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Effect of Mobility and Traffic Pattern on MANET Routing Protocols

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Abstract -- Mobile Ad-hoc networks (MANETs) are self-organizing networks which can form a communication network without any fixed infrastructure. Recently, MANET has gained popularity in many different applications having different mobility models and traffic patterns. There are several traffic patterns such as Exponential Probability Distribution, Pareto Probability Distribution, and Constant Bit Rate (CBR). The traffic pattern and number of nodes are plays an important role in the performance of a routing protocol. This paper will assess the performance of mobility models and traffic patterns for three routing protocols which are Reactive (AODV), Proactive (OLSR) and hybrid (TORA) for different traffic generators CBR, Exponential and Pareto traffic patterns with Random Way Point mobility model using different number of nodes. The performance of these routing protocols is analyzed with respect to three parameters that are packet drop, throughput and End-to-End Delay conducted using OPNET simulator. The conducted results show good ranking of routing protocols depending on both mobility models and traffic patterns.

***Keywords*-- Traffic Pattern; CBR traffic; Exponential traffic; Pareto traffic; mobility model.**

1. Introduction

MANETs is a wireless network temporarily and dynamically created only by nodes to create a multi-hop wireless network, without using any pre-existing infrastructure [1] [2]. Each node has a responsibility of relaying packets for other nodes to reach a destination in multiple hops communication. MANET is established by nodes acting as routers and transferring packets from one to another in ad-hoc manner. Routing in these networks is highly complex due to moving nodes and hence many protocols have been developed. Routing protocols are classified either as reactive, proactive or hybrid [3].

There are many challenges in designing of MANETs. The major challenge is the development of dynamic routing protocols that can efficiently find routes between two communicating hosts. The other challenges are issues to reduction of routing load, security concerns and mobility, etc. The Optimum solutions for these challenges exist in a variety of approaches. The majority of these approaches rely on the assumptions that are operating on cooperative environment. That is, they trust each node by assuming that a node will obviously forward a packet when requested [2] [3].

In reality, it is difficult to expect and maintain a favorable environment for an ad hoc network, such as, networks are created on the fly to unexpected circumstance. In such environments there may be nodes which are malicious, selfish or even intentionally uncooperative and harmful or unreachable due to mobility.

Mobility models are designed to evaluate the performance of ad-hoc networks and characterize the movements of real mobile node in which variation in speed and direction must occur during regular time interval. The mobility model is one of the factor that effecting network performance in significant way. The mobility of the nodes effects the number of average connected paths, which, in turn, influence the performance of the routing algorithm. Therefore, the impact movement of nodes in MANET causes link disconnections effecting the performance of the routing protocols. The mobility is an important parameter to be considered while measuring or comparing the performance for various applications under MANET. Therefore, there is a need to study effecting of mobility models in the routing protocol performance. The previous studies show that different mobility models have different behavior and serve different purposes [4][5][6].

This paper focus on the effect of mobility models and traffic patterns on AODV, OLSR and TORA routing protocols considering CBR, Exponential and Pareto traffic patterns with Random Way Point mobility model in different scenarios. The performance metrics used to evaluate the efficiency of the considered protocols are packet drop, throughput and End-to-End Delay.

The paper has been organized in a flexible manner. Section (2) focuses on overview of three routing protocols. Section (3) focuses on related works. Section (4) gives information on simulation parameters, performance metrics and traffic models The experimental results shown in section (5). Conclusion & future work will be highlighted in section (6).

2. Protocols Overview

2.1 Optimized Link State Routing Protocol (OLSR)

OLSR [6][7] is a proactive routing protocol, all nodes have route table for containing routing information to every node in the network. The routes are always immediately available when needed and the topological changes cause the flooding of the topological information to all available nodes in the network. OLSR protocol uses Multipoint Relays (MPR) to reduce the possible overhead in the network. Fig. 1, illustrates the MPR utilization in packet transmission. The idea of MPR is to reduce flooding of broadcasts by reducing the same broadcast in some regions in the network and to provide the shortest path. The OLSR uses the following control messages: Hello and Topology Control (TC). Hello messages are used for finding the information about the link status and the neighbor nodes. TC messages are used for broadcasting information about own advertised neighbors which includes at least the MPR Selector list.

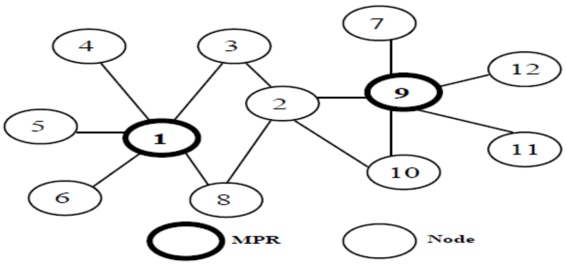

Fig. 1: Packet transmission using MPR[7]

Moreover, OLSR may optimize the reactivity to topological changes by reducing the maximum time interval for periodic control message transmission. It has also Multiple Interface Design (MID) to allow the nodes for having multiple OLSR interface addresses and provide the external routing information giving the possibility for routing to the external addresses. Based on this information, the node can act as gateways to another possible network. Furthermore, as OLSR continuously maintains routes to all destinations in the network, the protocol is beneficial for traffic patterns where a large subset of nodes is communicating with another large subset of nodes in which the source, destination pairs are changing over time [6].

2.2 Ad hoc On Demand Distance Vector Routing Protocol (AODV)

AODV [1][8][9] is an enhancement of Destination Sequenced Distance Vector (DSDV) routing protocol algorithm which contains the characteristics of DSDV and DSR. Each node maintains a route table contains routing information but does not necessarily maintain routes to every node in the network. When a source node desires to transmit the packet to its destination, the entries in the route table are verified to ensure whether there is a current route to that destination node or not. If it is there, the packet is forwarded to the appropriate next hop toward the destination. If it is not there, the route discovery process is initiated to locate the destination. The source node broadcasts a control message RREQ with its IP address, Route Request ID (RREQ ID), and the sequence number of the source and destination. While, the RREQ ID and the IP address is used to uniquely identify each request, the sequence numbers are used to determine the timeliness of each packet. To minimize network wide broadcasts of RREQ, the source node uses an expanding ring search technique [8].

Fig. 2, illustrates the route discovery process by broadcasting RREQ. The RREQ receiving node set the backward pointer to the source node and generates a RREP unicast packet with a lifetime, sent back to the source if it is the destination or contains a route to the destination i.e. intermediate node. An intermediate node set up a reverse route entry with lifetime for the source node in its route table to process the RREQ and forwards a RREP to the source. When the RREP reaches the source node, it means a route from source to the destination has been established and the source node can begin the data transmission. If the RREQ is lost during transmission, the source node is allowed to broadcast again using route discovery mechanism [8].

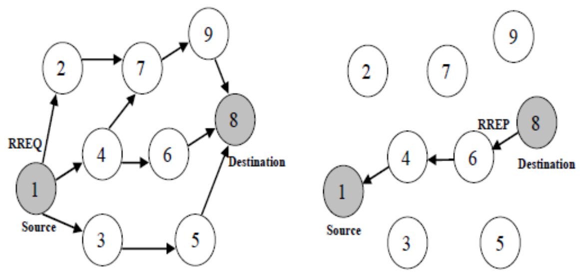

Fig. 2: AODV route discovery process [8]

The AODV has great advantage in having less overhead over proactive protocols and it also supports both unicast and multicast packet transmissions even for nodes in constant movement. AODV responds quickly to the topological changes in the network and updating only the nodes that may be effected by the change, using the RRER message. The Hello messages, which are responsible for the route maintenance, are also limited so that they do not create unnecessary overhead in the network.

2.3 Temporally-Ordered Routing Algorithm Protocol (TORA)

TORA [1] is a hybrid, distributed, highly adaptive routing protocol which is also known as link reversal protocol. TORA uses an arbitrary height metric to establish a direct acyclic graph and the length of the route that physically rooted at the destination. Consequently, multiple routes often exist for a given destination but none of them are necessarily the shortest route. Instead of using the shortest path for computing the routes, the TORA algorithm maintains the direction of the next destination to forward the packets. Thus a source node maintains one or more downstream. TORA reduces the control messages in the network by having the nodes to query for a path only when it needs to send a packet to a destination. In TORA three steps are involved in establishing a network.

- Creating the routes from source to destination
- Maintaining the routes and
- Erasing invalid routes.

The advantage of TORA is that the multiple routes are supported by this protocol between the source and destination node. Therefore, failure or removal of any of the nodes is quickly resolved without source intervention by switching to an alternate route to improve congestion. It does not require a periodic update, consequently communication overhead and bandwidth utilization is minimized. It provides the support of link status sensing and neighbor delivery, reliable in-order control packet delivery and security authentication.

3. Related Work

Vikas s. and Parveen K. [10] presented a study conducted to evaluate the performance of AODV, TORA and DSDV routing protocols based on both CBR and TCP traffic. These routing protocols were compared in terms of Packet delivery ratio (PDR), average end-to-end delay and throughput when subjected to change in number of nodes. Simulation results showed that the AODV is better in terms of PDR and average end-to-end delay. In case of CBR traffic, throughput remains almost constant for all three protocols irrespective of number of nodes. In case of TCP traffic, throughput changes rapidly with respect to change in the number of nodes, whereas PDR of AODV protocols remains almost constant and changes rapidly for TORA and DSDV protocols irrespective of the network load.

M. Inyat and N. Nawaz [11] analyzed the characteristics of Dynamic MANET on demand routing (DYMO) protocol by varying traffic patterns (CBR and TCP), number of nodes and topological areas. DYMO showed ups and downs in PDR using either traffic patterns, especially using CBR traffic. In case of PDR, DYMO is better suited to TCP traffic than CBR. The change of speed has more impact on DYMO, due to the fact that rapid change in topology causes change in node links and routing tables.

Patil V.P. [12] studied the performance of two MANET protocols AODV and DSDV based on TCP and CBR traffic. These routing protocols were compared in terms of PDR, average end-to-end delay, and throughput when subjected to change in number of nodes and traffic pattern. Simulation results showed that AODV were better in terms of PDR and average end-to-end delay.

A. Pal. et al. [13] tried to analyze the behavior of the mobile nodes for different speed for three different traffic patterns namely CBR, Exponential and Pareto. They found that AODV routing performs much better than DSR in Exponential and Pareto traffic. PDR for AODV routing remains same across all traffic patterns. The Normalized Routing Load (NRL) increases in DSR. The throughput decreases for increasing the node speed of all the traffic models in AODV and DSR routing.

Y. Saadi, et al. [14] found that the performance parameters of the routing protocols may vary depending on network load, mobility and network size. Under Manhattan Grid Mobility Model, the AODV and DSR experience the highest PDR and throughput with the increase of nodes pause time using CBR traffic sources and mobile nodes number. Whereas, DSDV experiences the lowest average end-to-end delay.

D. Verma, et al[15] evaluated the performance of the AODV routing protocol. They considered PDR and average end-to-end delay as criteria for evaluating the performance of this protocol in the case of CBR and TCP traffic patterns with connections for different pause time. The results showed that using CBR traffic is not a good indicator for the AODV protocol comparing to TCP traffic. That means, the TCP is better than CBR traffic.

4. Simulation Parameters, Performance Metrics and Traffic Models

4.1 Simulation Tool

Simulation is being carried out using OPNET 14.5 which is designed for modeling communication devices, technologies, protocols and to simulate the performance of these studies protocols [16].

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4.2 Simulation Parameters

Table (1) shows the parameters used in this simulation

Table 1 : SIMULATION PARAMETERS

Parameter	Value
Channel type	Wireless
Routing protocol	AODV,OLSR & TORA
Queue Length	50 packets
Number of nodes in topography	20, 80,120
X and Y Dimensions of topography	1000*1000 sq.m
Time of Simulation end	200 seconds
Traffic Type	CBR / PARETO / EXPONENTIAL
Omni directional	Antenna Type
Packet Size	512 bytes

4.3 Simulation Environment

The simulations are performed using OPNET 14.5 with nodes spread randomly over a square area of 1000m x 1000m. The mobility model used is "Random Waypoint Model" in which a node randomly chooses a destination and moves towards it in a straight line with a constant velocity.

4.4 Simulation Scenarios

The simulations are divided into three different scenarios which are initiated with 20 nodes and then increased to 80 and 120 nodes. Fig 3, 4 & 5 illustrate the three type of scenarios. The simulation was run for 200 simulation seconds with Queue Length 50 packet per second as shown in Table 1.

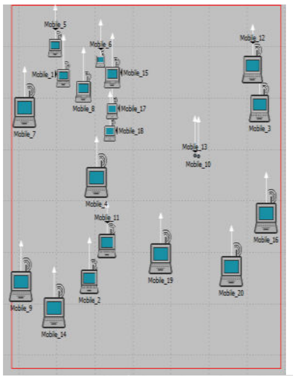

Fig. 3: Scenario with 20 nodes

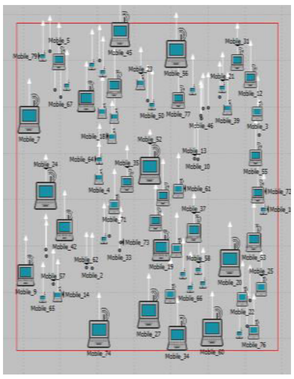

Fig. 4: Scenario with 80 nodes

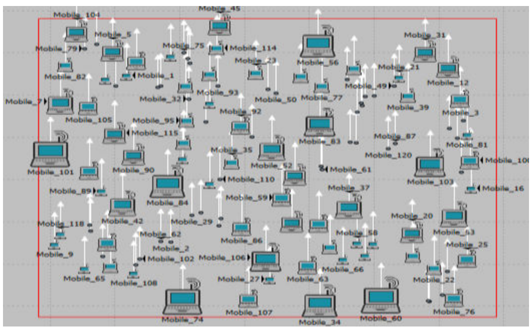

Fig. 5: Scenario with 120 nodes

4.5 Performance Metrics

Various parameters used for performance evaluation are:

- *Throughput:* It is the amount of data per time unit that is delivered from one node to another via a communication link. The throughput is measured in packets per unit TIL or bits per TIL. TIL is Time Interval Length. Moreover, high sending and receiving packets shows higher protocol performance.
- *Packet Drop:* It shows total number of data packets *that* could not reach destination successfully. The reason for packet drop may arise due to congestion, faulty hardware and queue overflow etc.. Lower packet drop rate shows higher protocol performance.
- *Average End to End delay* (End2End *delay):* This metric gives the overall delay for the packet from the source till reach the destination. Lower delay shows higher protocol performance. The following equation (1) is used to calculate the average end-to-end delay:

Average End to End Delay=(T_DataR – T_DataS) (1)

Where
T_DataR= Time data packets received at destination node
T_DataS = Time data packets sent from source node.

4.6 Traffic Generators

Three type of traffic generators have been used [17]

4.6.1. Exponential Probability Distribution Traffic

$$f(x,\gamma) = \begin{cases} Xe^{-\gamma x}, & x \geq 0 \\ 0, & x < 0 \end{cases} \quad (2)$$

Where γ is the average exponential occurrence rate. An on-off traffic can be generated by varying parameter γ.

4.6.2. Pareto Probability Distribution Traffic

A random variable X is said to follow Pareto distribution, when it follows the following probability distribution function.

$$f(x) = P(X > x) = \begin{cases} \left(\frac{x_m}{x}\right)^{\alpha}, & x \geq x_m \\ 1, & x < x_m \end{cases} \quad (3)$$

Where x_m is a scale parameter. is a shape parameter. Using x_m and α an on-off traffic can be generated by varying them.

4.6.3. Constant Bit Rate Traffic

Constant Bit Rate (CBR) traffic generator emits packets at fixed bit rate, the traffic parameters which are to be configured.

5. Experiment Results

Experimental results have been conducted for three different scenarios and three different routing protocols

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with different traffic generator pattern. Next subsections show the obtained results that are presented through figures for the evaluation and comparison.

5.1 First Scenario (20 nodes)

5.1.1 Throughput

Fig. 6 shows that the throughput in Exponential Traffic is increased during the simulation experiments for the AODV and OLSR protocols, whereas it remains constant in TORA after 10 sec. Therefore, it is noticed that throughput for the AODV and OLSR is better than the TORA.

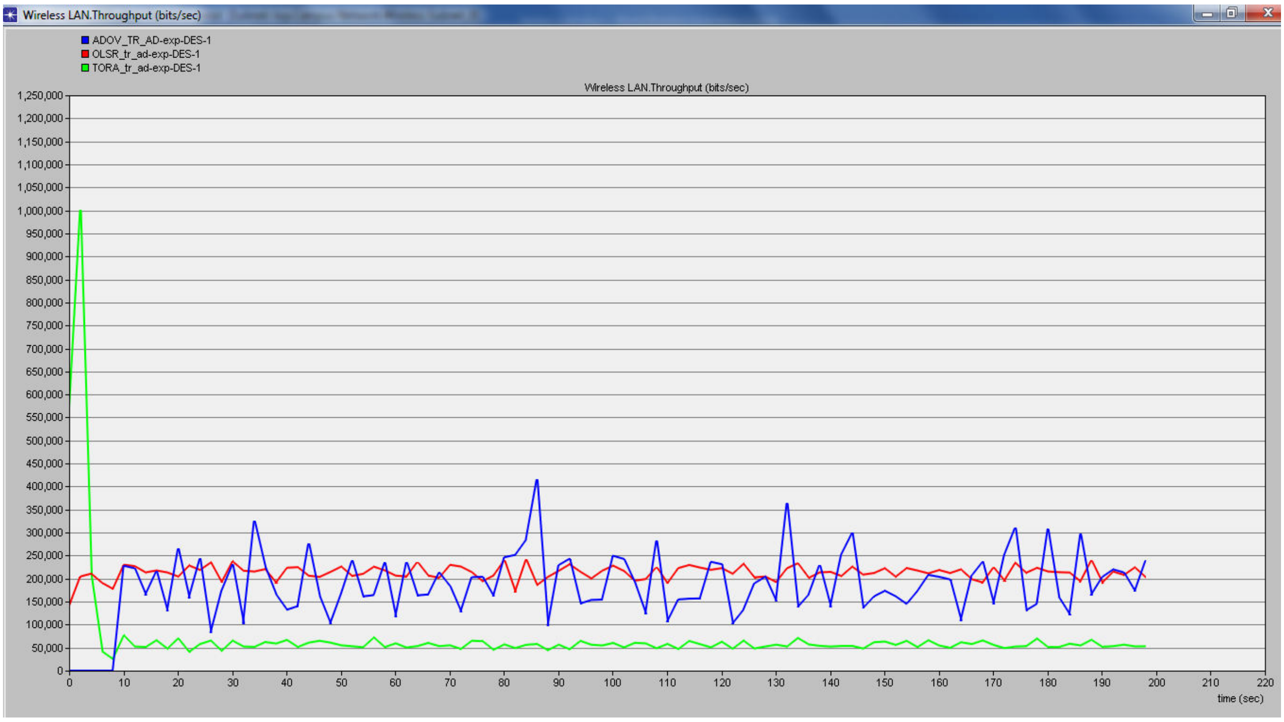

Fig. 6 : WLAN throughput on Exponential Traffic.

Fig. 7, shows the throughput in Pareto Traffic is increased at the beginning of simulation for three routing protocols AODV, OLSR and TORA. But after 10 seconds the throughput is remained stable in two protocols TORA and OLSR. Then, it is observed that the throughput for the AODV is better than the TORA & OLSR

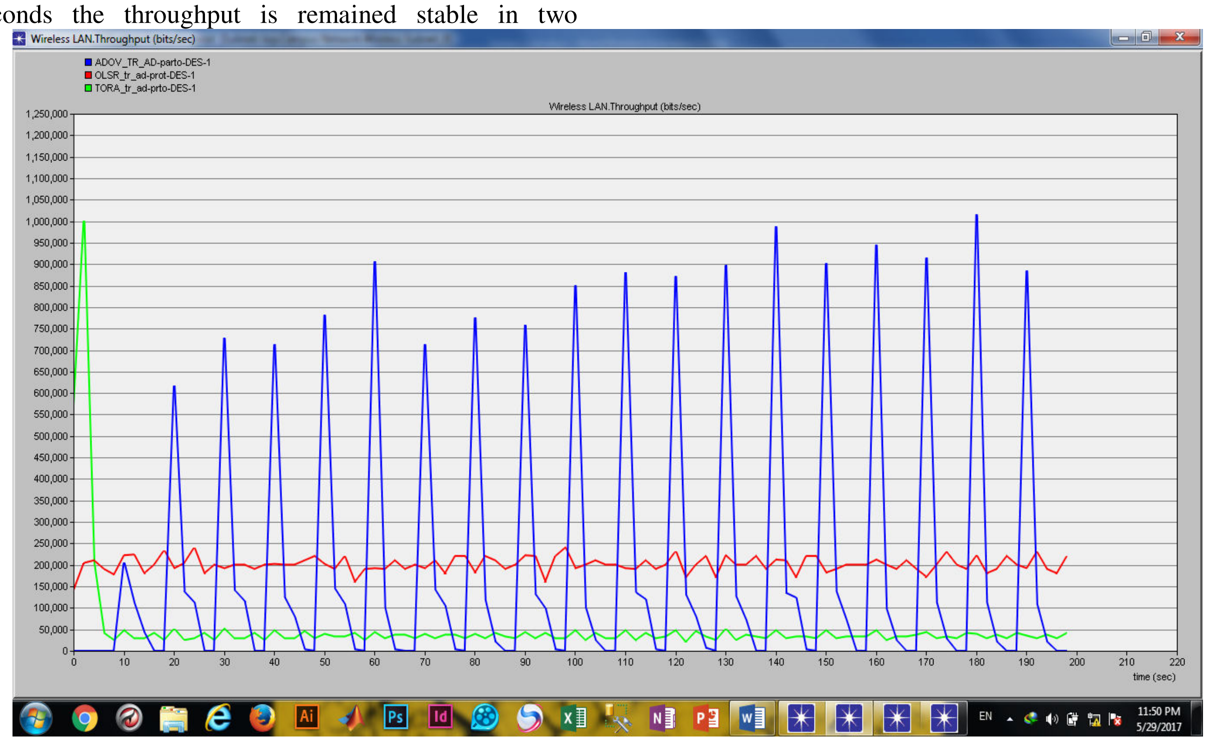

Fig. 7 : WLAN throughput on Pareto traffic.

Fig. 8 shows the throughput in CBR is increased at the beginning of simulation of AODV, OLSR and TORA protocols. But after 5 seconds the throughput in the two protocols (TORA, OLSR) are settled. Then, we can say that the throughput for the AODV is better than the TORA & OLSR.

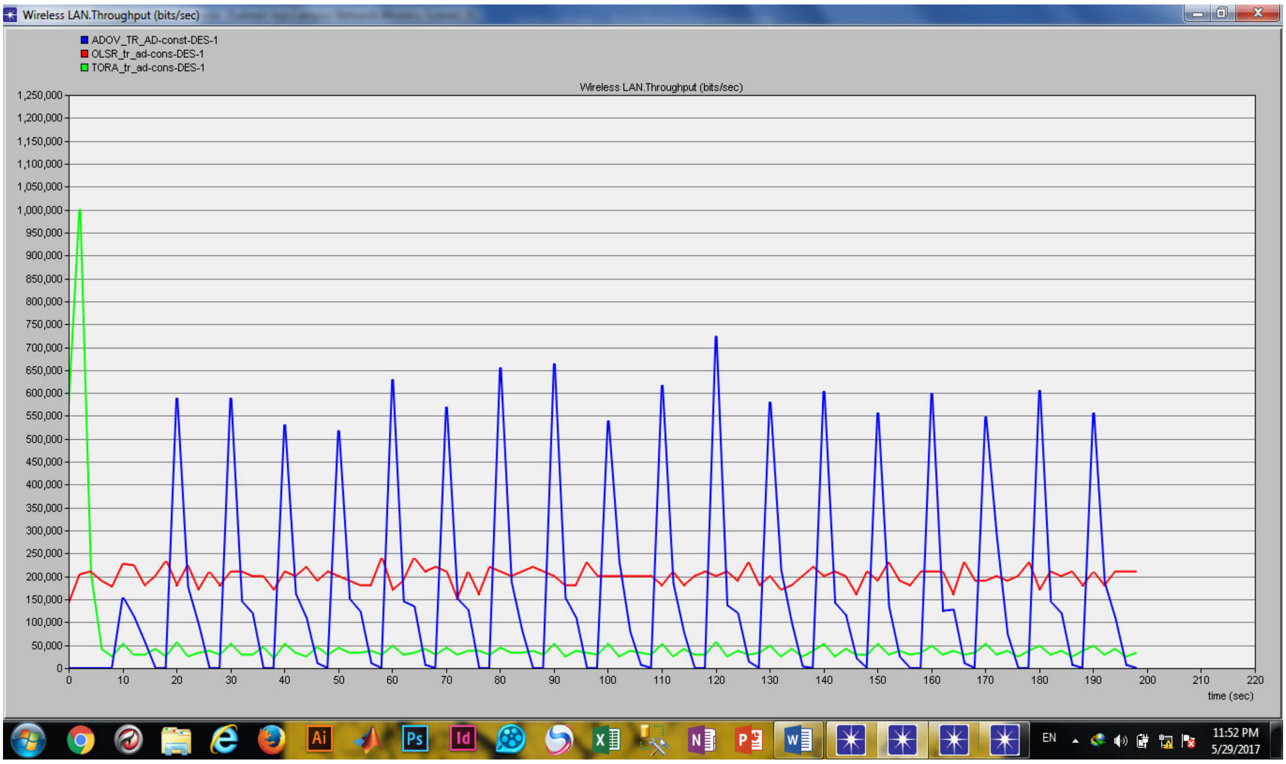

Fig. 8: WLAN throughput on Constant traffic.

5.1.2 Packet Drop

From figures 9, 10, and 11, it is observed that there is no any packet dropped during the simulation for all the three routing protocols using the three traffic patterns CBR, Pareto and Exponential in this scenario.

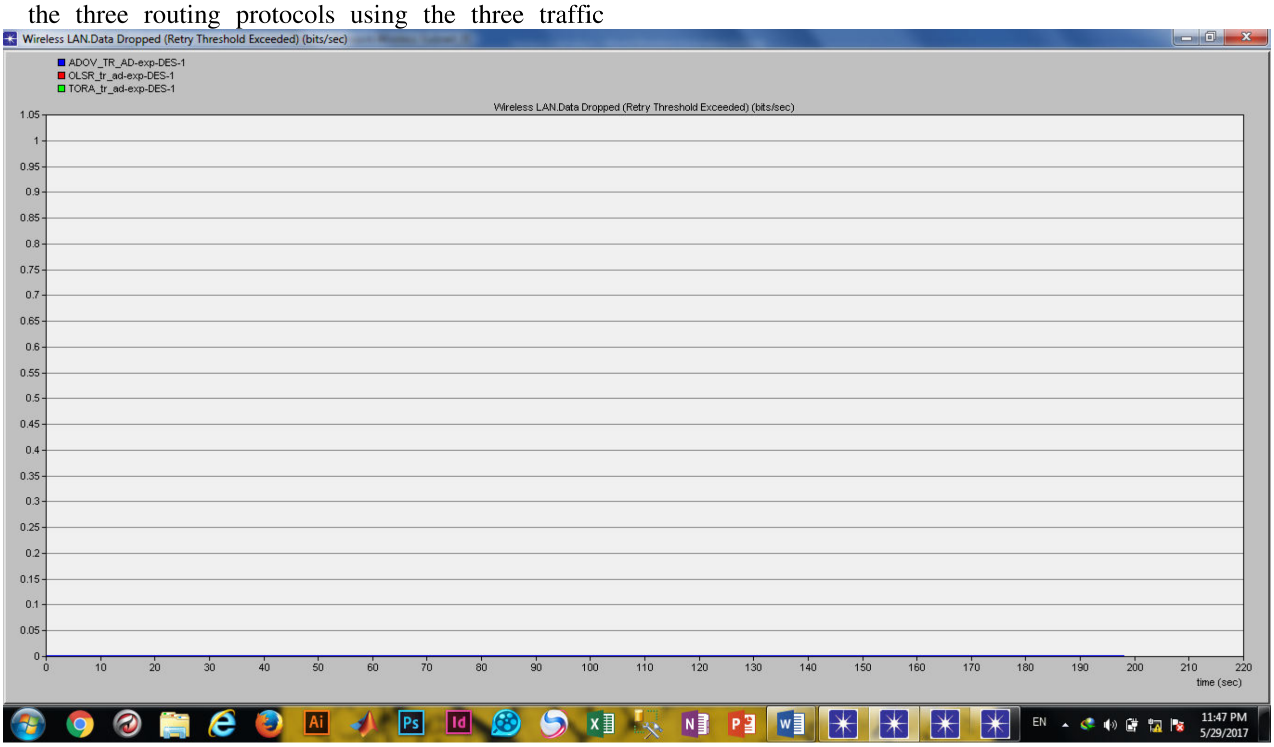

Fig. 9: WLAN Packet Drop on Exponential traffic.

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5.1.3 Average End2End delay.

Fig. 12, 13 & 14, show that the Average End2End delay for all the three different traffic patterns is increased at the beginning of simulation experiments. But it was constant after 10 seconds in AOAV, whereas it was shown constant after 5 seconds in TORA and OLSR protocols. Then, it can be observed that the Average End2End delay for the TORA and OLSR is better than the AODV.

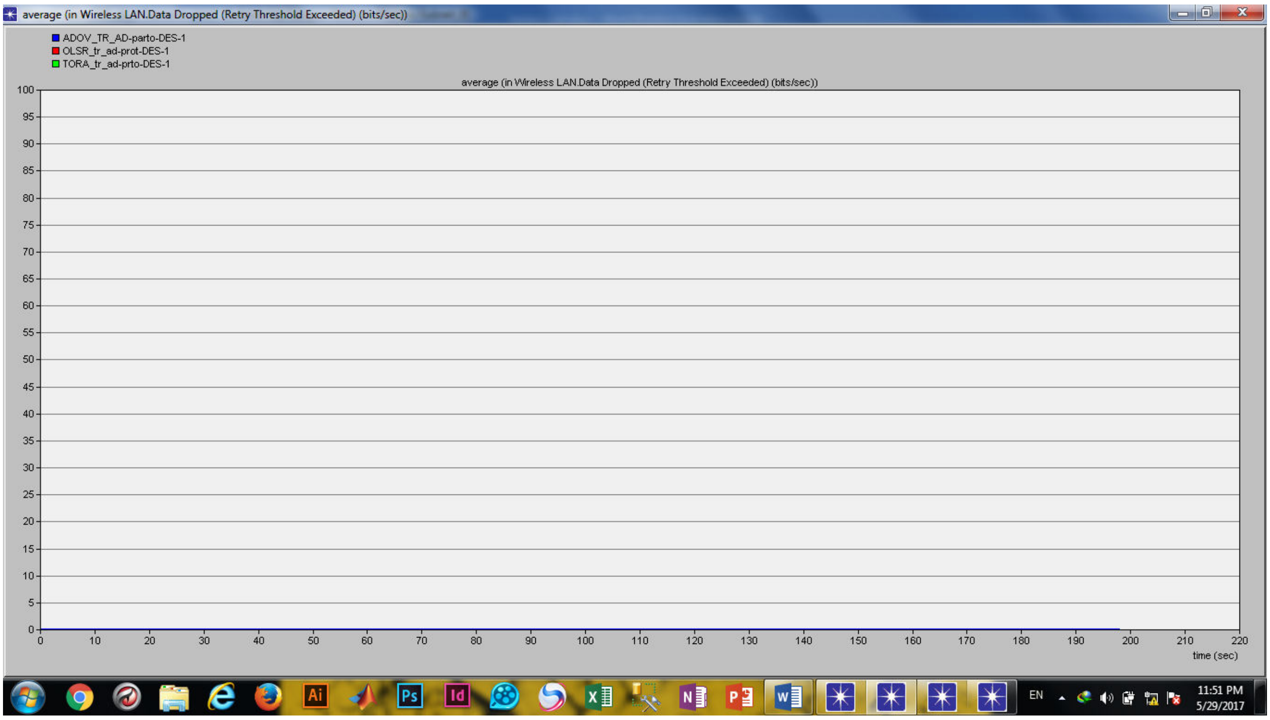

Fig. 10: WLAN Packet Drop on Pareto traffic.

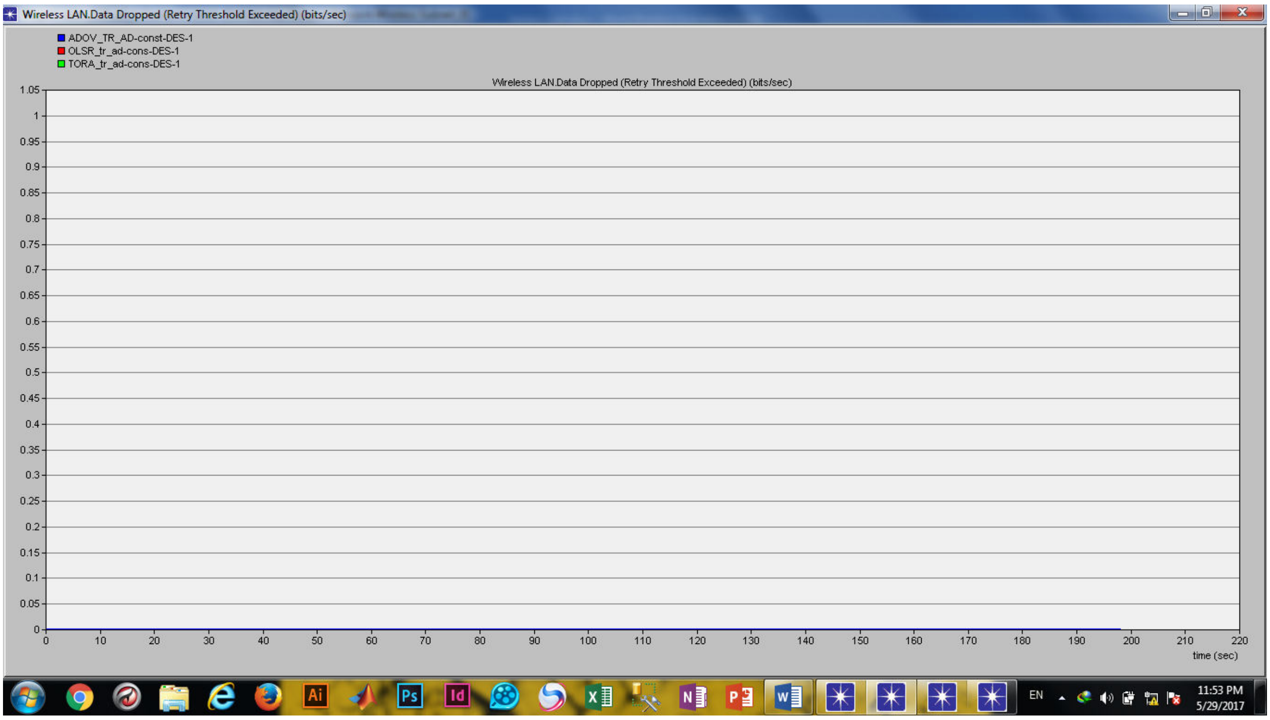

Fig. 11: WLAN Packet Drop on Constant traffic

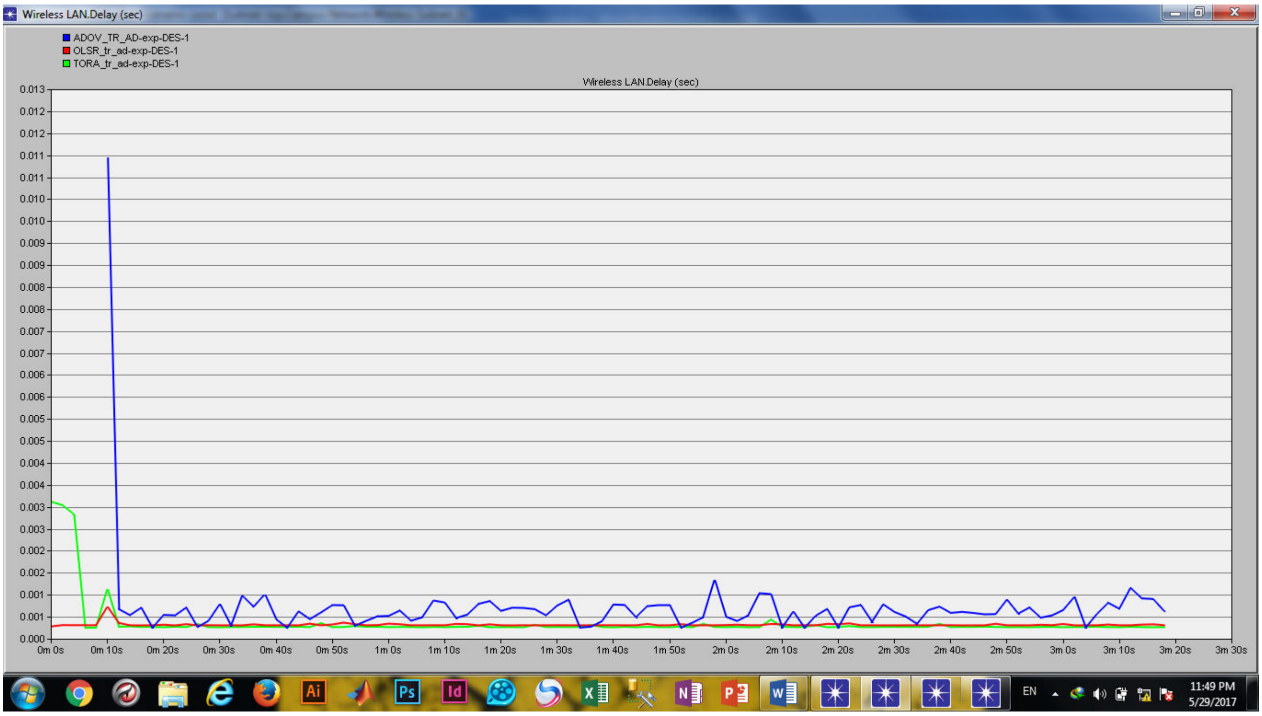

Fig.12: WLAN Delay on Exponential traffic

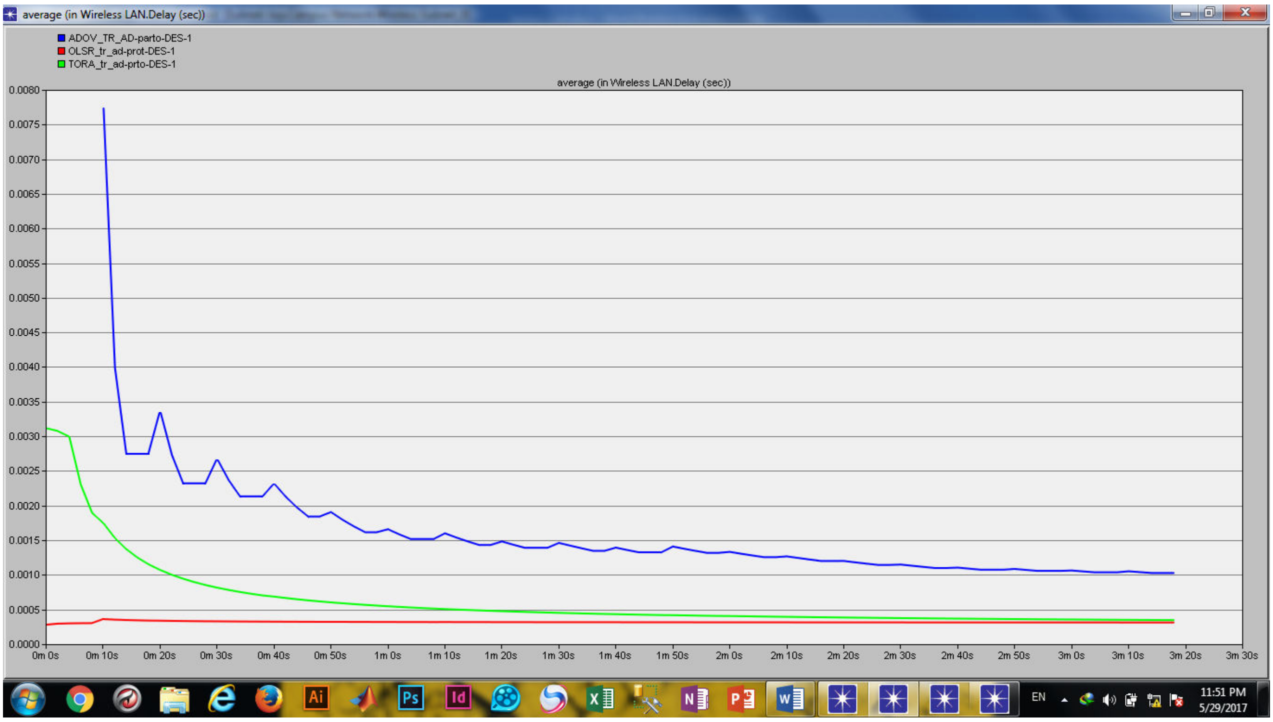

Fig. 13: WLAN Delay on Pareto traffic

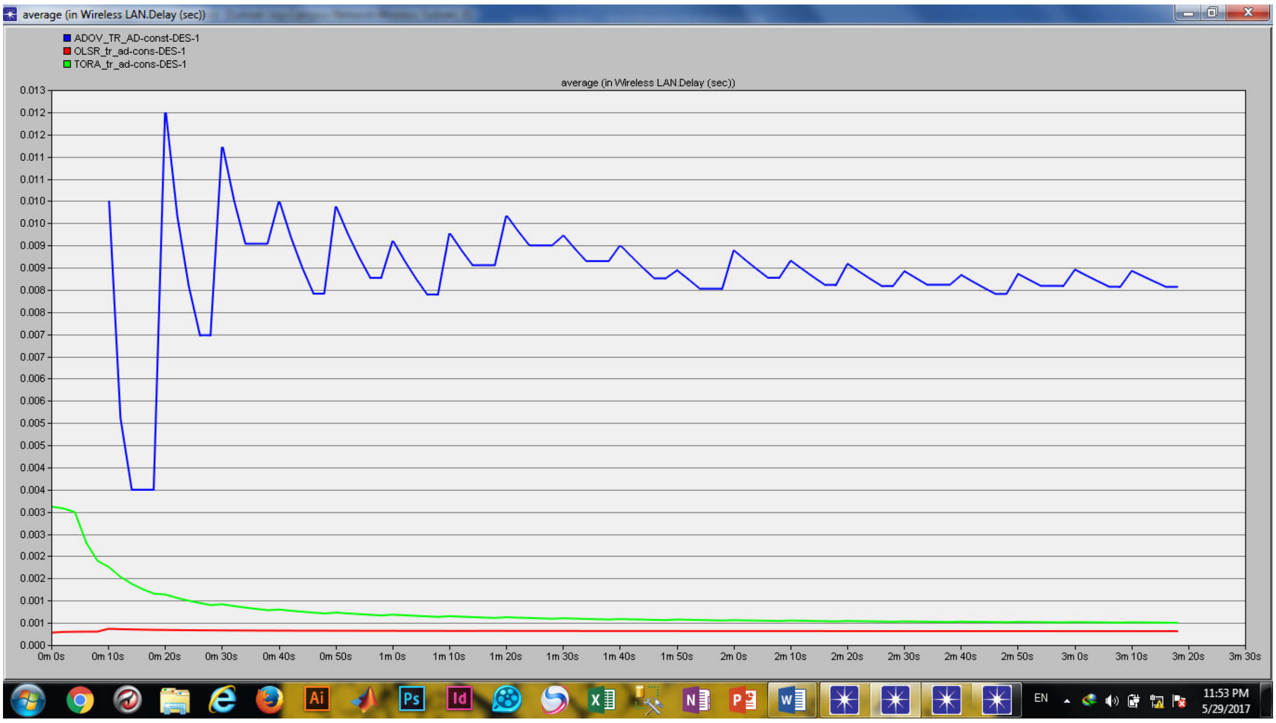

Fig. 14: WLAN Delay on Constant traffic.

5.2 Second Scenario (80 nodes)

5.2.1 Throughput

Fig. 15, 16 and 17, show that the throughput in the different traffic patterns is increased during the simulation of AODV, whereas it is shown constant after 10 sec. in TORA and OLSR. Therefore, it is observed that throughput for the AODV is better than the TORA and OLSR.

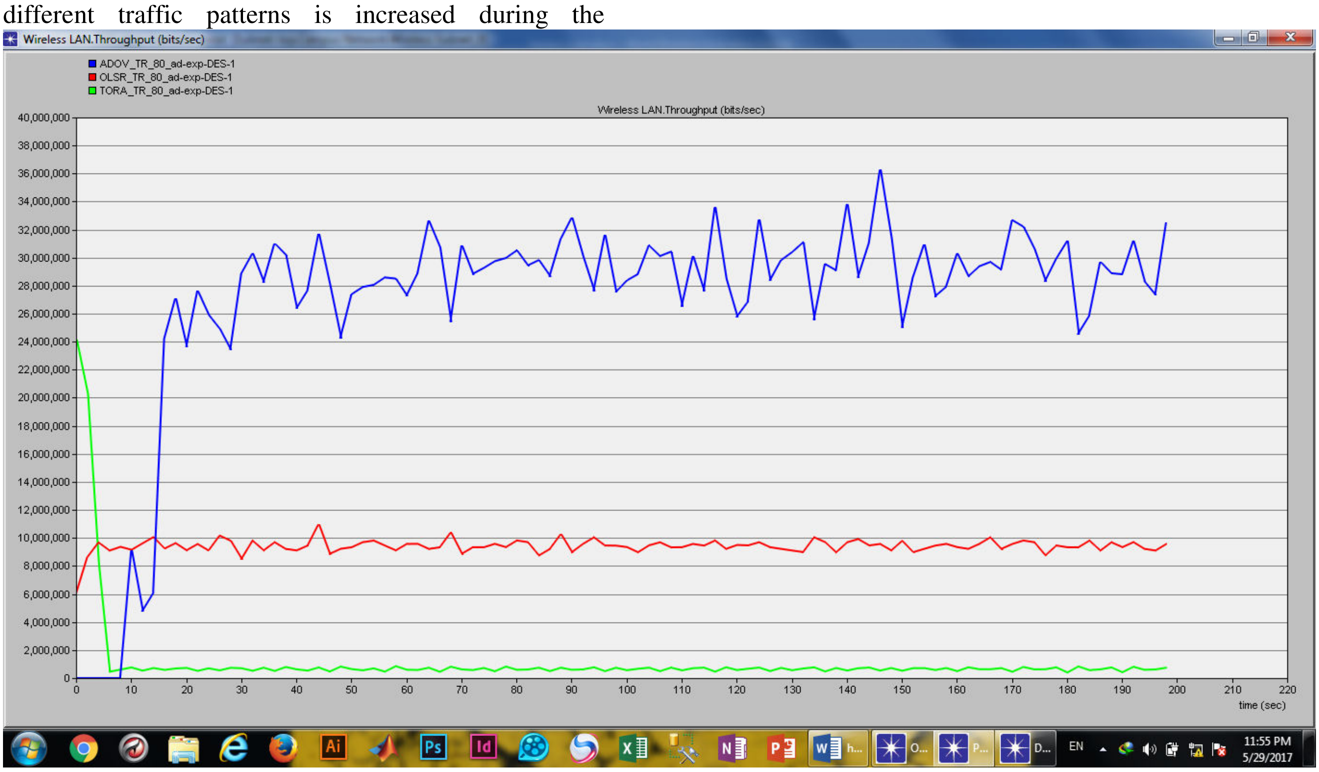

Fig. 15: WLAN throughput on exponential traffic and 80 nodes

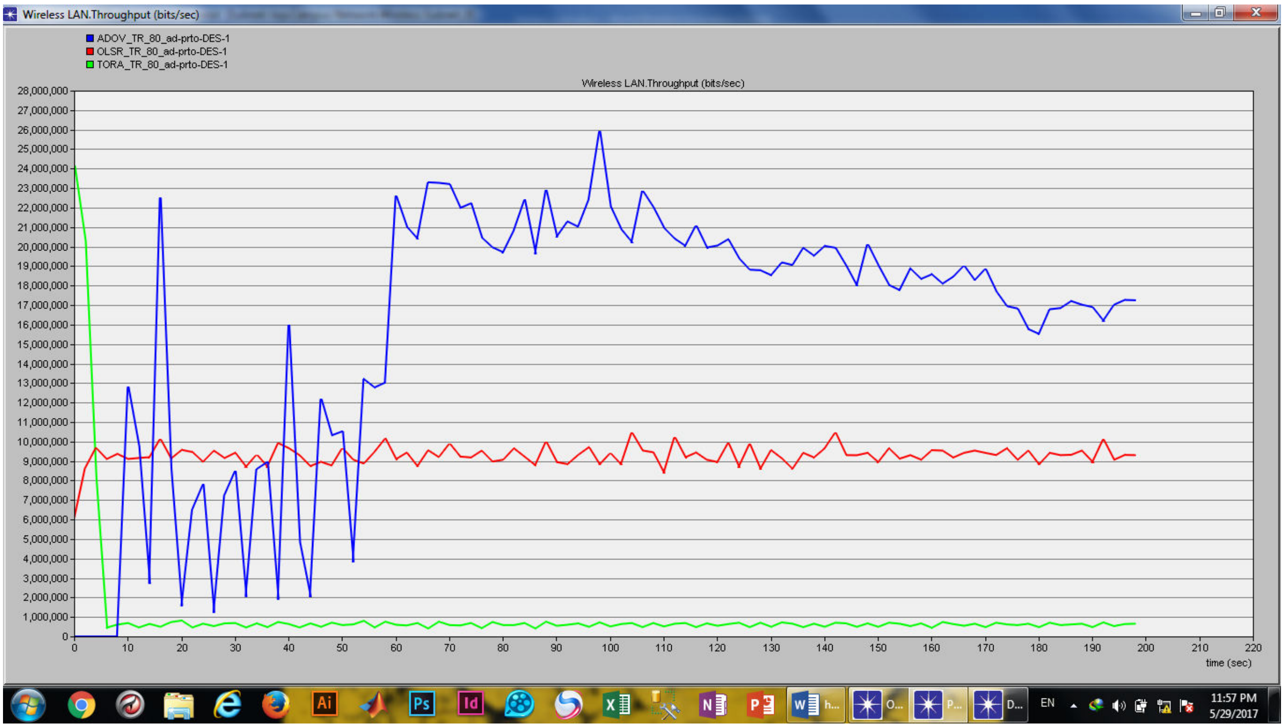

Fig. 16: WLAN throughput on Pareto traffic and 80 nodes.

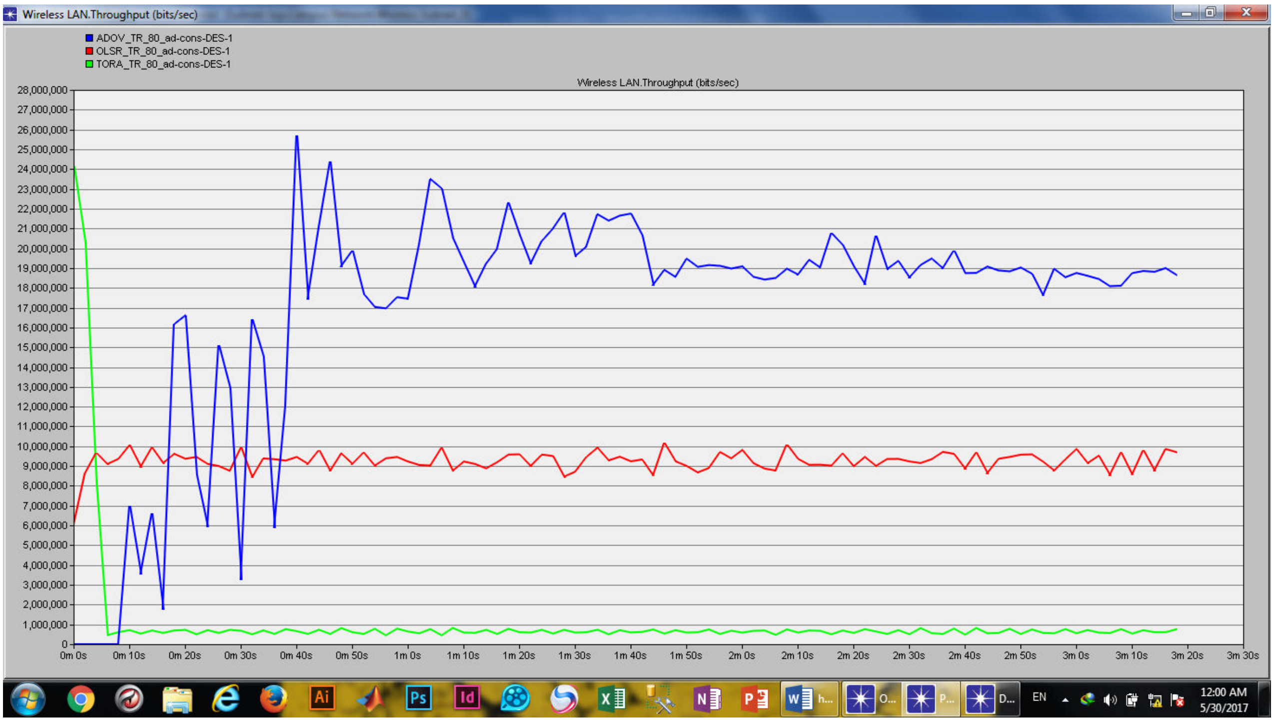

Fig. 17: WLAN throughput on Constant traffic and 80 nodes

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5.2.2 Packet Drop

Figures 18, 19 and 20 show that the packet drop is increased during the simulation of AODV, whereas there is no any packet drop in case of OLSR and TORA protocols. In this case, the OLSR and TORA better than AODV.

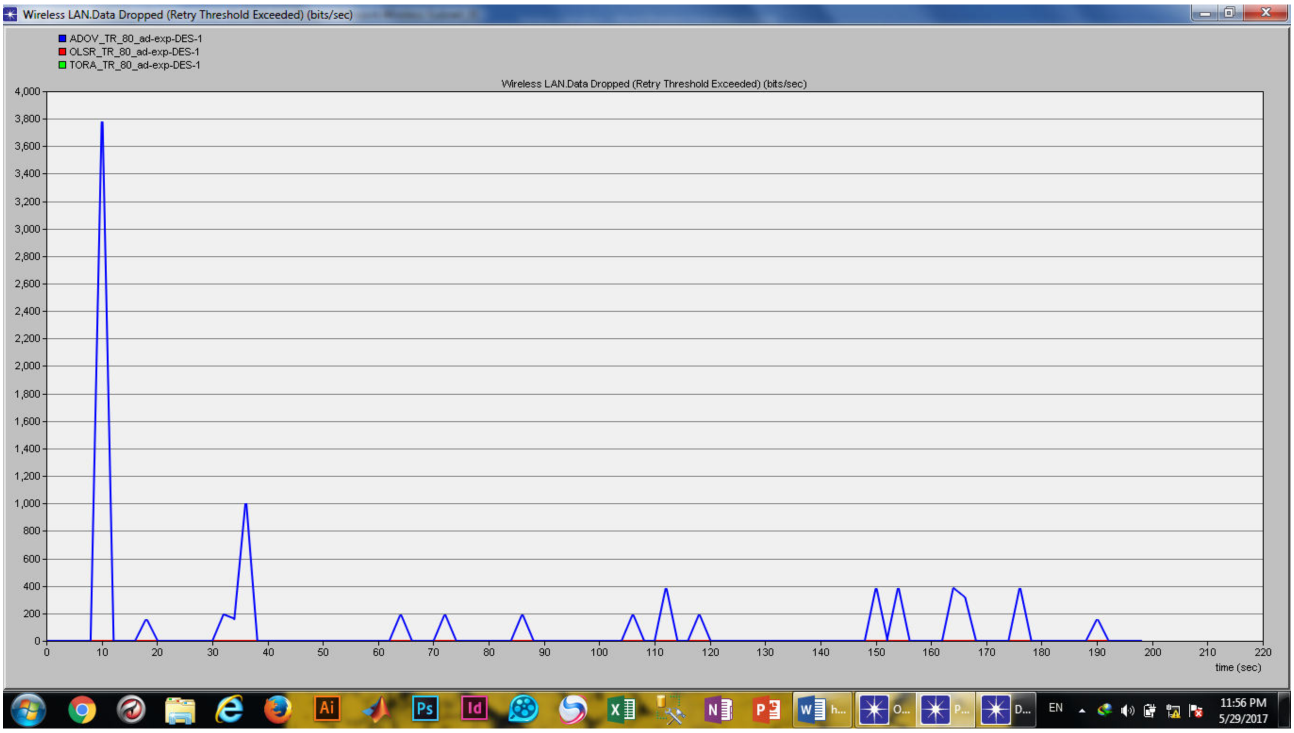

Fig. 18: WLAN Packet Drop on Exponential traffic and 80 nodes

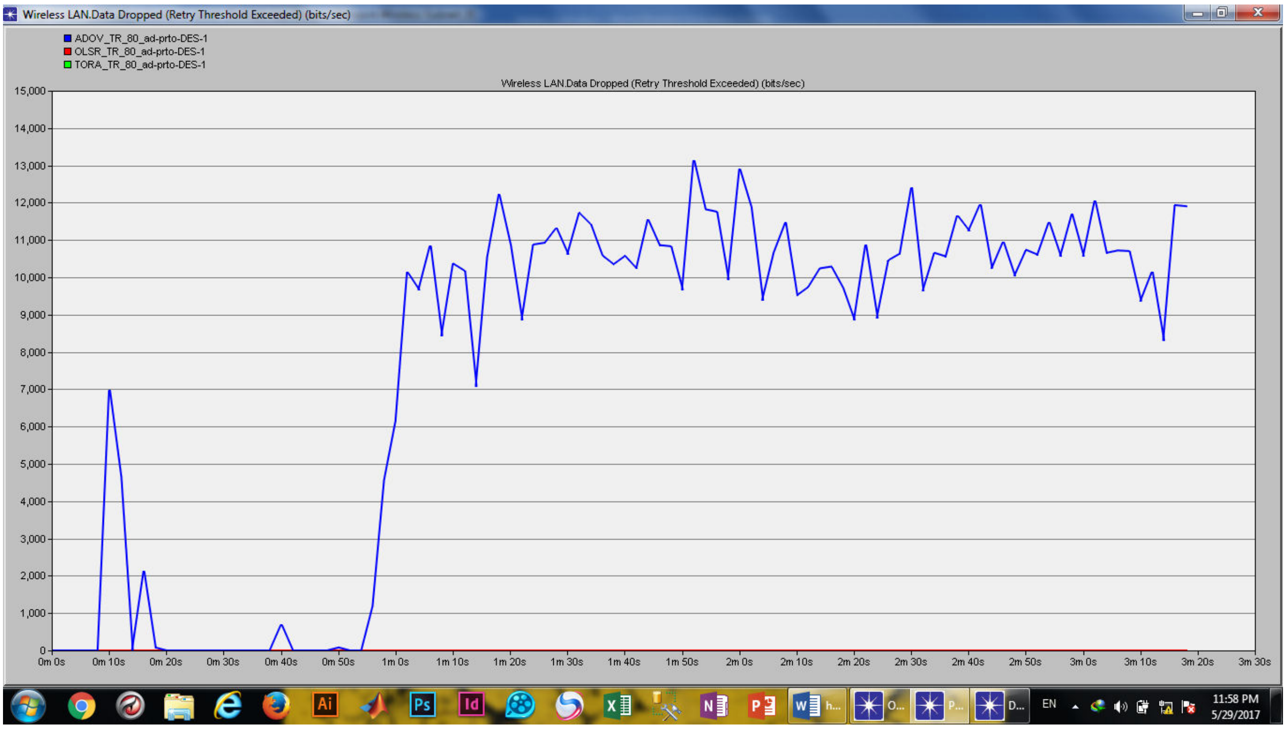

Fig. 19: WLAN Packet Drop on Pareto traffic and 80 nodes

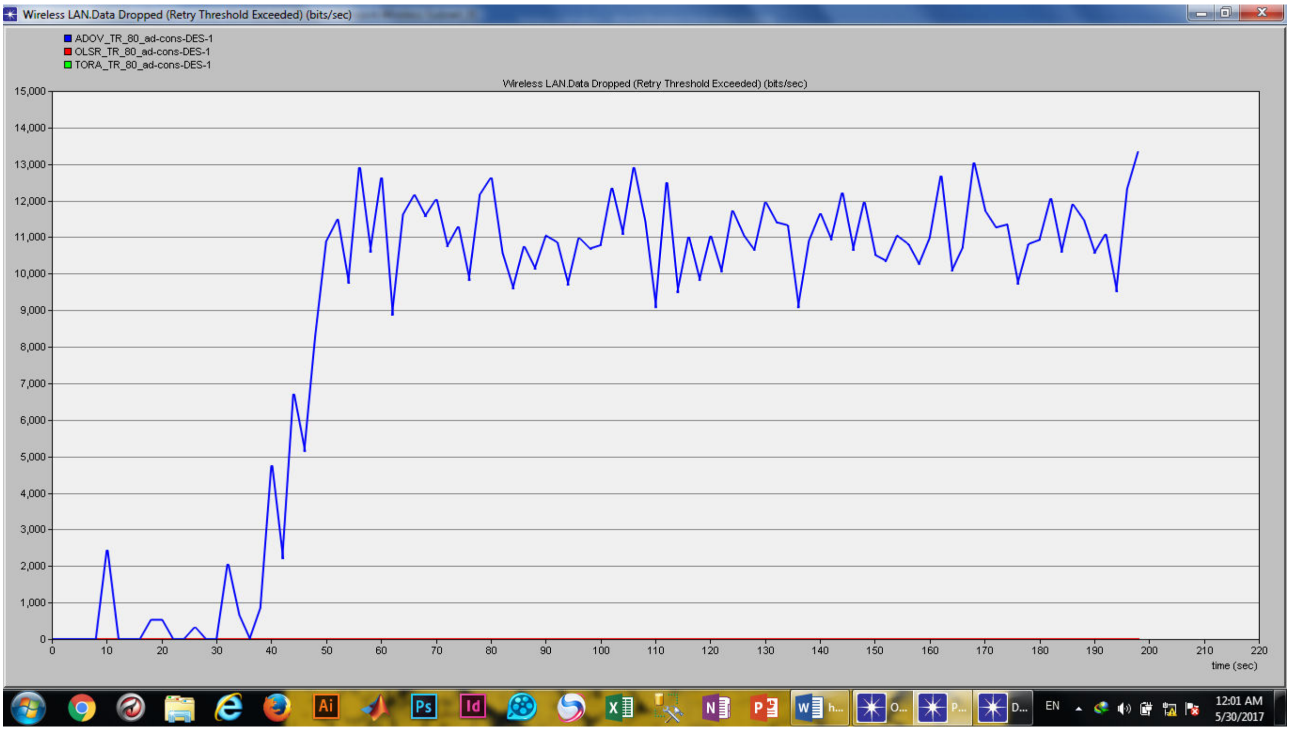

Fig. 20: WLAN Packet Drop on Constant traffic and 80 nodes

5.2.3 Average End2End delay.

Fig. 21, 22 & 23, show that the Average End2End delay for different traffic patterns is increased from the beginning of simulation experiments of AODV till 10 sec and then it is shown constant. Whereas, in TORA and OLSR protocols, it is shown constant after 5 sec. Then, we can say that the Average End2End delay for the TORA and OLSR is better than the AODV.

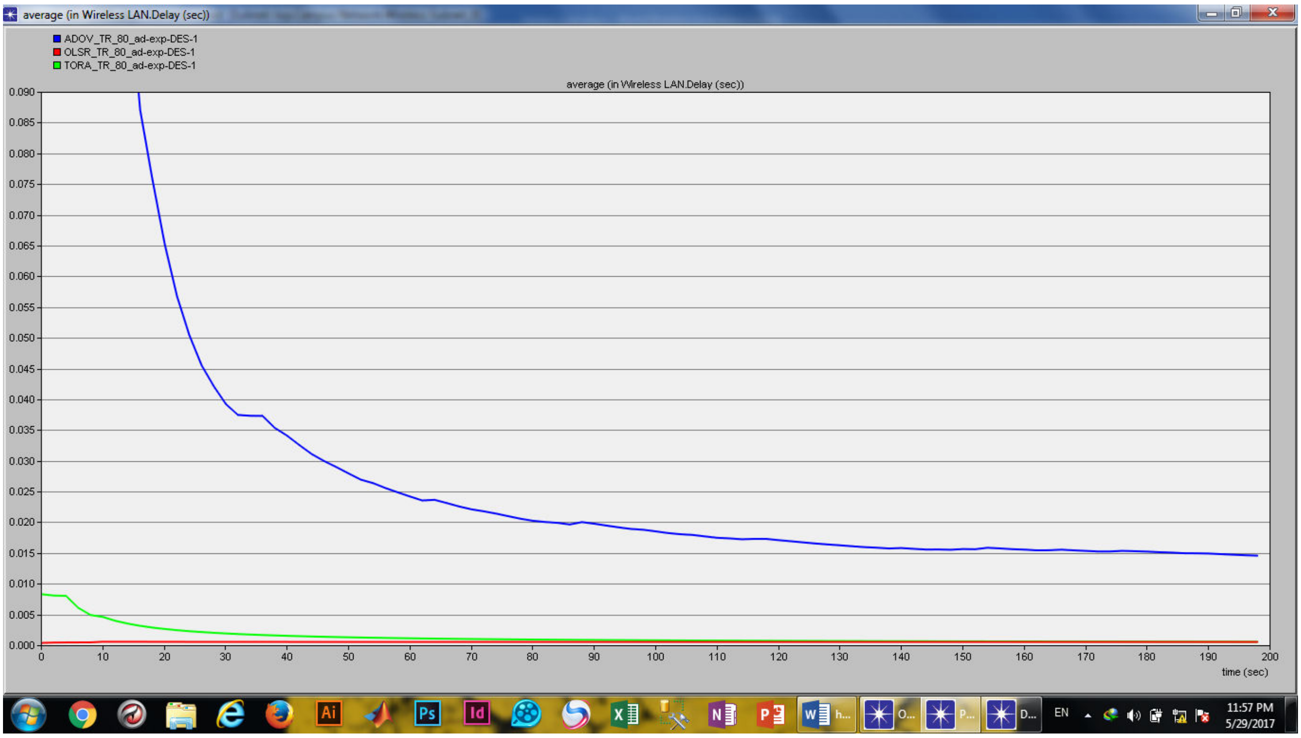

Fig. 21: WLAN Delay on Exponential traffic and 80 nodes

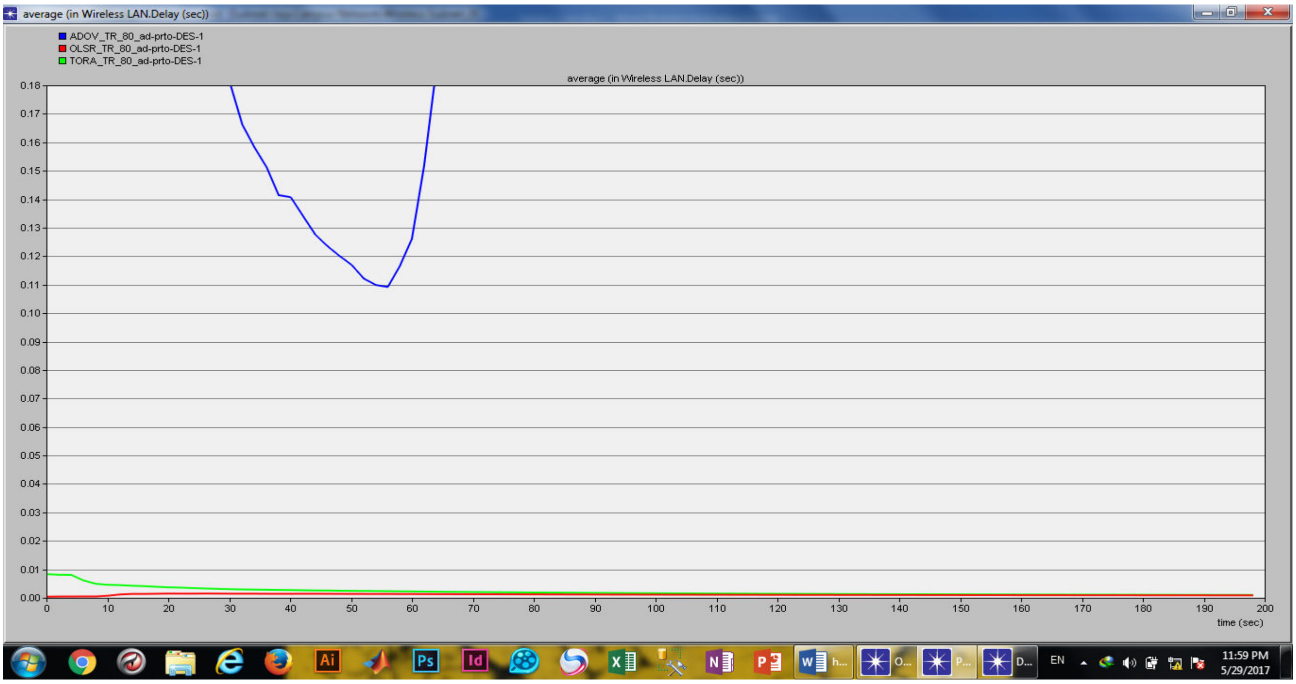

Fig. 22: WLAN Delay on Pareto traffic and 80 nodes

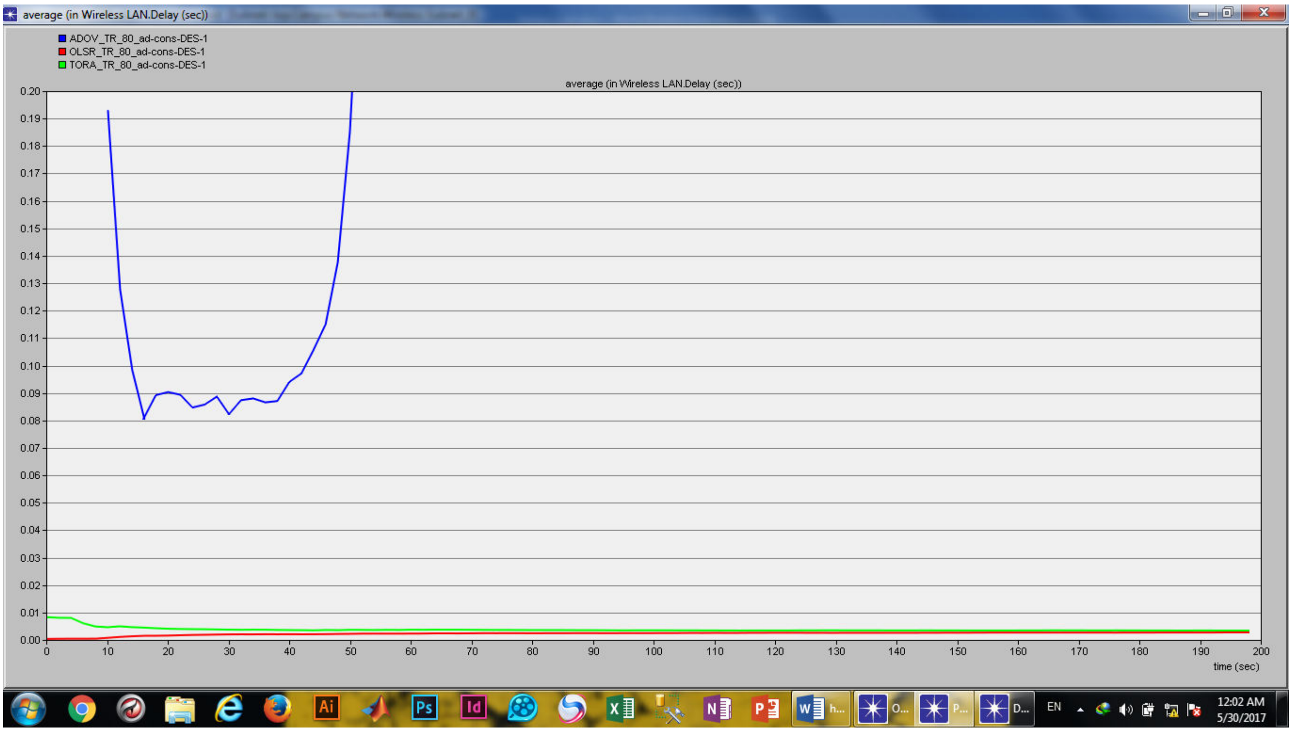

Fig. 23: WLAN Delay on Constant traffic and 80 nodes

5.3 Third Scenario (120 nodes)

5.3.1 Throughput

Fig. 24, 25 and 26, show that the throughput in different traffic patterns is increased during the simulation of AODV and OLSR, whereas it is constant after 10 sec. in TORA. Therefore, it is observed that throughput for the AODV and OLSR is better than the TORA.

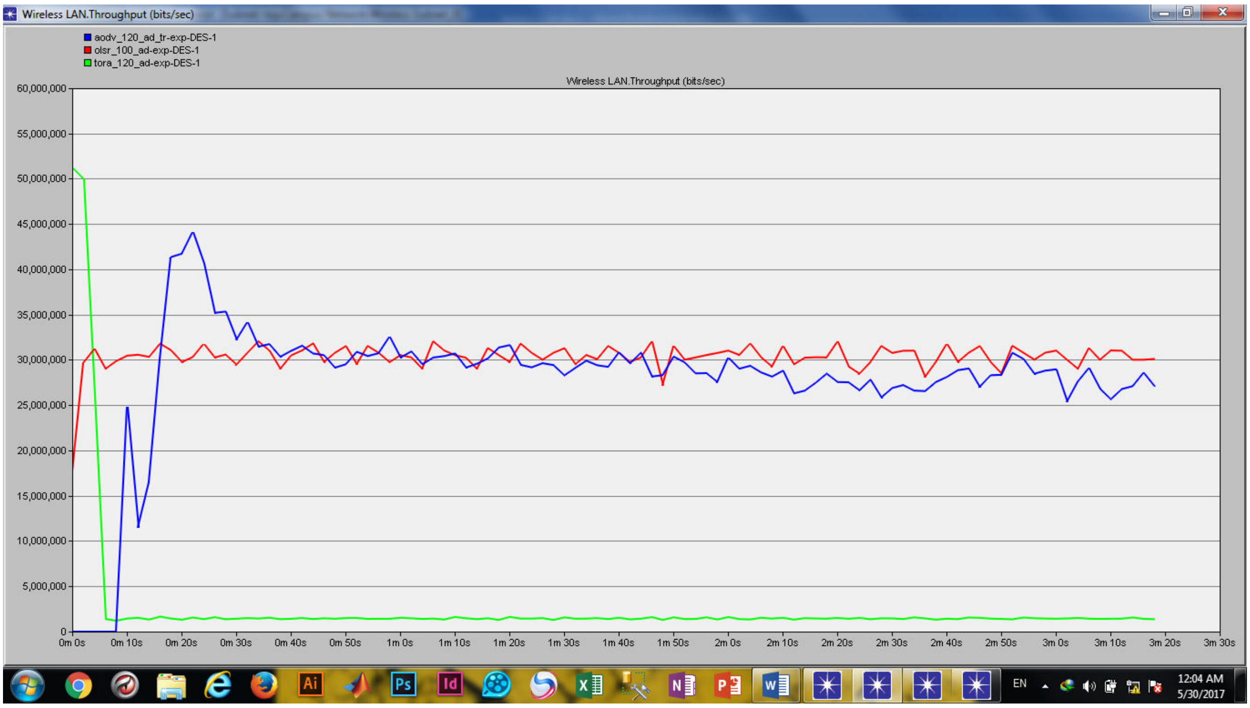

Fig.24: WLAN throughput on exponential traffic and 120 nodes

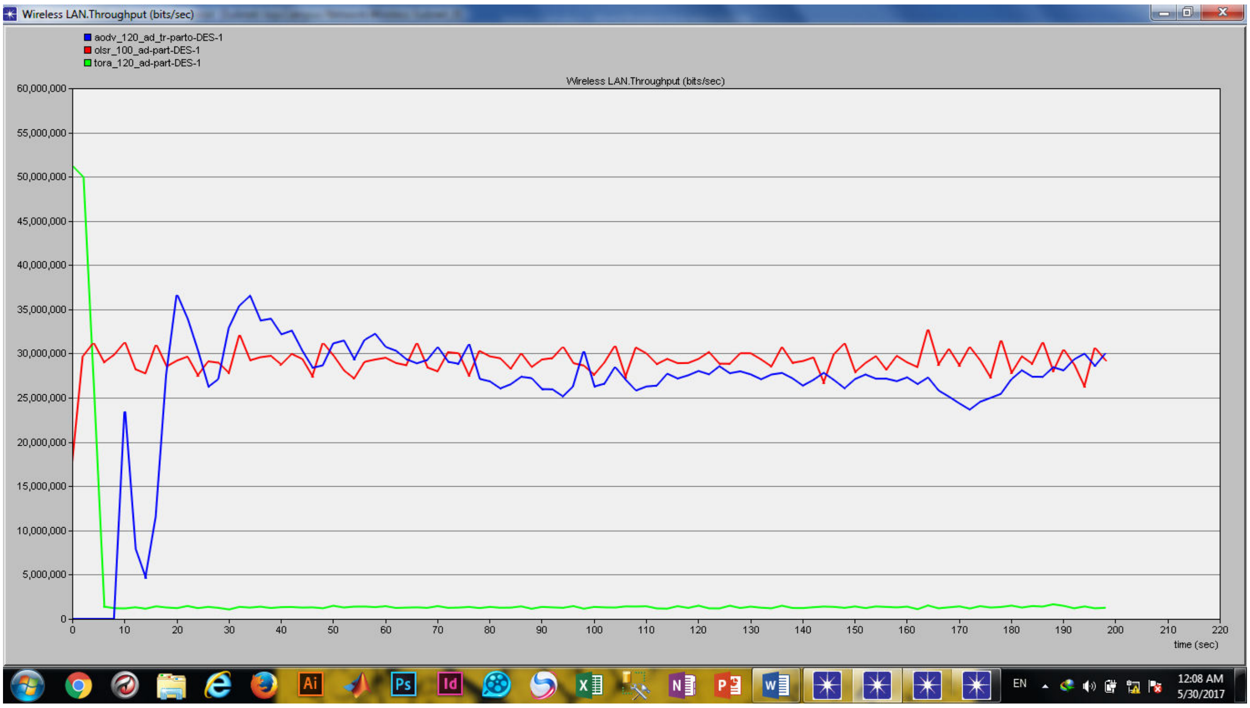

Fig. 25: WLAN throughput on Pareto traffic and 120 nodes

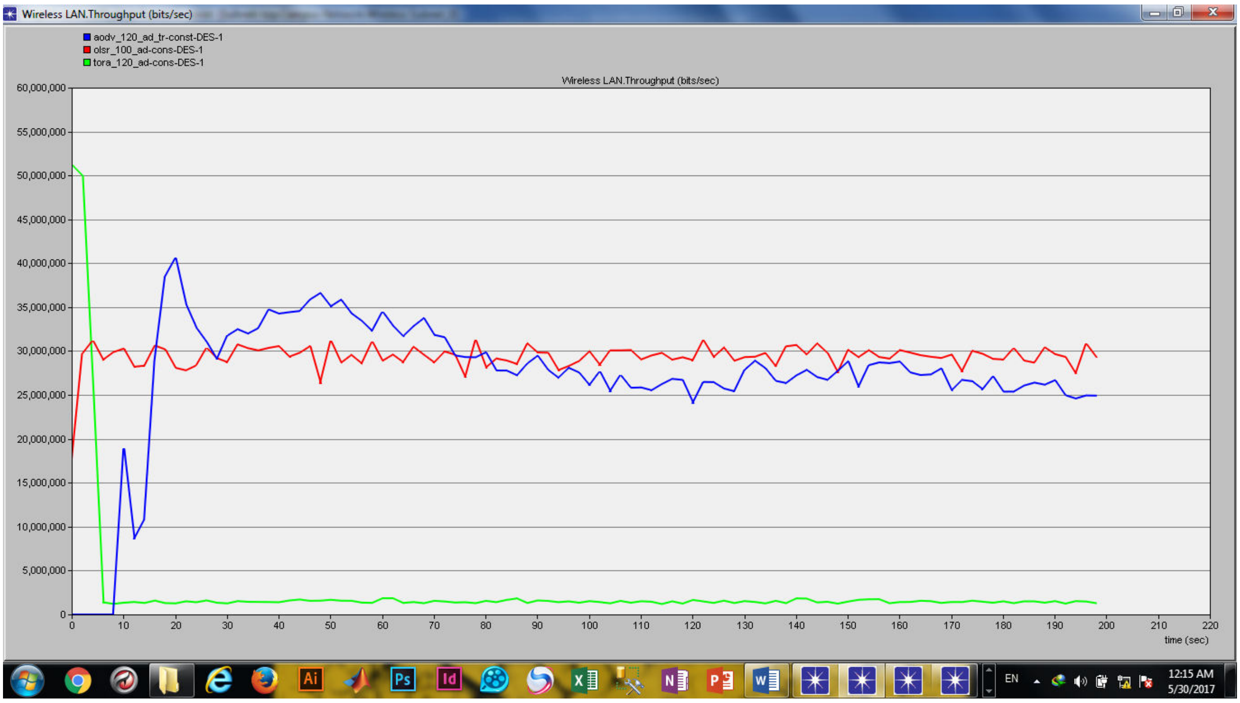

Fig. 26: WLAN throughput on Constant traffic and 120 nodes

5.3.2 Packet Drop

Figures 27, 28 and 29 showed the packet drop for the three routing protocols in the three different traffic patterns. Fig. 27 showed that there is a packet drop for AODV, whereas there is no packet drop in case of OLSR and TORA protocols. Also, Figures 28 and 29 showed that there are some dropping packets in OLSR. Therefore, it can conclude that the OLSR and TORA are better than AODV in this case.

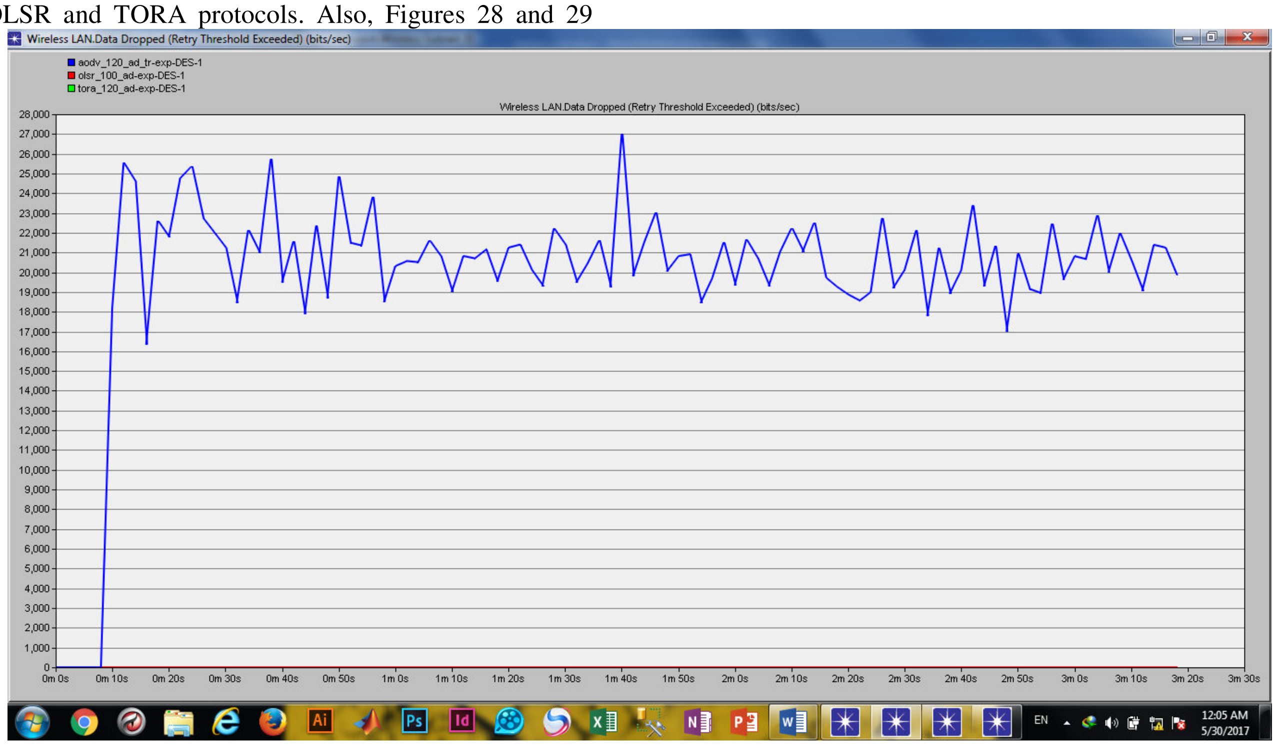

Fig. 27: WLAN Packet Drop on Exponential traffic and 120 nodes

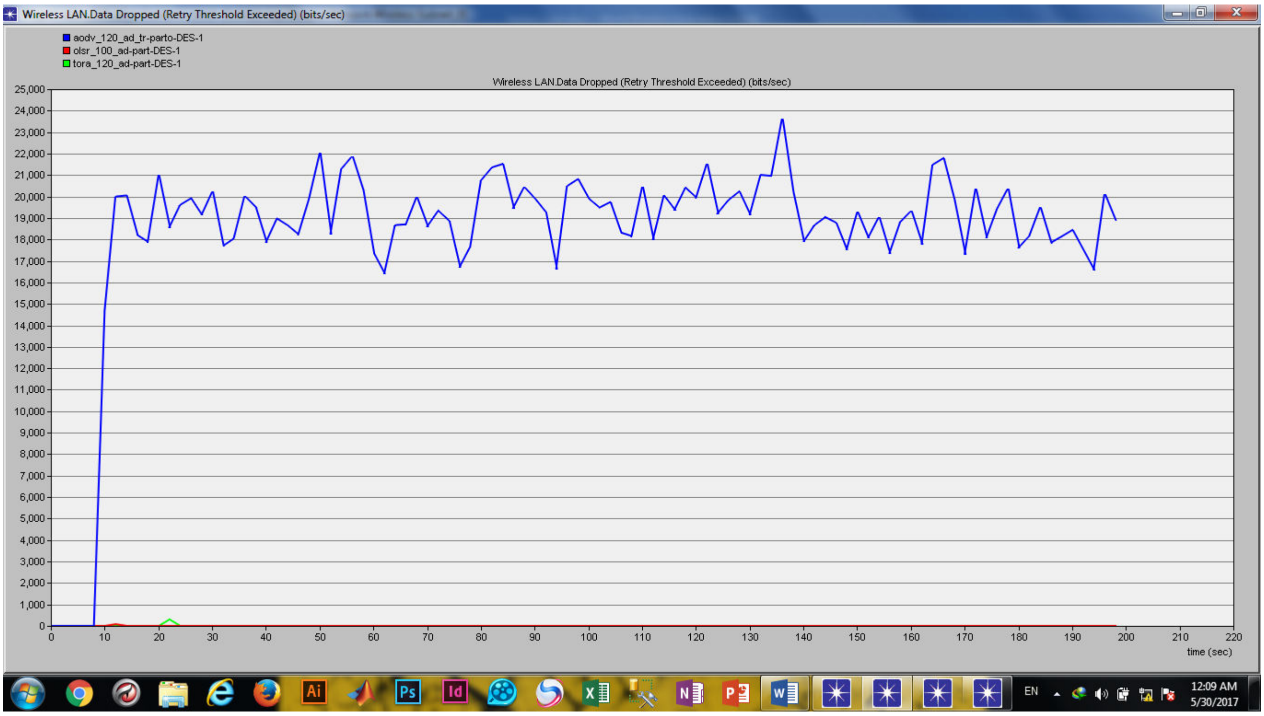

Fig. 28: WLAN Packet Drop on Pareto traffic and 120 nodes

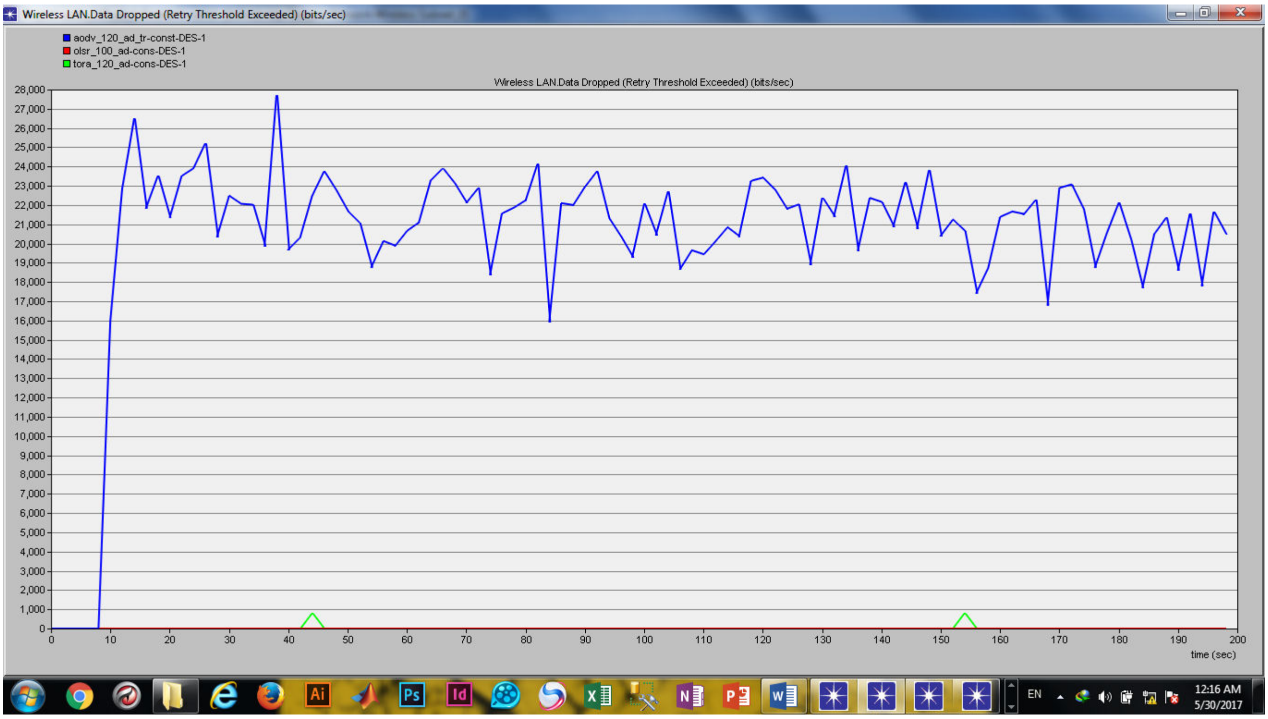

Fig. 29: WLAN Packet Drop on Constant traffic and 120 nodes.

5.3.3 Average End2End delay.

Fig. 30, 31 & 32, show that the Average End2End delay for different traffic patterns is increased from the beginning of simulation experiments of AODV until it reaches 10 seconds and then it is shown constant. Whereas, in TORA and OLSR protocols, the Average End2End delay is shown constant after 5 seconds. Then, we can say that the Average End2End delay for the TORA and OLSR is better than the AODV

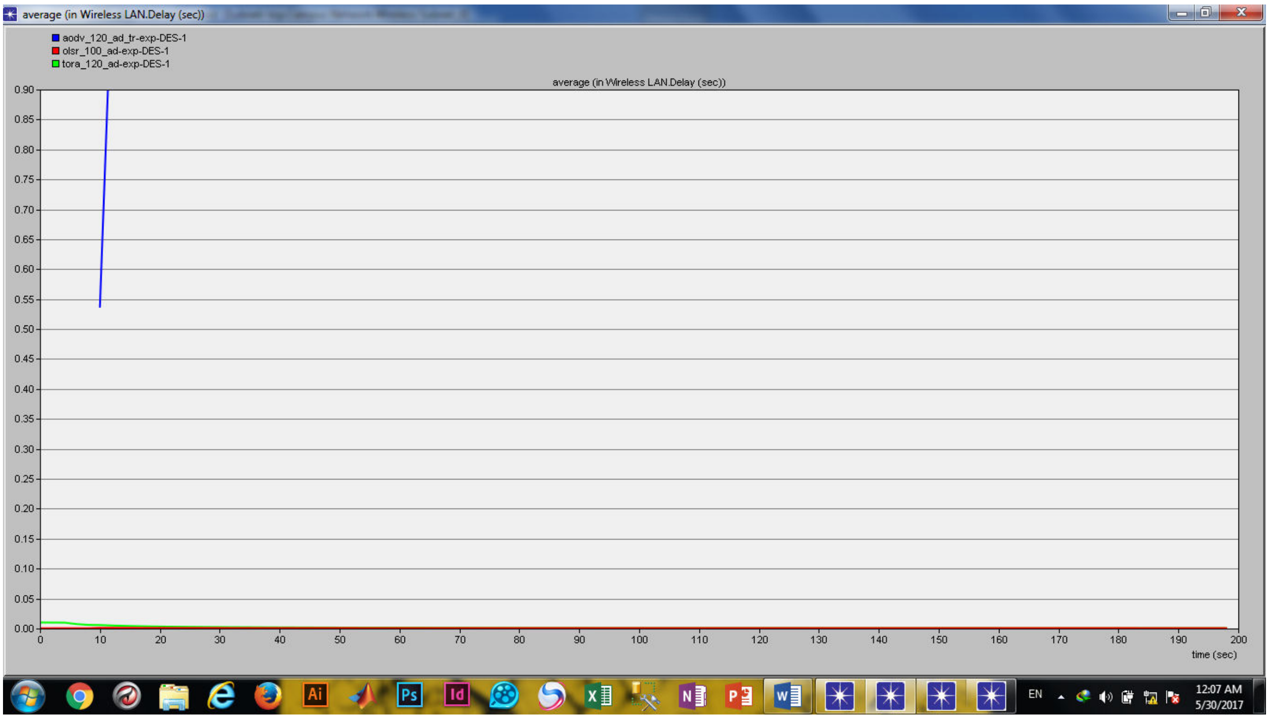

Fig. 30: WLAN Delay on Exponential traffic and 120 nodes.

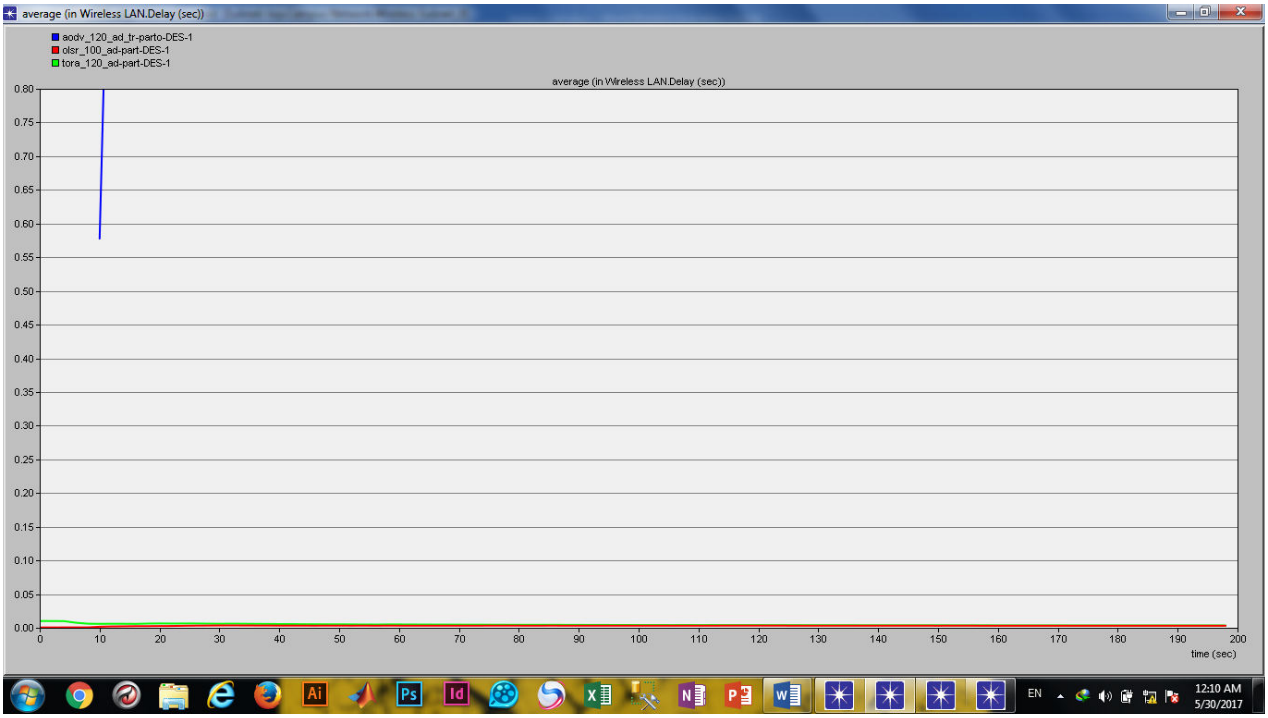

Fig. 31: WLAN Delay on Pareto traffic and 120 nodes

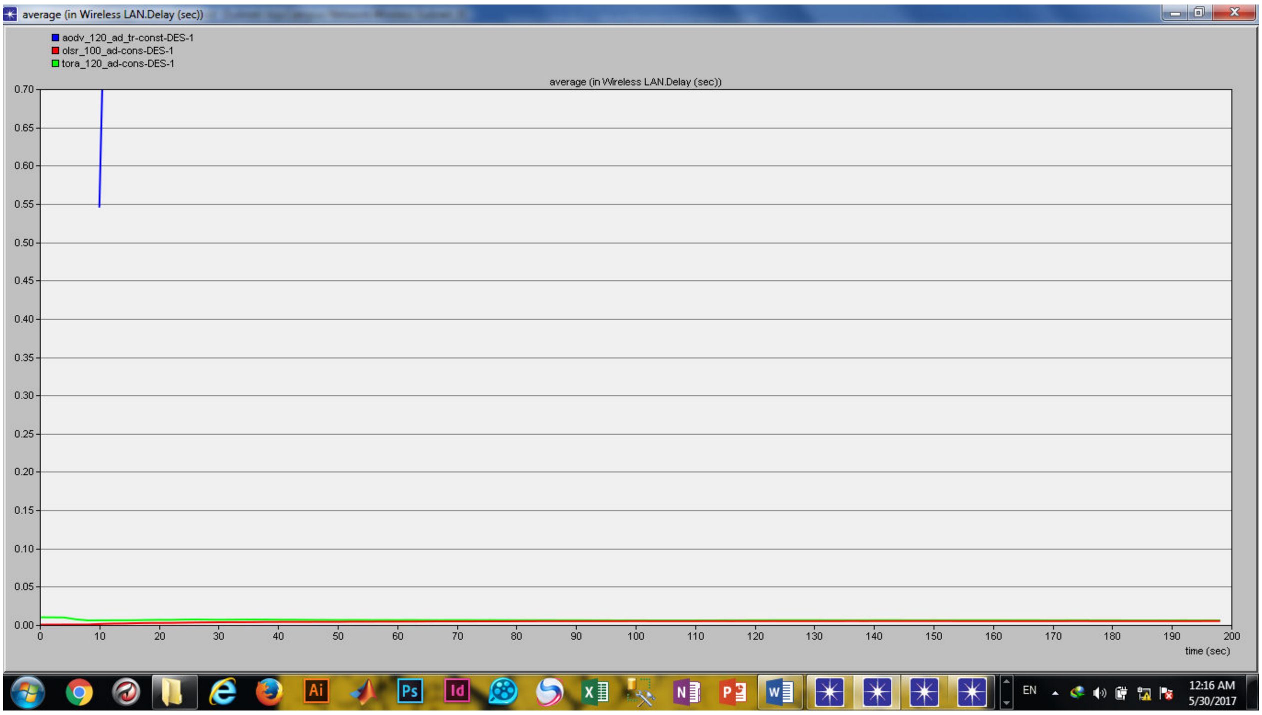

Fig. 32: WLAN Delay on Constant traffic and 120 nodes

6. Conclusion & Future work

In the recent years, MANETs have gained the popularity in many various applications having different mobility models and traffic patterns. The traffics patterns play an important role in the performance of routing protocols. In this paper, the traffic model determines the performance analysis of three routing protocols (AODV, OLSR and TORA) with different traffic patterns. The simulation results observed that the performance of AODV routing protocol in terms of throughput is better with CBR traffic model. Whereas, in case of packet drop the Exponential traffic model gives the good performance for AODV. Also PARETO traffic model is the good choice for End-to-End delay metric to enhance performance of AODV. Therefore, the results show that AODV routing protocol performs better in CBR, PARETO and EXPONENTIAL traffic patterns in terms of throughput and end-to-end delay compared to the other two protocols. In general, the conducted results show that the good ranking of routing protocols depending on both mobility models and traffic patterns. Future work will extend the study on more routing protocols.

References

1. Boukerche & Azzedine, “Algorithms and Protocols for Wireless Mobile Ad-Hoc Networks”, Wiley-IEEE Press, Nov.10, 2008.
2. S.Basagni, M. Conti & S.Giordano, “ Mobile Ad Hoc Networking”, Aug. 9, 2004. -IEEE Press 1 edition.
3. M. Malli, Q. Ni, T. Turletti, and C. Barakat, “Adaptive fair Channel Allocation for QoS Enhancement in IEEE 802.11 Wireless LANs”, 2004 IEEE International Conference on , 20-24 June 2004.
4. Amit K. Chaturvedi, Jitendra K. Khemani, “Analysis of Mobility Models in Mobile Ad-hoc Networks”, International Journal of Computer Applications, 2014, pages 5-9.
5. Ashutosh Bharadwaj, Dr. Ajit Singh, “The Performance and Simulative analysis of MANET Routing Protocols with Different Mobility Models”, International Journal of Computer Science IT, Vol. 5 (2), 2014, 2534-2539.
6. Kazuhiro Y., Kazunari M., et al, “Performance Analysis of Routing Methods Based on OLSR and AODV with Traffic Load Balancing and QoS for Wi-Fi Mesh Network”, ICOIN IEEE 2016.
7. C.E. Perkins & E.M. Royer, “Ad-Hoc On-Demand Distance Vector Routing for Mobile Computing Systems and Applications”, 1999, 25-26 Feb, IEEE Workshop.
8. Sunil Kr. Maakar, Sunita Kukerja & Sudesh Kumar, “Comparison of Random Based Mobility Model using TCP Traffic for AODV and DSDV MANET’s Routing Protocols”, IJITKM Volume 7 • Number 2 Jan– June 2014 pp. 180-184.
9. Bindeshwar S. K. & Pramod K. M, “Different Traffic Patterns Over Ad Hoc Network Routing Protocols”, International Journal of Computer Applications V-138 - No.11, March 2016.
10. Vikas S., Parveen K., “Traffic Pattern based performance comparison of reactive and proactive protocols of mobile Ad-hoc Networks”, International Journal of computer Application, Volume 5- No. 10, 2010.
11. M. Inyat, and N. Nawaz, “Measuring the Effect of CBR and TCP Traffic Models over DYMO Routing Protocol”, Global Journal of Computer Science and Technology, 2011, Volume 11 Issue 14 Version 1.0
12. Patil V.P., “Effect of Traffic pattern on the Performance of Table Driven and On Demand Routing Protocols of MANET”, International Journal of Computational Engineering Research, 2012, Vol. 2 Issue. 5, pp. 1311 – 1317

13. A. Pal, J. P. Singh, P. Duttac, “The Effect of speed variation on different Traffic Patterns in Mobile Ad Hoc Network” Elsiver, Procedia Technology, 2012, V-4, pp. 743 – 748
14. Y. Saadi, S. El Kafhali, A. Haqiq., B. Nassereddine, “Simulation Analysis of Routing Protocols using Manhattan Grid Mobility Model in MANET”, International Journal of Computer Applications, 2012, Volume 45– No.23.
15. D. Verma, D. Chandrawanshi “Comparative Performance Evaluation of AODV over CBR and TCP Traffic,”, 2011, IJCST Vol. 2, Issue 2.
16. OPNET : http://www.opnet.com/
17. Bindeshwar Singh Kushwaha, “Different Traffic Patterns Over Ad Hoc Network Routing Protocols” International Journal of Computer Applications, 2016, Volume 138 - No.11.

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