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Greedy Hop Algorithm for Detecting Shortest Path in Vehicular Networks

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ABSTRACT

VANET (Vehicular Adhoc Networks) is an upcoming research area due to the development in reducing traffic congestion. It has various challenges to adopt on the design of protocols that can serve in different topologies and scenarios. The main motive of VANET (Vehicular Adhoc Networks) is to build a robust network among vehicles so that the vehicles can communicate with each other for the safety of human beings. In case of accidents, the vehicles on the other end should receive the warning message in short time so that they can decide and make a proper decision for diversion. In this paper, we design the network in such a way that the warning messages are sent in shortest path using Greedy-hop algorithm. This will help the vehicles in the environment to be free from congestion. Hence, we evaluate our work with performance metrics like throughput, delay and packet delivery ratio.

Index Terms: Greedy-hop algorithm, shortest path, VANET, warning messages

I. INTRODUCTION

Vehicular Adhoc Networks (VANET) is subset of Mobile Adhoc Networks (MANET) where the vehicles move in the environment without any fixed infrastructure. The topology created by vehicles is usually dynamic and significantly non-uniformly distributed. From this it is clear that the movement of vehicles is similar to Adhoc nature.

The topology of VANET is dynamic because of the movement of vehicles at a very high speed. Hence, the communication link between the vehicles will be brief. Moreover the mobility model of a vehicle will depend on the speed as well as the environment structure.

There is unlimited battery and power storage in VANET which helps in effective communication and in making routing decisions. Hence, the characteristic of VANET is unique when compared to MANET.

There are many challenges in VANET which have sparked a lot of interest in different research communities like transportation, networking and wireless communication. One of the greatest challenges in VANET is that the vehicles in the network move at greater speeds, leading to a network that can frequently get disconnected. Hence, the movement of vehicles can be predicted only when it is subjected to the traffic rules and regulations.

VANET applications are classified into security and efficiency [1]. VANET provide safety information, traffic Management, location based service, toll service [2].

In this paper, we will discuss the challenges that are associated with VANET. To begin with, Section II explains about the architecture of VANET. In addition, Section III explains some challenges that are possible in VANET. Further Section IV discusses some existing works for vehicular networks. Section V gives an overall framework of the proposed work which includes pseudo code for Greedy-hop algorithm and scenarios.

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Section VI is the simulation of the proposed work. Section VII is the result and analysis. Finally, Section VIII gives the conclusion.

II. ARCHITECTURE OF VANET

The architecture of VANET is of three types. They are:

(A) Inter-Vehicular Communication

This is known as V2V (vehicle-to-vehicle communications). Here vehicles in the network communicate with each other by broadcasting and sending data. The broadcasting information mainly contains location, speed and identification. The data that is being traversed in the network may contain warning messages such as accidents, weather conditions, parking information, etc.

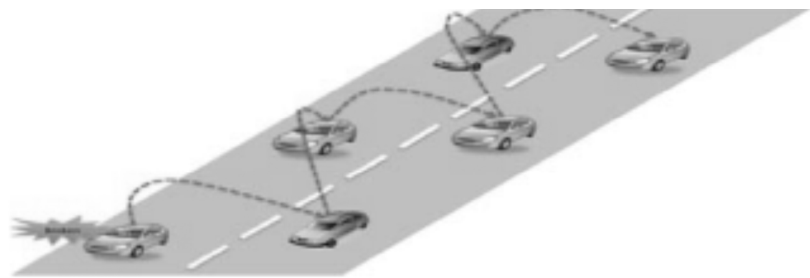

Figure 1: V2V communication [3]

(B) Infrastructure-Vehicular Communication

This is known as V2I (vehicle-to-infrastructure communications). Here the infrastructure can be RSU (Road Side Units) or traffic lights. The vehicles send data to the infrastructure and in turn the infrastructure sends the data to the neighboring infrastructures and to the other vehicles in the network.

Figure 2: V2I communication [3]

(c) Inter-road side Communication

This is the combination of V2V and V2I communications. This provides greater flexibility in data sharing in the network.

III. CHALLENGES IN VANET

There are some issues in VANET. They are:

- In VANET, the warning message has to be sent to the destination in short time to avoid congestion in the network. Hence the major challenge is find the shortest path with less delay and high link connectivity in the network.

- In VANET, electromagnetic waves are used for communication and these affect the environment. Hence, environmental impact has to be taken care. Some technical issues are related to design and architecture in Mac layer of VANET [4].
- In secured environment, even the authenticated vehicles can act as attackers and perform malicious activities in the network. Hence, the major challenge is to distribute private keys among the vehicles [4].
- Even though Authentication is performed to ensure that the message is created by authorized user, Denial of Service (DOS) attack is possible in the network. A regular monitoring of data is required to eliminate the false messaging [5].
- The most common type of attack is Eavesdropping attack on confidentiality. Routing attacks are the attacks which destroy the vulnerability of the network layer routing protocols [6].
- In the real world, vehicles are not uniformly distributed in the given region [7].

IV. RELATED WORK

Bidirectional search algorithm [8] is used to find most reliable routing in VANET from source to destination. Instead of searching a reliable route in one direction, this bidirectional algorithm searches the most reliable route from both the directions (i.e.) from source to destination and destination to source. This algorithm works faster in highways and is used in high traffic areas.

Huma Ghafoor *et al.* [9] proposed an anchor based connectivity aware routing protocol to ensure connectivity of routes with more delivered packets. This uses both greedy-forwarding approach and store-and-carry-forward approach to minimize the packet drop rate. The disadvantage of this paper is they consider only vehicle-to-vehicle (V2V) communication in which both source and destination are moving vehicles. Moreover there is no infrastructure (Road side Unit) in the network.

Amit *et al.* [10] proposed an approach that provides assistance in traffic routing using Grid computing with shortest path algorithm. The shortest path algorithm used in this paper is Dijkstra's algorithm. The advantage of using grid computing in VANET environment is that the approach is scalable as well as more computing power is added. Hence this approach will work for large number of nodes. By having large number of vehicles working together in the grid environment, the drivers can easily determine the best route to reach the destination.

Pardakhe *et al.* [11] presents a scheme called as vehicular routing algorithm (VRA). VRA offers quick adaptation to dynamic link conditions, low network utilization and low memory overhead. VRA will give useful routing information as they travel throughout the network. This will perform automatic route finding by taking an observation of surrounding traffic and environment conditions. But the major problem is to find the appropriate path to the destination.

Smitha shekar *et al.* [12] proposes a dynamic routing system which includes metro rail network along with road transport system to guide ambulances in real time scenarios. The shortest path algorithm that is used in this paper is Dijkstra's algorithm. Here Dijkstra's algorithm is used using time variable by considering non-recurring congestion thereby arriving at shortest path to the destination in minimum time.

V. PROPOSED WORK

(A) Greedy-hop

In this proposed work we use Greedy-hop algorithm to detect the shortest path to the destination. Here the vehicles are used as moving nodes in the network. Initially the vehicles in the network will send beacon messages to the neighboring vehicles as well as to the infrastructure (RSU). The beacon message will contain id, location, speed of the vehicle. The size of beacon signal is 400 bytes. Using this message the vehicles in the network will know their neighboring vehicles. So when warning messages like accidents or weather conditions or parking information has to be sent to the vehicles on the other end in short time, we use greedy-hop algorithm. This greedy-hop algorithm will find the shortest path from source to destination and will transmit the warning data in short time.

GREEDY-HOP ALGORITHM [13]

Input: source node

Output: path to destination node

ListN: Neighbor List

ListC: Candidate List, initialized as an empty list

ND: Destination Node

Base: Distance between current node and ND

If find (ListN, ND) then

next_hop <- ND

Return

End if

For i <- 0 to length (ListN) do

ListN[i].dist<- dist (ListN[i], ND)

End for

ListN: sort ()

next_hop<- ListN [0]

For i<- 1 to length (ListN) do

If dist (ListN[i], ND) e” base or length (ListC) - N

Then

Break

Else if dist (listN[i], listN [0] < R/2 then

ListC. Add (ListN[i])

End if

End for

(B) Scenarios

It is implemented in scenarios such as:

- In case of accidents, the accident message can be sent to the vehicles on the other end using Greedy-hop algorithm. This enables the vehicles on the other end to receive the accident message in short span of time and also make a proper decision for diversion.
- In scenarios like parking slots, it sends intimation to the vehicle regarding the vacant space so that the time consumption for identifying the vacancies is reduced and simultaneously minimizes the manual work.
- In situations where heavy traffic exists an alert message is given to the vehicles on the other end in order to take the possible route for diversion.

VI. SIMULATION

(A) NS2

The proposed work is evaluated in ns2 (Network Simulator). The goal of Ns2 is to support in networking research. It is an open source tool. The scripts are written in OTcl. Some are written in C++ for efficiency reasons.

(B) Simulation Parameters

Parameters	*Configrations*
Protocol	AODV
Network Interface Type	PHY/Wireless PHY
Number of vehicles	50
Area	2000mX1200m
Simulation start time	0 sec
Simulation stop time	180 sec
Communication range	250m

(C) Simulation Environment

Initially the environment will contain vehicles and RSU in the network where RSU's are fixed structure while the vehicles are in mobility.

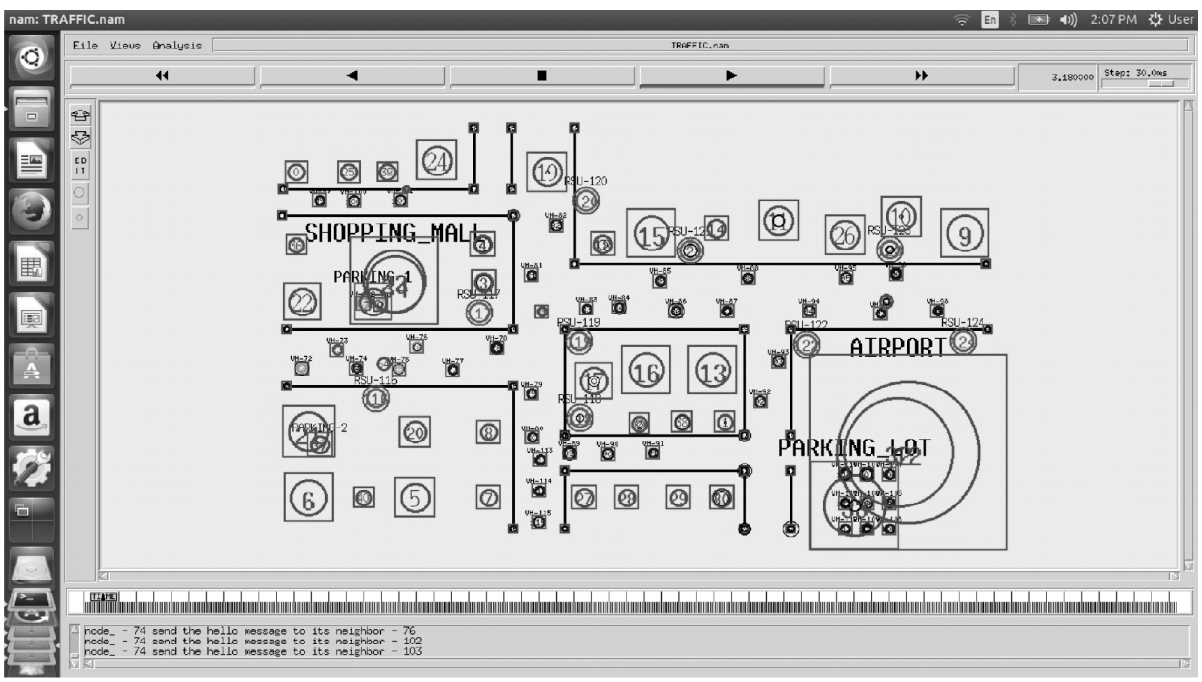

Figure 3: Simulation Environment

During the simulation, the vehicles in the network will send beacon messages to the neighboring vehicles and to the RSU's so that the vehicles in the network will know their neighbors. When an accident takes place, the vehicle that has met with an accident is taken as source vehicle. Now the source vehicle has to send the accident message to the destination in short time so that vehicles on the other end can decide for diversion. In order to send the warning message in short time we use Greedy-hop algorithm that takes message and sends to the destination in shortest path.

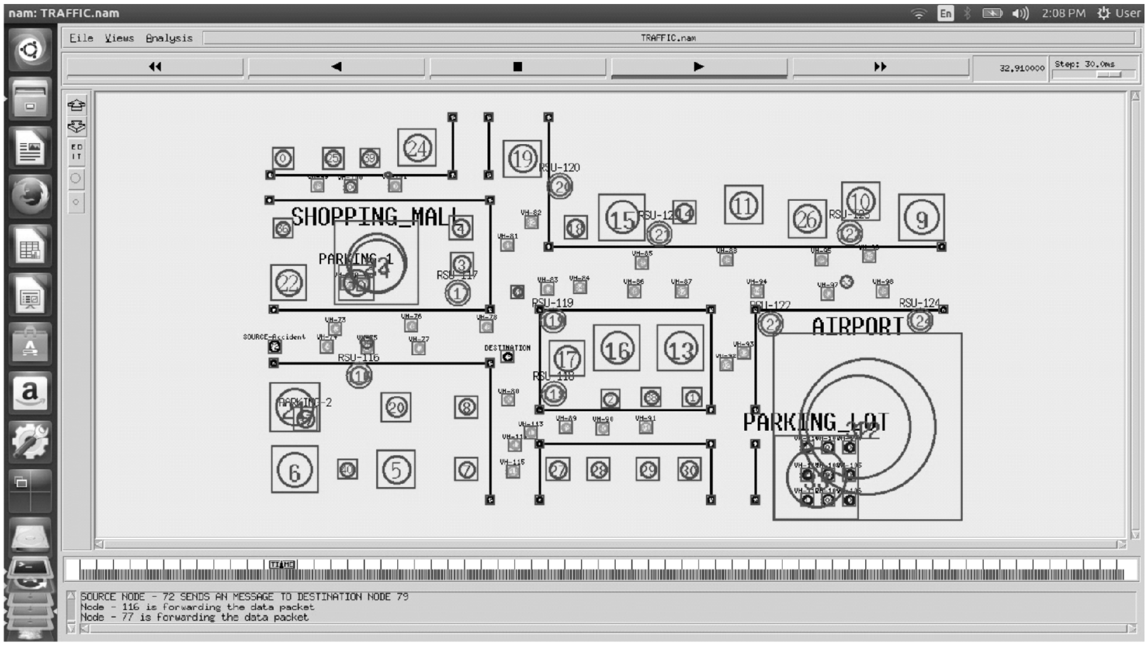

Figure 4: Data passed from source to destination

Once the data is passed to the destination, we can verify the shortest path that has been chosen. The path traversal is shown in separate file.

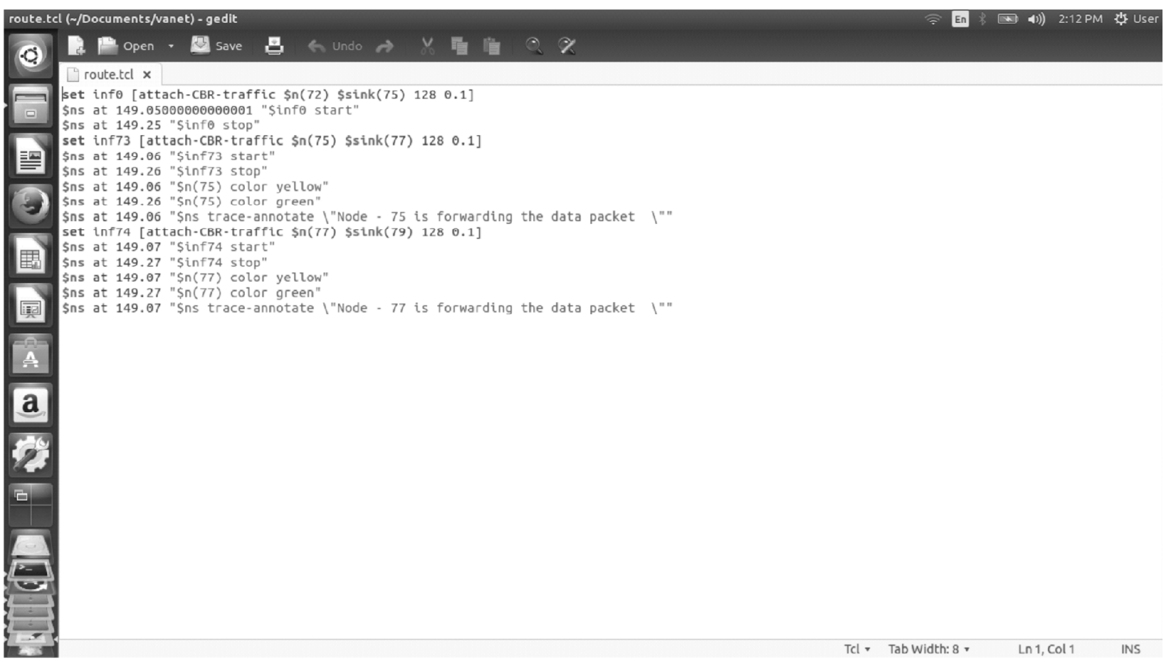

Figure 5: Path traversal

Similarly, the position of the vehicles and the distance between the vehicles are calculated in separate file.

VII. RESULT AND ANALYSIS

To evaluate the simulation scenario, we considered the performance metrics of packet delivery ratio, throughput and packet end-to-end delay.

(A) Packet delivery ratio

The ratio between the number of packets originated by the CBR sources and the number of packets received by the CBR sink at the destination.

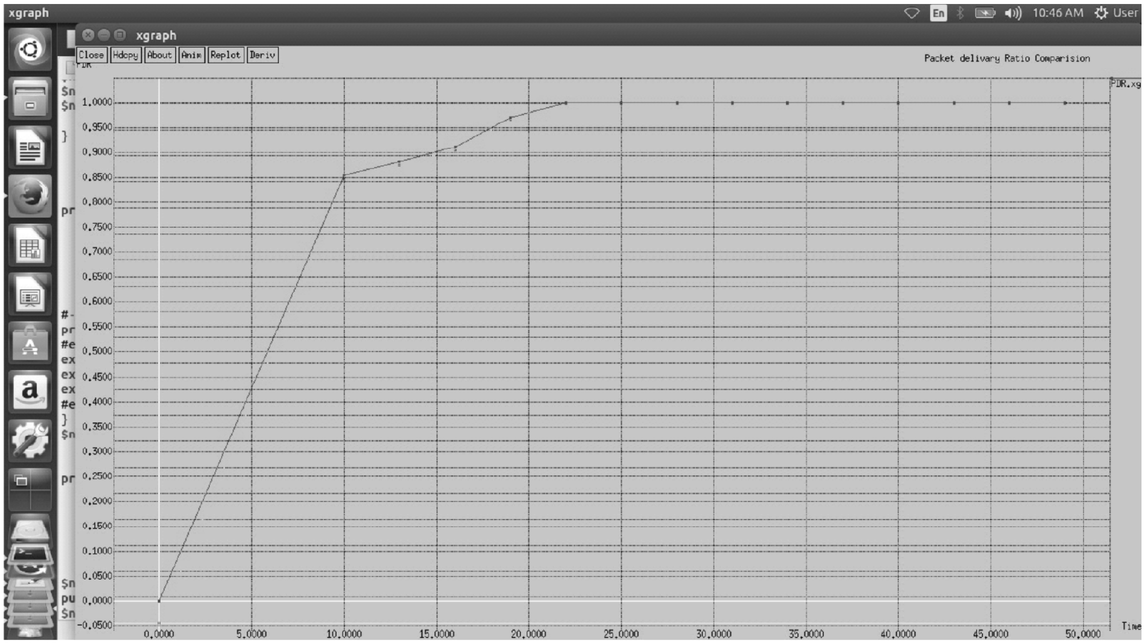

Figure 6: Packet delivery ratio

From the above graph, it can be inferred that by using Greedy-hop algorithm the packet can be sent with high accuracy and minimal loss.

(B) Throughput

The amount of data that can be transferred from one location to another in a given amount of time.

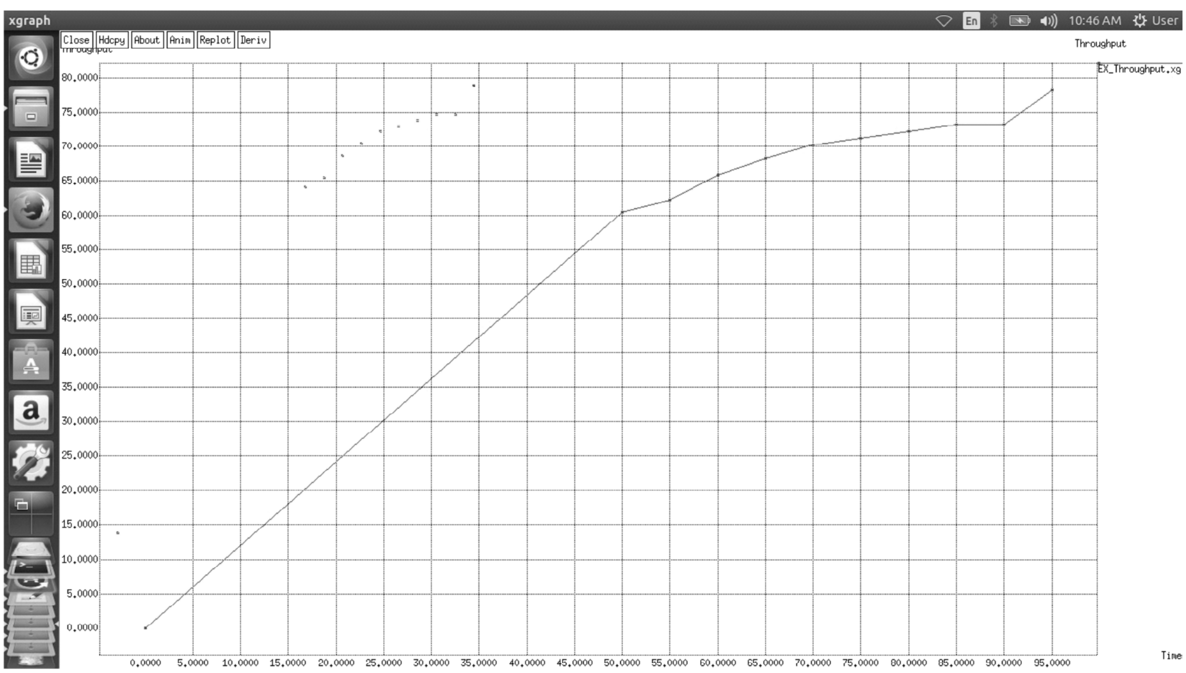

Figure 7: Throughput

From the above graph, it is inferred that the throughput rate obtained is very high.

(C) Packet end-to-end delay

Time from generating a packet till receiving the packet at the destination.

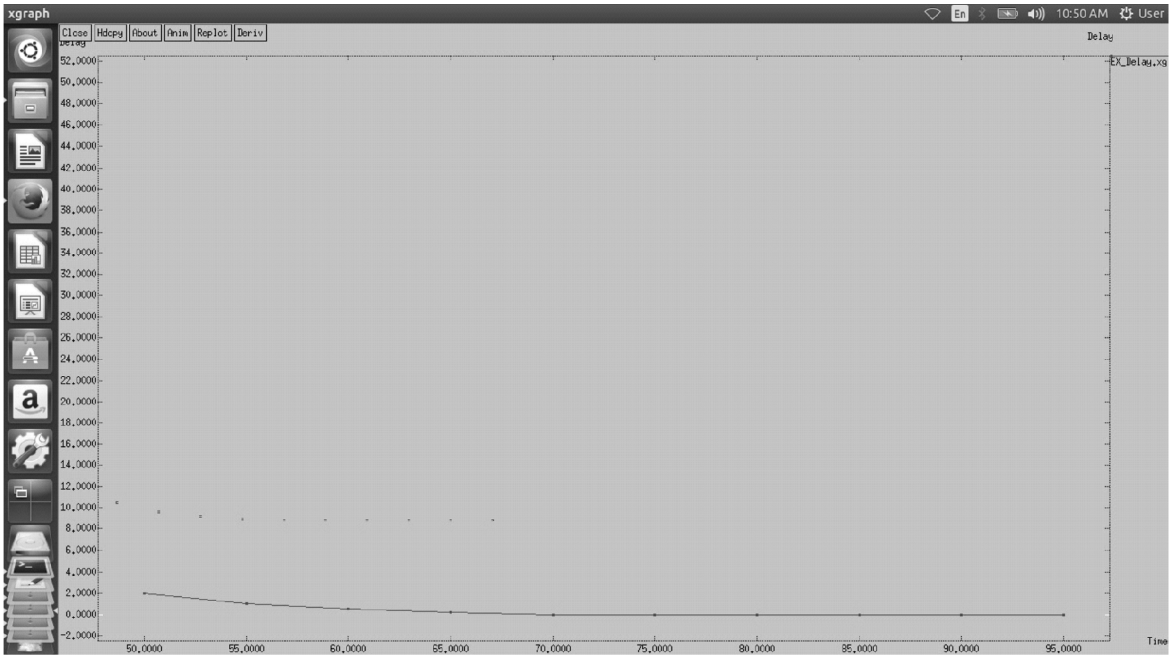

Figure 8: End-to-end delay

From the above graph, it is inferred that there is minimal delay in receiving the data at the destination. This proves that by using Greedy-hop algorithm we can have high packet delivery ratio and throughput with less delay in the network.

VIII. CONCLUSION

VANET is a key for future intelligent transport systems, smart vehicles and smart infrastructure. In this paper, we have proposed a shortest path algorithm called Greedy-hop algorithm that will send the data form source to destination in shortest path which will cause less delay in the network and be free from congestion.

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