ISSN: 0975-766X
CODEN: IJPTFI
Available Online through ***Review Article***
www.ijptonline.com

ROBUST AND HOP BASED ALGORITHM DESIGN FOR VEHICULAR AD HOC NETWORK

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Received on 13-02-2017 *Accepted on: 03-03-2017*

Abstract

Vehicular Ad Hoc Network (VANETS) are a unique case of Mobile Ad Hoc Networks (MANETS), where mobility is quite different. High speed and frequent change in network topology are the distinguishable characteristics leading to instability, hence affecting the network design topology considerably. It is also difficult to design a MAC scheme in VANETS due to high speed and network partitions that will satisfy quality of service in all network models. The Basic mechanism used by IEEE 802.11p is Distributed Coordination Function (DCF) which was basically design for networks of low mobility and does not work efficiently in high mobility network scenarios in VANETS. On the other hand vehicles of different speed have their own different limited time to connect to an access point (AP) or base station, thus restricting the opportunity of high speed vehicles to communicate with the access point or base station. This paper will propose a robust and hop based greedy algorithm design for VANET that defines the shortest routing path with minimum number of intermediate intersection nodes while taking connectivity into consideration. Also introducing back-bone nodes that play a key role in providing connectivity status around an intersection. And tracking the movement of source as well as destination, the back-bone nodes enable a packet to be forwarded in the changed direction.

Keywords: Hop based greedy algorithm, Back bone nodes, VANETs.

1. Introduction

VANETs (Vehicular Ad hoc Networks) are a highly mobile wireless ad hoc network which plays an important role in public safety communications as well as commercial applications. This is the technology that made vehicles to move as joint in network to make a transportable or infrastructure less network. VANETs are distributed, self-organizing communication networks between moving vehicles or mobile nodes can move safely with high speed and must communicate with each other and other neighboring nodes or vehicles quickly and reliably. Active nodes or participating vehicles become a wireless connection or router through VANET and it allow all the vehicles almost to connect 100 to 300 meters to each other and in order to create a wide range of transportable network, and also enables other vehicles to get connected to each other so that the a wide range of mobile internet can be created. When an accident occurs in a road or highway, alarm messages must be widespread, instead of ad hoc routed, to inform all other vehicles through Vehicular ad hoc network architecture in order to achieve intelligent communication that will improve road traffic safety and efficiency. VANET performs effective communication by utilizing routing information. Multiple ad-hoc networking technologies integrated in VANET such as, ZigBee, IRA, WiMAX IEEE, and Wi-Fi IEEE for convenient, effective, quick, exact communication within nodes on active mobility. The field of Inter Vehicular Communications includes both vehicle-to-vehicle communications (V-V) and vehicle-to-roadside communications (V-R), collectively known as VANETs which is recognized to be an important component of ITS. The Intelligent Transportation Systems (ITS) which apply rapidly emerging information technologies in vehicles and transportation infrastructures. VANET has unique characteristics like high mobility with a restricted road topology, initially low market engulfing ratio, widespread of network size, infrastructure support that differentiate it from MANET .This characteristics of VANET makes it appropriate for the high speed and frequent change in network topology features of vehicular networks. Hence the routing Protocols in VANET are being divided into various types likes Topology based, Geocast based, Cluster based, broadcast Based, Position based and Infrastructure based.

2. System

Many routing protocols are designed for mobile ad hoc networks and later featured to match the VANET scenarios. Existing Routing protocols like GPSR work well in city environments. But these protocols encounter different problems such as Intersection Node Probing Problem, Location Service Requirement Problem which motivated us to design a new robust scheme. In this paper we proposed a position-based connectivity aware back-bone-assisted hop based greedy algorithm design of VANET for city environments. The proposed algorithm of routing protocol finds a shortest routing path consisting of the minimum number of intermediate intersections or nodes. This is designed considering certain features in a city map, such as road segments, intersections, major roads, minor roads, four way crossings. To maintain connectivity at the intersections or four way crossings and to detect void regions, a group of nodes called back-bone nodes is designed which is quiet reliable and this back nodes works very efficiently. Merits of the proposed algorithm are the hop greedy algorithm finds the best possible path in terms of both hop count and connectivity and the zone wise partitioning of a city road network is an important design frame- work for the efficient functioning of the destination discovery procedure.

3. Back-bone-assisted Hop Based Greedy Algorithm in city environment

In this section, we present a position-based connectivity aware back-bone-assisted hop based greedy algorithm protocol for VANET of city environments to find the shortest routing path consisting of the minimum number of intermediate intersections or nodes. Basically, we are adopting a request-reply path to obtain destination position, which is used for computing the shortest routing path. In order to avoid the effects of mobility on routing decisions, a new robust scheme is developed to examine the movement of source and destination. The main objective of the hop Based greedy routing algorithm is to reduce the hop count or nodes for request-reply path, which ultimately reduces the end-to-end delay and it also ensures successful delivery of data packets from source to the destinations

3.1 Node Architecture

Each node is equipped with the data unit, timer, GPS locator, backbone activator and speed analyzer, route discovery unit, neighbor table, and beacon message generator. The beacon message containing information regarding the location of the vehicle and vehicle type, is generated in periodic interval by using timer with the help of beacon message generator. Each node will share this beacon message to all active neighbors. Based on movement of the vehicle i.e. speed of the vehicle the backbone activator categorizes the type of vehicle. The neighbor table stores the information of neighbor which includes location and neighbor type. The neighbor table gets refreshed in periodic interval to detect the available active vehicles and to delete un-available inactive vehicles. Data unit is used for generating the data in source vehicle. The route discovery unit helps to find the route by forwarding route request(RREQ) and route reply (RREP) messages. The routing manager controls whole node architecture. T/R is transmitter and receiver respectively.

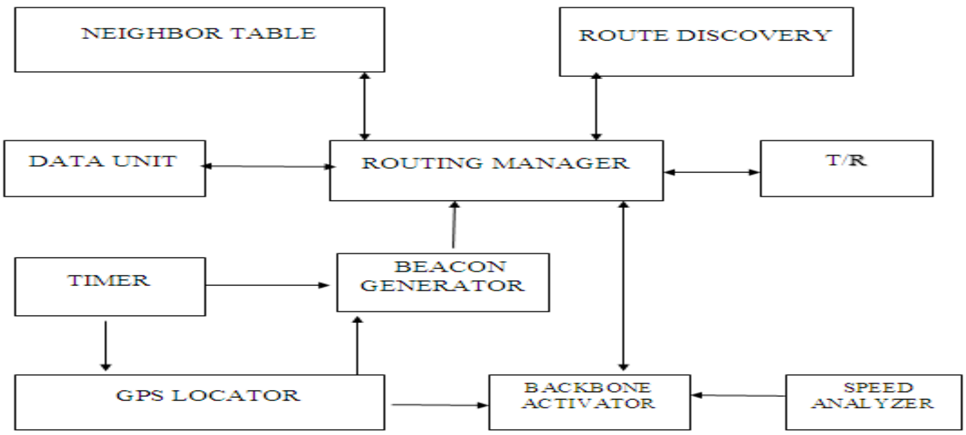


Fig 1: Node Architecture.

3.2 System Design

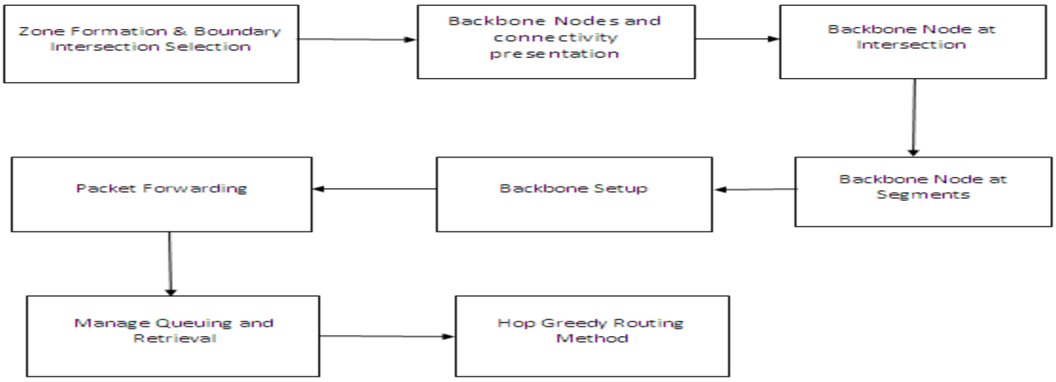


Fig 2: System design.

A. Zone Formation and Boundary Intersection Selection:

In this section the city map is divided into several zones such as road segments, intersections, major roads, minor roads. Some of the intersections are chosen to be the boundary intersections which are located on the boundary of a zone. Major roads are those roads having more than two lanes which are observed to intersect with each other, thus forming many polygons out of it. These polygonal areas are the building blocks of a city map. These zones shares their major roads with the adjacent zones. Minor roads are those roads having less than or equal to two lanes which are running inside a zone. At the corner of each zone, wide number of intersections are being noticed where major roads meets, it is most likely to find at least one node there at that intersection. Wider intersections at the corner and on the zone border are collectively called as the boundary intersections. The boundary intersections acts as the entry points of the packets sent to a zone. Here intersections, major roads, and minor roads are assigned with unique IDs.

B. Back-Bone Nodes and Connectivity Preservation:

Connectivity is the basic and essential requirement for any routing protocol for reliable and quick transmission of packets. A routing path includes a number of intermediate intersections at which the packet direction gets changed. Selection of a wrong intermediate intersection may result in delay of sending the packet or may also result in dropping of packets. Likewise if the source or destination may change its original position due to mobility, the ongoing communication for the transmission of packets may get disrupted. Similarly due to high mobility of vehicles temporary void regions may get created on a road segment. As a result the routing paths that is passing through such road segments gets weakens hence the connectivity gets deteriorated. In our attempt, we will allow some of the nodes to take care of the preceding connectivity issues. Such nodes are called as back-bone nodes. Based on their functionality, back-bone nodes are classified into back-bone nodes at intersection and back-bone nodes at road segments.

C. Back-bone nodes at road segment:

Suppose a road segment is longer than the transmission range which is devoid of nodes, it gets noticed by the nodes which are present at the boundary of the void region. Hence nodes which are closer to the void region from both directions declare themselves to be as back-bone nodes which are termed as "void-guard" back-bone nodes. The main purpose of theses "void-guard" backbone nodes is to detect and inform the presence of a void region to the neighboring active back-bone nodes stationed at intersections. Henceforth for such transactions among the back-bone nodes a piggybacked beacon message is used.

D. Back-bone nodes at intersection:

If any of an unconnected road segment is observed then the back-bone node at the intersection prohibits the packets from getting delivered to the unidentified road segment. Hereby the packet is forwarded by choosing new route Back-bone nodes at intersection to maintain the connectivity at an intersection. It is required for a back-bone node to declare its presence as soon as it enters any intersection region. For this purpose back-bone nodes use positional beacons because in periodic beacons message the interval is larger than the duration of presence of a node at an intersection.

E. Back-bone setup:

Back-bone nodes are classified into three type i.e. stable, primary and secondary back bones. A stable backbone node is selected during red traffic signal when a number of vehicles are waiting at the intersection. From the waiting vehicles, the vehicle which is present closer to the intersection declares to be the stable back bone. Moreover, the primary and secondary back bones are chosen from the group of vehicles crossing the intersection when the signal is green.

The primary back bone is the one which is located inside the intersection and the secondary back bone is the one which is situated outside the intersection. Firstly, a random node declares itself to be the primary back bone. Then, the primary backbone node choses a secondary back-bone node by comparing the average speed, the position, and the moving direction of all it's of different neighboring vehicles. When the current primary back-bone node moves out of an intersection region, it sends notification to the secondary back bone to declare itself to be the new primary back bone. This notification about the new primary back bone is also being sent to other vehicles in or around the intersection.

F. Packet forwarding: A back-bone node is always preferred for forwarding a node from an intersection because back-bone nodes always maintain the transmission history of the packet and stores the packet when there is no forwarder present at the intersection. A forwarding node always maintain a checks list of its active neighbor so that it can probe it to the available back-bone nodes by comparing the packet forwarding time and the staying time of each back-bone node. If the forwarding node is moving, it always declares stable backbone nodes as the forwarder. The primary back bone is superior to secondary back bone. Among the stable back bones, the back bone node which is closer to the intersection is more preferable.

G. Message queuing and retrieval:

The stable back-bone nodes performs packet buffering i.e. in absence of a suitable forwarding node the packet is stored in a stable back-bone node. As soon as a forwarding node in the desired direction gets available then the packet is retrieved and hence forwarded. The stable back-bone nodes maintain a database of all communications with a timestamp so that they can store the source and destination addresses along with the time of arrival of the packets. Whenever similar packet arrives with a new timestamp the previous database information gets refreshed automatically. While a packet is being routed along the choosed path suddenly either destination or source changes position informing about their identity in their beacons and start moving to a new road segment then to forward packet desired point back-bone nodes are used, which keep track of the movements of the both source and destination. Whenever source or destination changes its position, the back-bone node updates the corresponding details in its transmission history. So that during the transmission of packet the back-bone nodes can provides updated information regarding the nodes.

H. Algorithm:

1) Collects the GPS and Map info

2) Check whether anchor node is found

    a. If yes

        i. Share the own speed and direction movement to anchor node

    b. If no

        i. Ignore

3) Check whether node has data (it may be own or receive from others)

    c. If yes

i. If route is found

1. Send the data to destination

ii. If no route

1. If anchor node found

a. Check with anchor node

2. If no anchor node

a. Checks through neighbor node

4. Performance Evaluation

In this Section we have evaluated the performance of the position-based connectivity aware back-bone-assisted hop based greedy algorithm using an ns-2.35 simulator. A city traffic scenario is considered to demonstrate the performance.

4.1Network Animator Window (Nam)

A. Hop-Based Greedy Algorithm

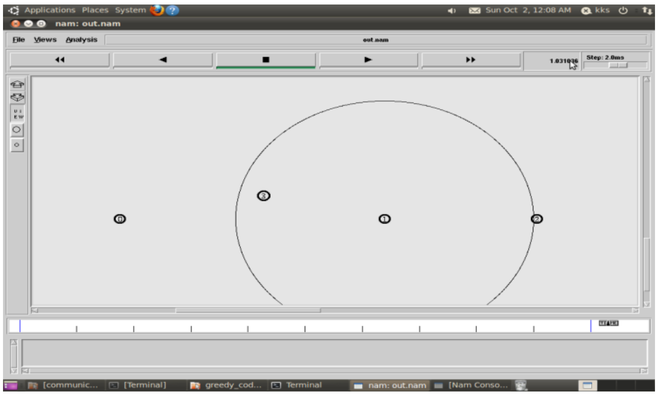


Fig 3: Source Node(1) Sending RREQ to One-Hop-Node

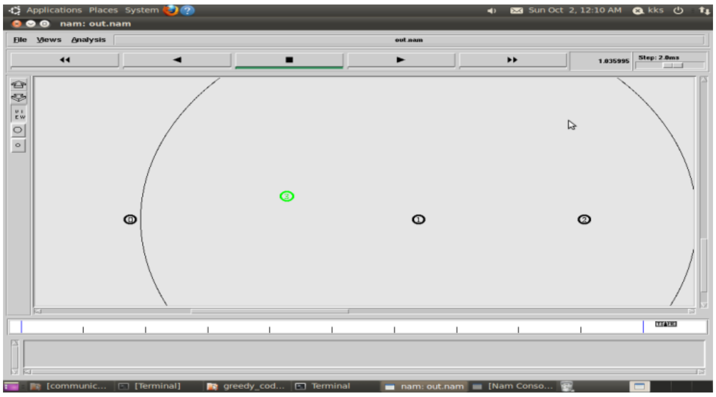


Fig 4:One-Hop Node(3) Sending RREP to Source Node(1)

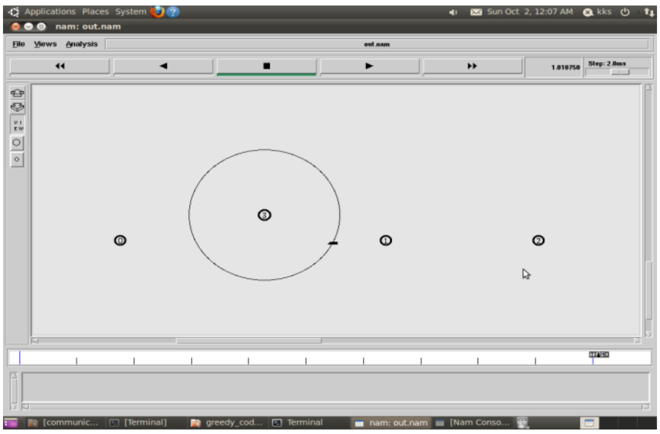


Fig 5: Source Node(1) Sending Packets to (3)

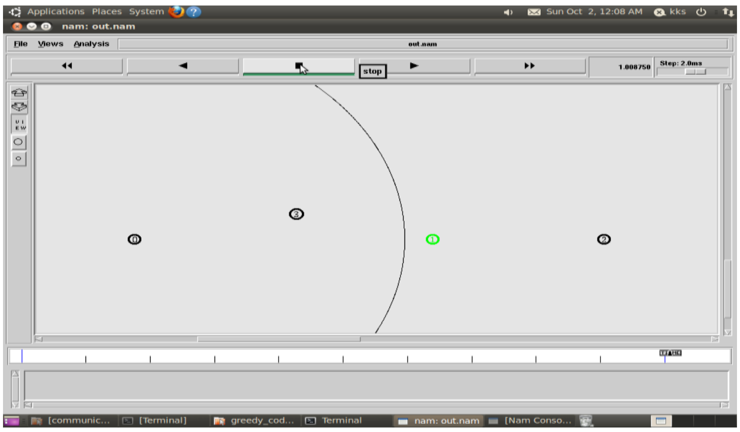
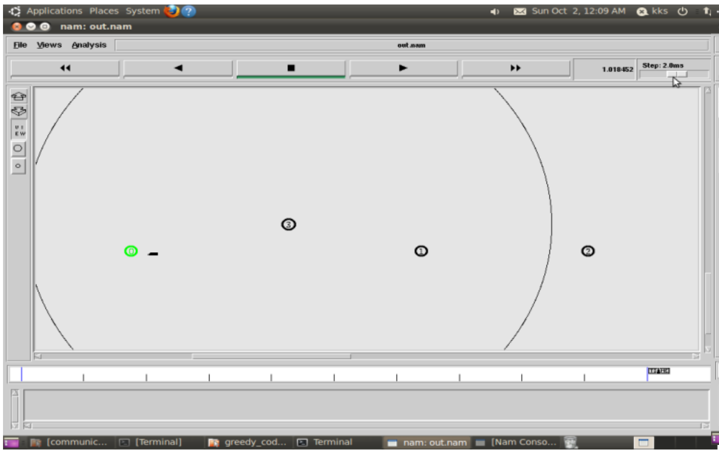


Fig 6: After transmission of packets from source node (1)

One-Hop Neighbor Node One-hop Node Sends (3) a RREQ in search of Destination Node



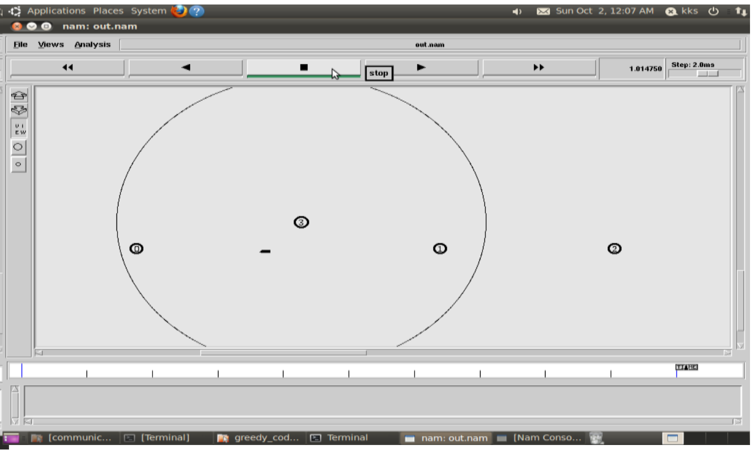
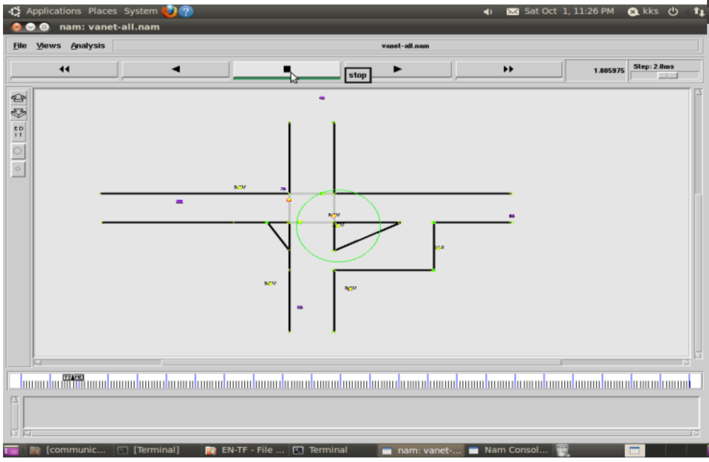


Fig 7: After receiving RREP from Destination Node (0) Fig 8: Successful Packet Transmission taken place between packet transmission takes place between themSource node (1) & Destination Node(0) via One-hop-node(3)

B. Hop-Based Greedy Algorithm in V2V Communication



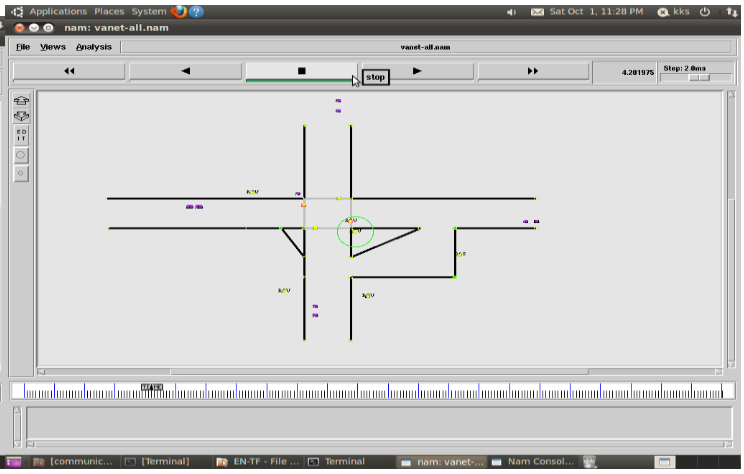
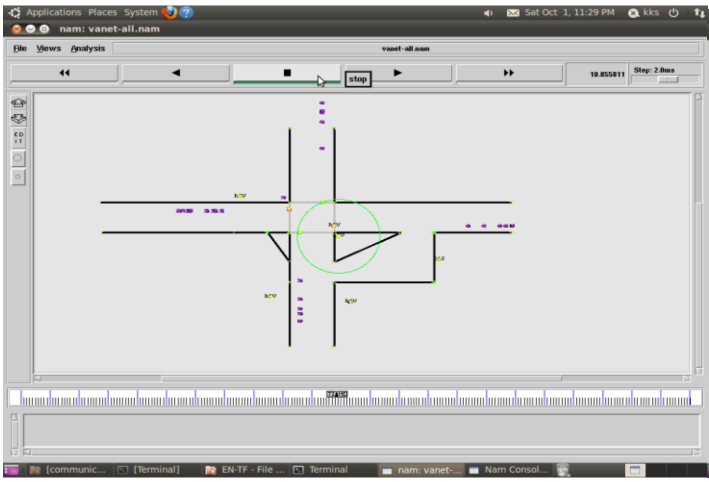


Fig 9: V2V communication Fig 10: Increasing No of Nodes in V2V Communication



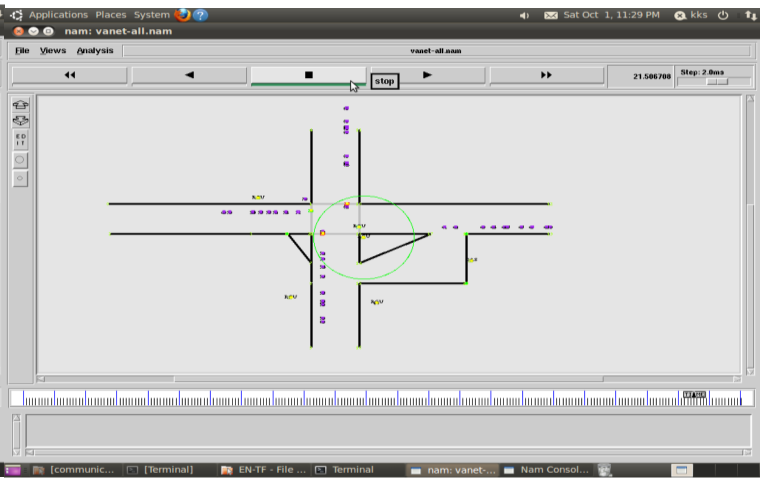


Fig 11: No of Nodes Coming towards the road segmentation Fig 12: Nodes entering the RSU Domain for further Communication.

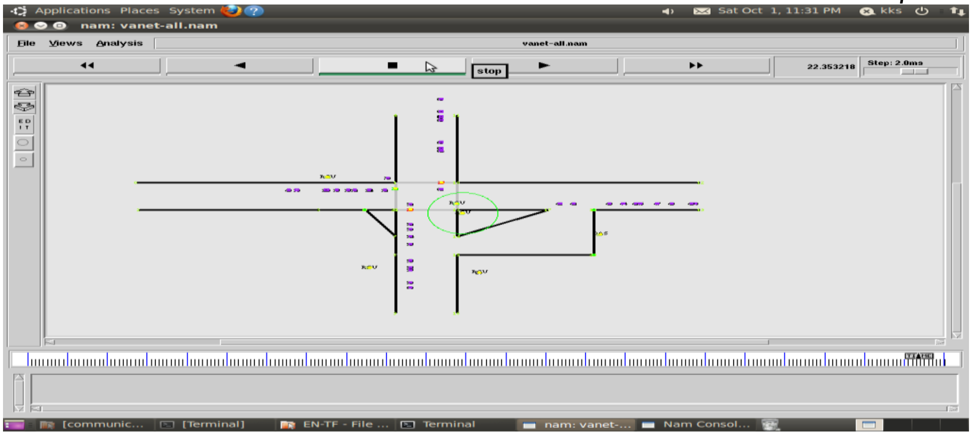
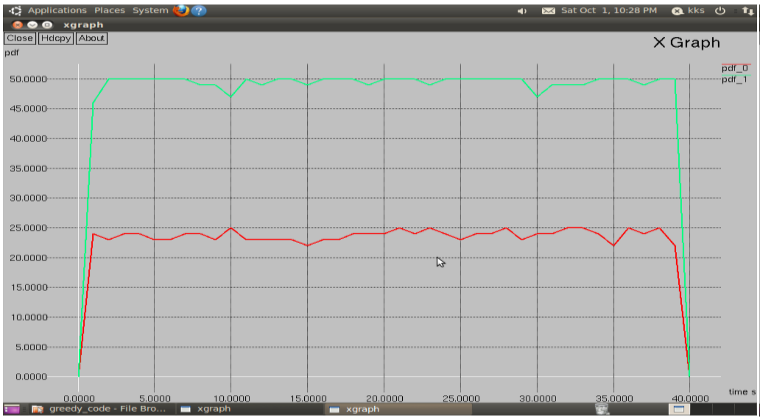


Fig 13: Nodes entered the RSU region for further communication.

4.2 X graphs

A. X graphs for Hop-Based Greedy Algorithm:



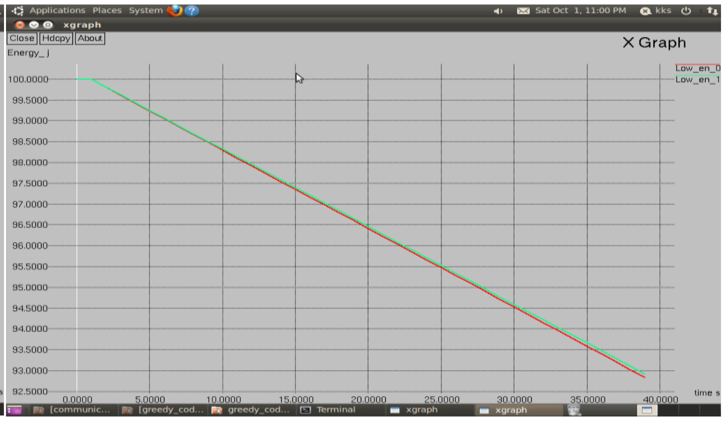


Fig 14: Comparison of Packet Delivery Ratio between the Existing System and Proposed System

Fig 15: Comparison of energy state between the Existing System and Proposed System

B. Xgraph for Hop-Based Greedy Algorithm in V2V Communication

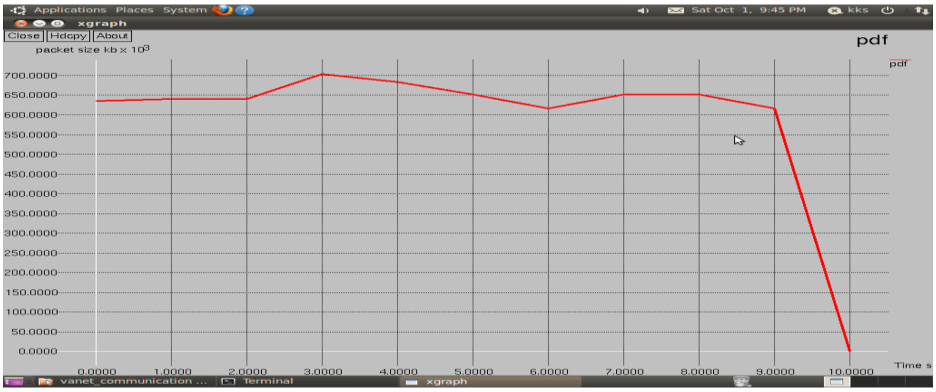


Figure 16: Packet Delivery ratio in V2V Communication Based On Hop-Based Greedy Algorithm

5. Conclusion

The VANET has witnessed several sincere attempts toward the development of suitable routing schemes. Multi-hop information dissemination in VANETs is constrained by the high mobility of vehicles and the frequent change in network topology. A hop-based greedy Algorithm has been attempted that defines a routing path with the minimum number of intermediate intersection nodes where connectivity is an essential consideration. Back-bone nodes have been introduced that play a key role in maintaining connectivity status around an intersection or for an intersection. Moreover by keeping a record of the movement of source as well as destination, the back-bone nodes is more preferred for forwarding a packeteven in the condition of changed direction.

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