out next forwarder for defining RoI (Region of Interest) and capacity enhancement in perspective of packet delivery ratio as well as lower point-to-point delay and reduce channel load. Since there is fast development of ITS applications, so there is excessive load on network. Therefore, there is a great need of efficiently use of the available bandwidth. In this paper performance evaluation is carried out using RCP. It also calculates RoI accuracy. A productive sending mechanism was intended to guarantee an excessive degree of reach ability and short dissemination delay.

**Pierpaolo Salvo et al. (2015)** proposed a spurious forwarding technique which enhance the throughput rate and packet delivery ratio. In this author investigate various time based VANET networking protocols, which shows the data flow along a highway by using multi-hop vehicular ad-hoc network. To resolve the degrading effects induced by the spurious forwarding phenomenon, a simple probabilistic logic is integrated into the packet forwarding mechanism.

**Ali J. Ghandour et al. (2014)** proposed IEEE WAVE 1609.4 protocol which is a multi-channel protocol and guarantees the coexistence of safety and infotainment application over same network. This paper characterizes three novel commitments. In the first place, proposes a logical examination and a simulation investigation of IEEE 1609.4 and unsafe effect of synchronous channel exchanging on message delay and delivery ratio. Second, researches the issue of scattering over multichannel VANET of safety broadcast messages. Third, proposed WAVE-upgraded Safety message delivery (WSD) technique to permit quick scattering of safety messages over multichannel

VANET and investigate its execution. Multichannel network is used because it reduces the chance of collision.

**Nasser Torabi et al. (2014)** proposed the execution of IEEE 802.11p/ 1609.4/WAVE in NS-2. IEEE 802.11p works on PHY (physical) and MAC (medium access control) layer .WAVE defines family of standards known as 1609.x protocol. IEEE 1609.4 protocol is characterized above IEEE 802.11p standard. It isolates access time into interims named as Control Channel Interval (CCHI) and Service Channel Interval (SCHI). It additionally characterizes the engineering of mobile node in NS-2 and performance execution in terms of Packet conveyance Ratio and Delivery Delay.

**Ali J. Ghandour et al. (2013)** proposed a cognitive design with the intention to extend the CCH utilized by vehicles to send security messages. For achieving this task, they propose a range detecting scheme through which vehicle can distinguish accessible range resources along with their pathways and forward the data to resources. These resources are normally Road side Units and furthermore characterize a fuzzy logic based range assignment algorithm through which RSU's sense the contention conditions and assess execution on the premise of Throughput and Packet Delivery proportion.

**Mousumi Paul and Gautam Sanyal (2016)** discussed mainly two factors. First, lack of traffic analysis and modelling for VANETs. Second, network optimization for VANET. To determine best fit distribution Kolmogorov-Smirnov test is performed for continuous traffic distribution. Exponential, normal, lognormal, gamma distributions were implemented to determine the goodness-of-fit test and concluded that packet inter-arrival time distribution can be best modelled by Gamma instead of exponential.

**Azzedine Boukerche, Cristiano Rezende (2009)** demonstrates the importance of link reliability to support Quality of Service (QoS) policies and calculation of link reliability is completely based on link availability. In this paper, author also defines a structure to implement link reliability in VANET and then use this structure to implement packet forwarding.

**Moumena Chaqfeh et al.** gave an idea of a novel technique for data dissemination in

multi-hop scenario to provide scalable broadcasting without any extra overhead. Due to collision and redundancy, data storm problem can occur. So to tackle this issue, principle target is to stay away from superfluous loss of vital information and minimize redundancy. For this they propose different variations of SAB (Speed Adaptive Broadcasting) like P-SAB, S-SAB, G-SAB and also propose a protocol DRIVE as a solution for Data storm. Author also defines a sweet spot in AOI. On the behalf of this hotspot, next forwarder will be elected.

**Ramon S. Schwartz , Anthony E. Ohazulike (2014)** proposed a data dissemination protocol named as Fair-AD (Fair and Adaptive data Dissemination) which disseminate data fairly along with controlling traffic load. This protocol accomplishes fairness with idea of Nash Bargaining from Game Theory. Fair-AD is dissemination protocol that uses the accessible transmission capacity by maximizing the data utility and controlling system load. It additionally joins data selection algorithm and adaptive Transmission rate.

**Ozan Tonguz , Nawaporn Wisitpongphan (2008)** gave complete explanation of multi-hop broadcasting protocols of VANET and defines broadcasting in different regions like dense network, sparse network and in regular traffic. To deal with different situations, author proposed DV-CAST protocol and integrates the various routing solutions.

**Yueyue Li, Stylianos Papanastasiou** proposed a TMDA (Traffic Message Delivery Algorithm) for broadcasting of data. This is an intelligent strategy which uses pre-existing information of semi-mobile node and concluded that through this broadcast storm can be reduced and also compares TMDA with flooding with different traffic densities.

**Jiawei Huang, Yi Huang (2014)** proposed multi-hop IEEE802.11 based protocol VDF (Vehicle Density Forwarding) to solve the issue of emergency message dissemination. This protocol will choose next forwarder according to vehicle density and also decreases the transmission collision which in result decreases the broadcast delay.

**Mrs. A. N. Mahajan et al.** classified various routing protocols and divide into two categories i.e. Based on Topology and Geographic. In this paper author also compare various routing protocols using standards like 802.11p & WAVE on various performance matrices such as Packet Transmission Delay, Jitter, Packet Success Rate and Packet Loss Rate and concluded that overall performance of AODV is better than DSDV Routing.

**Rex Chen, Wenlong Jin (2010)** defined the importance of routing protocol and also defines a review of routing protocols for Broadcasting and emphasize on two main issues i.e. Broadcast Storm Problem and Network disconnect problem.

<b>Approach</b>	<b>Author/Year</b>	<b>Ideology</b>	<b>Performance Matrices</b>
Multihop data dissemination	Moumena Chaqfeh (2016)	<ul style="list-style-type: none"> <li>• Various Speed Adaptive Broadcasting (SAB)</li> <li>• Data dissemination in vehicular environment (DRIVE)</li> <li>• sweetspot</li> </ul>	<ul style="list-style-type: none"> <li>• Delay</li> <li>• Delivery ratio</li> <li>• Overhead</li> </ul>
Broadcasting of safety information	Y.H.Know (2016)	Game Theory based on Bayesian Nash Equilibrium(BNE)	<ul style="list-style-type: none"> <li>• SINR</li> <li>• Transmission Probability</li> <li>• Throughput</li> </ul>

Broadcasting of safety message defining ROI (Region of Interest)	Sofrana Zemomi (2015)	Define ROI by defining critical Junction(CJ) and RCP (Road Casting Protocol) for broadcasting	<ul style="list-style-type: none"> <li>• SNR</li> <li>• PDR</li> <li>• end-to-end Delay</li> <li>• Overhead</li> </ul>
Avoid Cogestion around RSA	Jai Mahabole (2015)	Cooperative Binding game approach	<ul style="list-style-type: none"> <li>• Power consumption</li> </ul>
Broadcasting of Message	Pierpaolo Salvo (2015)	Various categories of Broadcasting like <ul style="list-style-type: none"> <li>• Probabilistic</li> <li>• Time based</li> <li>• Cluster based etc</li> </ul>	<ul style="list-style-type: none"> <li>• PDR</li> <li>• Throughput</li> </ul>
Traffic Anaysis	Mousumi Paul (2015)	Kolmogorov Smirmove test to best fit distribution	<ul style="list-style-type: none"> <li>• Packet Inter-arrival time</li> <li>• Service time</li> </ul>
Fast dissemination of safety message over multi-channel VANET	Ali J Ghandour (2014)	WAVE- enhanced safety message delivery (WSD)	<ul style="list-style-type: none"> <li>• PDR</li> <li>• Average Delay</li> <li>• PURI</li> </ul>
Fair dissemination of data	Ramon S. Schwartz (2014)	Nash Bargaining and Fair-AD (Fair and Adaptive data dissemination) protocol	<ul style="list-style-type: none"> <li>• Delay</li> <li>• Fairness Index</li> <li>• Utility per message</li> </ul>
Implementation of IEEE802.11p/WAVE	Nasser Torabi (2014)	To support multichannel operation IEEE 1609.4 is used and define DSRC spectrum	<ul style="list-style-type: none"> <li>• PDR</li> <li>• Delivery Delay</li> </ul>

Safety Message Broadcasting by choosing next forwarder	Jiawein Hiang (2014)	VDF (Vehicle Density Based Forwarding)	<ul style="list-style-type: none"> <li>• Delay</li> <li>• Broadcast Count</li> </ul>
Safety message delivery through cognitive vehicular network	Ali J Ghandour (2013)	Fuzzy logic based spectrum allocation algorithm to dynamically extend CCH bandwidth	<ul style="list-style-type: none"> <li>• Delay</li> <li>• PURI</li> <li>• PDR</li> <li>• Throughput</li> </ul>
Broadcasting of message	Yueyne Li (2013)	TMDA (Traffic Message delivery Algorithm)	<ul style="list-style-type: none"> <li>• End-to-end Delay</li> <li>• Network reachability</li> </ul>
Message broadcasting and analysing Various problems	Rex Chen (2010)	Comparing various routing protocols and categorize them into traffic based, cluster based, distance based	<ul style="list-style-type: none"> <li>• Delivery ratio</li> <li>• Delay</li> <li>• Packet Transmission</li> </ul>
Link reliability approach to provide QoS (Quality of Service)	Azzedine Boukerche (2009)	Define a model to estimate link reliability	<ul style="list-style-type: none"> <li>• Range</li> <li>• Beacon period</li> </ul>
Multihop Broadcasting in different regions	Ozan Tonguz (2008)	DV-CAST (Distributed Vehicular Broadcast)	<ul style="list-style-type: none"> <li>• Delay</li> <li>• Packet loss ratio</li> <li>• Packet penetration ratio</li> </ul>

Table 5: Related work for Routing Protocols

### **3.2 Work related to Bio-inspired Optimization Technique:**

**Kennedy and James (2011)** proposed the PSO (Particle Swarm Optimization) Technique. PSO is a metaheuristic calculational method as it makes no or few assumptions. In PSO, most useful solution in search area is analyzed in step with particles position and velocity. Every particle's action is prompted with the aid of it's possess best known location as well as complete swarm's best known function. Author also defines the term particles. He defines particle as a member having mass and volume equivalent to zero and are subject to velocities. Author also describe the stepwise procedure of PSO algorithm and proves how PSO is advantageous than Genetic algorithm.

**Dorigo and Marco (1996)** proposed ACO (Ant Colony Optimization) technique. ACO is probabilistic method for solving computational problems. This optimization technique reduces the problem of finding good optimal paths. Ants have a collaborative behaviour for finding shortest path between ant nest and food sources by following pheromone trails. After that ant takes a probabilistic decision for choosing the path having stronger pheromone trail. In this paper, author also define major 3 functions of ACO: a) Ant solution construct, b) Pheromone update, c) Daemon Action

**Reza (2011)** proposed Fish Swarm Algorithm (FSA). FSA is a population based and also a evolutionary computation technique for Swarm intelligent. FSA is encouraged through natural schooling habits of fish. FSA signify its D-dimensional role and have a strong potential to preclude neighbourhood minimums to obtain optimization. But this algorithm has high computational complexity and has difficult implementation as compared to PSO.

**Xingshe et al. (2013)** proposed Firefly algorithm which is heuristic as well as swarm based algorithm. Firefly algorithm is inspired by the flashing behaviour of firefly. According to this, each brighter firefly attracts its partner, which makes the search space accessible more efficiently. In this paper, author also defines 3 rules based on flashing characteristics of firefly:

- a) All fireflies are unisex and will strikes closer to extra brighter fly despite their sex.
- b) Probability of attractiveness of a fly is straightforwardly relative to its shine.

c) Brightness of a firefly is dictated by the estimation of the goal capacity.

**Karaboga and Basturk (2007)** proposed Artificial Bee colony (ABC) technique. In this, colony of bees constitutes three varieties of bees: employee bees, onlooker bees and scout bees. Whole colony is split into two materials: half of colony constitutes employee bees and 1/2 of constitutes onlooker bees or we are able to say number of worker bees shall be equal to quantity of meals sources. The worker bees whose meals sources are exhausted will work as scout bees, that's, will do random search. In this paper, writer also defines the algorithm in 3 steps:

- a) Employee bees are sent to meals sources which then calculate the nectar quantity.
- b) Onlooker examines the information shared via employee bees and on the basis of nectar quantity determination of food supply is finished.
- c) Scouts are sent to the food sources, for the extra discovery of feasible meals source

<b>Author (Year)</b>	<b>Technique</b>	<b>Ideology</b>
Dorigo (1996)	Ant Colony Optimization (ACO)	Pheromone Trail
Karaboga (2007)	Artificial Bee Colony (ABC)	Amount of food source
Kennedy (2011)	Particle Swarm Optimization (PSO)	Velocity of swarm
Reza (2011)	Fish Swarm Algorithm (FSA)	Schooling Behaviour
Xingshe (2013)	Firefly Algorithm (FA)	Brightness of fly

*Table 6: Related work for Optimization Techniques*

# Fisheye State Routing Protocol and Artificial Bee colony Optimization

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### 4.1 Fisheye State Routing (FSR) Protocol:

The fish eye catches more features close to the pixel focal point. The information's detail component diminishes as the separation from the fish eye increases. In terms of routing, this routing method manages accurate distance and link path values data for the nearer neighbouring nodes, with less accurate details as the distance from source node increases.

Functionally, FSR is almost similar to LSR. This is a Table Driven Routing Protocol in which a Topology Map is kept at each Node. The only difference between FSR and LSR is the way of dissemination. In LSR, the messages are flooded in the network after a particular and small interval of time, which in turn consumes a notable amount of bandwidth, in LSR. Whereas in case of FSR, the LS packets are not flooded but interchanged with their link state neighbours. The neighbour list and tables are updated, which are Link State Table, Topology Table and Next Hop table. A Link State Table is maintained based on the current data generated from the neighbouring nodes. Entry replacements are done by using sequence number. The periodic and sequence table update is comparable to vector exchange in DSDV [14], in which the distance is synchronized according to the sequence numbers of nodes. In FSR, link states rather than distance vectors are spread. In LS, shortest paths are computed by keeping a complete topology map at each node. Smallest scope nodes of routing table are disseminated to the neighbours with the highest frequency and the remaining entries are sent with lower frequencies. The message size is reduced, as a large number link state entries are suppressed in a typical update. For the result, routing update overhead can be reduced by using various interchanging intervals for distinct entries in Routing Table.

Routing Table stores the topology information of directly connected neighbours more accurately as compared to the nodes farther away from it. The route information for a

farther node may be incorrect as there can be loss of information. FSR is more suitable for large VANET, because routing overhead reduces due to use of varying frequencies for updates.

#### **4.1.1 Topology Representation in FSR**

The wireless Ad hoc system can be represented as a undirected graph  $G$ , constituting  $V$  and  $E$ .  $V$  is defined as the set of nodes and  $E$  as the set of edges. Each node has a specific identifier and represents a wireless communication node with a vehicle having radio range,  $R$  and unlimited storage space. Vehicles can roam around and their velocity or direction can vary independently. An undirected path  $(x,y)$  linking two nodes  $x$  and  $y$  is possible only when separation  $x$  and  $y$  is less than or equal to radio range  $R$ . If nodes move out of range of each other then connection between  $x$  and  $y$  is removed from  $E$ .

In the FSR implementation, for each node  $x$ , one list, that is, Neighbour list ( $L$ ) and three tables are maintained, that is, Topology Table ( $TT$ ), Next hop Table ( $NT$ ), and Distance Table ( $DT$ ).  $L$  defines the set of vertex that are directly connected to vertex  $x$ . Each destination vertex  $y$  has an entry in  $TT$  which constitutes two parts:  $TT$  ( $LS$ ) and  $TT$  ( $SEQ$ ).  $TT$  ( $LS$ ) defines the link state information and  $TT$  ( $SEQ$ ) defines the time stamp. Each node is tagged with a time stamp value in the node's database for every local node. When this node does not hear HELLO message from some specific neighbour within time stamp period then that neighbouring node will be discarded from the neighbour list.  $NT$  defines another hop to which packet has to be transmitted.  $DT$  describes the shortest path from origin to destination.

In FSR, there are three major tasks:

- a) Discovering Neighbours: is responsible for initializing and managing neighbour connection.
- b) Disseminating Information: is responsible for circulating LS Packets to all the other nodes in the system.
- c) Computation of Route: responsible for computing paths using the LSP information.

Every node initialize with a vacant neighbour list and a topology table. Mechanism of discovering neighbour is invoked to acquire neighbours and keep up current neighbour connections. By utilizing the Dissemination of information procedure, the circulation of LSP in the system is created. Each node has a directory comprising of LSPs started by each node in the system From this directory, the node utilizes the Computation of route procedure to form a routing table. This process is repeated after a specific interval of time.

a) Discovering Neighbours: This technique is responsible for establishing and maintaining the correlation in local nodes. Neighbours can encounter each other by exchanging a special HELLO message over the broadcast network. HELLO messages are transmitted periodically within the transmission range of sender vertex. And the nodes who receive these special packets are recorded as neighbours in the neighbouring list. Each node is tagged with a timeout value in the node's database for every local node. When this node does not hear HELLO message from some specific neighbour within timeout period then that neighbouring node will be discarded from the neighbour list. Timeout values are reset when HELLO message is heard.

b) Dissemination of information: This process is responsible for disseminating link state packet to all vertices present in the network. The main purpose of information disseminations is to manage the link state packet integrity. When the router produces a new link state packet, then that new packet must be disseminated to all the other routers. A most simple technique is flooding, in which each data packet received is broadcasted to every neighbour. The main drawback of flooding is that a router has no capability to guess that the most currently received link state packet is the one which is most currently produced by that node. Two link state packets can travel through different paths but they may not receive in same order as they produced. To resolve this problem, sequence numbers are used. A sequence number is just a counter. When new LS packet is generated, a new sequence number is produced. Whenever a LS packet is received by router, it compares the received LSPs sequence number with the one saved in dataset and only receives the link state packet if it has a higher sequence number. The most currently produced sequence number has more value.

c) Computation of route: In this process, the appropriate or shortest path is computed from source vertex to destination. This route computation can be done by using

Dijkstra algorithm. This algorithm will calculate the entire shortest path from the single source node.

## **4.2 Artificial Bee Colony (ABC)**

In ABC model, Bee colony consists of three types of bees: employee bees, onlooker bees and scout bees. Employee bees visit food source by themselves. Whereas, onlookers wait on the dance area and finalize the decisions of food source and scouts carry out random search. A common supposition, that one employee bee is assigned to each food source. That means count of food source is equal to count of employee bees around the hive.

ABC algorithm consists of 3 steps:

- i. Initialize
- ii. Repeat
  - (a) Place employee bees on food origin in the database.
  - (b) Place onlooker bees on food origin in the database.
  - (c) Send the scouts to the explore area for finding new food origin.
- iii. Until termination condition is reached.

Employee bees are addressed to food origins which then calculate nectar amount and store it into memory. Onlooker examines the data shared by employee bees and determines the amount of nectar and food origin selection is done on the basis of nectar amount. Scouts are addressed to the food origin, for the further discovery of possible food sources.

Food sources are selected at random and the nectar amount is determined for each of the food source. Then the bees come to hive for sharing the data with other bees which are waiting at dance area. After the data is distributed among bees, Employee bees head towards the food source area which is in their memory as it was visited by herself, and if possible, also find more food sources in neighbour. Onlooker bees are turned to Scout bees and go in search of new food sources when the already available food sources are exhausted by the Employee bees. Onlooker bees keep an eye on the dance area and choose the food sources depending upon the dance pattern of the Employee bee. More the nectar amount in the food, more are the chances of it being chosen as food source. Hence the dance of employee bees having higher nectar

amount is selected by the onlooker for the food origin area with. After reaching at recruited area, bee makes a search a new food origin in neighbourhood which is based on visual information. When the nectar amount of food origin is exhausted by the bees, another food origin is randomly determined by scout bees and replaced by abandoned one.

Algorithm:

- i. Initialize population for node  $P_{ij}$ .
- ii. Evaluate the population.
- iii. Generate new solution (food origin position)  $V_{ij}$ , in the vicinity of source node for employee bees using the equation.

$$V_{ij} = P_{ij} + r_{ij} (P_{ij} - P_{kj})$$

Where  $r_{ij}$  is the random number generated

- iv. Implement Greedy selection process between  $P_{ij}$  and  $V_{ij}$
- v. Evaluate the probability constraint of solution  $X_{ij}$  based on fitness values.
- vi. Initiate the new solution  $V_i$  for onlookers from the chosen solution  $X_i$ , depending on probability constraint and evaluate them.
- vii. Again Implement Greedy selection process for onlooker between  $X_{ij}$  and  $V_{ij}$
- viii. Discover exhausted nodes and tag it as abandoned node and replace it with new randomly generate solution  $X_{ij}$  for scouts.
- ix. Memorize best food position.
- x. Repeat from step 3.

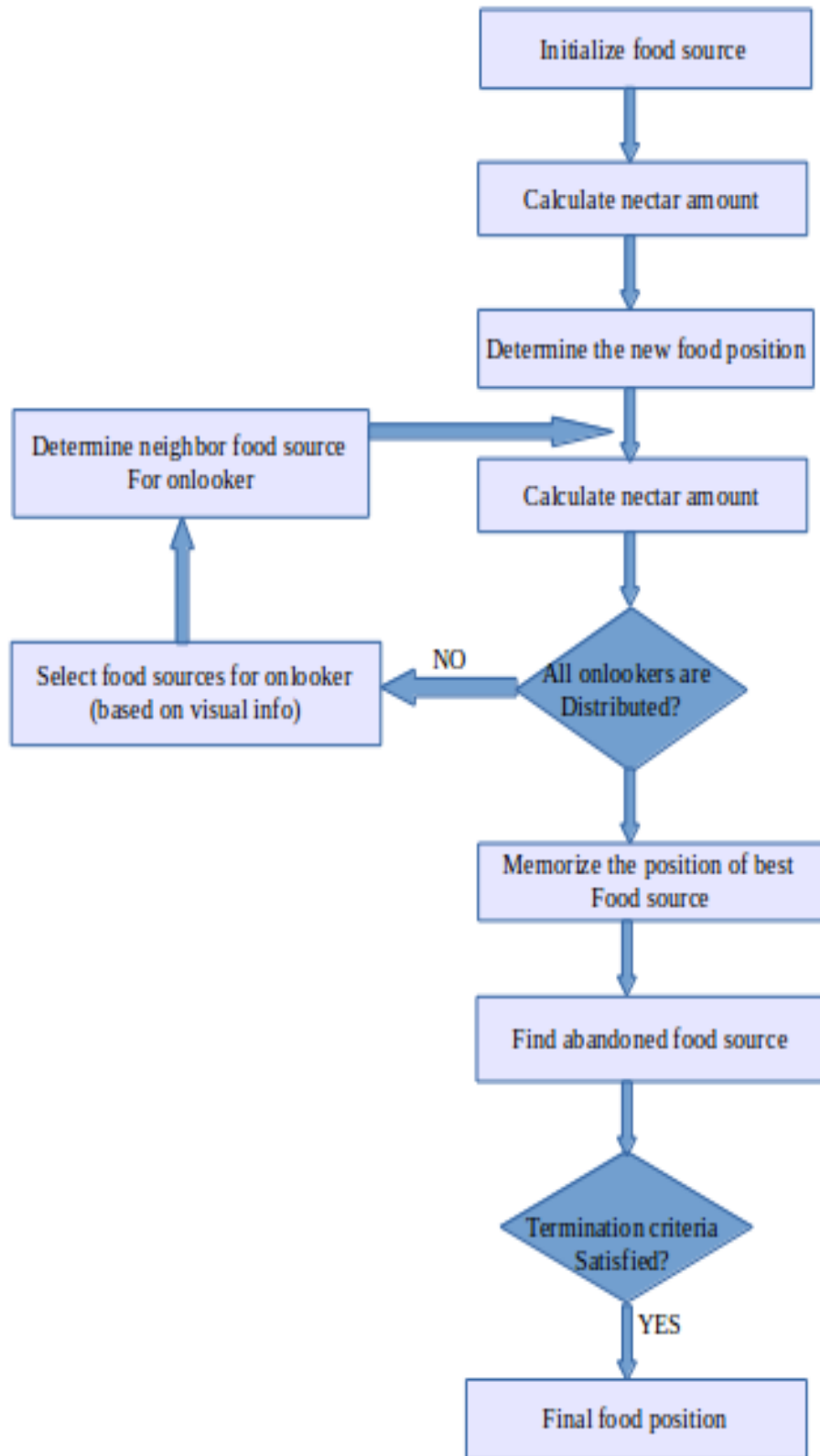


Figure 6: Flowchart for ABC optimization

## CHAPTER 5

### Problem Statement

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The vehicular ad hoc networks are the infrastructure less networks. VANETs are the temporary wireless networks. All the routing information is managed by the node itself. In VANET, efficient message broadcasting is the big problem. For this many VANET protocol comes into picture. These routing protocols are already discussed in section 2.1. The efficiency of these protocols can be calculated on the basis various performance matrices like transmission delay, packet delivery ratio, signal to noise ratio, message overhead etc.

In this dissertation work, we try to improve performance of fisheye state routing protocol.

In Fisheye State Routing, there are many drawbacks:

- a) Poor performance in small ad hoc networks.
- b) Don't have any information about distant nodes.
- c) Message overhead
- d) Redundancy in selecting next forwarder

Here, we focus mainly on 2 issues. First is, Redundancy in selecting next forwarder. In FSR, selection of next forwarder is done on the basis of only one parameter and that is distance. Evaluation will be improved if it is done with more number of parameter. Selections of next forwarder will be more crisp and fine. So we evaluate next forwarder on the basis of two parameters, that is, distance and density. Second issue is, Message overhead. In FSR, a node receives a same message more than once due to which message overhead increases. To remove this problem, Artificial bee colony optimization technique is implemented along with FSR. By using ABC optimization with FSR, the node which gets the data packet once will be considered as abandoned and will not be considered for further evaluation.

### **6.1 ABC- based Fisheye State Routing**

In this section, a new broadcasting technique has been proposed which uses Artificial Bee Colony for selecting next forwarder node. Here next forwarder has been selected on the basis of distance and density instead of distance only. These two parameters are chosen to remove message overhead, that is, somehow if there are three nodes in region having same maximum distances than it becomes difficult to choose next forwarder. But by using density parameter along with distance parameter, message overhead can be reduced.

The flow chart in Figure 8, show the stepwise working of our proposed method. This flowchart begins with dividing the universe into regions of predefined range. Then source node is initialized and number of nodes belongs to region 1 is calculated. After that a HELLO message is broadcasted to each node in the region 1, also neighbouring list and topology table is calculated by each node which receives beacon message. Then employed bees will memorize its food source (node) position and go back to hive (source node). Here onlooker bees are waiting on dance platform. After getting all the information shared by employed bees, source quality is evaluated. Source quality will be calculated on the basis of distance and density. Value of food source is based on proximity in terms of distance to the nest and richness in terms of food source. Firstly, distance of each node from source node is calculated and then density of nodes having maximum distance is evaluated. Then node having highest distance and largest density will be selected as next forwarder. Once a node is visited, that is, if food source is exhausted, that node will be abandoned and will not be further considered for evaluation. This is done to remove redundancy, that is, one node will not get message more than once.

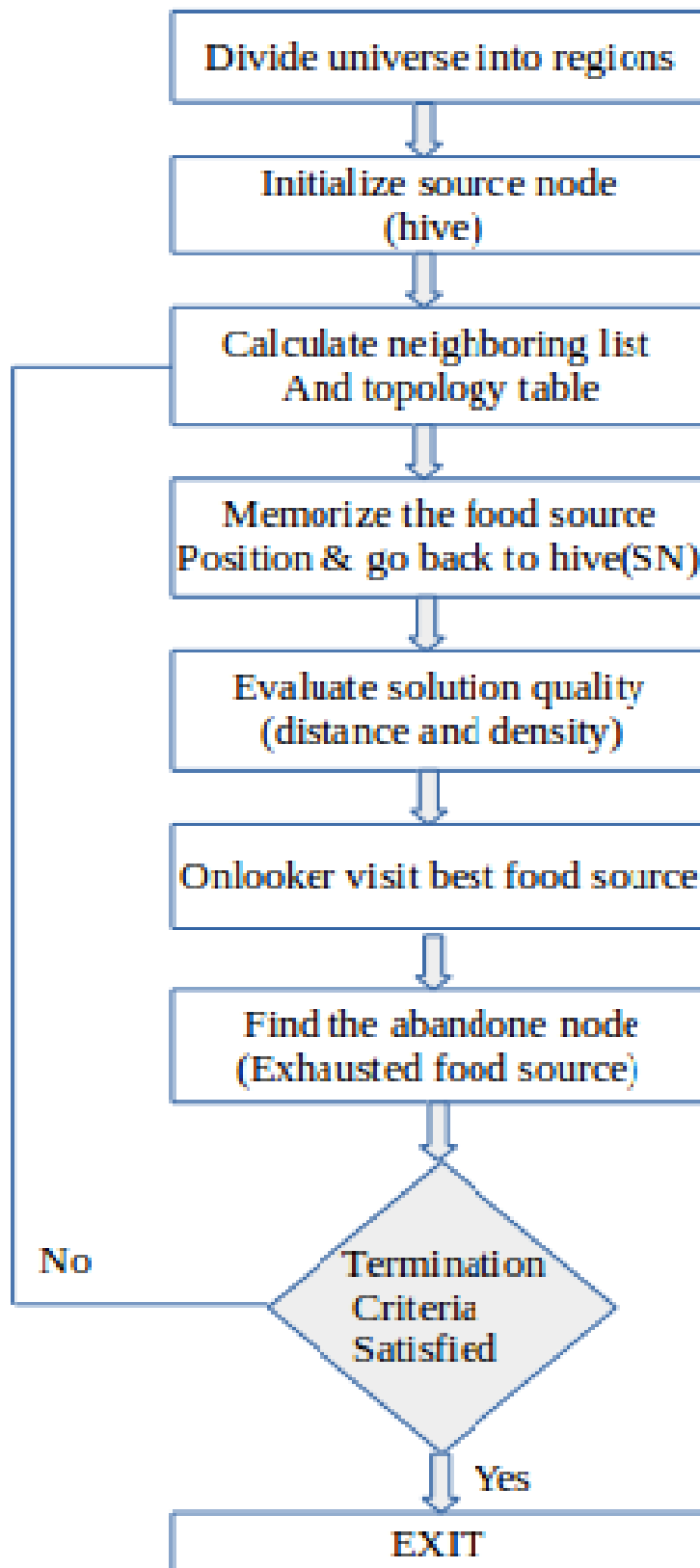


Figure 7: Flowchart for working of ABC-based FSR

We have applied the proposed algorithm on a dataset, which contains data about various vehicles. We have latitude and longitude of each vehicle at different intervals of time. We considered that all vehicles are moving with same velocity. The distance (dis) between source node (node1) and other node (node2) is calculated as follows:

$$d\text{longi} = \text{longi2} - \text{longi1}$$

$$d\text{lati} = \text{lati2} - \text{lati1}$$

where longi2 is longitude of second node and longi1 is longitude of first node

lati2 is latitude of second node and lati1 is latitude of first node

$$x = (\sin(d\text{lati}/2))^2 + \cos(\text{lati1}) * \cos(\text{lati2}) * (\sin(d\text{longi}/2))^2$$

$$y = 2 * \text{atan2}(\sqrt{x}, \sqrt{1-x})$$

$$\text{dis} = R * y$$

Where R is the radius of earth

After calculating distances, distribution of nodes into regions is done on the basis of distances, that is, if distance is less than 250m then node belongs to region 1, if distance is between 250-500m then node belongs to region 2 and this work is done till region 4. After that broadcasting is done region by region.

After that, neighbour list will be created along with a topology table and routing table is formed. Then compare the distances of each node belongs to network. On the basis of neighbour list and topology table, calculate number of one hop neighbours. All the nodes belong to region1 are considered as one hop neighbour. One hop neighbour is those node from source node which can get message without any intermediate node. Then out of region1 nodes, nodes having highest distance are selected and are queued. Then their density is calculated and node having highest distance and largest density will be selected as next forwarder node. And for each iteration same procedure will be followed till termination condition is satisfied (Region 4 is reached).

## 6.2 Execution Algorithm

Universe U

Source Node SN

Number of nodes= n

Neighbour List  $N_x$

Topology Table  $TT_x$

Routing Table RT

- i. Evaluate distance(dis) from latitude and longitude.
- ii. Set  $SN=x$ ;  $Range=R$ ;
- iii. Divide universe into regions.
- iv. Examine the region of each node
  - for ( $i=1$ ;  $i \leq n$ ;  $i++$ )
  - if(  $R(i) < 5$  ) then region 1
  - if(  $R(i) > 5 \ \&\& \ R(i) < 7$ ) then region 2
  - else region 3;
- v. Initially  $N_x = \Phi$ ;
  - $TT_x = \Phi$ ;
  - flag=1;
- vi. iteration=1;
- vii. Repeat
- viii. Evaluate  $N_x$  for node x
  - for each node  $\in U$
  - do
  - $dis(x,y) \leq R$ ;
  - node (y)  $\sim \rightarrow N_x$
- ix. Evaluate the population
- x. Update (  $N_x$  RT ,  $TT_x$  )
- xi. Apply Greedy Selection process
  - if  $dis(y+1) > dis(y)$
  - node(y+1)  $\rightarrow S[y]$
  - for each node  $\in S[y]$

- if (density(y+1) > density (y))  
node(y+1) -> NF;
- xii. Memorize node(n+1)
- xiii. for each node  $\in N[x]$   
flag= -1
- xiv. iteration= iteration +1
- xv. until maximum region is met

Parameters	Values
Tool used	MATLAB
Version	R2013a
Number of nodes	25, 50
Number of Regions	4
Simulation Time	1202
Range	500

*Table 7: Simulation Parameters*

### 5.3 Results

We have proposed a dissemination technique which works on the principal of Fisheye state routing (FSR) protocol. Table 7 shows the parameter which we have consider for simulation. Firstly, implementation of Fisheye State Routing (FSR) is done on 25 nodes (vehicles). On implementing FSR on 25 nodes following outputs are obtained as shown in Figure 9. This list in shows the output list for 25 vehicles when message is disseminated through source node. In this list, each row represents respective vehicles and columns represents distance, latitude, longitude and region respectively. In region column, if value is -2, then it is forwarding node. If value is 1, 2, 3 then it means node belongs to region 1, region 2 and so on respectively.

ans =

```
[ 0, 5284623083202951/140737488355328, -107334193778243/8796093022208, -2, 0, 0]
[ 481, 660512382654851/17592186044416, -4293270160220109/35184372088832, 1, 0, 23]
[ 3148, 5287838802518631/140737488355328, -2147054866612665/17592186044416, 1, 0, 23]
[ 2588, 5287209566615569/140737488355328, -1073500466244345/8796093022208, 1, 0, 23]
[ 3339, 5288071901798469/140737488355328, -8588275866999119/70368744177664, 1, 0, 23]
[ 8194, 2646798000810139/70368744177664, -8590016107153255/70368744177664, 3, 0, 0]
[ 7655, 2646510426270683/70368744177664, -8589784629169283/70368744177664, 3, 0, 0]
[ 7662, 1323255770807639/35184372088832, -8589793249340445/70368744177664, 3, 0, 0]
[ 3720, 5288568095739039/140737488355328, -8588356826239295/70368744177664, 1, 0, 23]
[ 12772014, 0, 0, 4, 0, 0]
[ 8392, 5293827413457631/140737488355328, -4295040015060233/35184372088832, 3, 0, 0]
[ 9798, 5295377092237785/140737488355328, -4295315952016777/35184372088832, 3, 0, 0]
[ 7719, 5293086464358437/140737488355328, -268431695670233/2199023255552, 3, 0, 0]
[ 9667, 1323804999911477/35184372088832, -8590594819705373/70368744177664, 3, 0, 0]
[ 4211, 5289188673471817/140737488355328, -8588470162138667/70368744177664, 1, 0, 23]
[ 742, 660675204845801/17592186044416, -4293533715796115/35184372088832, 1, 0, 23]
[ 12328, 2649136558248521/70368744177664, -8591505039411311/70368744177664, 4, 0, 0]
[ 237, 5284364894651063/140737488355328, -8586639638885751/70368744177664, 1, 0, 23]
[ 2360, 2641154189680735/70368744177664, -8585544708263221/70368744177664, 1, 0, 23]
[ 6575, 5291742197572037/140737488355328, -2147363593644777/17592186044416, 2, 0, 0]
[ 4186, 2644583560466425/70368744177664, -53677839772225/4398046511104, 1, 0, 23]
[ 5514, 2645329203864543/70368744177664, -8588946129287411/70368744177664, 2, 0, 0]
[ 12772014, 0, 0, 4, 0, 0]
[ 269, 5284331144393981/140737488355328, -1073328139347119/8796093022208, 1, 0, 23]
[ 2390, 2643504773137497/70368744177664, -4293953687016679/35184372088832, 1, 0, 23]
```

Figure 8: Output list for 25 vehicles when  $NF=1$

When source node is 1, following graph is obtained

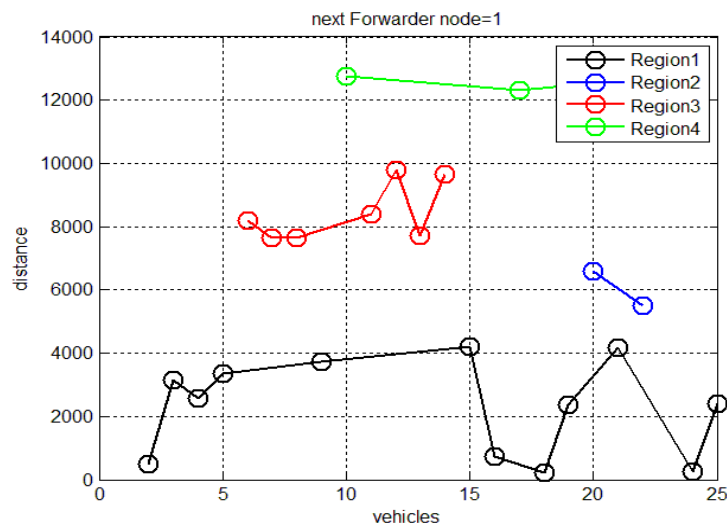


Figure 9: Densities Graph for FSR when  $NF= 1$

In the graph shown in Figure 9, black dots represent nodes belonging to region 1, it

means out of 25 nodes 12 nodes belongs to region 1. Similarly, blue, red, green represents nodes belong to region 2, region 3 and region 4, respectively.

On the basis of next forwarder selection matrices (distance), node having highest distance will be selected as next forwarder. So on the basis of distance, node 15 is selected as next forwarder. For node 15, same output list will be generated, which gives the result as shown in Figure 11.

In this list, same as above list rows represents rows and columns represents distance, latitude, longitude and region to which it belongs. Since 15 node is selected as next forwarding node, so -2 as a flag is tagged in place of region column. Similarly, tag 1, 2, 3, 4 represent region 1, 2, 3, 4 respectively. In this technique, the node which is already get message, if lies in the range of next forwarding node even then message is again forwarded.

```
ans =
[      0, 5284623083202951/140737488355328, -1073341937778243/8796093022208, -2, 0, 0]
[  4692,  660512382654851/17592186044416, -4293270160220109/35184372088832,  1, 0, 23]
[  1112, 5287838802518631/140737488355328, -2147054866612665/17592186044416,  1, 0, 23]
[  1669, 5287209566615569/140737488355328, -1073500466244345/8796093022208,  1, 0, 23]
[   915, 5288071901798469/140737488355328, -8588275866999119/70368744177664,  1, 0, 23]
[  3984,  2646798000810139/70368744177664, -8590016107153255/70368744177664,  1, 0, 23]
[  3446,  2646510426270683/70368744177664, -8589784629169283/70368744177664,  1, 0, 23]
[  3453, 1323255770807639/35184372088832, -8589793249340445/70368744177664,  1, 0, 23]
[   510, 5288568095739039/140737488355328, -8588356826239295/70368744177664,  1, 0, 23]
[ 12772758,      0,      0,      0, 4, 0, 0]
[  4183, 5293827413457631/140737488355328, -4295040015060233/35184372088832,  1, 0, 23]
[  5588, 5295377092237785/140737488355328, -4295315952016777/35184372088832,  2, 0, 0]
[  3509, 5293086464358437/140737488355328, -268431695670233/2199023255552,  1, 0, 23]
[  5457, 1323804999911477/35184372088832, -8590594819705373/70368744177664,  2, 0, 0]
[  4211, 5289188673471817/140737488355328, -8588470162138667/70368744177664, -2, 0, 23]
[  3470,  660675204845801/17592186044416, -4293533715796115/35184372088832,  1, 0, 23]
[  8121,  2649136558248521/70368744177664, -8591505039411311/70368744177664,  3, 0, 0]
[  4448, 5284364894651063/140737488355328, -8586639638885751/70368744177664,  1, 0, 23]
[  6556,  2641154189680735/70368744177664, -8585544708263221/70368744177664,  2, 0, 23]
[  2364, 5291742197572037/140737488355328, -2147363593644777/17592186044416,  1, 0, 23]
[    26,  2644583560466425/70368744177664, -536778397772225/4398046511104,  1, 0, 23]
[  1305,  2645329203864543/70368744177664, -8588946129287411/70368744177664,  1, 0, 23]
[ 12772758,      0,      0,      0, 4, 0, 0]
[  4480, 5284331144393981/140737488355328, -1073328139347119/8796093022208,  1, 0, 23]
[  1860,  2643504773137497/70368744177664, -4293953687016679/35184372088832,  1, 0, 23]
```

Figure 10: Output list when NF=15

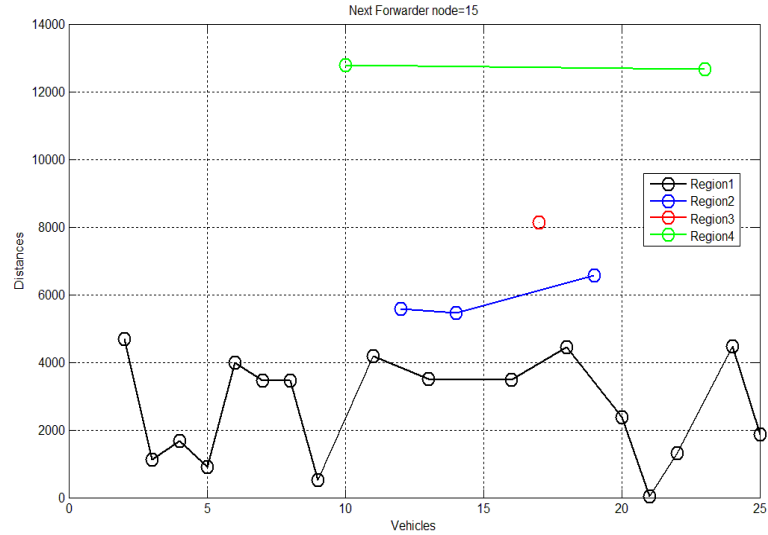


Figure 11: Densities graph for NF=15

After that, FSR is implemented in conjunction with ABC is implemented on same data. Here also, we set node 1 as the source node. After implementing proposed technique following output is generated as shown in Figure 13.

```
matrix output after calculation of distance and density with next node forwarder 1
--1-->      --2-->      --3-->      --4-->      --5-->
--1-->         0      37.54951   -122.02485   -2.00000         0
--2-->    481.00000    37.54578   -122.02208    1.00000         0
--3-->   3148.00000    37.57235   -122.04594    1.00000         0
--4-->   2588.00000    37.56788   -122.04287    1.00000         0
--5-->   3339.00000    37.57401   -122.04674    1.00000         0
--6-->   8194.00000    37.61326   -122.07147    3.00000         0
--7-->   7655.00000    37.60918   -122.06818    3.00000         0
--8-->   7662.00000    37.60919   -122.06830    3.00000         0
--9-->   3720.00000    37.57754   -122.04789    1.00000         0
--10-->  1.27720e+07         0         0         4.00000         0
--11-->   8392.00000    37.61491   -122.07238    3.00000         0
--12-->   9798.00000    37.62592   -122.08022    3.00000         0
--13-->   7719.00000    37.60964   -122.06860    3.00000         0
--14-->   9667.00000    37.62480   -122.07969    3.00000         0
--15-->   4211.00000    37.58195   -122.04950    1.00000         0
--16-->    742.00000    37.55504   -122.02957    1.00000         0
--17-->  12328.00000    37.64649   -122.09263    4.00000         0
--18-->    237.00000    37.54767   -122.02349    1.00000         0
--19-->   2360.00000    37.53306   -122.00793    1.00000         0
--20-->   6575.00000    37.60009   -122.06349    2.00000         0
--21-->   4186.00000    37.58179   -122.04928    1.00000         0
--22-->   5514.00000    37.59239   -122.05627    2.00000         0
--23-->  1.27720e+07         0         0         4.00000         0
--24-->    269.00000    37.54743   -122.02328    1.00000         0
--25-->   2390.00000    37.56646   -122.04150    1.00000         0
```

Figure 12: Output list for proposed technique when NF=1

And the graph for corresponding matrix is:

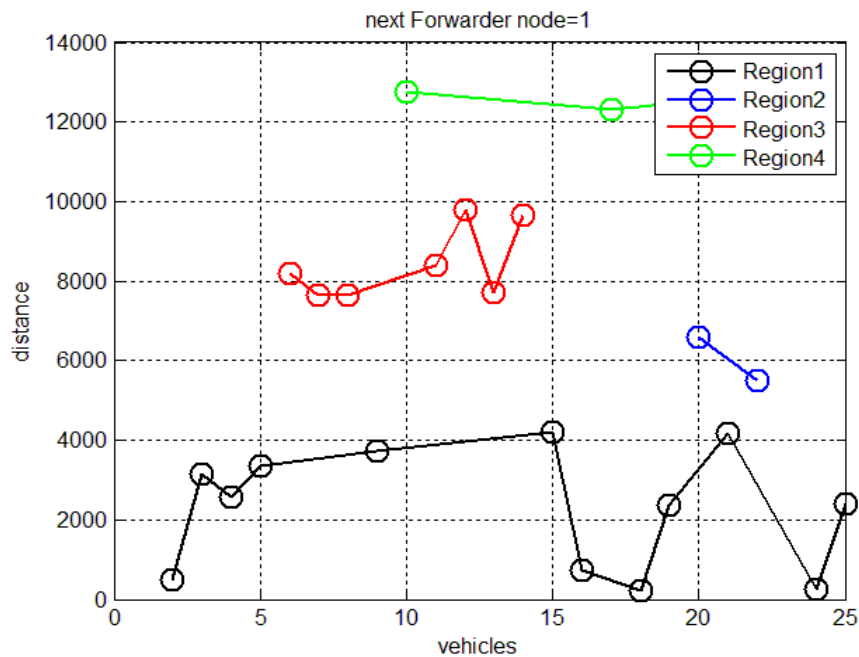


Figure 13: Densities graph for NF=1

Figure 14 depicts the graphical representation of ABC based FSR technique when NF=1.

For second iteration, the matrix for source node will be same for both FSR and ABC. In this also node 15 will be selected as next forwarder. And the list for next forwarder is shown in Figure 14.

In this list, -1 is assigned to those nodes to which message are already delivered. And will be discarded for next iteration. Since node 2, 3, 4 etc belongs to region 1 and are already processed so at second iteration -1 is assigned to all nodes belongs to region 1. So by optimizing FSR with ABC, number of nodes for message dissemination reduces.

matrix output after calculation of distance and density with next node forwarder 15

	--1-->	--2-->	--3-->	--4-->	--5-->
--1-->	0	37.54951	-122.02485	-2.00000	0
--2-->	481.00000	37.54578	-122.02208	-1.00000	0
--3-->	3148.00000	37.57235	-122.04594	-1.00000	0
--4-->	2588.00000	37.56788	-122.04287	-1.00000	0
--5-->	3339.00000	37.57401	-122.04674	-1.00000	0
--6-->	3984.00000	37.61326	-122.07147	1.00000	0
--7-->	3446.00000	37.60918	-122.06818	1.00000	0
--8-->	3453.00000	37.60919	-122.06830	1.00000	0
--9-->	3720.00000	37.57754	-122.04789	-1.00000	0
--10-->	1.27728e+07	0	0	4.00000	0
--11-->	4183.00000	37.61491	-122.07238	1.00000	0
--12-->	5588.00000	37.62592	-122.08022	2.00000	0
--13-->	3509.00000	37.60964	-122.06860	1.00000	0
--14-->	5457.00000	37.62480	-122.07969	2.00000	0
--15-->	4211.00000	37.58195	-122.04950	-2.00000	0
--16-->	742.00000	37.55504	-122.02957	-1.00000	0
--17-->	8121.00000	37.64649	-122.09263	3.00000	0
--18-->	237.00000	37.54767	-122.02349	-1.00000	0
--19-->	2360.00000	37.53306	-122.00793	-1.00000	0
--20-->	2364.00000	37.60009	-122.06349	1.00000	0
--21-->	4186.00000	37.58179	-122.04928	-1.00000	0
--22-->	1305.00000	37.59239	-122.05627	1.00000	0
--23-->	1.27728e+07	0	0	4.00000	0
--24-->	269.00000	37.54743	-122.02328	-1.00000	0
--25-->	2390.00000	37.56646	-122.04150	-1.00000	0

Figure 14: Output list for proposed technique when NF=15

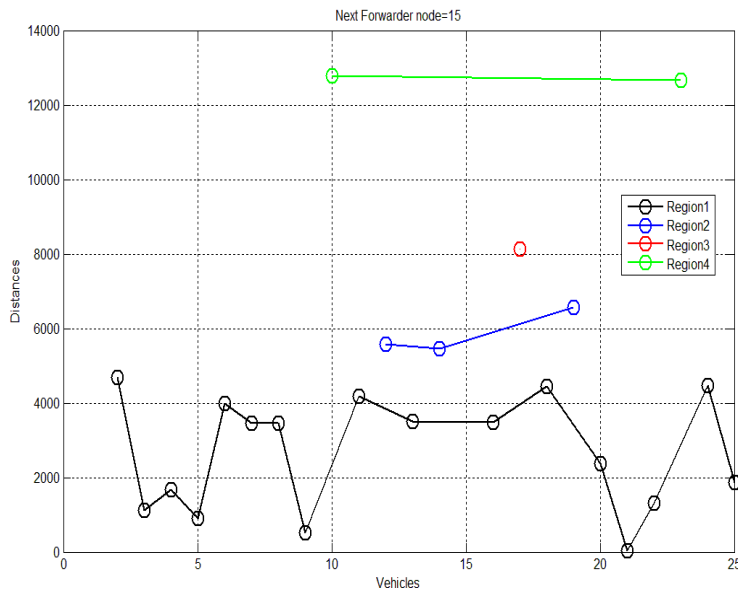


Figure 15: Densities graph for proposed when NF=15

In the graph shown in Figure 16, number of nodes for region 1 reduces from 17 to 7, that is, message overhead reduces by using our proposed technique.

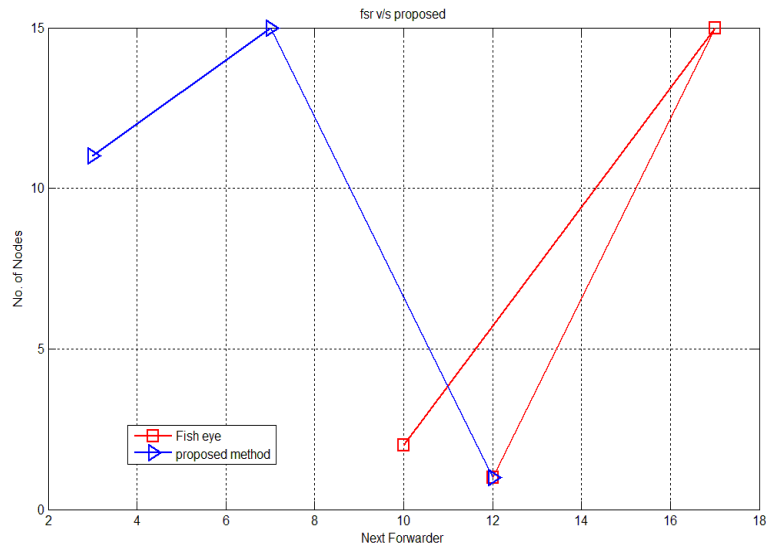


Figure 16: Comparison between FSR and proposed

After testing on 25 nodes, same techniques are implemented on 50 nodes. In this case also we got much better results. Following are the results:

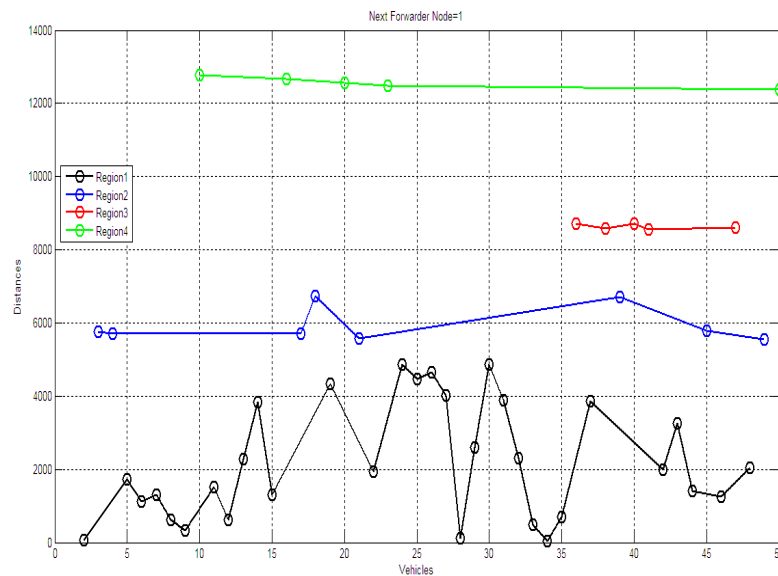


Figure 17: Densities graph for FSR 50 nodes when NF=1

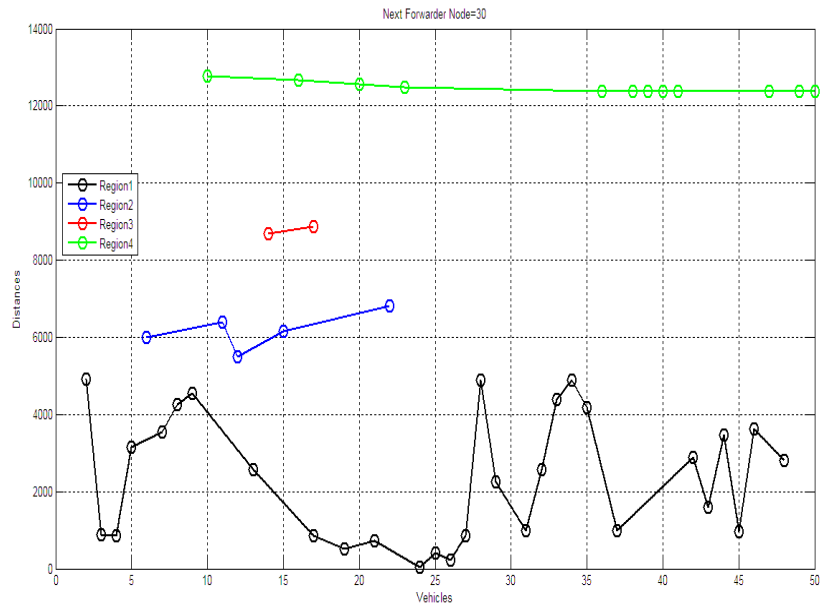


Figure 18: Densities graph for FSR when NF=30

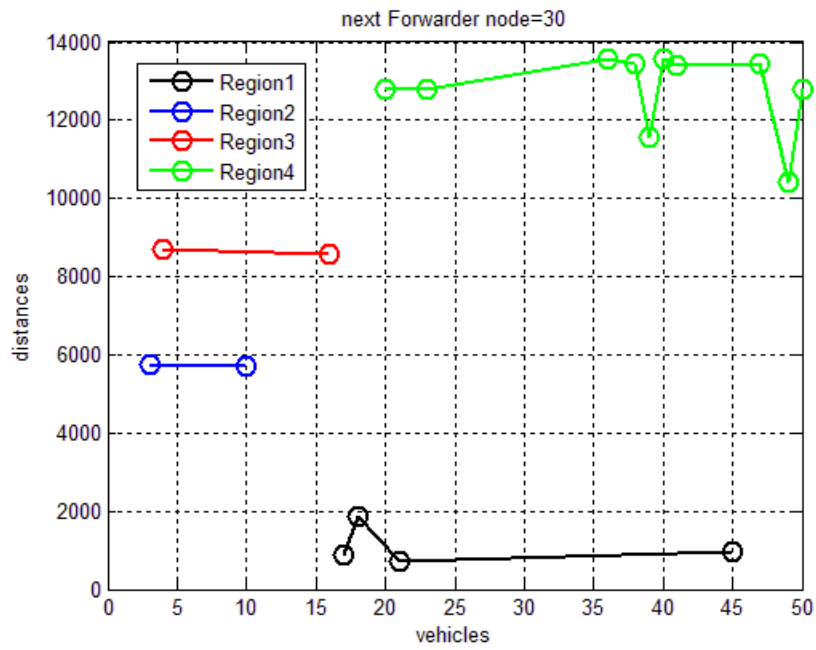


Figure 19: Densities graph for proposed technique when NF=30

#### 7.1 Conclusion

Vehicular Ad hoc Networks (VANETs) is the collection of wireless nodes (vehicles) that make a momentary network. VANETs comprises of mobile nodes that have capability to communicate with each other. In this, we presented the ABC-based Fisheye State Routing protocol for message dissemination in VANET scenario. Goal of this dissertation is to enhance the performance of Fisheye state routing. An efficient forwarding mechanism is designed having short dissemination delay. The proposed system focuses on the issues such as inaccuracy in choosing next forwarder that means nodes having same distances results in choosing many nodes as next forwarder which creates redundancy. The obtained results have proved the proposed technique more efficiency then convention fisheye state routing. Firstly we have examined the proposed forwarding mechanism on 25 vehicles, the on 50 vehicle data set. After that entire protocol was examined and compared with traditional FSR and proposed forwarding technique.

#### 7.2 Future Scope

The future Scope of this research is to implement the proposed technique on dynamic network. Also we can implement it on large number of vehicles, that is, more than 50. Along with density, some other parameters like direction, speed etc. should also be considered to enhance by reducing the effectiveness of these issues, we make VANET as the good transportation system.

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