Performance Evaluation of AOMDV and AODV in City Scenario With Changeable Traffic Density in VANETS BLSTM With Attention Mechanism

S. Devi (devi.s45679@gmail.com)
PRIST (Deemed to be UNIVERSITY)

Research Article

Keywords: Ad-Hoc On-Demand Distance Vector (AODV), Ad-hoc On-Demand Multipath Distance Vector (AOMDV), Vehicular Ad-hoc Network (VANET), Emergency Services

Posted Date: August 9th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-724555/v1

Abstract

The survey indicates that VANETs use two vital routing protocols namely AODV and AOMDV. AODV is implemented by providing a single dedicated path between source and receiver and it doesn't search for the alternate path in the case of an emergency situation. On the other hand, AOMDV is implemented by providing an intermediate participant node to reach the receiver i.e., it provides multipath and unlike AODV, it searches for the alternate path in the case of an emergency situation. Due to this capability, AOMDV finds its application in broad areas of research. In this paper, both the protocols are established and their performances are analyzed in terms of PDR, PLR, E2E, and Throughput. The simulation results are obtained using NS2.34. Using these results, the appropriate protocols can be implemented in real-time for various city environments with changeable traffic density and topography in the established network.

1. Introduction

Vehicular ad hoc networks (VANETs) are implemented by the application of concepts of mobile ad-hoc networks (MANETs). Thereby VANETs spontaneously create a wireless network for the exchange of data to the network of nodes/vehicles. Figure 1 shows the basic components of VANET architecture. It builds the network among Vehicle to Vehicle (V2V), Vehicle-to-Roadside (V2R), and Roadside to Roadside (R2R) communicating networks to provide safety on the road, navigation, and several roadside applications. VANETs are an essential part of the framework of intelligent transportation systems. Hence VANETs are mentioned as Intelligent Transportation Networks synonymous to the Inter-Vehicle Communication even though its focus resides on the spontaneous networking, less usage of Road Side Units (RSUs)/ cellular networks. VANETs basically use all kinds of wireless networks with wireless local area networks (WLAN) as the very important short-range radio technology (Standard Wi-Fi/ ZigBee). Also, VANETs use cellular technology/ LTE. VANET communication includes V2V, V2R, and R2R. V2V is apt for a short distance with a safe, reliable, and fast vehicular network without the need for any roadside infrastructure, and it broadcasts warning messages between vehicles. V2R communicates between vehicles and the RSUs with the use of available network infrastructure (wireless access points) and it sends warning messages to pre-RSUs, and RSUs in turn send the warning messages to vehicles. R2R is apt for long-distance vehicular networks. Today, the terrible increase in traffic on the road led to an increase in accidents in peak and busy hours. This problem is getting worse and has become worse every day. And it threatens the life of the people and there exists a risk in every second of life. These uncontrolled networks and life risk are a big problem and it has to be recovered by the means well-organized network so that traffic jams, accidental incidents, and longer delays can be avoided with the help of dynamic timely information by the vehicles in advance. Thereby the safety and efficiency of the network can be improved. Being self-organized, VANET provides road safety and solves numerous traffic management problems and hence today it becomes an indispensable component in the intelligent transport system. In this paper, the network is analyzed with two routing protocols namely AODV and AOMDV. As the network topology changes rapidly and also the communication connectivity varies, there prevails a tough situation for routing protocols in VANETs. And these protocols must be dynamic and reliable to the changing load condition. Hence in this paper, real-time city scenario is designed with the characteristics of fast varying topology to study the performance. Figure 1 represents the city scenario taken for simulation. This network provides V2V and R2R connectivity over a wireless connection having the IEEE 802.11p standard. An emergency message was sent from a vehicle on the network and this supports RSUs to multicasting emergency messages within the network.

2. Literature Review

Many research works have been done on VANET routing protocols corresponding to the number of parametric conditions. In [8], the characteristics of each AODV and DSR routing protocol are studied and analyzed, corresponding to the dropping of packets, and end-to-end (E2E) delay using NCTUns- 4.0 simulator. Their results showed that AODV is more efficient than DSR in most of the situations with respect to E2E delay as the nodes increase. In [14] AODV and DSR for VANETs are applied to learn the condition affecting each case of two possible scenarios namely urban and highway. It was noticed that AODV is better in terms of packet-delivery-ratio (PDR) in the above-said scenarios. It was found that DSR works in a satisfactory way in urban areas and highways in terms of E2E delay. In [13], for both AODV and DSR protocols, the throughput and delay were studied on the VANET network using NS2. Their result showed that DSR performs well in terms of throughput for less number of nodes. But for the more number of nodes, the AODV protocol suits well compared to DSR for routing. In [17], the packet delivery ratio was analyzed both on AODV and DSR protocols using MOVE along with SUMO and NS2. Their results showed that AODV is suitable for packet delivery ratio when compared to DSR by using CBR and TCP as two different traffic connections. In [15] the attitude of AODV and DSR routing protocols are analyzed by using TCP and CBR connections on a VANET corresponding to E2E delay and average throughput. In [1] DSDV, AOMDV, and AODV are compared in low, high and middle-density regions and developed a road traffic scenario with 50, 100, and 150 vehicles as low, middle, and high-density region respectively. The authors [2] analyzed the characteristics of AODV and DSR routing protocols using NS2. Their results show that DSR has poor packet reception than AODV and packet received ratio for AODV was high when comparing with DSR protocol. Artimy et al. [3] proposed a multi-channel cluster-based communication approach to make use of DSRC channels greatly. Davesh et al. [4] analyzed the efficiency of AODV and DSR protocols using NS2 keeping the nodes as highly variable. Their results show that AODV exhibits very high efficiency in all assumptions and DSR was suitable for low scalable networks with mobile nodes moving at moderate speed. Fan li. et al. [5] surveyed all issues related to VANETs and its applications and described the network simulators such as NS-2, MOVE, Trans, VanetMobiSim, GloMoSim, NCTUns, and QualNet. Goel A. et al. [6] investigated methods about safety propagation of related messages to accidental areas. Gupta P. et al. [12] showed in their experiment that DSR has performed well than AODV in terms of delay and throughput on fewer nodes and with low load and motion but in the case of high load and mobility condition and with increasing nodes, AODV has performed well than DSR. In [7] the characteristics of AODV and OLSR routing protocols are evaluated under two topical and realistic mobility models for VANET using the OMNET++ simulator. Their results conclude that the performance of AODV is better than OLSR. Manvi S. et al. [9] analyzed the performance of AODV and OLSR using OPNET Modeler 14.5. The simulation results showed that OLSR shows low media access delay and low network load than AODV. Monika et al. [10] analyzed the characteristics of AODV and DSR protocols for VANET in the presence of and without RSU using the Estimate Simulator. They decided that AODV showed higher throughput than DSR with a varying number of nodes. A Road-based vehicular traffic (RBVT) [11] routing is proposed for the city environments to create road based paths between endpoints for the high contention areas by using the distributed-type mechanism. The authors [16] implemented an improved AODV Routing Protocol by restricting the hop- count visited using NS2. They showed that the improved AODV protocol exhibits excellent delivery ratio, throughput, and jitter over the AODV. Prabha R et. Al [13] evaluated an improved swarm intelligence based multipath MANET routing using OPNET link estimation and swarm intelligence. It was observed that the QOS was highly influenced by link quality in multipath routing protocols. Recently, Ad-hoc On-Demand Multipath Distance Vector (AOMDV) protocol is gaining interest in the highly variable topology conditions, mobile networks and can be implemented in the areas where the failure in route happens regularly and if the dedicated link is failed. AOMDV is gaining popularity in multipath networks and it has the capability of choosing an alternate path (stable path from the record of the database in each active node) in the case of failure of the dedicated link for its effective communication. In this way, AOMDV maintains the stability of the partially disjoint path. Hence AOMDV is implemented for the scenario shown in Figure 2 using NS2 with the vehicles/nodes having changing speed and with active adjacent nodes. The experimental simulation shows that the AOMDV routing protocol provides improved Packet-Delivery-Ratio (PDR) while AODV has a low Average End-to-End (E2E) delay.

3. Aodv And Aomdv

This paper analyzes the efficiency of VANET by reviewing two kinds of routing protocols namely AODV and AOMDV.

• Ad-hoc On-Demand Distance Vector (AODV) is a reactive protocol where the route is established from the sending node to the receiving node in case if the node has something and if it wants to send a packet to the intended receiving node. This protocol includes route-discovery and route updating and maintenance as the two major processes.

• Ad-hoc On-Demand Multipath Distance Vector protocol (AOMDV), is also a reactive protocol like AODV. Here also the route is established from the sending node to the receiving node in case if the node has something and if it wishes to transmit the packet to the intended receiving node. But it will determine multiple alternate paths to reach the specified destination by using the RREQ process.

The AODV is single path routing protocol and it performs route discovery on-demand only when there is a requirement for establishing a path and every node has a lookup table where it contains the entry of nodes in the network, routing details of the next-hop count, sequence number, and the path to reach the destination. This process is updated periodically and on all the occasions of the existence of an active link between the source and destination. This protocol includes route discovery and route updating and maintenance as the two major processes. The route discovery helps in discovering route from source to the destination node and route updating and maintenance technique helps in keeping up the route in the case of route failure. The advantage of AODV is that it utilizes less memory space since it tracks the data of active routes only and is updated in the routing table. Thereby the performance of the designed network using AODV is improved. The disadvantage is that AODV does not support larger networks i.e., poor performance is noticed and leads to different asymmetric links. Whereas, AOMDV is an extension of AODV and is a multiple path routing protocols. This algorithm provides many authentic paths from the source to the intended destination in the case of failure in connection. It presents several, static, authentic, committed, and uncommon paths. After the discovery of multiple/ several routes, that information regarding each path is updated in the routing table. Thus route discovery is a major task in AODV and the sub-path is selected depending on the number of hop-count in the entry of the routing table. The path is selected based on fewer hop-counts and its fidelity of flooding the request from the sending node to the receiving node. Further computation is done with AOMDV. Initially, it evaluates and maintains a number of available paths at each node of the network and then it checks out disjoint connected paths in order to evaluate the characteristics.

3.1. Methodology and Implementation

In this work, the city traffic pattern is considered and designed with 62 mobile nodes disseminated and is considered to be highly mobile in the network. The vehicles/ nodes which are moving at a variable speed (own mobility) can communicate with its neighboring node in their contact area. Also, the vehicles communicate to the available intermediate nodes or RSU. Each vehicle is installed with an Omni-Directional antenna and it radiates stable power in entire directions. In this work, Wi-Fi is equipped with IEEE 802.11 to the network. With these features, the designed network is utilized with two routing protocols namely AODV and AOMDV to study and analyze the number of performance merits such as PDR, PLR, Average E2E delay, and throughput. The above-mentioned metrics are estimated for the two protocols from trace file using NS-2 and the comparative graph is plotted after summing up the average value of the metrics. In this implementation, 62 nodes are considered in a rectangular area of 1000m*1000m, simulation time is 380 seconds and the mobility speed of every vehicle is varied from 10m/s and it is increased further. Table 1 shows the parameters utilized in the NS2 simulator. The performance of AOMDV is found to be comparatively better than AODV. The merits of the protocols are evaluated with their performance metric parameters and its Quality of Service (QoS) is identified. These performance metrics are discussed below to make the comparison for AODV and AOMDV.

Table 1. Simulation Parameters

Parameters	Simulation Value
Simulator	NS2
Speed	10 m/s
Type of Traffic	CBR
Simulation Period	380 sec.
Antenna type	Omni Directional Antenna
Radio propagation model	Two ray propagation
MAC Type	802.11P
Routing protocol	AOMDV, AODV
Simulation Range	1000m *1000m
Mobile nodes	62

- **Packet Delivery Ratio (PDR)**

Packet delivery ratio (PDR) is referred to as the successful delivery of packets to the receiving node (Ṛ) to the packets sent by the sending node (Š) during the specified period of simulation. PDR is given by equation 1,

$$PDR = \frac{Ṛ}{Š} * 100 \tag{1}$$

- **E2E Delay**

End-to-End delay calculates the time excerpted by the packet to transit from the sending node to the receiving node. It gives the average E2E delay for the successful reception of packets (Ṛ). Average E2E delay is given by equation 2,

$$Average\ E2E\ Delay = \frac{f - g}{Ṛ} \tag{2}$$

Where f denotes the packet received time and g denote the packet sent time respectively.

- **Average Throughput**

Average Throughput is the successful reception of packets (Ṛ) during the stipulated simulation time (Ṫ) given in bits per second. Average Throughput is given by equation 3,

$$Average\ Throughput = \frac{R}{T} \quad (3)$$

3.2. Experimental Results and Relative Analysis

For the network designed, the NS-2.34 simulator is applied to obtain the simulation results and from the results, the performance metrics like PDR, PLR, E2E, and average throughput are determined for the 62 nodes distributed in the designed network. The nodes are mobile and its speed is variable with the simulation range of 1000m*1000m. The type of traffic is Constant Bit Rate (CBR) with a User Datagram Packets (UDP) of 1000 bytes size over a simulation time of 380 seconds. The vehicles/nodes are considered to move in the opposite direction in two ways and changeable speed and they are considered to communicate among them. The TCL code for this designed network is executed and its outcome is analyzed and it gives the nam (network animator) file and tr file (trace). In addition 'awk' command is used for evaluating PDR, Throughput, and E2E Delay. The comparison of AODV and AOMDV shows that AOMDV significantly decreases the congestion request on a neighboring single node and also traffic delay with authentic connectivity. Hence it is found that AOMDV is more efficient than AODV. Figure 3 shows the terminal window (nam) showing the Topology Graph designed during the Simulation. Figure 4 displays the formulation of the road using VANET. Figure 5 displays the formulation of the roadside unit (RSU). Figure 6 shows the arrival of vehicles, Figure 7 shows the beginning of communication, Figure 8 shows the movement of vehicles, Figure 9 shows that data transfer between vehicles, Figure 10 shows the crossing of vehicles, Figure 11 shows the situation of an emergency alert, Figure 12 shows the mode of transferring of data, and Figure13 shows the situation of vehicles moving out.

Figure. 14 represents the simulation result for packet delivery ratio (PDR) and it shows that the AOMDV routing protocol outperforms AODV in the designed network environment. It achieved 95% more than AODV. In Figure. 15 throughputs is illustrated and it's better for AOMDV (392 Kbps) as compare to AODV routing protocol. Also, the performance of the network with AOMDV is improved with the increase in nodes as compared to AODV. In Figure. 16, shows the E2E delay and is inferred that it is a minimum for AOMDV as compared to AODV. Hence from the simulation results, it is speculated that the designed network shows improved performance in all the above situations (Figure 4 to Figure 13) using AOMDV as compared to AODV.

4. Conclusion

In this paper, the main focus is on the emergency services in the created road context. In this concept, both the protocols AODV and AOMDV are compared and their performances are analyzed for services offered by them during emergency conditions in terms of PDR, PLR, E2E, and Throughput. The simulation results are obtained using NS2.34. By this analysis, it is inferred that the AOMDV significantly improved network efficiency and was capable of granting the best emergency services in the designed scenario. Using these results, the appropriate protocols can be implemented for various city environments with changeable traffic density and topography in the established network.

Declarations

AUTHORS' CONTRIBUTIONS:

Funding

Not applicable.

Availability of data and materials

All data generated or analysed in this study are included in this published article.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Conflicts of Interest

The authors declare no conflict of interest.

References

1. Ameur Bennaoul, Mustapha Guezouri and Mokhtar Keche,‖ Performance Evaluation of Routing protocols in Vehicular Networks, International Journal of Computer Network and Information Security,2013,pp. 11-16.
2. Amit N. Thakare, Mrs. M. Y. Joshi, ―Performance Analysis of AODV & DSR Routing Protocols in Mobile Ad hoc Networks, Indian Journal of Computer Application, Special Issues, 2010, pp. 231-240.
3. Artimy M.M., W. Robertson, and W. J. Phillips. ―Connectivity in inter-vehicle ad hoc networks‖.Engineering Canadian Conference on Electrical and Computer, Volume: 1, May 2004, pp. 100-112.
4. Davesh Singh and Dhananjaya Singh,―Performance Analysis and Simulation of AODV, DSR and TORA Routing Protocols in MANETs, International Journal of Recent Technology and Engineering (IJRTE), Vol. 1, Issue-3, August 2012, pp. 218224.
5. Fan Li and Yu Wang; ―Survey of Routing in Vehicular Ad hoc Networks, In Proceedings of IEEE Vehicular Technology Magazine, Volume 2, Issue 2, June 2007; pp. 12-22.

6. Goel A., Ramakrishnan K. G., D. Kataria, and D. Logothetis, ―Efficient computation of delay-sensitive routes from one source to all destinations, In Proceedings of IEEE Conference on Computer Communications, 2001, pp. 854-858.
7. Jerome Haerri ―Performance Comparison of AODV and OLSR in VANETs Urban Environments under Realistic Mobility Patterns, Department of Mobile Communications, June 2005, pp. 123-134.
8. Khaleel Ur Rahman Khan, Rafi U Zaman, A.Venugopal Reddy,"Performance Comparison of On-Demand and Table Driven Ad Hoc Routing Protocols using NCTUns", Tenth International Conference on Computer Modeling and Simulation, May 2008.
9. Manvi S., Kakkasageri M.S. and Mahapurush , Performance Analysis of AODV, DSR, Routing Protocols In Vehicular Ad hoc Network Environment‖International conference on future Computer and Communication., April. 2009, pp. 21-26.
10. Monika, Sanjay Batish and Amardeep Dhiman, ―Comparative Study of AODV, DSDV and DSR Routing Protocols in vehicular Network Using EstiNet Simulator‖, International Journal of Scientific & Engineering Research , Vol. 3, Issue 6, June 2012.
11. Nzouonta J. R., Guiling N. and Wang Borcea C., ―VANET Routing on City Roads Using Real-Time Vehicular Traffic Information, In Proceedings of Vehicular Technology, IEEE Transactions on Vol. 58, Issue. 7, Sept. 2009, pp. 33-37.
12. Pooja Gupta and Rajesh Kumar Tyagi‖ A significant study and comparison of DSDV, AODV and DSR protocols in MANET using NS-2, In Proceeding of International Journal of Engineering Research and technology, Vol. 2, Issue 3, 2013, pp. 1-8
13. Prabha R and Ramaraj N, ―An improved multipath MANET routing using link estimation and swarm intelligence. R. and N. EURASIP Journal on Wireless Communications and Networking, 2015, pp.2-9
14. Pranav Kumar Singh, Kapang Lego, Dr. Themrichon Tuithung, "Simulation based Analysis of Ahoy Routing Protocol in Urban and Highway Scenario of VANET", International Journal of Computer Applications, January 2011, Vol.12– No.10.
15. Ramadhan Mstafa, Abdalraouf Alarabe, Eman AbdelFattah Ammar Odeh and Muneer Alshowkan, "Analysis of Routing Protocols over VANET", ASEE Northeast Section Conference, 2013.
16. Reza Fotohi and Shahram Jamali and Fateme Sarkohaki and Shahram Behzad, "An Improvement over AODV Routing Protocol by Limiting Visited Hop Count‖, In Proceedings of I.J. Information Technology and Computer Science,Vol.09, 2013, pp.87-93.
17. Yatendra M Sharma, Saurabh Mukherjee,"Comparative performance exploration of AODV, DSDV & DSR routing protocol in cluster based VANET environment" International Journal of Advances in Engineering & Technology ,Sept 2012, Vol. 4, Issue 2, pp. 120-127.

Figures

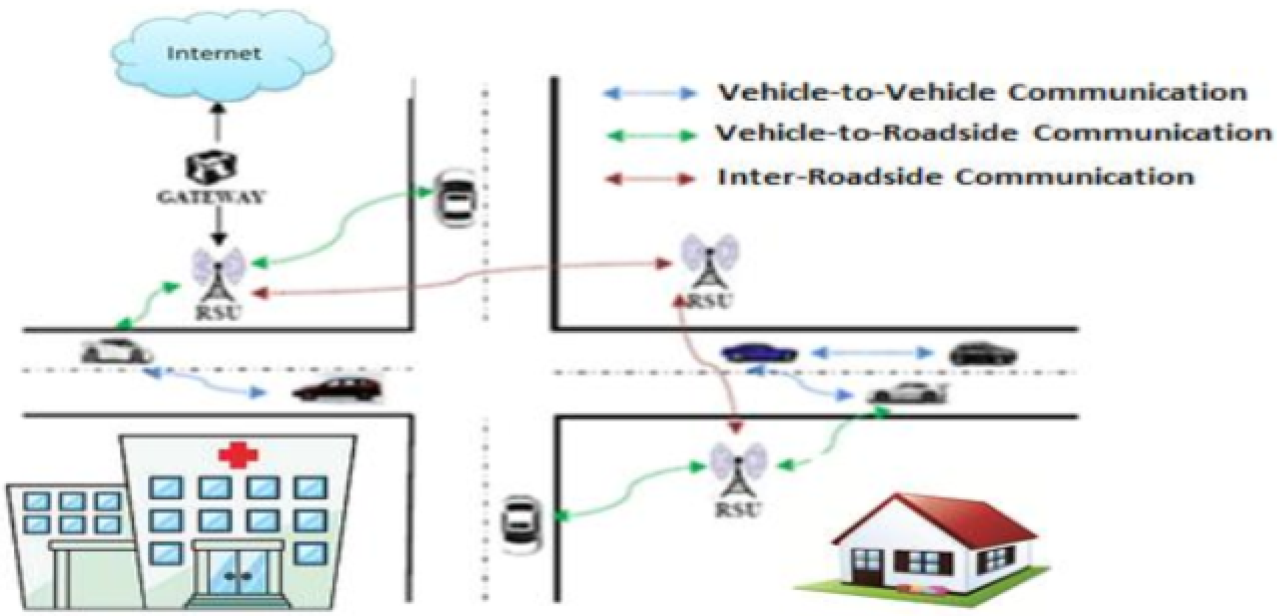

Figure 1

VANET architecture

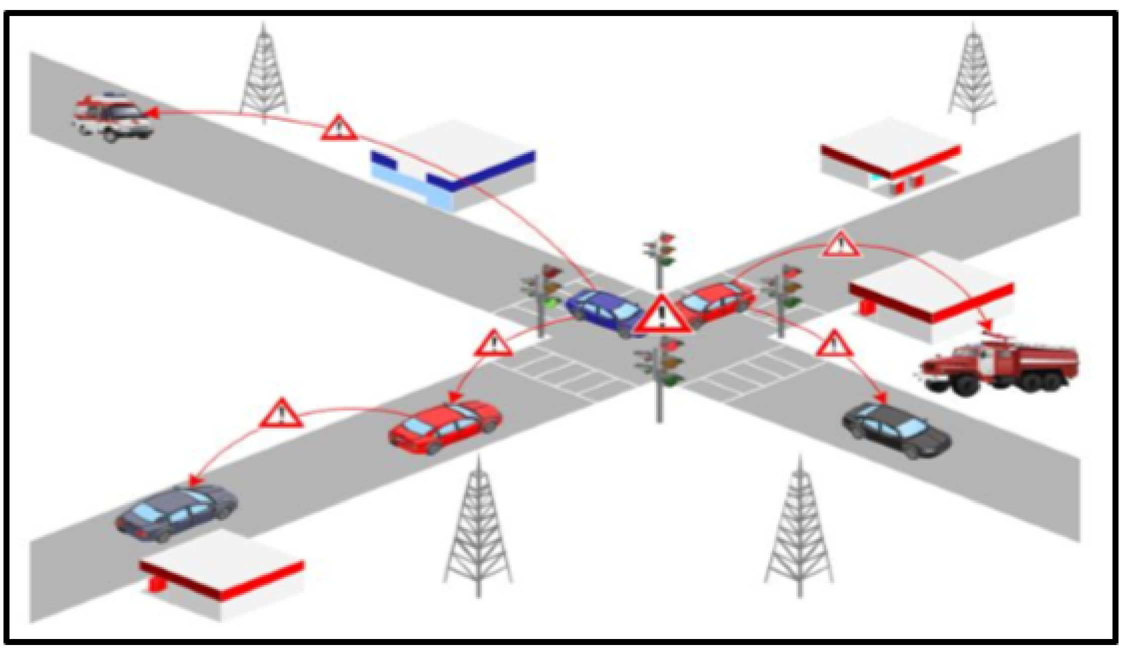

Figure 2

Scenario taken for implementation

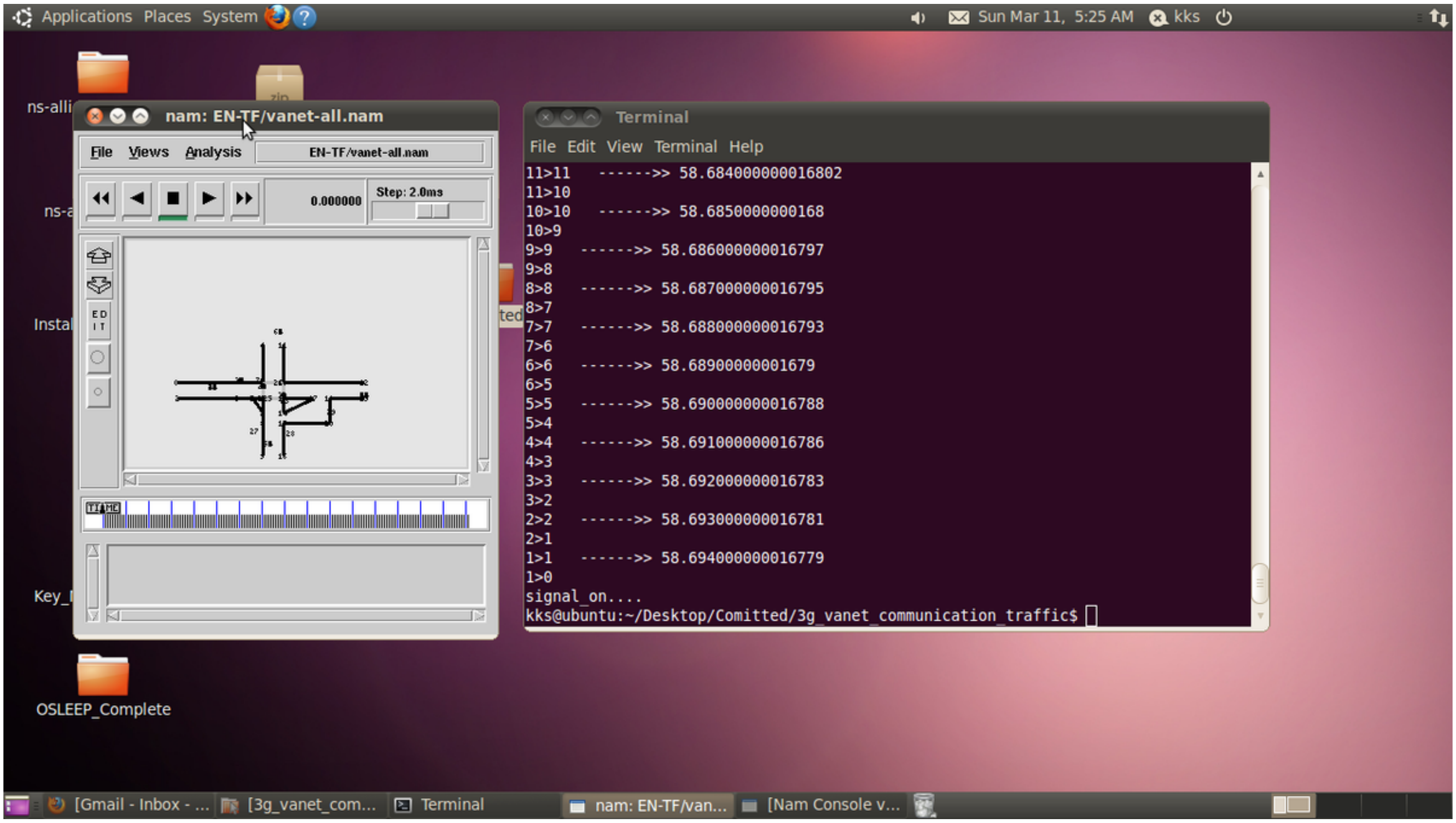

Figure 3

NAM Showing Topology Graph during the Simulation

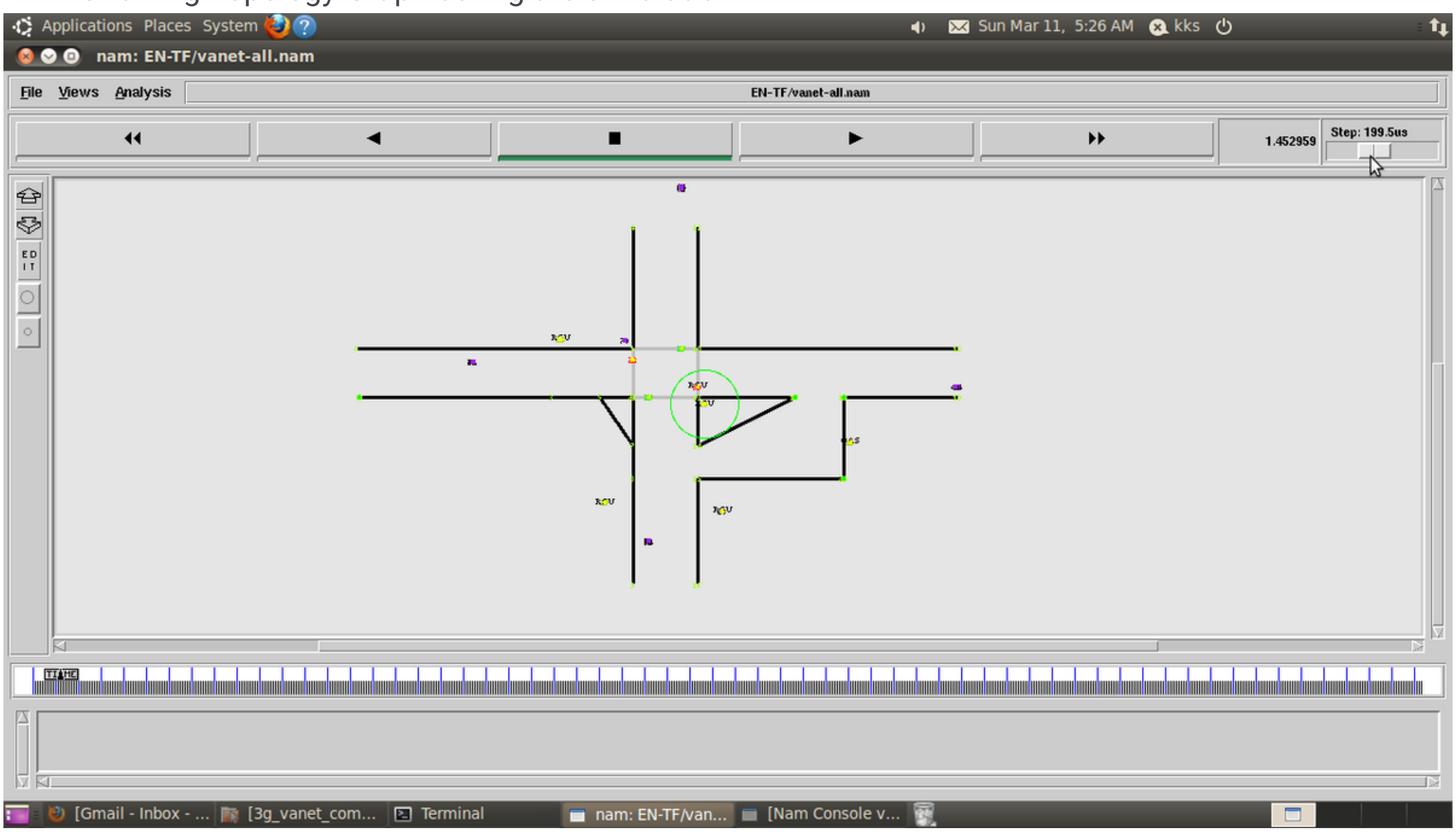

Figure 4

Creation of Road using VANET

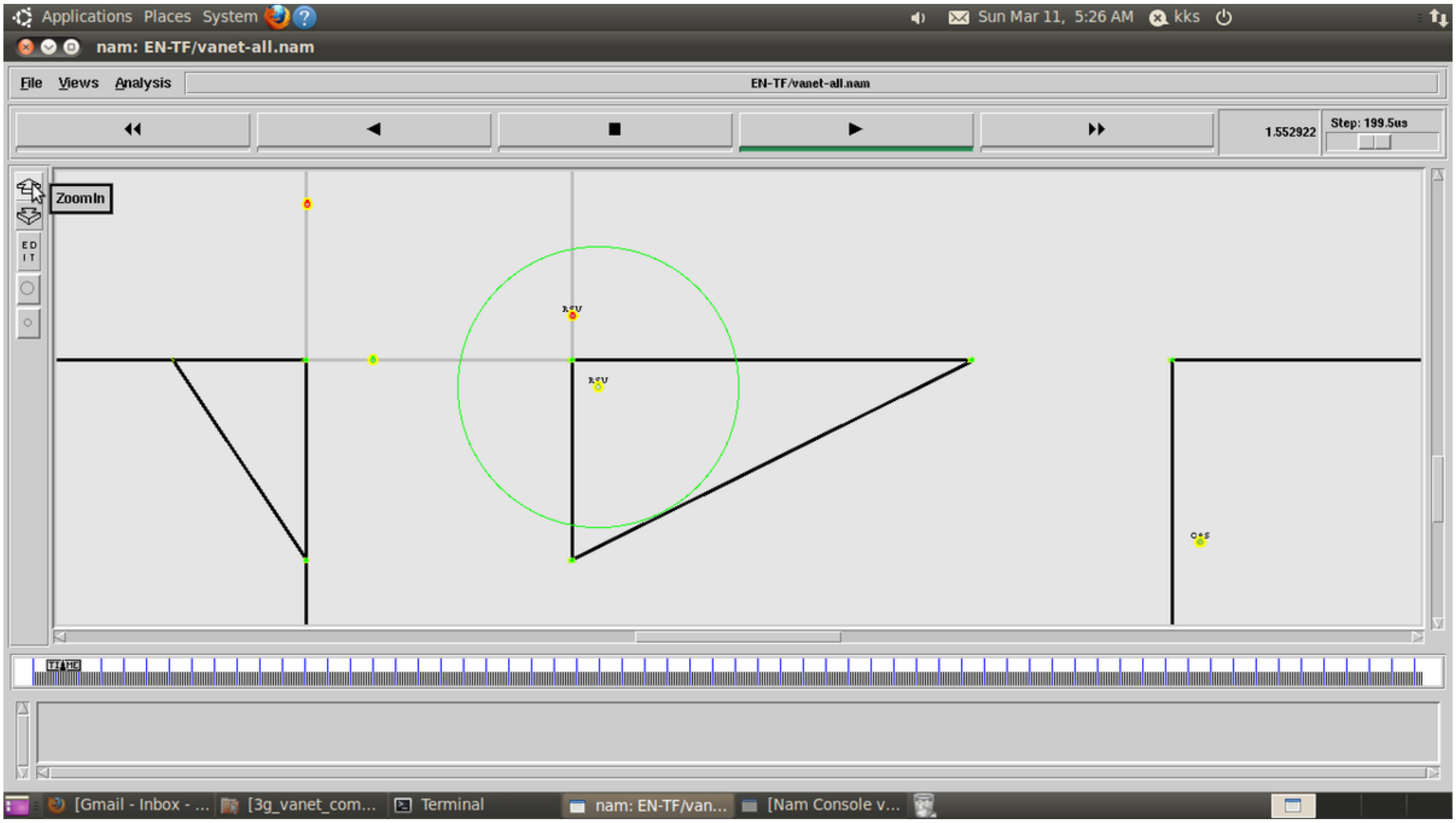

Figure 5

Creation of road side unit (RSU)

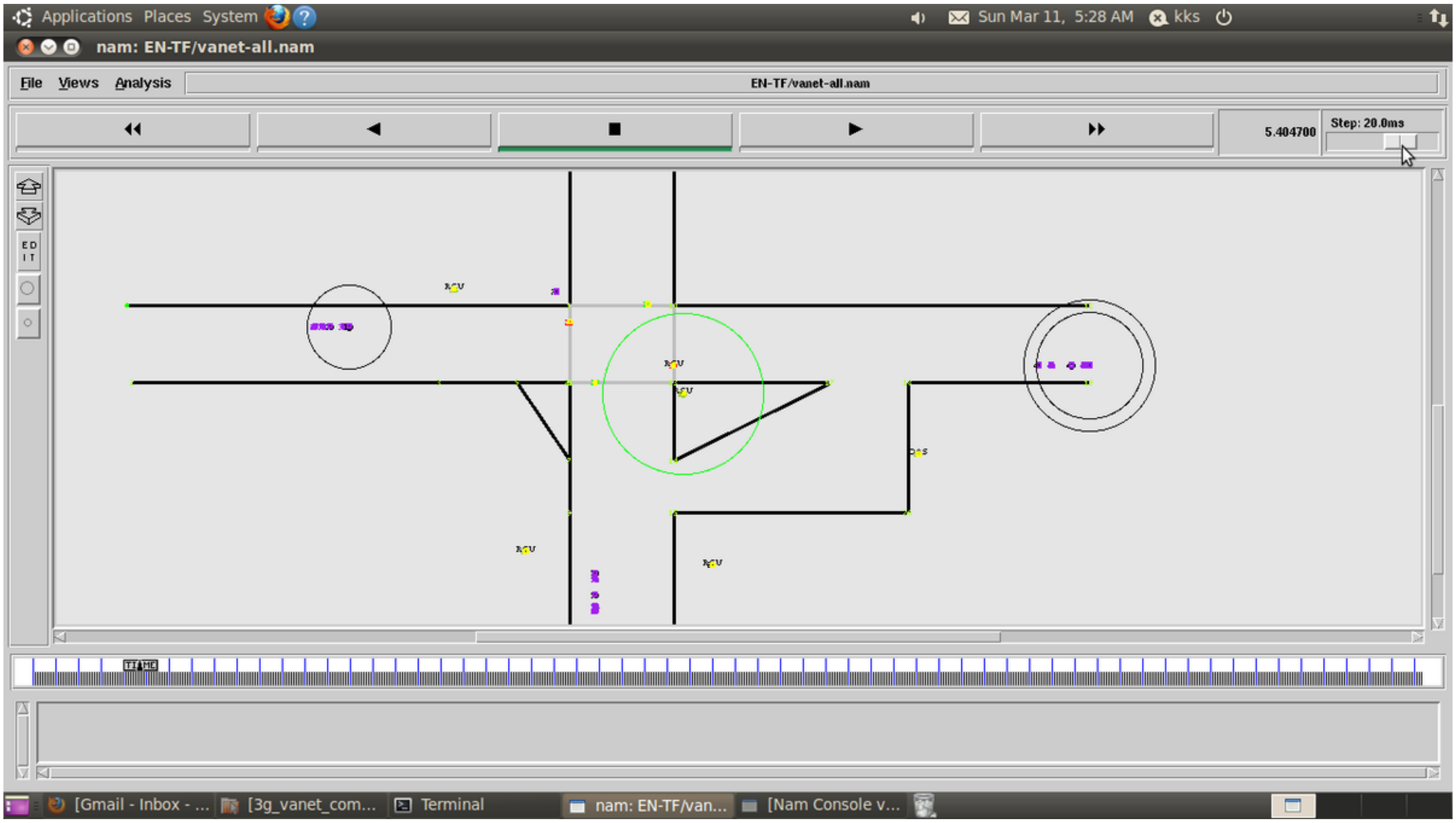

Figure 6

The arrival of vehicles

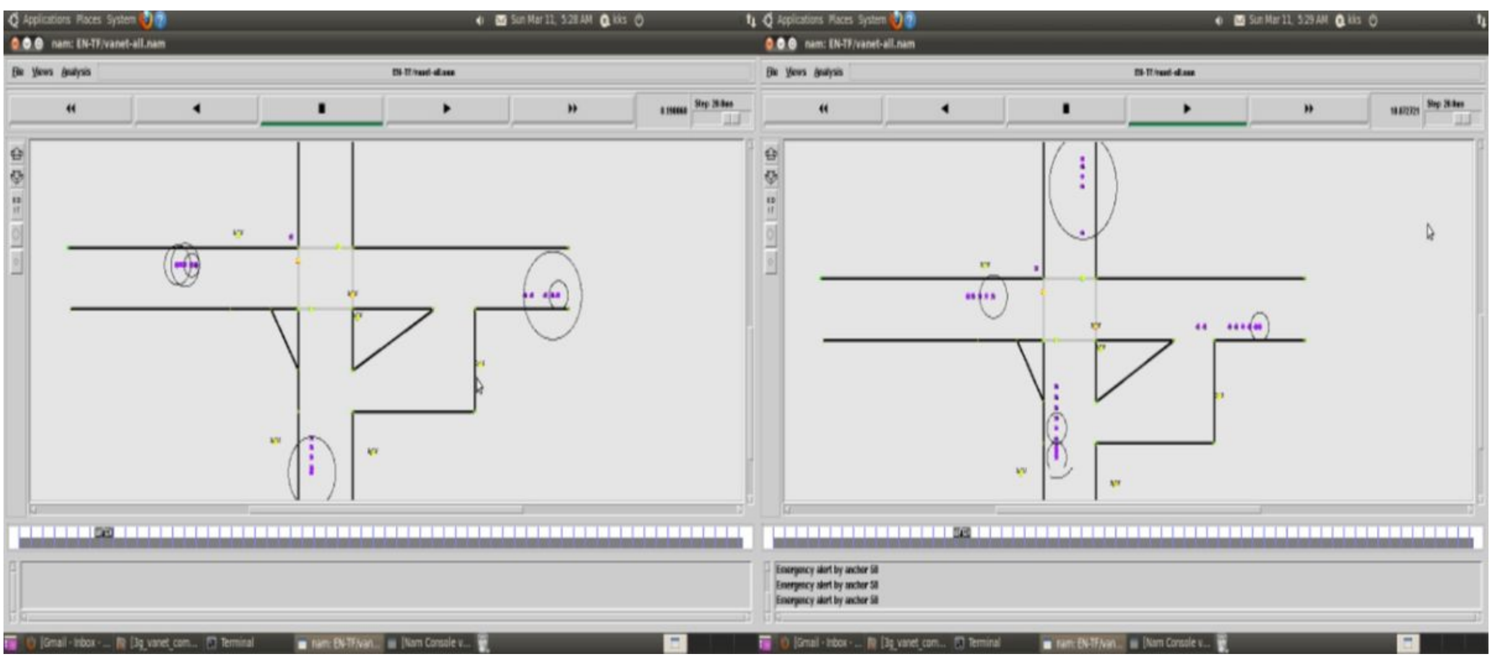

Figure 7

The beginning of communication phase

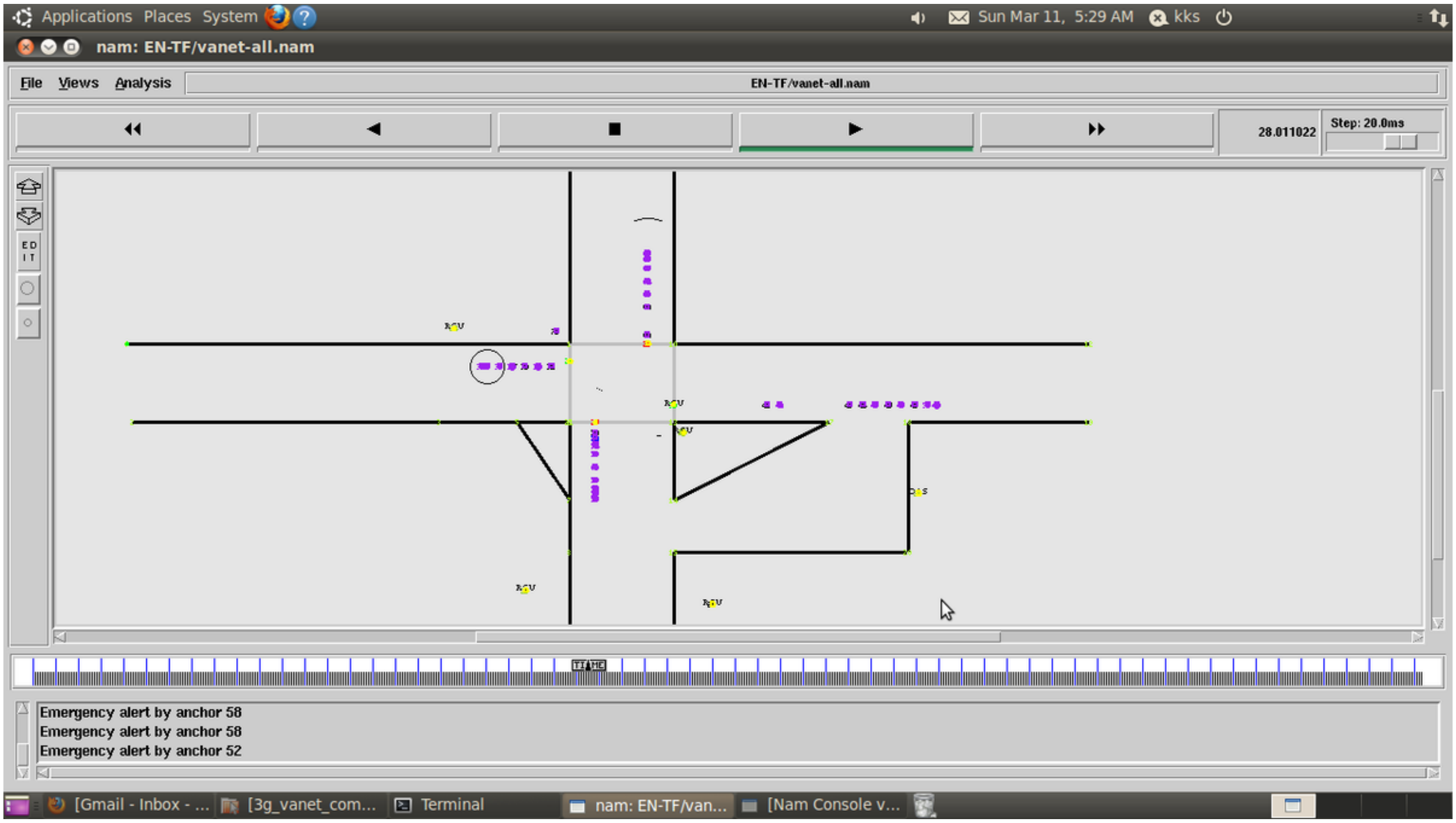

Figure 8

The movement of vehicles

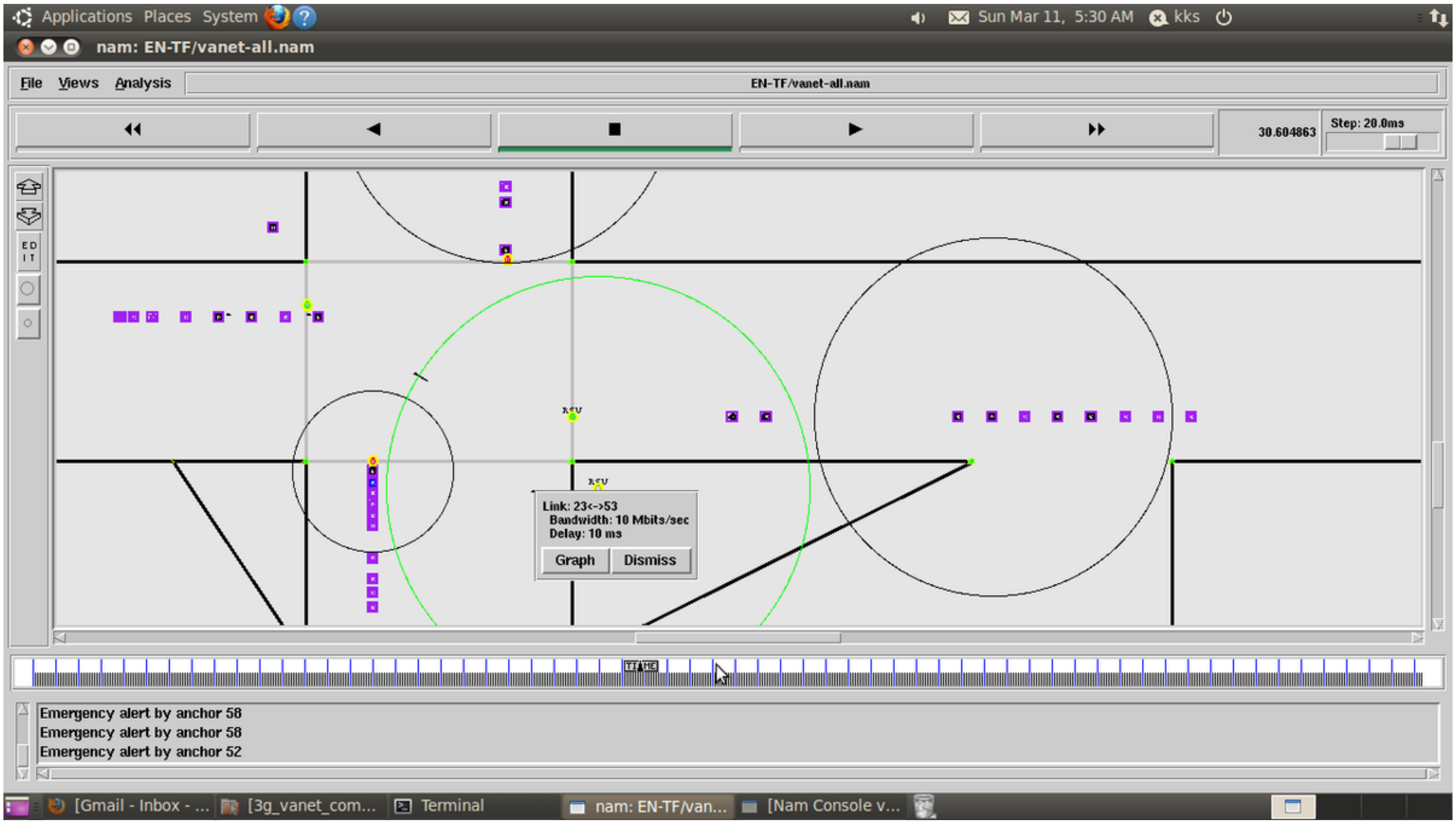

Figure 9

Data transfer between vehicles

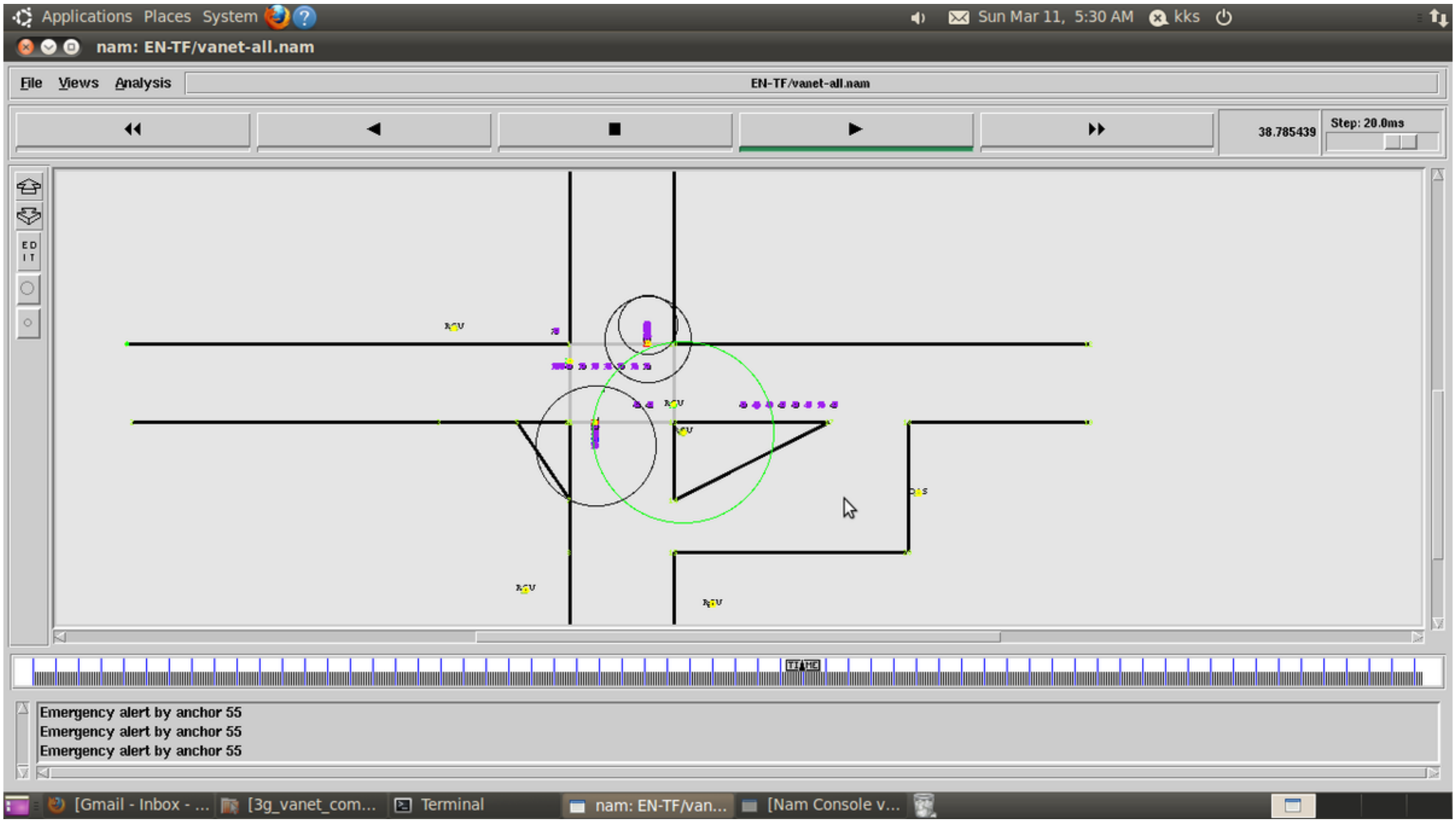

Figure 10

Crossing of vehicles

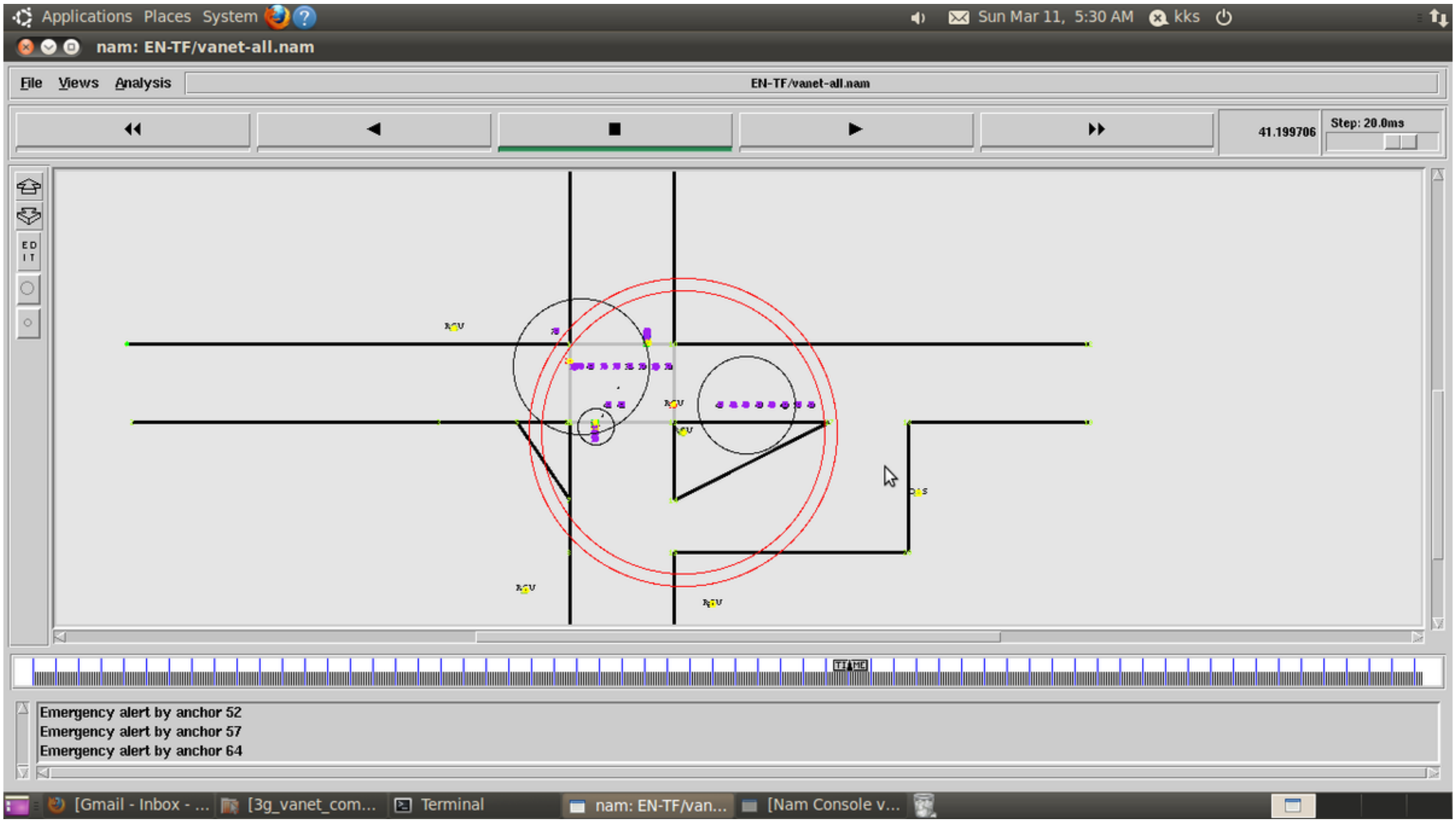

Figure 11

The situation of emergency alert

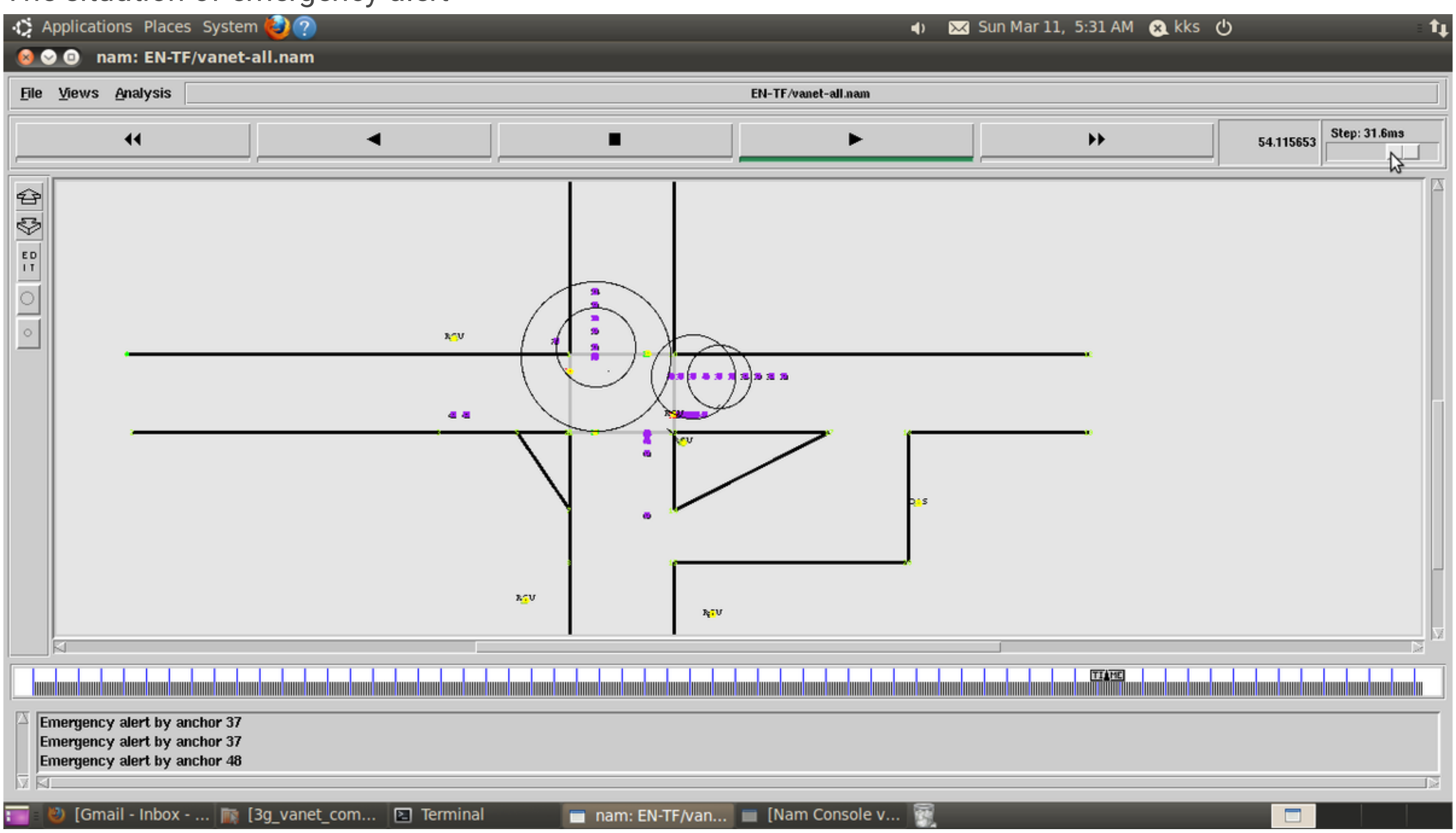

Figure 12

The mode of transferring of data form vehicles to RSU

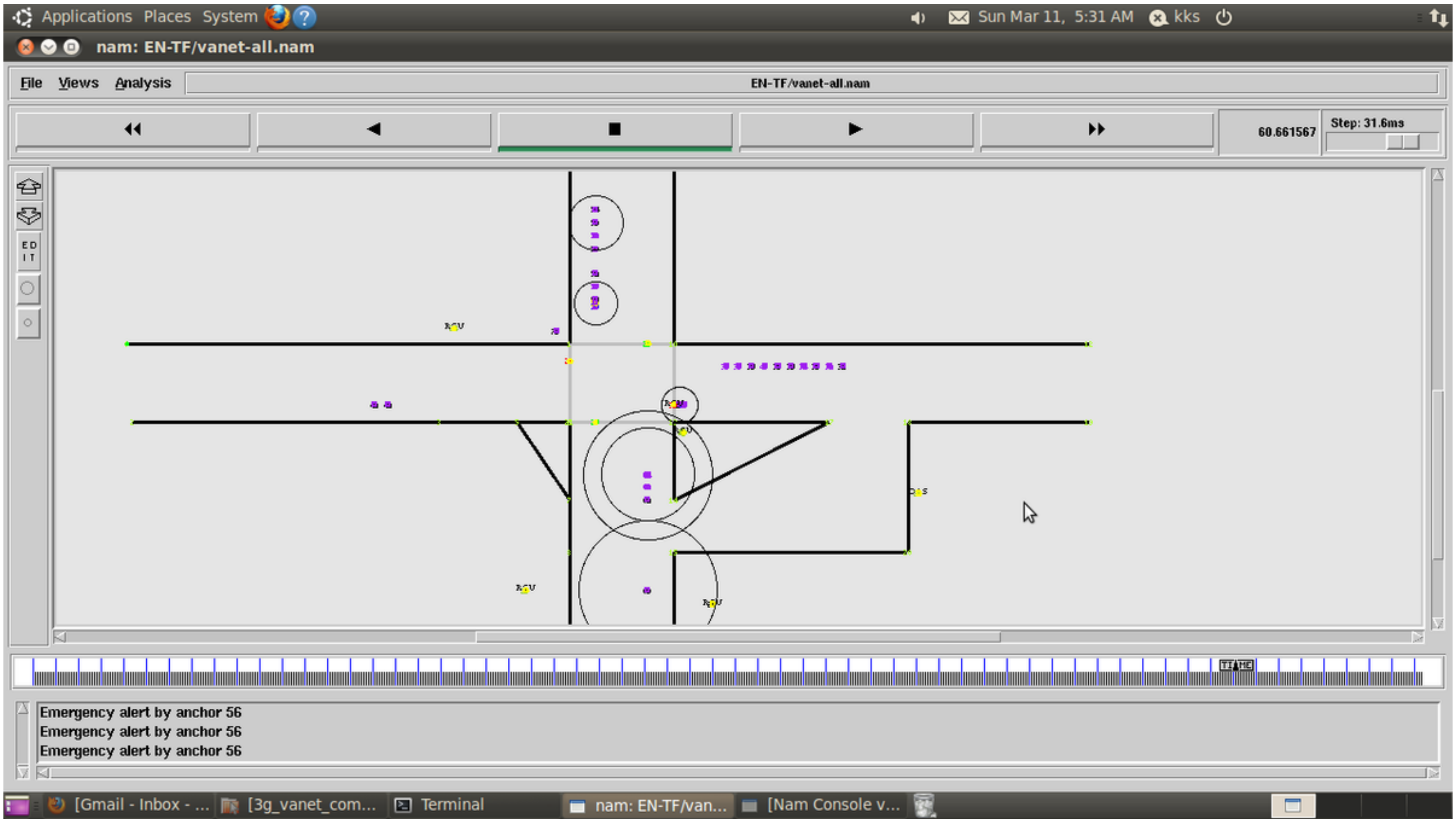

Figure 13

The situation of vehicles moving out.

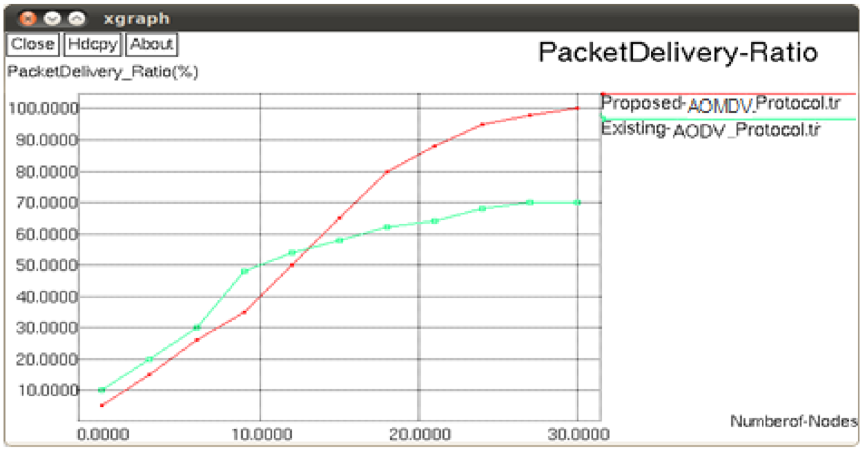

Figure 14

Packet-Delivery-Ratio comparison in AOMDV and AODV

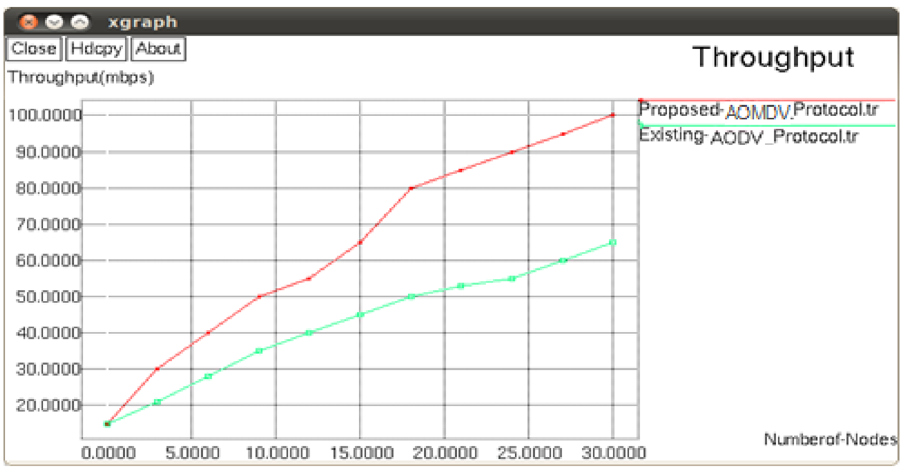

Figure 15

Comparison of Throughput in AOMDV and AODV

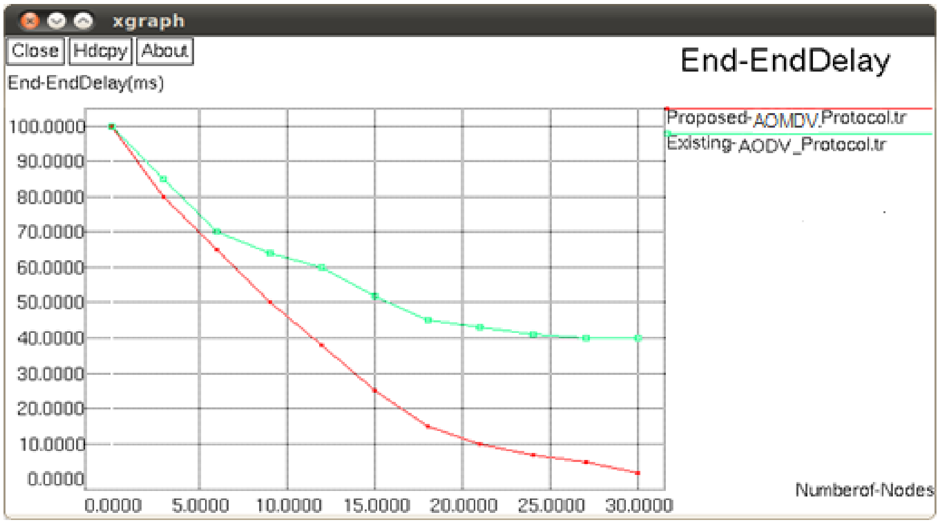

Figure 16

Comparison of End to End Delay in AOMDV and AODV