

**Analysis of enhanced Hybrid Approach using Greedy Perimeter Stateless Routing in
VANET**

A Dissertation submitted

By

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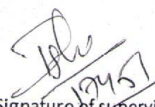
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ABSTRACT

VANET (Vehicular adhoc network) is an emerging new technology. Vanet is a popular research area these days. In VANET every vehicle act as router and connect to the other vehicle to form a network. The primary goal is to increase road safety. Routing in Vanet is an important issue. In this report various routing protocols are discussed, and out of all Position based routing protocols are appropriate for Vanet. GPSR is one of the most suitable position based routing protocol. This report presents a hybrid approach PHRHLS (A Movement Prediction based Joint Routing and Hierarchal Location Based Service) coupling GPSR protocol and HLS location service with mobility algorithm. In which RGPSR protocol is proposed which is enhanced version of GPSR protocol and it will gives better results as compared to existing protocol in terms of end-to-end delay, packet loss and throughput.

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Neha

DECLARATION

I hereby declare that the dissertation proposal entitled, submitted **Analysis of enhanced Hybrid Approach using Greedy Perimeter Stateless Routing in VANET** for the M.Tech Degree is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

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CERTIFICATE

This is to certify that **Neha** has completed M.tech dissertation proposal titled **Analysis of enhanced hybrid approach using Greedy perimeter stateless routing in VANET** under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of the dissertation proposal has ever been submitted for any other degree or diploma.

The dissertation proposal is fit for the submission and the partial fulfillment of the conditions for the award of M.tech Computer Science & Engg.

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CHAPTER 1

INTRODUCTION

1.1 Adhoc Network

Adhoc network is a self-organizing and decentralized type of network in which communication between nodes take place without wires. The nodes communicate with each other in their same radio range or outside their radio range. In wireless Adhoc network, infrastructure is not permanent. The topology of network changes very quickly. All nodes in network are participating in procedure of forwarding packet for routing purposes from source to destination. Adhoc networks are a new prototype of wireless communication in mobile hosts. Basically, it is used for many purposes like in military communication, automated battle fields, rescue operations, entertainment and many more. The wireless networks have certain advantages over the wired networks:

- Installation of wireless network is easier and fast as compared to the wired network.
- Wireless networks are easily adaptable to changes and are more flexible.
- It can be extended to those places where wired communication is not possible.

There are two types of wireless networks.

- Infrastructure networks
- Infrastructure less networks

Infrastructure network- An infrastructure network is the network in which communication takes place between the access points and wireless stations. The base station acts as a bridge between the networks. The nodes can communicate with each other if they are of the same base station but when nodes of a particular base station have to communicate with the nodes lying in any other base station they have to take the use of access points.

The following types of infrastructure networks are

- Cellular networks
- Wireless LAN

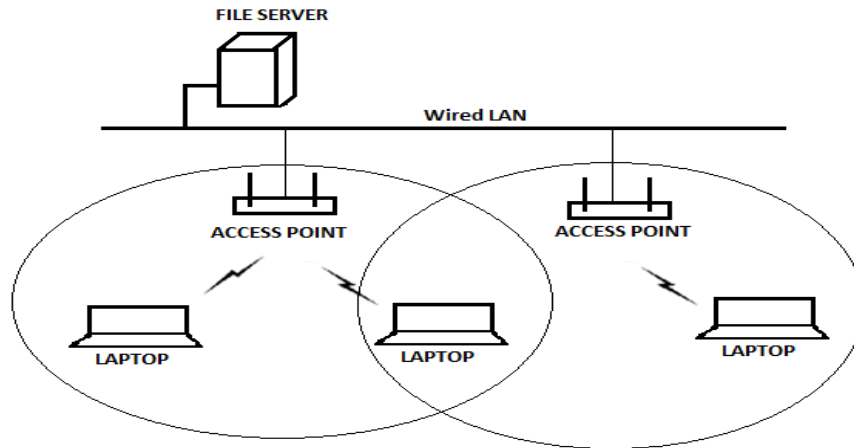


Figure 1.1: Infrastructure Network

Infrastructure less network- An infrastructure less network is the network in which all nodes are mobile and nodes act as a router and it is the decision of router to connect or depart the network. In this network nodes are communicate with each other in wireless mode. In this there is no predefined building design.

The infrastructure less network in which all access points are controlled by the base stations which uses server file Wi-Max. In this communication takes place with the help of Wi-Fi and the access points and base station uses Wi-Max. The following figure shows the networking between different nodes.

The following types of infrastructure less networks are:

- MANET
- Wireless Sensor Network
- Wireless Mesh network

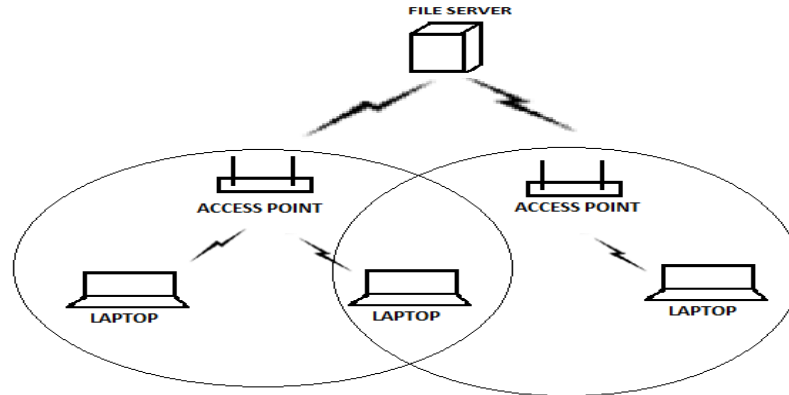


Figure 1.2: Infrastructure less network

1.1.2 Essentials of Adhoc Network

Two types of essentials in Adhoc Networks are:

- **Single Hop-** Each node exhibit in the network specifically interacts with each other in this chance of link failure may occur.
- **Multi Hop-** In these nodes corresponds with each other with the help of two or more nodes and these nodes act as relay nodes in network.

1.1.3 Indicative of Adhoc Network

The following are indicatives of Adhoc Networks:

- Temporary network is sustained by collecting mobile nodes.
- Topology modified repeatedly and rapidly.
- Router act as a independent.
- All nodes are self-organizing.
- There are numerals nodes present in network.
- Multi-hop is used in this networking.

1.1.4 Types of Adhoc Networks

MANET – It stands for mobile adhoc network which is infrastructure less in nature. In this wireless technique is used for connecting the nodes. To move a data from one point to other point controller is not required. Topology is maintained by all the nodes in network. In this nodes employed as router and host all nodes have ability to connect or depart the network in this inadequate bandwidth and node mobility are entailed. It issued different types of protocols and benefits in power battery consumption and routing traffic. The route is discovered with the help of routing protocols and changing topology causes link failure in network.

Wireless Mesh Network – In this network mesh topology is used that interact with each other through radio nodes. The network employed mesh router, mesh clients and gateways for interaction purposes. For communication mesh clients used laptops, cell phones and wireless devices. The mesh router is not connected to internet but cover traffic in path to and from a gateway.

Wireless Sensor Network – A wireless sensor network is a combination of small sensor nodes that obtained energy from the batteries. A sensor node is made up of sensing unit, processor, transceiver and power source. The nodes are fewer in hardware and support software deployment. It is very useful for data gathering purposes like military, irrigation and underwater. The main problem in WSN is power efficiency that is attained by DPM or DVS.

WSN used to examine the disaster, forest fires, surveillance and environment monitoring. The functions of WSN are:

- Efficient data gathering protocol
- Efficient routing protocol
- Automatic network formation

1.2 VANET

Vehicular ad-hoc network (VANET) is a self organizing infrastructure less based network. It is the application of MANET in which all the vehicles are connected to each other through wireless links. The vehicles perform as nodes in the network. The types of communication in VANET are V2V, V2I and V2R. VANET is the most important constituent of intelligent transportation system (ITS) in which vehicles are prepared with some short range and some medium-range wireless communication. A VANET revolve each engaged vehicle into a wireless router permitting vehicles to connect with in a same range. The major goal of VANET is to raise road safety, improving transportation system and increasing vehicle safety. To attain this vehicles operate as sensors and bartered of warnings that facilitate the drivers to react early in dangerous conditions like accidents and traffic jams. Instead of safety applications it provides easy functions to all road users. The examples are internet access, e-commerce and multimedia applications. Through internet access users can download music, send e-mails and play games. There are different kinds of applications that were expanded under cooperation of various government and car manufacturers some of them are (ADASE2), (CAMP), CARTACK 2000 and Fleet Net.

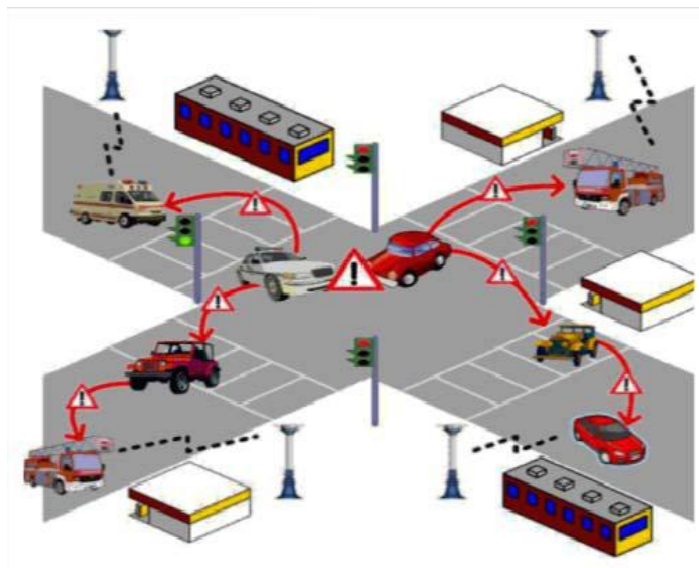


Figure 1.3: Vehicular Ad hoc Networks Scenario

1.2.1 Modes of Communication

- **Vehicle to Vehicle (V2V)** -It works in dedicated short-range vehicular network which endow with real time safety, fast and reliable. It does not require any roadside infrastructure. It is valuable in the thick associated system and low thickness vehicular system. In this notice messages are transmit from vehicle to vehicle.
- **Vehicle to Roadside (V2R)** -It this correspondence is happens in the middle of vehicles and roadside units. It may utilization of predefined foundation, for example, remote access focuses. In V2R messages send to the roadside unit and afterward these messages send to all the vehicles introduce in the network.
- **Vehicle to Infrastructure (V2I)** - It provides communication between longer- range vehicular networks.

1.2.2 Characteristics of VANET

The following are some characteristics of VANET

- **High Dynamic Topology** - Due to movement of vehicles at high speed the topology changes.
- **Frequent Disconnect Network** - While exchanging the information frequent disconnection occurs between vehicles.
- **Mobility Modeling** - The versatility rely on driver driving conduct and speed of vehicles.
- **Battery Power and Storage**-In vehicles storage and battery force is endless so it is valuable for all the routing choices in the system.
- **Interaction with installed sensors**- Onboard sensors like GPS is useful to locate the current position of vehicles and development of these vehicles.

1.2.3 Applications of VANET

The applications where VANET is efficiently used are:

- Traffic Signal
- Vision Improvement
- Weather Circumstances
- Driver Assistance
- Automatic Parking

1.2.4 Advantages of VANET

The various advantages of VANET are:

- VANET provides more suitable communication between vehicles.
- VANET offers internet services to drivers while driving cars.
- VANET provides faster transaction processing.
- The best path from source to destination is found with the help of VANET.
- Unlike other adhoc network VANET provides the safety and reliability.
- VANET will increase road safety and it minimizes the road mishaps.
- VANET help the cars establishing communication with other cars in the network.

1.2.5 Challenges in VANET

There are many challenges in vehicular adhoc networks some of them are described below:

- Mobility- In VANET nodes are highly mobile and move from one place to another place within a particular area vehicle make connections with other vehicles and connection last for few seconds and vehicle move in different directions so the mobility is very difficult problem.
- Network Scalability- The coverage of network is very large in the world and it is increasing day by day and there are different DSRC standards in different countries so it will create a problem as there is no global authority.

- Volatility- In VANET connections between vehicles are lasting for very short time or it can be easily removed as vehicle changes its direction it also lacks long life context so the contact of devices with hotspot need long life password so this is very difficult for securing the virtual connection.

1.3 Routing Protocols in VANET

The routing protocols in VANET can be categorized into different categories such as Topology based routing, Position based routing/Geographic routing, Cluster based routing, Broadcast routing and Geocast routing.

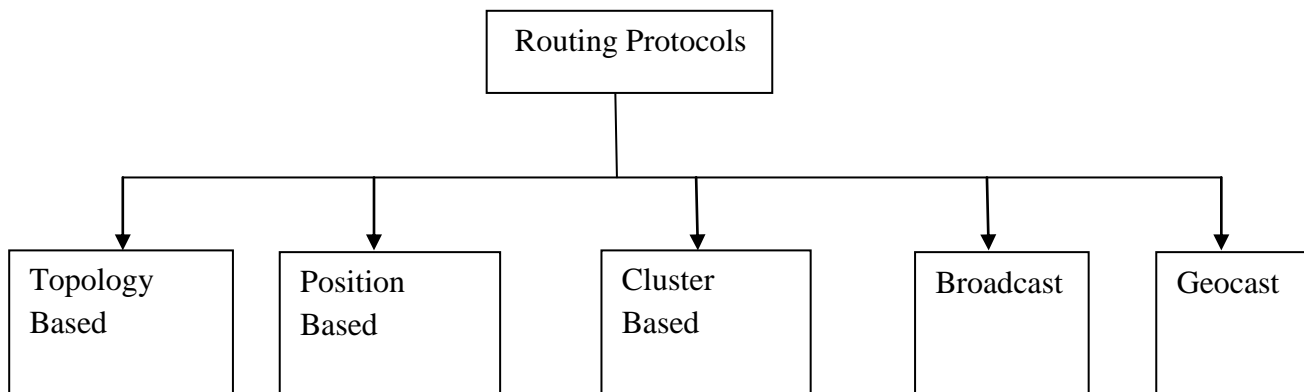


Figure 1.4: Classification of Routing Protocols

1.3.1 Topology Based Routing Protocols

Topology based routing perform packet forwarding by using the links exist in the network. The different forms are proactive, reactive and hybrid.

Proactive protocols

Proactive protocols are table driven routing protocols e.g. FSR, OLSR, and TBRPF.

- **Fisheye state routing (FSR)** – FSR has a great similarity with the link state routing (LSR). In this routing topology table is sustained by every node on the basis of information received from the neighboring nodes. One drawback of this routing is that with increase in table size network size also increases and because of high

mobility of nodes in VANET, route to remote destination sometimes becomes less accurate.

- **OLSR** - In this routing nodes select some neighbors known as MPR (multipoint relays). It will transmit packets again and nodes which are not having multipoint relays can only read and process the packet.
- **TBRPF** – It is a link state routing protocol for adhoc networks. In this source tree is constructed with the help of topology table.

Reactive Protocols

These are designed to overcome the overhead caused by proactive protocols. These are also known as on demand routing protocols. Whenever some data is to be sent, they frequently update their routing table. These protocols use the method of flooding and therefore some overhead also occurs in this routing. One shortcoming of reactive routing is that route should be discovered initially which makes it unsuitable for VANET applications. It is further divided into three types.

- **AODV** – it establish a route only when node has some data packets to send which is send with the help of route discovery in this no loops are present in network.

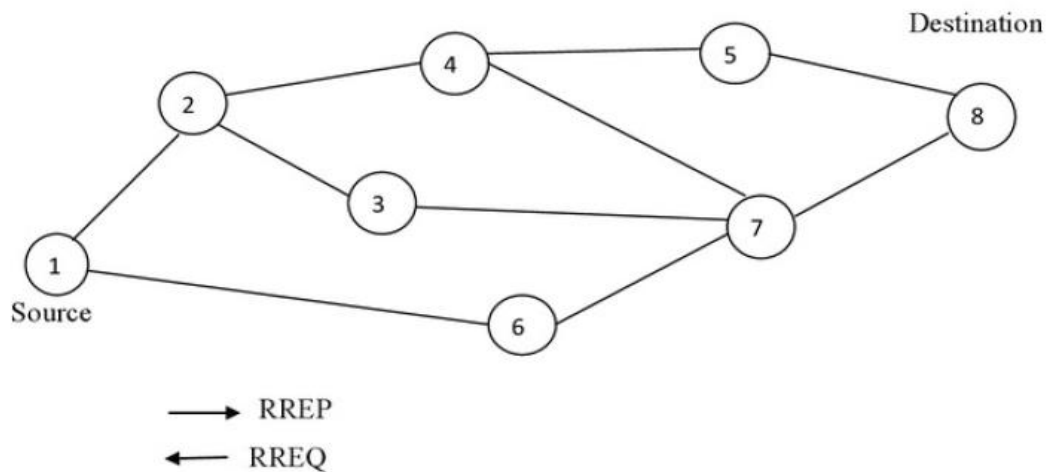


Figure 1.5: AODV algorithm

When node wants to send the data packets to destination it uses route discovery phase. The node sends a RREQ packet to other nodes. As the discovery phase is completed the next phase is data transmission phase that transmitted the data to

nodes. If there is any error then it sends RERR packet it will create the overhead. To recover the error route maintenance phase occurs in which the broken link send RERR packet back to source and it will check the old route to destination if route is present then it uses that route otherwise route discovery phase occurs in this again RREQ packet is send. It will choose the new path to destination. In VANET nodes are highly mobile so it is very difficult to maintain route for long time.

- **DSR** – it consist of two functions- route discovery and route maintenance that makes itself configuring and self organizing. With the increase in mobility the performance of the protocol decreases.
- **TORA** - in this directed acyclic graph is constructed by nodes by broadcasting the query packets.

Hybrid Protocols

These protocols are combination of proactive and reactive protocols to make routing more scalable and competent. These are further divided into two types.

- **Zone Routing Protocol (ZRP)** - It divides the entire network into overlapping zones.
- **Hybrid Adhoc Routing Protocol (HARP)** – In this network is separated into non-overlapping zones. In this routing there are two zones: inter-zone and intra zone.

1.3.2 Position based routing protocols

In position based routing protocols every vehicle knows the position of their neighboring vehicle with the help of GPS. In this routing table is not required. To send packet to destination every node in the network requires knowledge about the neighboring nodes. To update information in routing table, hello messages are used and with help of these hello messages the location of neighboring node is found. Location services are used in this protocol to find the position of all nodes. There are various types of these routing protocol out of which GPSR is mostly used in VANET.

The various types of these protocols are described below

- **GSR-** Geographic source Routing is one of the position based routing protocol used in city environment. It is the combination of geographic based routing with topological knowledge to ensure promising routing. It selects the shortest path by using the dijkstra algorithm. The problems in city environment are too many hops, routing loops, network disconnection and incorrect route selection.
- **A-star-** It is maintained for city maps. It computes junction paths with help of traffic awareness. Routing in city environments is very complex as there are large buildings. Anchor based routing and spatial based routing are the two routing schemes used in A-star.
- **B-MFR** in this protocol border nodes are used to find the destination node it does not require the interior nodes. To send data to destination source border send data to the destination nearby border node it will reduce the delay and overhead in the network. The drawback in this protocol is that if the two nodes are at the same distance then it is difficult to choose which node is selected for data forwarding in the network.
- **AMAR-** Adaptive movement aware routing .In this protocol the next hop is calculated by using the speed, direction and position of node and from all these weighted score is calculated but in this protocol the drawback is if two nodes are having the same weighted score then it is difficult to choose the next hop.
- **BMAR-** This protocol is mainly used in the city environment and in the urban areas. In this protocol the problem of the weighted score is removed with the help of the probability factor.
- **GPSR** Greedy perimeter stateless routing is one of the position based routing protocol. In this protocol beacon message is broadcast to its entire neighbor. The position of neighbor is found by means of hello message and the position of destination is found with the help of location service. If the node does not receive the message then it assumes that it failed and it delete from the table. GPSR uses two methods of forwarding packets.

Greedy Forwarding – In this technique source node selects the node that is closest to destination node as a intermediate node. The figure given below shows that node y is considered as a intermediate node because his node is closest to the destination node.

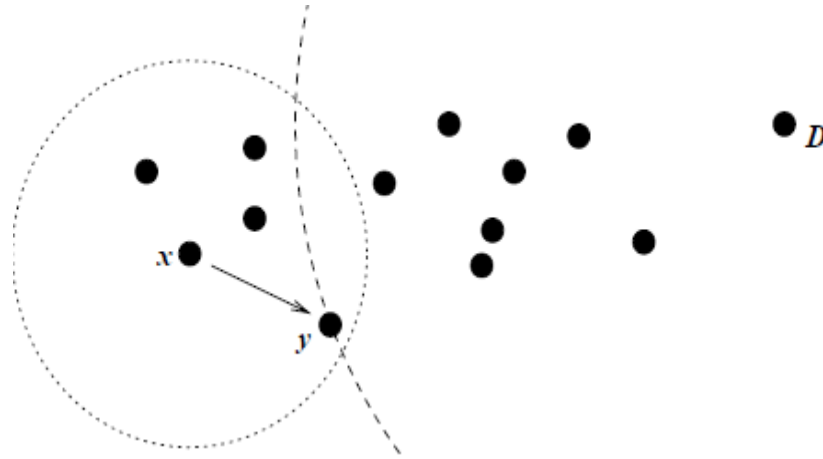


Figure 1.6: y is closest neighbor of x

When there is no closest neighbor in network then the problem of local maxima is arises in network. As in the figure given below there are two nodes w and y that are equidistant from node x this is local maxima problem in which node is not able to decide which node is considered as the neighbor node for broadcasting the message to destination node.

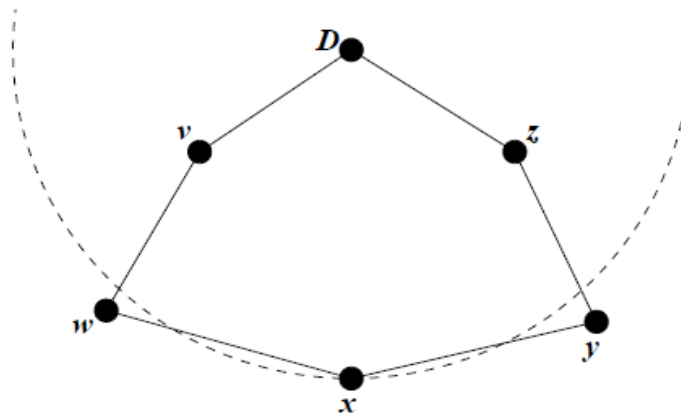


Figure 1.7: Failure of greedy forwarding

Perimeter Forwarding- This technique is used when the above technique is failed. It uses the right hand thumb rule. In figure given below the node y send packet to node x then node x forward packet to node z.

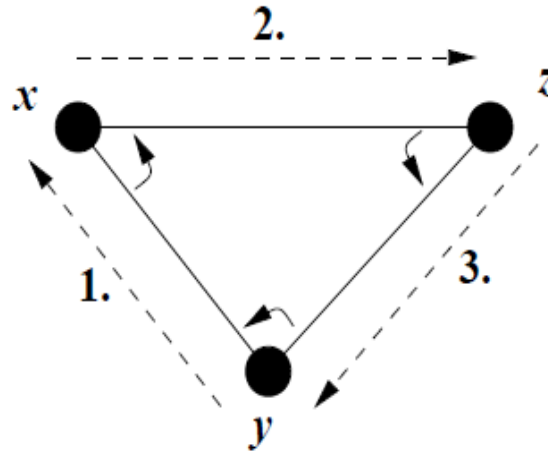


Figure 1.8: Right hand thumb rule

1.3.3 Cluster based routing protocols

In this the vehicles close to each other form a cluster. There are two types of communications inter-cluster and intra-cluster. In intra-cluster vehicles communicate with every other vehicle via the direct links and in inter-cluster vehicles communicate with each other by using cluster heads.

Subcategories of this type of routing are:

- **HCB-** It is designed for high mobility which consists of two- layer communication architecture. In layer 1 the nodes communicate by single radio interface through multi-hop path and in layer 2 by the base station super nodes are communicate.
- **CBLR-** Cluster based location routing in this every node will broadcast a hello message to the all other nodes and wait for the reply message if the reply is come in a predefined time the it become a member of the cluster head. Then the table is maintained by the cluster header and the table will contain the addresses and locations of the members.

- **CBR-In** Cluster Based routing area is divided into four square grids. The data is promoted to next hop by using the geographical area.
- **CBDRP**- It is proposed for highway scenarios, in which according to moving direction of the vehicles the header of cluster selects another header. In this paper the problem of the link stability in the VANET is solved by the CBDRP. According to this paper the CBDRP protocol is better as compared to AODV and GPSR protocols so that it provide high link stability, high latency and high packet delivery rate.

1.3.4 Geocast routing protocols

These protocols are also known as the location based routing protocols Geocast routing protocols are the protocols used to transmit information in particular area known as Zone of Relevance. These protocols are separated into beacon-based and beaconless-based protocols. Beacon-based are IVG and DRG. Beaconless-based are Cached Geocast, ROVER, Abiding Geocast, DG-Castor, DTSG, Constrained Geocast, Mobicast routing.

The different kinds of these protocols are described below:

- **IVG**- The purpose of IVG is that if there is any danger in the highway or accident occurs then it informs the vehicles about the risk in the particular area.
- **DRG**- This protocol having the Zone of relevance and Zone of forwarding. This protocol if receive the message then it checks the zone of relevance if the vehicle belongs to it then it reads the message otherwise it will forward the message to the zone of forwarding.
- **ROVER**- Reliable geographic multicast routing it will broadcast the control packets and deliver the application messages. In rover message contain the triplet application, message and ZOR.
- **DG-Castor**- This protocol support link availability and estimates the neighbors having the same ability to communicate.
- **Mobicast Routing**- The goal of this routing is to transmit messages from source node to the zone of relevance.

- **DTSG-** The goal is to update the vehicles present in a particular region about the accident for definite phase of time.
- **Constrained Geocast-** It consists of destination position of nodes based on future position of nodes.

1.3.5 Broadcast routing protocols

Broadcast routing protocols are the protocols that are used to send the information to all the vehicles when any accident takes place in the network. Subcategories of these protocols are described below:

- **Broadcomm-** It is used in highway network which is based on hierarchal arrangement in this there are two levels of hierarchy. The first level will contain cells and second level will contain cell reflectors.
- **V-trade-** It uses GPS technology and idea is similar to ZRP. In this neighbor are divided into forwarding groups and for rebroadcasting message small group of vehicles are selected. It will improve bandwidth.
- **DV-Cast-** In this hello messages are used for broadcasting message. The vehicles are divided into three types firstly well connected in which persistence technique is used secondly sparsely connected in which vehicles rebroadcast message in similar direction thirdly total disconnected in which vehicles accumulate broadcast message and packet is discarded if timer expires.
- **EAEP-** This protocol is highly dynamic in nature. In this overhead is reduced by removing additional beacon messages for transferring information between different clusters. The problem of flooding is resolved in this protocol.
- **SRB-** It gives more stable route as compared to other protocols. The nodes are classified into three groups

Inner nodes- These nodes are close to sending node.

Outer nodes- These nodes are away from sending node.

Secure Ring nodes- These nodes are preferable distance from sending node.

Table 1.1
Comparison table of various routing protocols in VANET

Protocols	Proactive Protocols	Reactive Protocols	Position Based Protocols	Cluster Based Protocols	Broadcast Based Protocols	Geocast Based Protocols
Forwarding Method	Wireless Multihop	Wireless Multihop	Heuristic Method	Wireless Multihop	Wireless Multihop	Wireless Multihop
Virtual Infrastructure Requirement	No	No	No	Yes	No	No
Recovery Strategy	Multihop Forwarding	Carry and Forward	Carry and Forward	Carry and Forward	Carry and Forward	Flooding
Digital map Requirement	No	No	No	Yes	No	No
Realistic traffic flow	Yes	Yes	Yes	No	No	Yes
Scenario	Urban	Urban	Urban	Urban	Highway	Highway
Pros	Route discovery not required, very low latency	Memory requirement less, saves bandwidth	Lowest overhead, more suitable for distributed nodes, provides good performance	Good scalability	Minimize overhead, packet transmission reliable	Reduced overhead and congestion, reliable packet delivery
Cons	Needs GPS	No response on link failure	High latency	Delay in highly dynamic network	Consume large amount of bandwidth	Packet transmission delay
Examples	DSDV, OLSR	AODV, DSR	GPSR, GSR, BMFR	HCB, CBLR	DECA, POCA	IVG, ROVER

CHAPTER 2

REVIEW OF LITERATURE

Routing protocols are used to find the best path from a source to destination. Different routing protocols exist in literature for VANET.

Aggarwal and Singh (1) discussed about various applications of VANETs like intelligent transport applications, comfort applications, collision prevention, cooperative driving, traffic improvements and location-based services all these applications help drivers, avoid congestion on road, and maintain security and any more. Then in this paper, they discussed about the pros and cons of various routing protocols.

Raw and Das (2) compared protocols namely GPSR, GSR, A-STAR, GYTAR, BMFR, AMAR, BMAR. In these routing protocols neighboring node is found with the help of GPS information. To send data these protocols need information about the neighboring node and destination node. In this information is updated with the help of hello messages. Location services are used to find the position of all vehicles in the network. In this paper, they simulated the above mentioned protocols on the basis of two parameters delay and packet delivery ratio which shows BMFR performs well as compared to all other protocols.

Batish et al. (3) discussed about various position based routing protocol. B-MFR in this protocol border nodes are used to find the destination node it does not require the interior nodes. To send data to destination source border send data to the destination nearby border node it will reduce the delay and overhead in the network. The drawback in this protocol is that if the two nodes are at the same distance then it is difficult to choose which node is selected for data forwarding in the network.

AMAR- Adaptive movement aware routing .In this protocol the next hop is calculated by using the speed, direction and position of node and from all these weighted score is calculated but in this protocol the drawback is if two nodes are having the same weighted score then it is difficult to choose the next hop.

BMAR- This protocol is mainly used in the city environment and in the urban areas. In this protocol the problem of the weighted score is removed with the help of the probability factor

Rani et al. (4) compared performance parameters of three different VANET routing protocols that is AODV, DSDV, and DSR. In AODV protocol it establish a route when data packets send by the node it maintains routing table and within certain time period if node is not used then it is deleted from the table. In destination sequenced distance vector it uses the bellman ford algorithm in this each node retain a routing table it uses two kinds of route update packets full dump and incremental packets. In dynamic source routing the source node send RREQ packets with the help of other nodes to destination and when packet arrive at destination then it propel RREP packet to destination. Then in this, they compared all these protocols on various parameters which show no protocol performs well.

Karp and Kung (5) presented the protocol that employs destination of data and position of routers for data forwarding. GPSR algorithm uses two techniques for forwarding packets:

In greedy forwarding technique immediate neighbors of destination node are used for forwarding the packets table is maintained which contains information of neighbors. In this beacon messages send to neighboring nodes in particular time period if forwarding node cannot obtained hello message from neighboring node then that node is deleted from table. The problem in greedy forwarding technique is local maxima problem in this if sender having the two neighbor nodes on same distance then sender will not decide to send the data packet to which neighboring node in greedy forwarding.

The perimeter forwarding technique is used when greedy forwarding technique is failed. In this technique right hand thumb rule is applied according to rule every node transmit packet around void region and every edge pass through called perimeter. Then they discussed about the planarized graphs in which edges not cross each other there are two planar graphs. In relative neighborhood graph two edges share the same area built-in shaded lune and there is no witness and in Gabriel graph crossing edges are removed which in between shared area of nodes. The network disconnection is less in Gabriel graph as compared to relative neighborhood graph.

Hu et al.(6) they proposed a new routing strategy on GPSR by taking density, speed and direction of vehicles in this proposed system is different from the existing one firstly in this hello packets is send to the one hop neighbor of current node transmission range. Secondly taking the distance and velocity set the priority on the current vehicles neighbors and next hop is selected which is not closest to destination. Thirdly local maxima problem is solved by taking quorum as buffer. In the existing GPSR there is problem of high packet loss and delay due to high moving speed of nodes and changing network topology the forwarding process will fail. So improved GPSR will reduce these problems by equipped the all vehicles with GPS device and various sensors for vehicle velocity and intelligent devices for calculating capacity.

In this, three schemes are used neighbor table update scheme, next hop selection scheme and recovery scheme. Quorum based location service is used for node updates. By using these schemes it proved that improved GPSR have high packet delivery ratio and overhead is less. In future we take the infrastructure for further improvements.

Liu et al. (7) they proposed a geographic stateless VANET routing which avoids the local maxima problem and the forwarding algorithm is improved it calculate the forwarding route by using connective characteristic of urban map the packets are forward in two modes by removing the geographic protocol. In this they discussed GeoSVR algorithm local maxima and next hop selection are the main problem in geographic routing to solve these problems restricted forwarded algorithm is proposed to recover the next hop selection algorithm. In this GeoSVR gives better results as compared to other routing protocols and to further improve this delay tolerant techniques are used and other approach is the multipath that provide the different routes.

Lin et al. (8) they focused on 3D routing issues in VANET the existing protocols are mainly designed for plane scenarios but there are many problems in these plane based scenarios like hop count and packet delivery ratio so TDR three dimensional routing protocol is proposed which maintains a route hop by hop and broadcast packets to the best possible immediate neighbor as far as possible in same plane. The problem in existing protocols is that if there are different road layers like upper layer and bottom layer the vehicles are measured to be on

same layer. Then in this paper the detailed analysis of the problem is given analysis about hop count and analysis about the delivery ratio this analysis shows that existing protocols are not suitable for three dimensional scenarios. So the proposed protocol TDR is mainly of two parts the purpose of temporary nodes and data transmission process and the performance of this protocol is excellent as compared to existing protocols

Ayaida et al. (9) proposed the two combinations one is the GPSR with the grid location service (GLS) called HRGLS hybrid routing and grid location service and the other one is GPSR with hierarchical location service called HRHLS hybrid routing and hierarchical location service. In this paper for routing the packets GPSR used the location information, to find the exact destination position the packet is send to the old destination position and from that old position local location request send to get back the exact position. In this the HLS and GLS algorithms are altered by HRHLS and HRGLS in which old position is used to forward data packet then intermediate node send location request to find the new destination.

In this function poslookup is modified by using the old position to forward the packet if location information is not fresh. Then the author gives the cost complexity study between the proposed approaches and HLS, GLS then concluded that the cost complexity of HLS, GLS is $O\sqrt{N}$ and the proposed approaches have $O(\log N)$ which shows that combined approaches decreases the query cost. So this concluded that proposed approaches gives better results and reduces overhead.

Ayaida et al. (10) proposed the routing technique which is amalgamation of geographic routing protocol greedy perimeter stateless routing and Hierarchical location service. The routing packets are handled by the GPSR protocol and hierarchical location service is used to find the destination position. The problem arises in this is location overhead when the source and destination are far away so the combination of the GPSR protocol and HLS service will reduce the overhead and improve the network performances.

They combined the GPSR and HLS into HHLS algorithm and this algorithm is implemented in three different functions poslookup, GPSRemit and forwardpacket. In the poslookup packet information updates the destination position. The GPSRemit function will

route the new packets from sender by confirming it has fresh or non fresh information regarding the destination. The forwardpacket function is used to forward the data packets to destination with the help of intermediate nodes. So the proposed technique gives the better results in terms of network parameters and reduces overhead.

Ayaida et al. (11) compared the location based services. These services are mainly classified into flooding-based and rendez-vous-based. Grid location based and hierarchical locations based are type of rendez-vous-based and reactive location based service is type of flooding-based. In this paper these three services are coupled with the GPSR (greedy perimeter stateless routing). The flooding based services are not suitable for VANETs because it adds the problem of latency. In rendez-vous-based there is a exceptional mapping of one node to another nodes the elected nodes known as the location servers are distributed the geographic information it made up of two element location update and location request.

In this paper they discussed about the grid location service in which the area is divided into the small four squares but in the hierarchical location service the area is divided into hexagonal cells in this all the participating nodes know about the fixed partitions. At the end comparison of hierarchical and reactive location with GPSR protocol in terms of query success rate, overhead and request travel time which shows that hierarchical location based service is best for VANETs.

Ayaida et al. (12) proposed a hybrid approach which is the combination of the GPSR protocol and the HLS location based service. In movement prediction based joint routing and location based service with the help of predictable position route to the destination is found. To attain the predictable destination position cell with the help of intermediate nodes it uses the old route but it has a drawback that if intermediate node have been moved or changing their speed then it cannot take use the old route to reach the estimated cell for broadcasting and whenever packet reaches at the intermediate nodes these nodes has to check the route to the destination causes slow data transfer problem. They also explained the proposed changes in the algorithms in this two algorithms are used firstly Location based service HLS in which two operations are used Poslookup and Predictpos Secondly GPSR protocol in which the two

operations are GPSRemit and forward packet. The problem can be resolved by choosing the vehicles with relative speed to the source node as intermediate nodes.

Mann et al. (13) discussed about GPSR routing protocol for VANET which makes greedy forwarding decisions and uses the closest neighbor information of destination. To provide enhanced routing every node having knowledge about its own physical position and neighbor node position. Greedy forwarding technique fails when there is no closest neighbor node to destination then it uses the perimeter forwarding technique. The problem of local maxima is arises in greedy forwarding. When there is no closest node to destination perimeter forwarding technique uses the right hand thumb rule and heuristic approach to reach the destination. There are many problems in this technique too many hops, network disconnection, routing loops and incorrect route selection.

Ding et al. (14) they proposed improved AODV routing protocol because in VANET simple AODV protocol give poor performances. In this improved protocol two steps are used to improve stability and decrease overhead firstly optimization in route discovery and other one is route selection process. In the route discovery phase nodes are selected with stable links to reach the destination RREQ packets are send to neighbors and nodes with stable links are selected by the source node it calculate speed and direction of the neighbors and then link weight is calculated. In second step route selection process mainly stable route is selected in this different strategies are used one is route expiration time (RET) this route is having longest life time and the other one is using total route weight in this the route having minimum total weight is selected.

In this performance is evaluated on the basis of effect of speed of nodes and effect of number of nodes so this improved AODV gives better results in packet delivery ratio and broken links.

Paul et al. (15) - discussed about characteristics of VANET some of them are high dynamic topology, frequent disconnect network, mobility modeling, battery power and communication environment. In this paper they also discussed about various pros and cons of routing protocols. Various pros of topology based are route discovery is not required, low

latency and flooding required when demanded some of cons are excessive flooding causes disruptions and unused paths occupy bandwidth. Various pros of position based are high mobility pattern and scalability some of cons are GPS does not works in tunnels.

Raw et al. (16) – discussed about various applications, security issues, security requirements and attacks on VANET. The two applications of VANET are safety related applications and user based applications. They discussed about technical, social and economic challenges in VANET. Before deployed VANET satisfy some security requirements and these are authentication, availability, Non-Repudiation, privacy and data verification. They also discussed about some of attacks and these are impersonate, identity revealing, location tracking, repudiation, eavesdropping and denial of service attack. It also provided solutions to the attacks.

Irshad et al. (17) – discussed about properties of attackers some of them are insider, outsider, coverage area and technical expertise. They proposed different classes of attacks and their threat levels the main objective is to identify the attacks. The first class is network class having high priorities and it will create difficulties for legitimate users examples are DOS and Sybil attack. The second class is application class in this attacker change the contents and send wrong messages which may lead to accidents. The third class is timing attack in which the attacker adds time slots which produce delay in message. The fourth class of attack is social attack it will indirectly create difficulty in original message. The fifth class of attack is monitoring attack which monitors the whole network.

Granelli et al. (18) – proposed a new algorithm MORA in which communication takes place between direct neighbors present within the network and it provides a robust routing strategy. This algorithm will send a route request message to destination and then it will send route reply message to sender and also contain location information. After that data payload can be broadcasted. It use flooding technique for finding destination position and metric m is used for routing messages and then the probe messages having highest metric value is send in network.

In this paper they considered two methods of implementing MORA routing algorithms firstly standalone disadvantage of this method is during packet exchange information is not updated. Second method is link layer integrated it will remove the limitation of standalone method.

Lee et al. (19) – compared performances of AODV, DSR and AOMDV reactive protocols using mobility models. In VANET there are two mobility models:

User defined models- In this graph defined by user in between vertices and edges. The speed limit is sustained by edges.

Space models – In this graph is defined between different clusters and these clusters sustained the speed limits and obstacles.

In this paper they described methodology to be used firstly it selects the network presentation, network simulator and VanetMobisim process. It is a java program that identify mobility model.

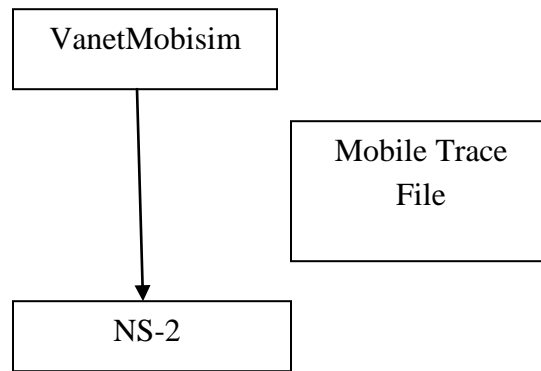


Figure 2.1: VanetMobisim Process

In this, author compared reactive protocols in terms of performance parameters packet delivery ratio and delay and AOMDV protocol gives better results as compared to other protocols.

Harri et al. (20) – described GPSRJ+ uses the road segments near to destination nodes in this decisions takes place at junctions. When local maxima arise the node goes to recovery

mode in which right hand rule is used and packet is come back to junction. In this prediction of forwarding node is based upon junctions. If the next hop contains same coordinates as forwarding node then that node is considered as the next hop. GPSRJ+ will contain the lesser number of hops as compared to GPCR.

In this author take four assumptions firstly edge is made by two or more points. Secondly because of obstacles nodes are not able to detect each other. Thirdly every node knows about its position. Lastly there is no diagonal straight road. At the end author concluded that GPSRJ+ gives better result as compared to other protocols.

CHAPTER 3

PRESENT WORK

3.1 Problem Formulation

In vehicular ad hoc networks, the vehicles communicate with each other using dedicated short range communication (DSRC). The information that is exchanged between the vehicles is usually related to traffic monitoring services, tourist guiding information and natural hazards etc. The vehicles move at random speeds as compared to the nodes in mobile ad hoc networks where mobility of nodes is usually less. The information must be passed to the destination vehicle accurately without affecting it i.e. that should not depend upon the speed of the vehicles. Whenever the destination vehicle moves from one place to another, the source vehicle has to broadcast the route request messages in order to find a route to the destination. So there arises a need for the routing protocol that must be designed for the vehicular ad hoc networks in such a way that routing overhead is minimized. In the base paper they proposed a method in order to find a route between source and destination vehicle using hybrid routing and hierarchical location service which makes use of the greedy perimeter stateless routing along with location services and mobility prediction. According to PHRHLS, whenever the source node has to send data to the destination vehicle the GPSR protocol will ask the location services in order to find the fresh route to the destination. It estimates the new location of the destination using velocity and movement angle i.e. the direction of the vehicle. So the source forwards the data message to the nodes that has previous route to the destination and when data reaches the intermediate node which is located near the estimated position of the destination then route request message is broadcasted to find exact position of the destination. The shortcoming in this approach is that intermediate vehicular nodes might have changed the speed i.e. may become slower or faster. So forwarding the data through the intermediate node prior to broadcasting the route request message might cause problem if intermediate nodes have varied their speed parameter so the following objectives must meet to overcome the problem of slow data transfer.

3.2 Objectives

- To find intermediate nodes by estimating the relative speed of all moving vehicular nodes with the source node.
- To find the path from source to destination using relatively moving vehicles.
- To compare the performance of existing and proposed method for routing on end-to-end delay, packet loss and throughput.

3.3 Research Methodology

First we will generate the traces of the vehicles with the help of the SUMO files. After the traces are imported in network simulator, the whole network will be arranged into particular cells. It is assumed that vehicles in a particular cell will have access to road side unit. The road side units will track the velocity of the vehicles moving in its range. Since the vehicles move at greater speeds in vehicular ad hoc networks, the link breakage in such conditions is frequent. In order to reduce the network overhead caused by the link breakage, we use the concept of the selecting the path from source to destination vehicle consisting of the nodes which are moving relatively at the same speed as the source vehicle so that the link breakage can be reduced. Every time the source node has to send data to the destination vehicle, it will send query message to the road side unit along with its speed. The road side unit on receiving the query will reply back to source vehicle with vehicles moving at relatively same speed as the source vehicle. The source vehicle will send data to the destination using the information provided by the road side units.

Tool used

Ns2 is a event based network simulator. It is a discrete event packet level simulator. In it tcl is used as scripting language and in Ns2 NAM files are used to show the output. OTCL scripting language is used as a front end

Programming language is used as a back end.

NS2 has different types of agents. In- built protocols are used in it like AODV, DSDV and DSR

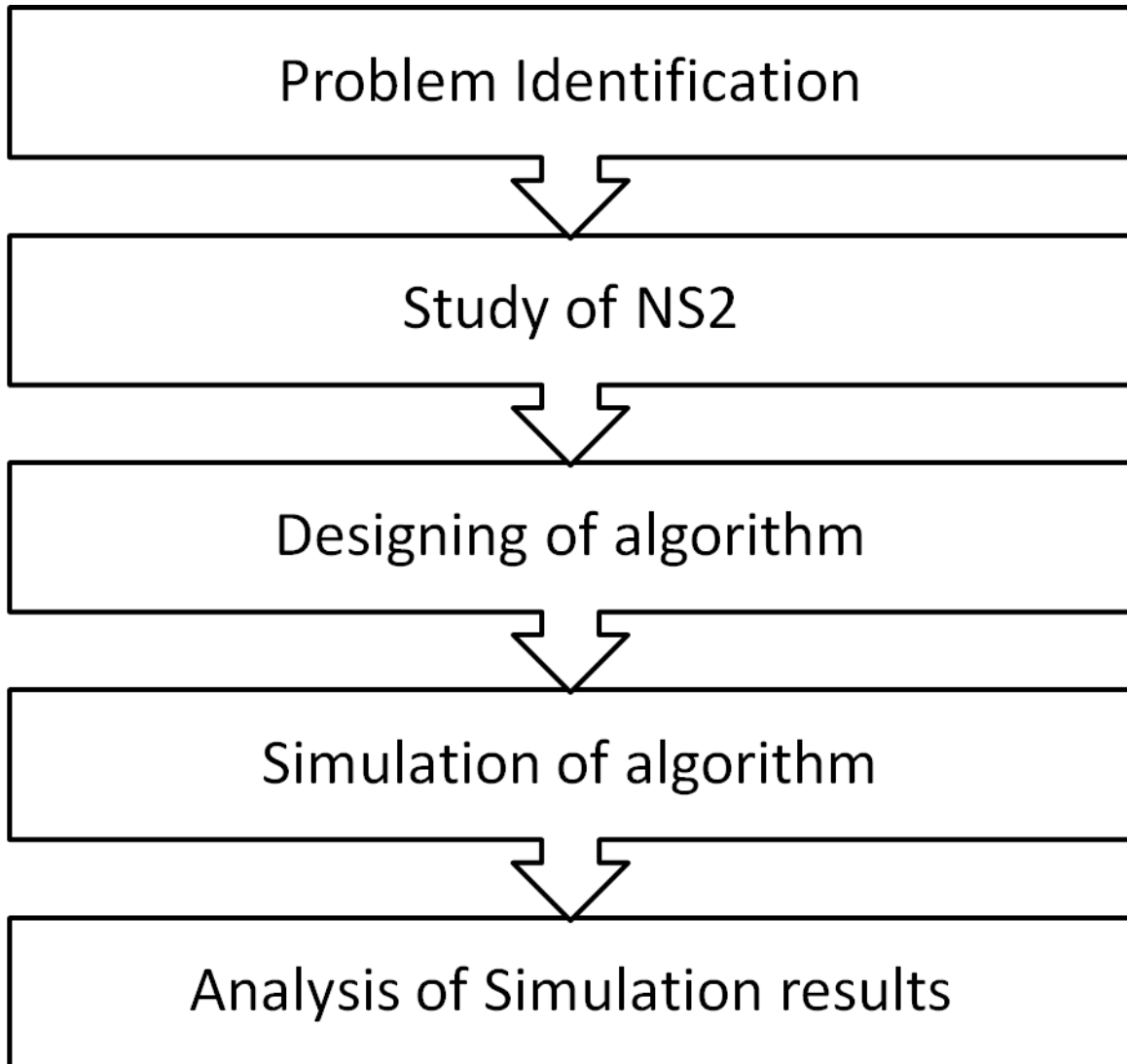
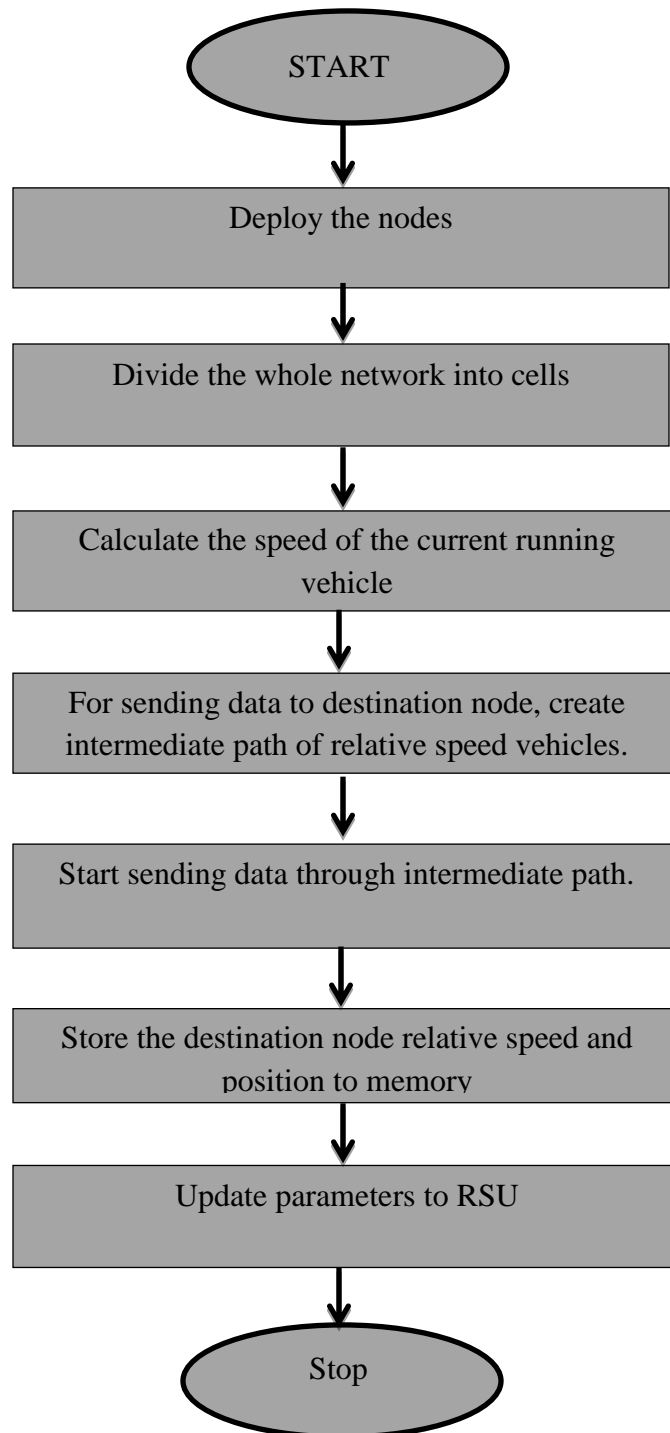


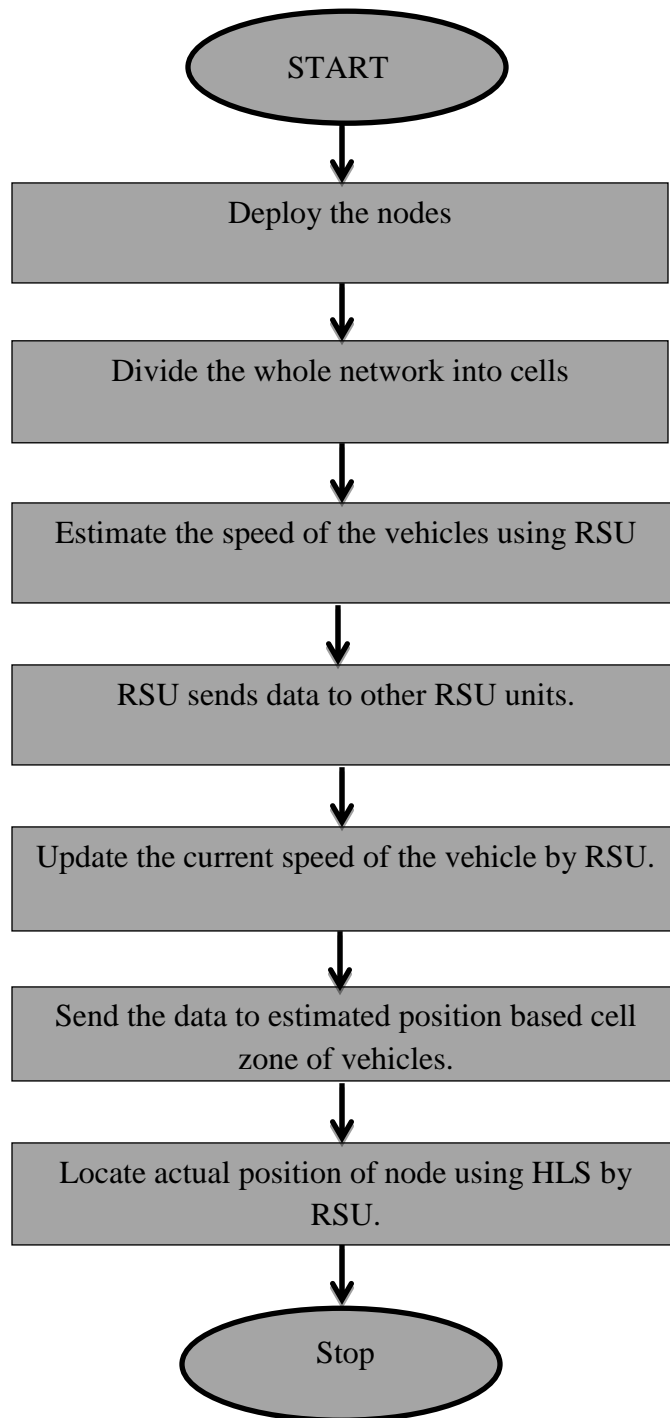
Figure 3.1: Research Methodology

Flowchart

The flowchart for finding intermediate nodes having relative speed with source, if the destination node position is not unknown.



Flowchart for sending the data through RSU, if destination position is known.



3.4 Algorithm Steps

Procedure 1:

- Start to send data packet from vehicle s to vehicle d .
- Request send to RSU unit within the cell where vehicles is located
- If RSU has information of vehicle d then receive the data packet from vehicle s otherwise follow Procedure 2.
- Send the data packet received from vehicle s to vehicle d using intermediate RSUs.
- Finally the packet received by RSU of the destination vehicle's cell zone RSU.
- Locate the actual position of vehicle d using HLS and then transfer the data packet.
- Update the actual position and speed of the vehicle d to source cell RSU.

Procedure 2:

- Request neighbor vehicle for speed update and request for further update of other vehicles in the network.
- Accept the request for path creation from those neighbors whose speed is relative to the source vehicle node s .
- When path created, start to send the data packet to the neighbor's vehicles.
- Update the destination position and speed to cell zone RSU for further successful communication setup via intermediate RSUs.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction to NS2

Network simulator is a event based simulator it is an open source simulator used for various research purposes. NS2 has steadily increased enthusiasm from industry, the scholarly world and government. It is well-liked as compared to all other simulators. It will contain different types of applications and protocols. NS2 used scripting language for routing purposes in the network. In this animation of various protocols is run with the help of “NAM” files.

To run network simulator following parameters are required:

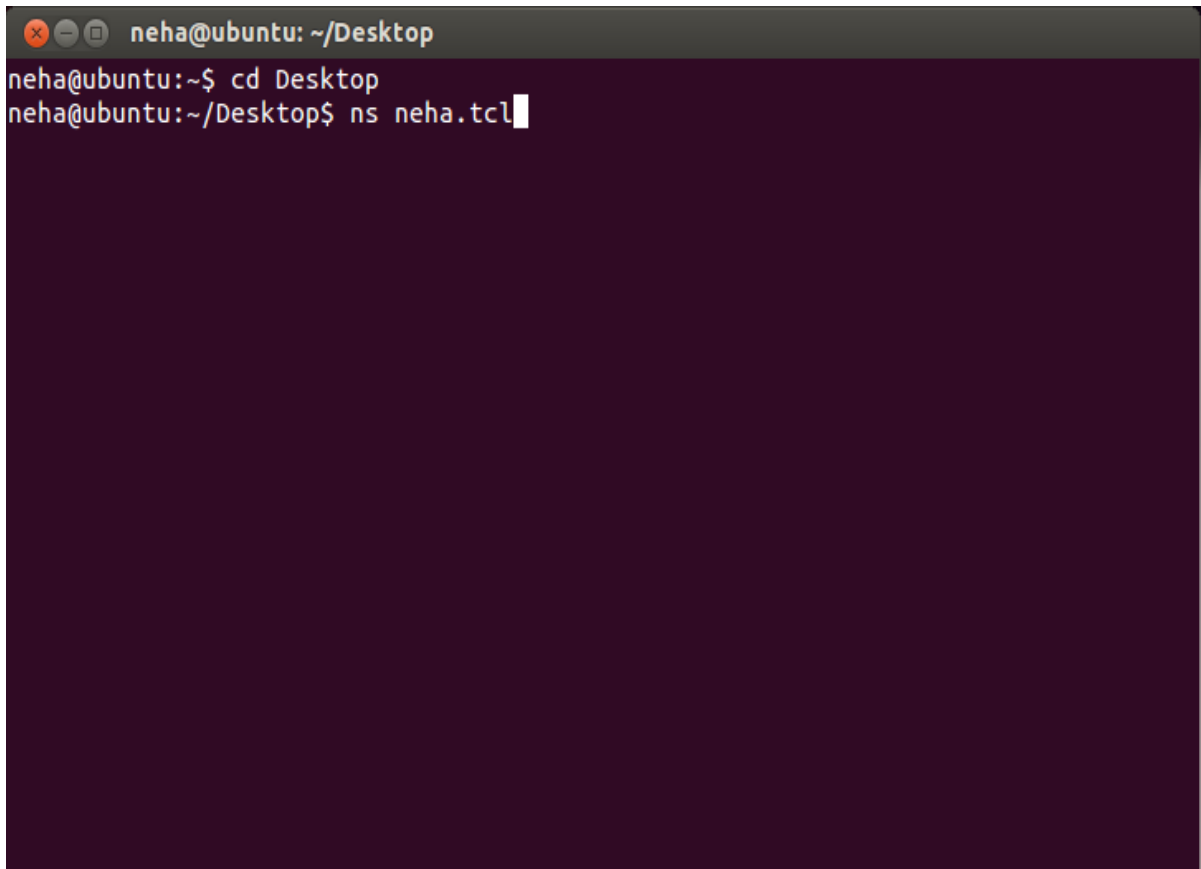
- UNIX
- LINUX
- Free BSD
- Sun OS/Solaris
- Windows 7/8 with Cygwin

Two languages are used in NS2

- Front End- use a OTCL language
- Back End- use a programming language

OTCL provide front end mechanism it is easy to use, describe different network topologies and application of protocols. C++ provides back end mechanism it increases the efficiency and implements the different operations and protocols.

In NS2 there are different types of agents and some in-built protocols like AODV, TORA and DSR. It is employed for both wired and wireless networks. It will contain the TCP, UDP and routing algorithms.

A terminal window with a dark purple background and a grey title bar. The title bar contains the text 'neha@ubuntu: ~/Desktop'. The terminal shows the following commands and prompts: 'neha@ubuntu:~\$ cd Desktop', 'neha@ubuntu:~/Desktop\$ ns neha.tcl', and a cursor at the end of the second line.

```
neha@ubuntu:~/Desktop
neha@ubuntu:~$ cd Desktop
neha@ubuntu:~/Desktop$ ns neha.tcl
```

Figure 4.1: How to run tcl file

The above figure shows how to run a tcl file in ns2. For this firstly open the terminal in ubuntu and write the command:

```
ns neha.tcl
```

4.2 Simulation Parameters:

Table 4.1: Simulation Parameters

Parameter	Value
Channel Type	Wireless
Mac Type	802.11
Interface Queue Type	Queue/Droptail/Priqueue
Link Layer Type	LL
Max packet in ifq	250
Number of nodes	26
Simulation Time	100s
Traffic Type	CBR

4.3 RESULTS

The results presented the relationship between performance parameters in terms of delay, throughput and packet loss. These experiments are done with the help of network simulator 2.35.

4.3.1 Implementation

In this vehicles and roadside units are shown below:

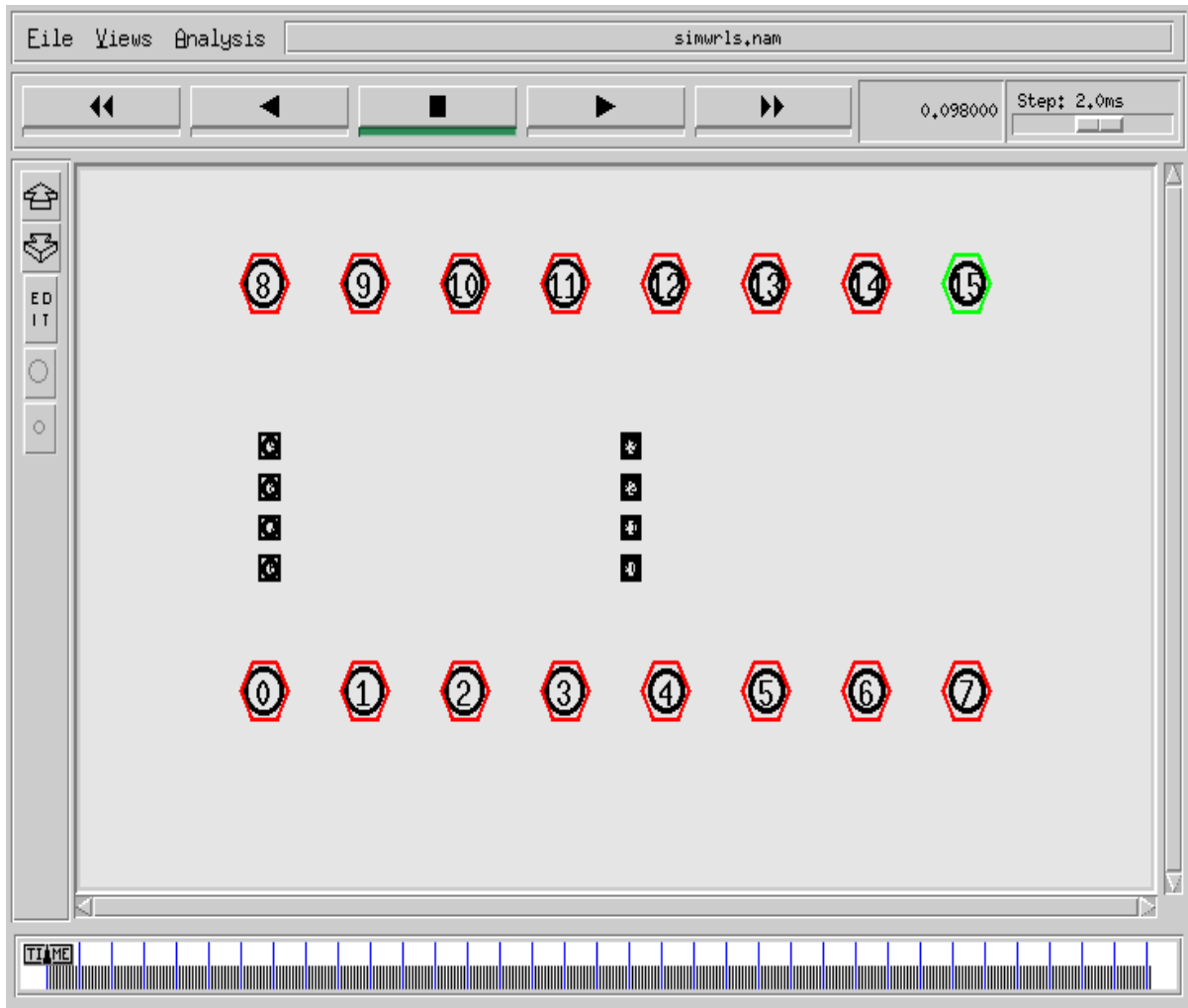


Figure 4.2 Vehicles and RSU

In this figure communication between vehicles and roadsides units will take place. The roadside units will take the information of all the vehicles present in the network and it shows the range of vehicles and RSU.

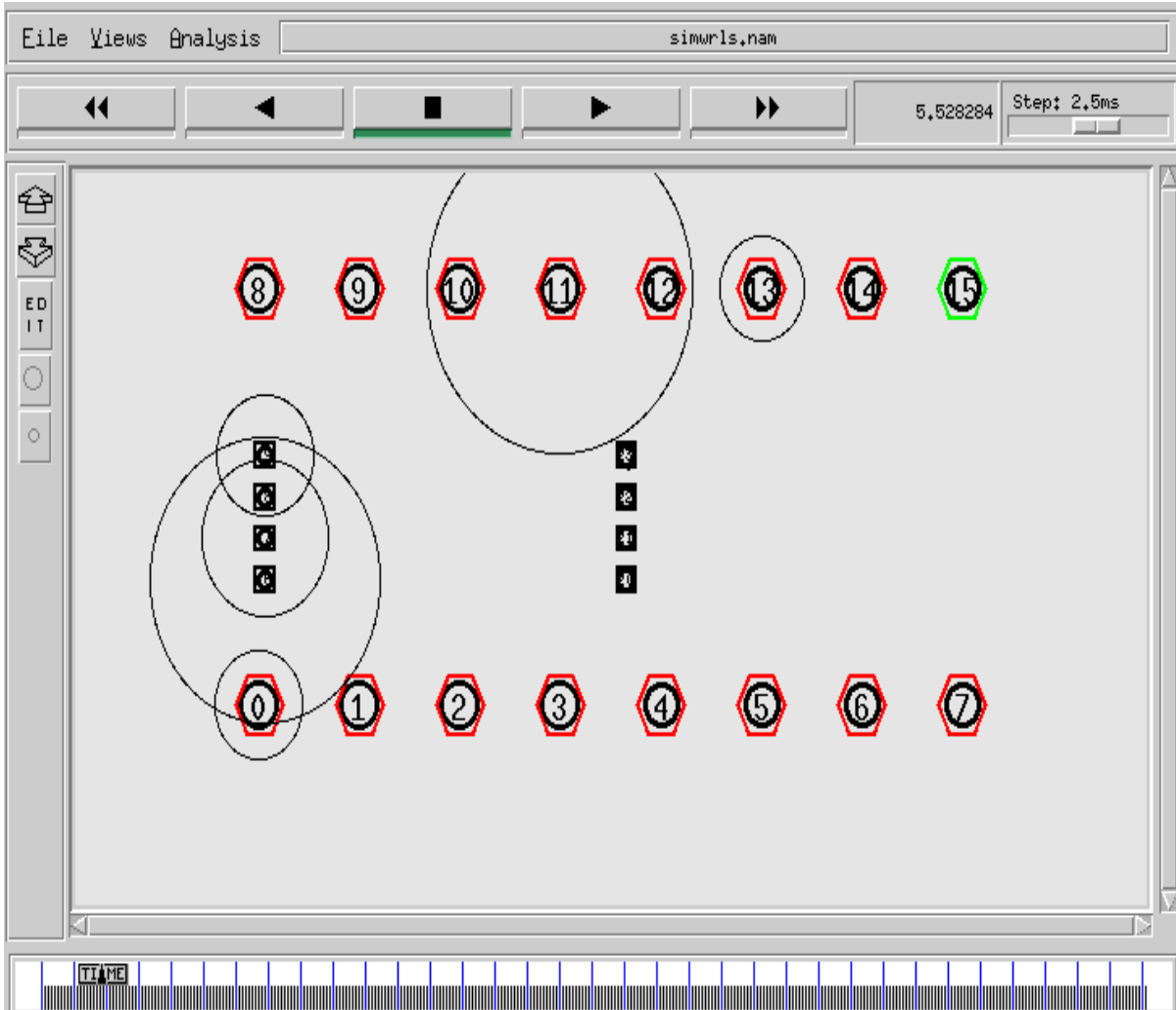


Figure 4.3 Showing Range of RSU and Vehicles

In this figure the stationary nodes are considered as roadside units and nodes that are moving in the network are considered as vehicles. In this 8 nodes are considered as vehicles that are moving in the network for sending the data from one place to another place.

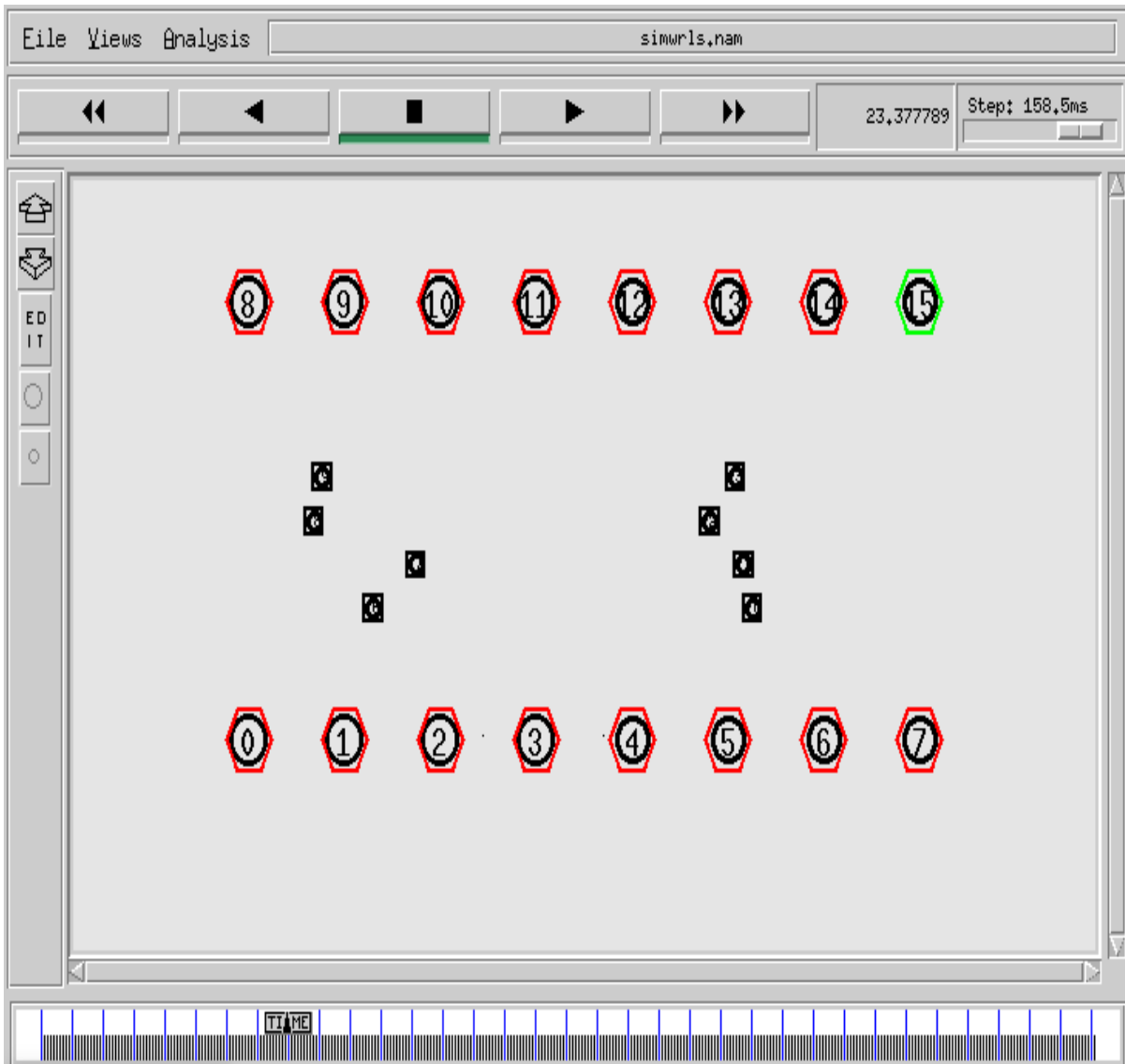


Figure 4.4 Moving Vehicles

In this figure communication between vehicles and RSUs are shown and there is a dropping of packets are also shown

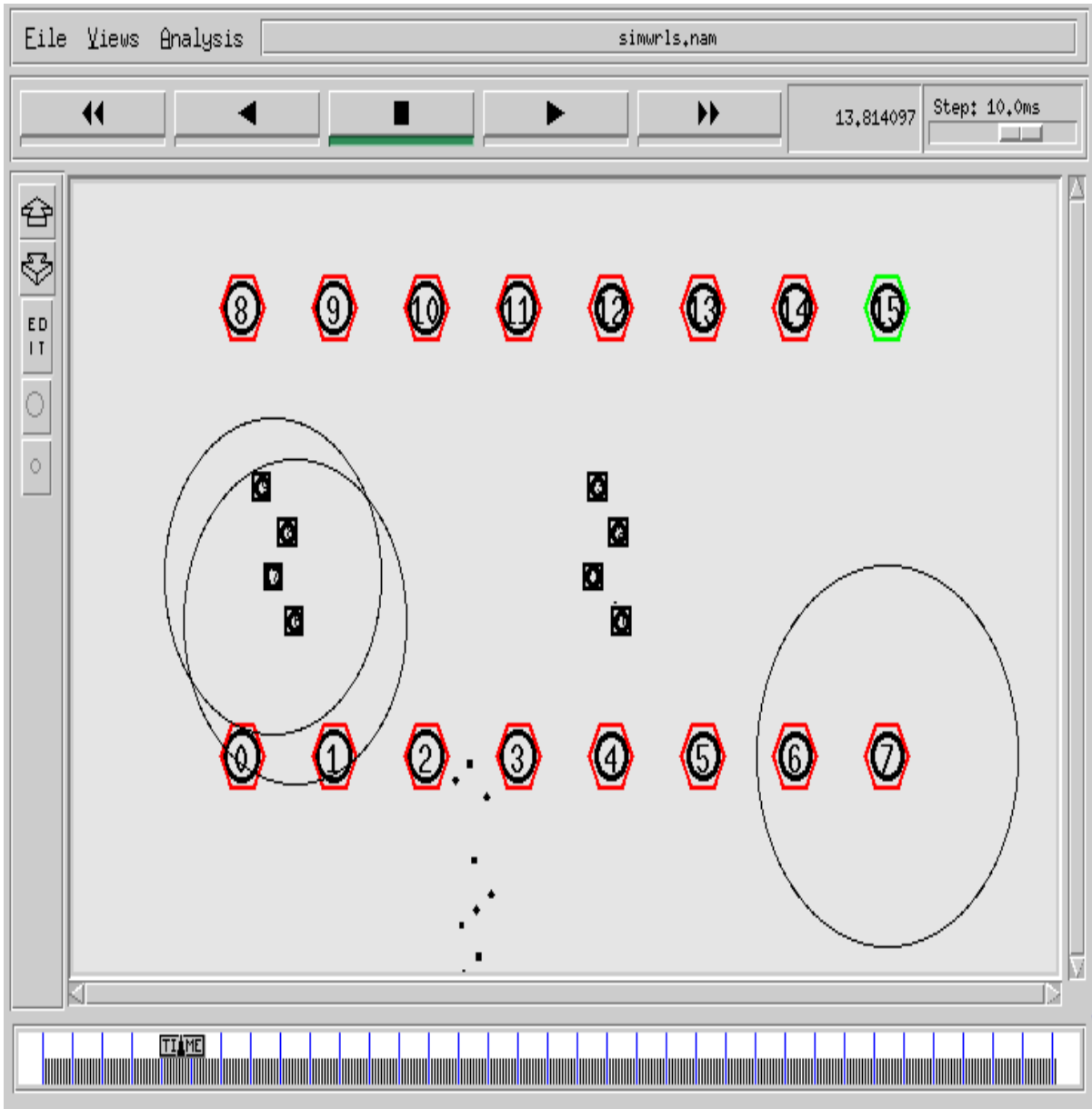


Figure 4.5 Showing Packet drop

In this figure vehicles are moving from one place to other place by communicating vehicles and RSU. The RSU has all the information of vehicles present in their communication range and it will help broadcasting message from one place to another place.

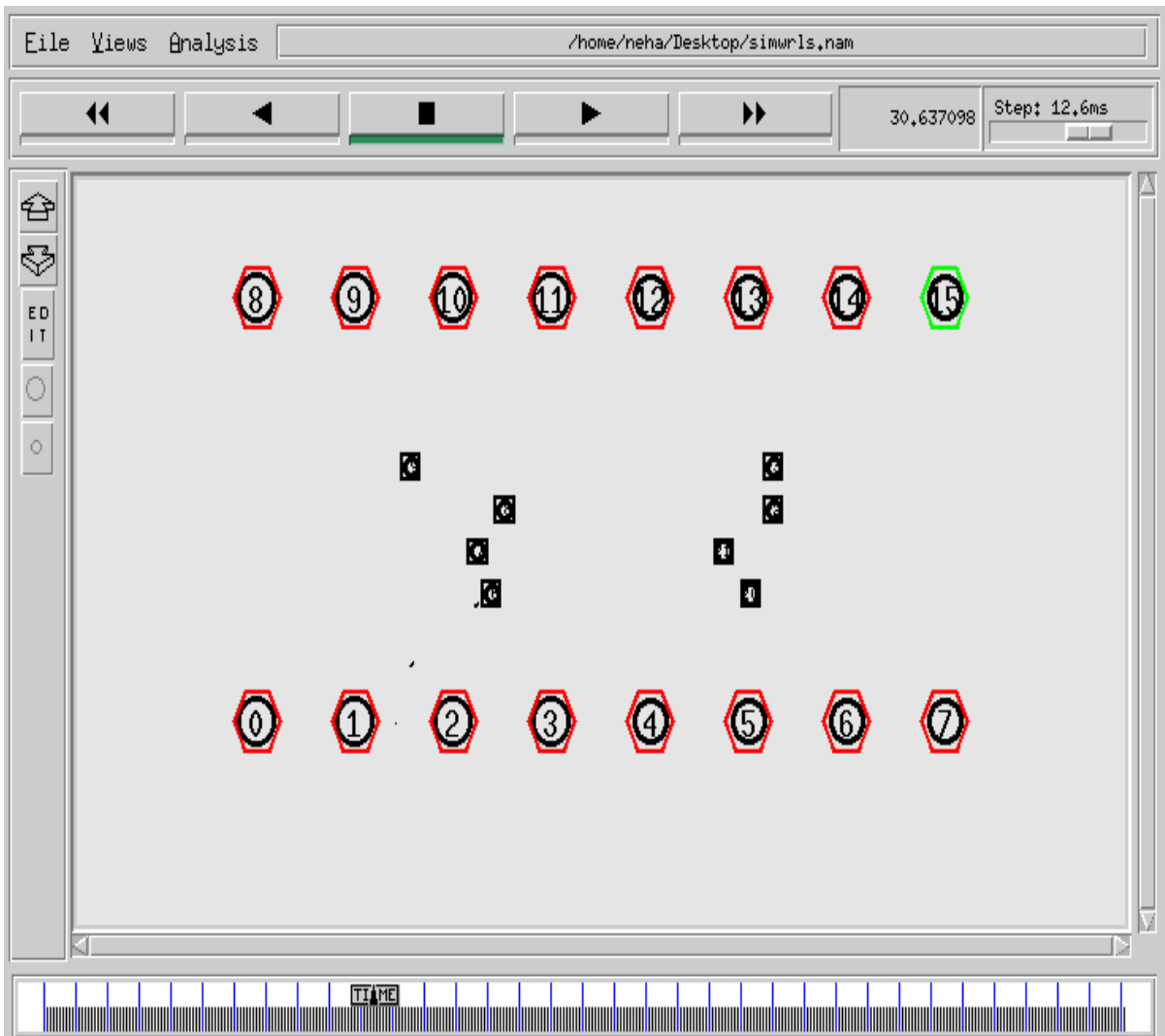


Figure 4.6 Vehicles communicating RSU

4.4 Comparison of Graphs

4.4.1 Delay Comparison

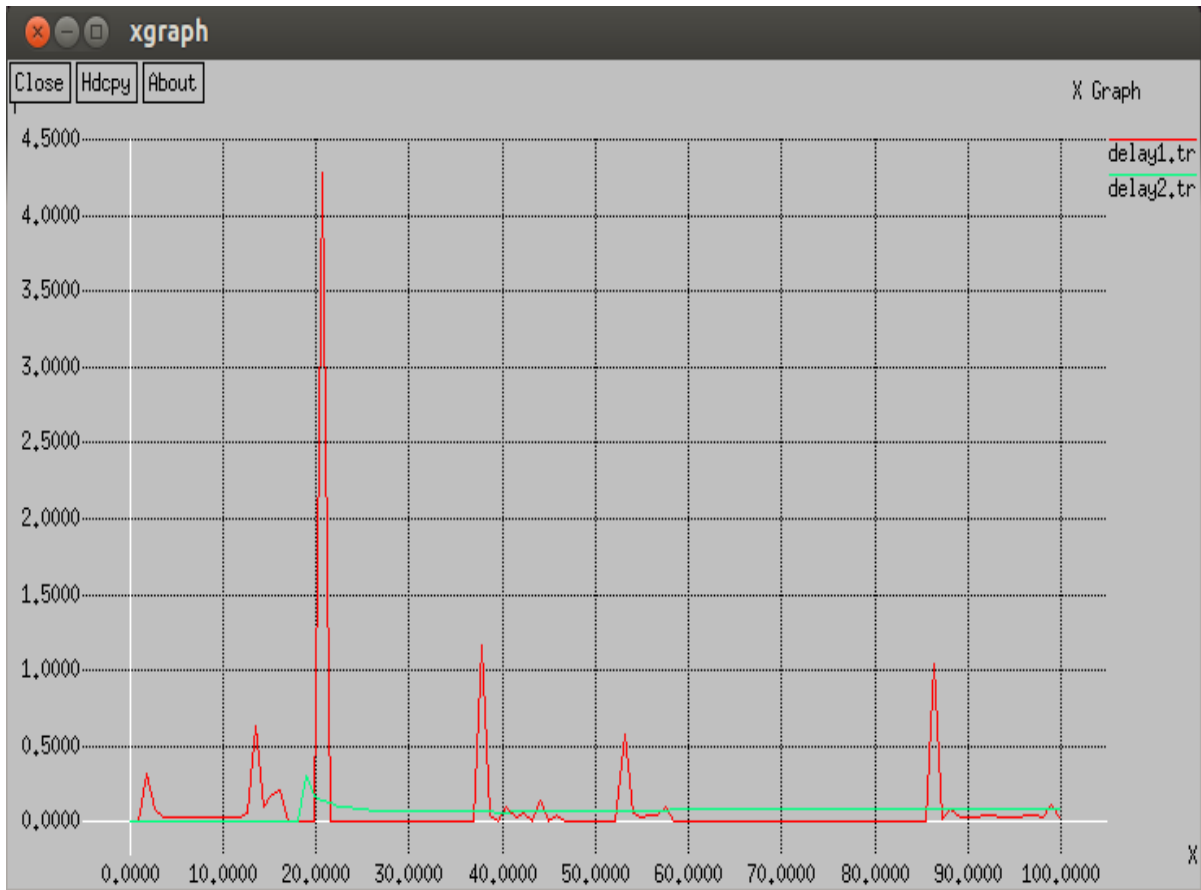


Figure 4.7: Delay

In this graph the red line represents the old delay and green line represents the new delay.

This graph shows the RGPSR have less delay as compared to the GPSR.

The enhanced protocol gives better result in terms of delay as compared to previous protocol.

4.4.2 Packet Loss Comparison

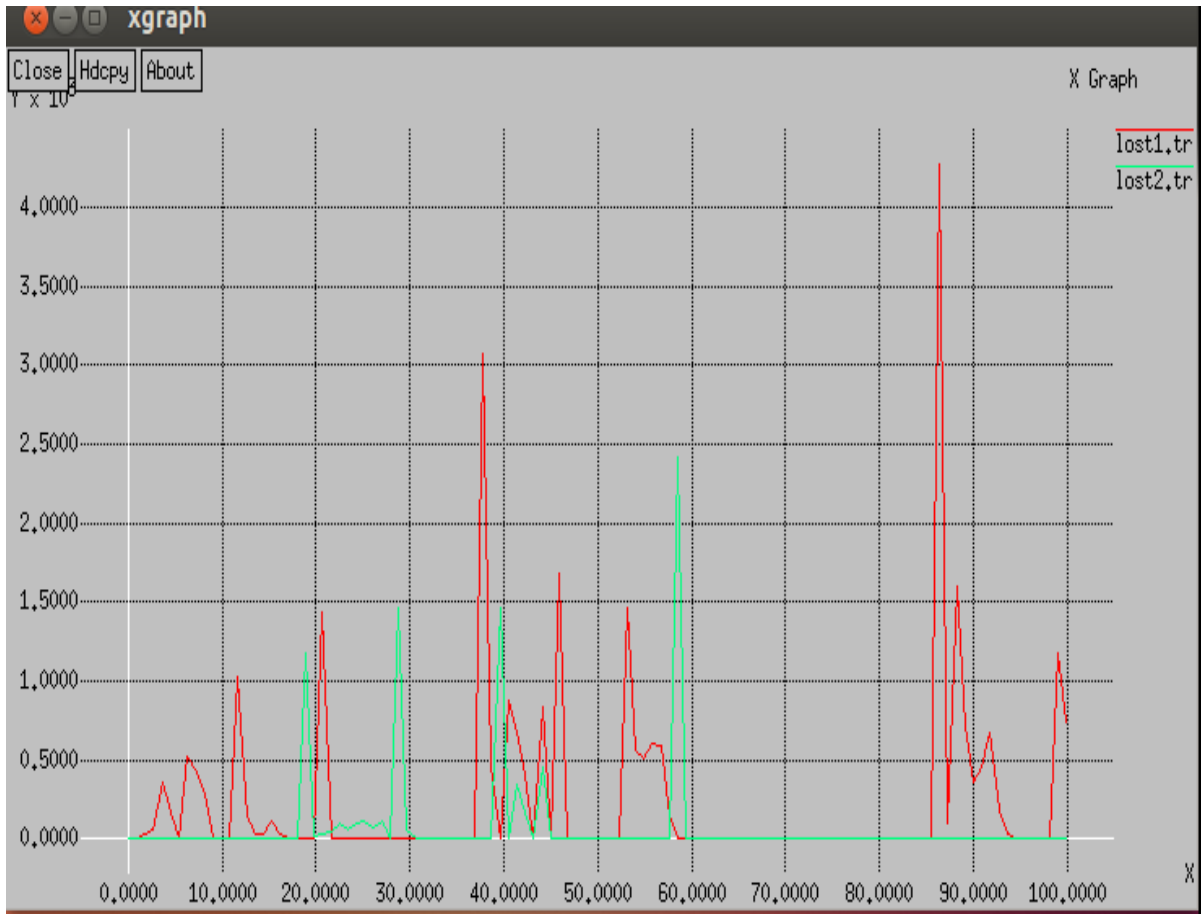


Figure 4.8: Packet Loss

The above graph will clearly show the comparison of packet loss between the RGPSR protocol and GPSR protocol the red line shows the old packet loss and green line shows the new packet loss.

So, the enhanced protocol gives better results as compared to old protocol.

4.4.3 Throughput Comparison

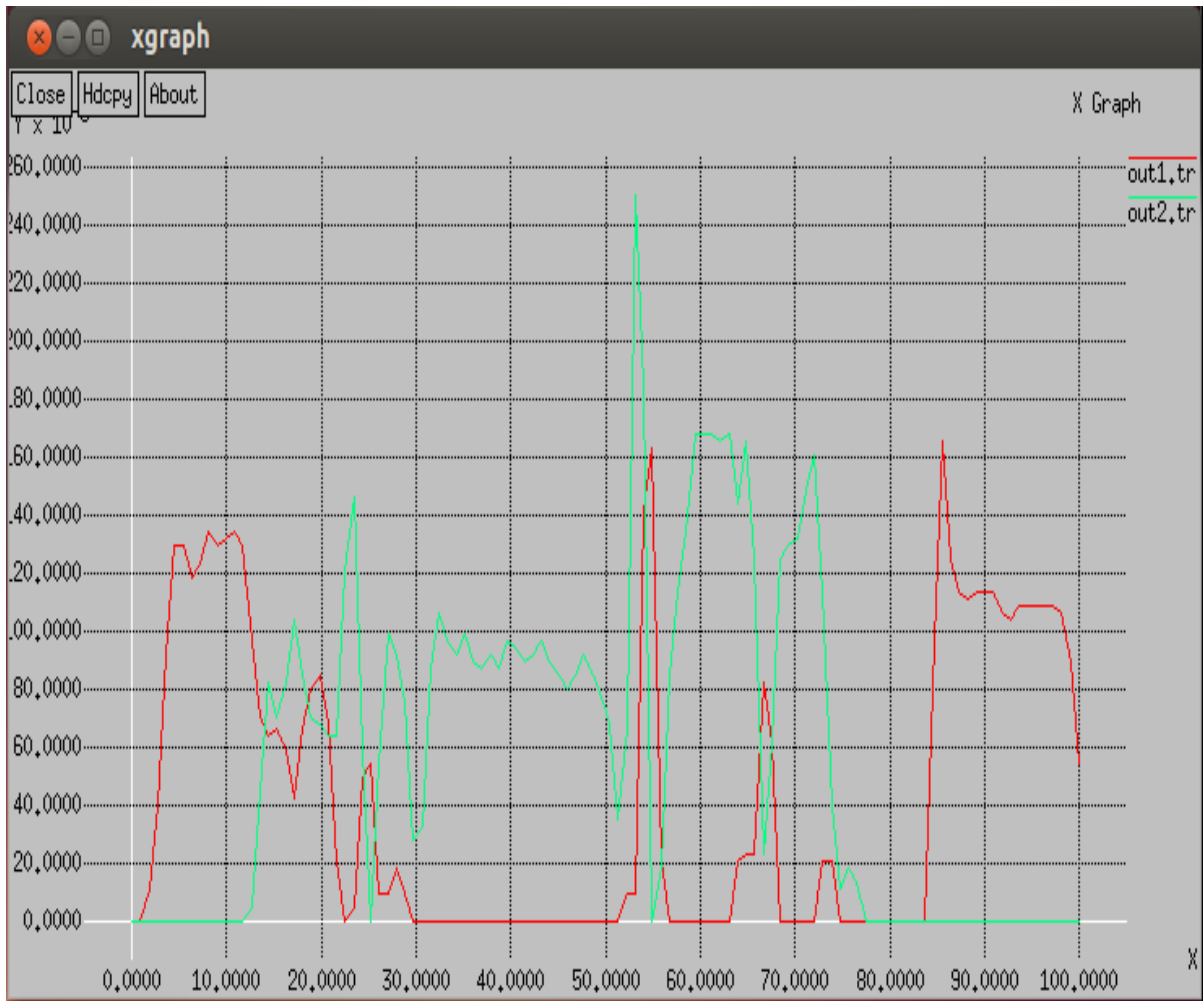


Figure 4.9: Throughput Comparison

The above graph will show throughput comparison between the RGPSR and GPSR protocol. The green line shows the new throughput and red line shows old throughput. The enhanced protocol will give better results.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

The enhanced approach provides more efficient path for broadcasting the route request message as compared to the existing system. To reduce the overhead caused by link breakage we take relative speed of vehicles with respect to source node as the intermediate nodes and find the path from source to destination. This will give the more reliable path as compared to previous one. This will increase the throughput and reduce end-to-delay and packet loss when compared with the existing system. This enhanced approach gives better performances.

5.2 Future Scope

In this dissertation work we enhanced approach by using relative speed of vehicles and RSUs. The results in form of delay, packet loss and throughput are very good. In future we use clustering technique for broadcasting the message in which small subset of vehicles made a cluster which is selected for broadcasting. Each cluster can have a cluster head which is responsible for secure communication between vehicles. In this two types of clusters are made inter-cluster and intra-cluster. In intra-cluster vehicles communicate with every other vehicle via the direct links and in inter-cluster vehicles communicate with each other by using cluster heads. By using clustering technique it will reduce the cost effect.

CHAPTER 6

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CHAPTER 7

APPENDIX

ABBREVIATIONS

MANET	Mobile Adhoc Network
VANET	Vehicular Adhoc Network
V2V	Vehicle to Vehicle
V2R	Vehicle to Roadside
V2I	Vehicle to Infrastructure
ITS	Intelligent Transportation System
GPSR	Greedy Perimeter Stateless Routing
GPS	Global Positioning System
AODV	Adhoc on Demand Distance Vector
HLS	Hierarchical Location Service
GLS	Grid Location Service
HHLS	Hybrid Hierarchical Location Service
NS 2	Network Simulator Version 2
ROVER	Reliable Geographic Multicast Routing
DTSG	Dynamic Time Stable Geocast
DRG	Distributed Robust Geocast
CBR	Cluster Based Routing

CBLR	Cluster Based Location Routing
HCB	Hierarchical Cluster Routing
AMAR	Adaptive Movement Aware Routing
BMAR	Border Node Based Movement Aware routing
BMFR	Border-node Based Most Forward Radius Routing
A-STAR	Anchor Based Street and Traffic Aware Routing
RGPSR	RSU Based Greedy Parameter Stateless Routing
EAEP	Edge-Aware Epidemic Protocol
DV-CAST	Distributed Vehicular Broadcast Protocol
V-TRADE	Vector Based Tracing Detection