ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 4, April 2016

Performance Analysis of Routing Protocols in MANETs Using OPNET 14.0

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***Abstract*: A Mobile Ad-hoc Network (MANET) is a group of mobile devices dynamically creating a communication network without any centralized control and pre-existing network infrastructure. Due to the existence of mobility in the MANET, the interconnections between stations are likely to change on a continual basis, resulting in changes of network topology. This research aims to study the impact of four IETF (Internet Engineering Task Force) standardized routing protocols (AODV, DSR, OLSR and TORA) on MANETs and thereby comprehensively analyzes their performance under varying network sizes and node mobility rates.The network size is varied from 15 to 60 nodes whereas mobility rate is varied from 10 to 30 m/s for the four routing protocols using FTP and HTTP as applications. The performance of above mentioned routing protocols is evaluated using performance metrics like Wlan delay, Retransmission attempt and throughput. The simulations results reveal that out of the four routing protocols, OLSR can adapt relatively well to the changing network sizes as well as node speeds. As the resultsshows, its use is therefore highly recommended as one of the most robust routing protocol in a majority of environments.**

Keywords: AODV, DSR, MANET, OLSR, OPNET 14.0, Routing Protocols, TORA.

I. INTRODUCTION

The use of wireless technology has turn into one of the popular methods to access the internet or design connection to the local network. It presents an easier and inexpensive deployment with the capability of adding new devices to it at lower cost. Devices equipped with wireless adapters together with a wireless access point form wireless local area networks (wlan). However, these wlan have fixed infrastructure and as a result, mobility becomes a major drawback in such types of networks. To overcome this problem, mobile ad hoc networks (MANET) are introduced. In these networks, wireless capable devices (nodes) may operate as autonomous entities and they communicate via multiple wireless hops without any pre-established fixed infrastructure. Nodes may be mobile or fixed in nature and can randomly combine with each other to form arbitrary topologies. Thus, these nodes act as both routers as well as hosts. The self configuring capability of mobile nodes makes this technology suitable in providing communication for disaster hit areas, where no communication infrastructure is available and network is urgently required. (e.g. Mumbai 26/11 attacks and Kedar Nath rescue operation).

MANET is comprised of a set of independent mobile and fixed nodes, where the nodes should work together in a distributed manner to enable routing among them. Due to lack of centralized control and frequent changes of network topology, routing becomes a vital concern and quite a challenge in these networks. A routing protocol is mainly used to determine the shortest, most efficient and correct path while providing the data transmissions between different wireless devices in ad-hoc network. Now a days, MANETs are found to be able to insert the routing functionality into the mobile nodes, which economize energy for other nodes by bringing down the routing overhead in the network. Moreover, this routing algorithm establishes the communications and formalizes agreement among nodes, which is essential to the overall performance of a MANET [1]. Routing protocols for ad-hoc networks have been of great interest for many years as theunderlying Internet routing protocols are mainly intended to support the permanent infrastructure network; eventually, the properties of those protocols are found to be inappropriate for MANETs. Consequently, a variety of MANET routing protocols has evolved over recent time. Examples of such routing protocols are, among others [2], the Optimized Link State Routing Protocol (OLSR) [3], the Wireless Routing Protocol (WRP) [4], the Ad-hoc On Demand Distance Vector Routing (AODV) [5], the Dynamic Source Routing Protocol (DSR) [6] and the Temporally Ordered Routing Algorithm (TORA) [7]. There are different types of applications like File Transfer Protocol and HTTP may be used to analyze performance of above mentioned routing protocols using different performance metrics (e.g. Throughput, Wlan Delay, Retransmission Attempt).

In this article we discuss about the working of rounting protocols in Manets . This paper is organised in sections: second sectiondeals with classification of routing protocols; in third section we discuss about the performance metrics used to evaluate the performance of routing protocols;in fourth section we represent our experimental results and analyze them; section fifth gives us the conclusion of whole presented paper.

II. CLASSIFICATION OF ROUTING PROTOCOLS

A. *AODV*

The Ad-hoc On Demand Distance Vector (AODV) is considered an efficient MANET routing protocol and supports both unicast and multicast routing mechanisms. The AODV routing protocol utilizes an on-demand technique in order to discover the routes. This means that the route between two endpoints (nodes) is formed as per requirement for the source node and maintained as long as the routes are needed.

B. DSR

Dynamic Source Routing (DSR) is a widely used reactive (on-demand) routingprotocol which is designed particularly for the mobile ad-hoc networks. DSR permits the network to run without any existing network infrastructure and thus the network becomes as a self-organized and self-configured network.

C. TORA

The Temporally-Ordered Routing Algorithm (TORA) is a highly efficient distributed routing protocol and known as a hybrid protocol which can simultaneously support both table-driven and on-demand approach in multi-hop wireless networks.

D. OLSR

OLSR is operated as a proactive (table-driven) routing protocol i.e. frequently exchanges topology information with other nodes of the network [9]. This protocol is basically an optimization of traditional link state protocol developed for mobile ad-hoc network. The responsibilities of OLSR protocol are to minimize the required number of control packets transmission and also to shorten the size of control packets.

III. PERFORMANCE METRICES:

To evaluate the performance of routing protocols we used performance evaluation factors throughput, end to end delay and retransmission attempt.

The average rate at which the data packet is delivered successfully from one node to another over a communication network is known as throughput. It represents the end to end delay when all the packets are received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layer. It is measured in seconds. Retransmission attempt is defined as the total number of retransmissions required to deliver a packet from source to destination node. It also shows the number of packets dropped in the process. It is also called as retransmission rate and measured in packets/sec.

The throughput is usually measured in bits per second (bits/sec). A throughput with a higher value is more often an absolute choice in every network. Mathematically, throughput can be defined by the following formula [8].

$$Throughput = \frac{Number\ of\ delivered\ packets * Packet\ size\ (Bytes) * 8}{Total\ duration\ of\ simulation\ (\mathrm{sec})}$$

IV. EXPERIMENTAL RESULTS AND DISCUSSIONS

In this section we analyze the performance of routing protocols with varying node size (15, 30 and 60 nodes) at fixed node speed of 10m/s and at varying speeds (10,20,30)m/s with fixed node sizes of 30 nodes. All the routing protocols considered were compared on the basis of performance metrics taken in this i.e throughput, end to end delay and retransmission attempt. First the node speed was fixed to 10m/s and node sizes were varied and then node size was fixed to 30 nodes and node speeds were varied.

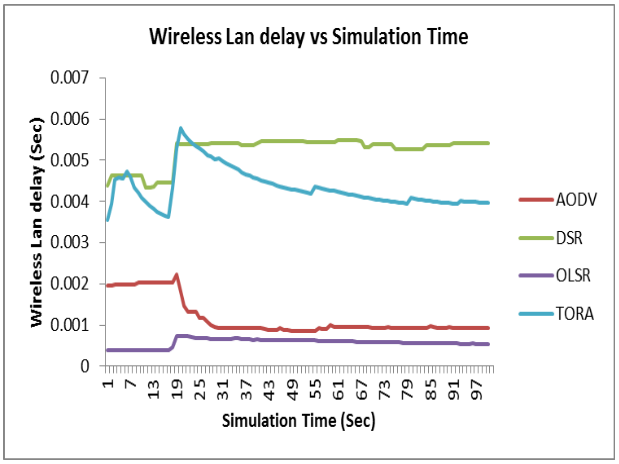

Figure 1. Wireless Lan delay at node speed 10m/s and node size of 15 nodes

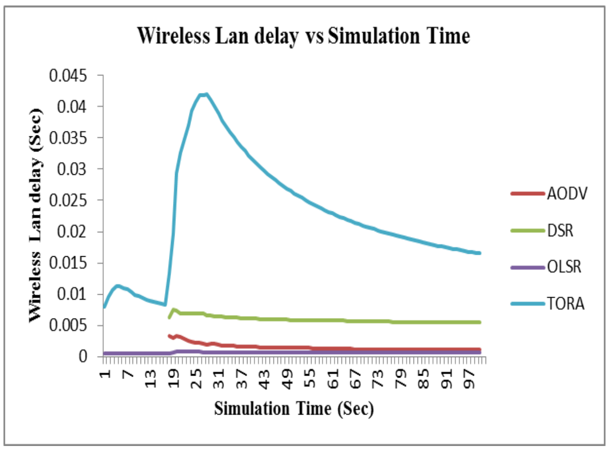

Figure 2. Wireless Lan delay at node speed 10m/s and node size of 30 nodes

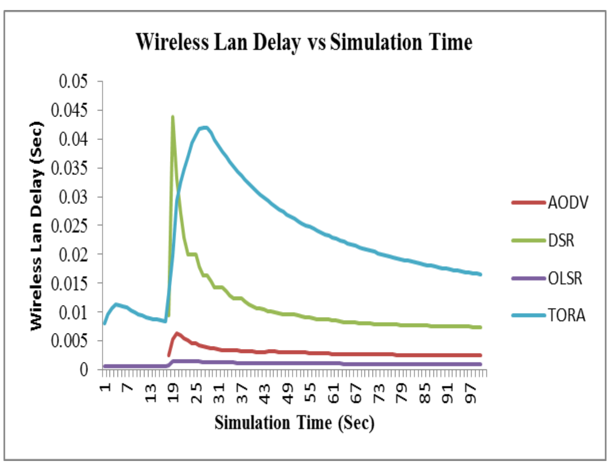

Figure 3. Wireless Lan delay at node speed 10m/s and node size of 60 nodes

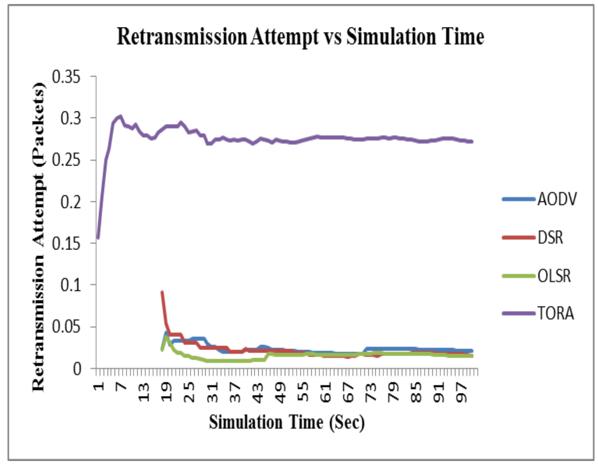

Figure 4. Retransmission Attempt at node speed 10m/s and node size of 15 nodes

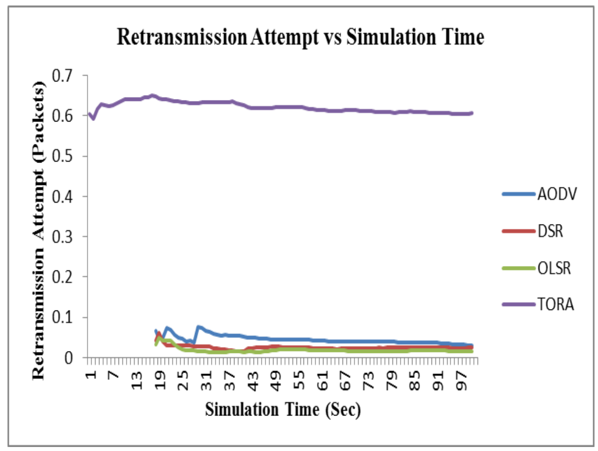

Figure 5. Retransmission Attempt at node speed 10m/s and node size of 30 nodes

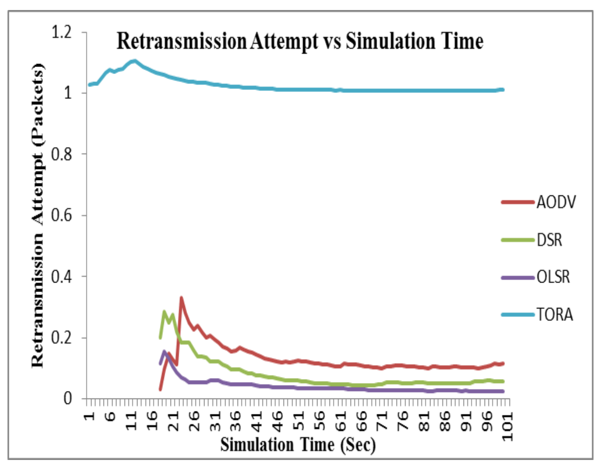

Figure 6. Retransmission Attempt at node speed 10m/s and node size of 60 nodes

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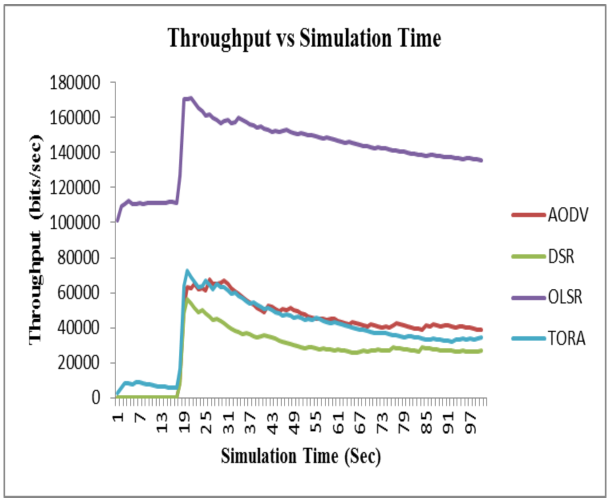

Figure 7. Throughput at node speed 10m/s and node size of 15 nodes

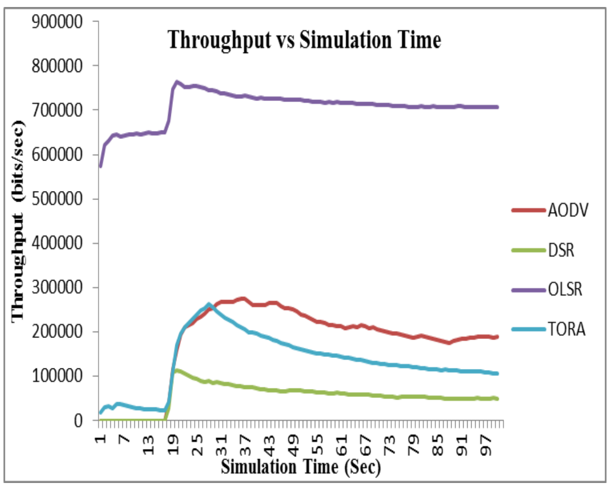

Figure 8. Throughput at node speed 10m/s and node size of 30 nodes

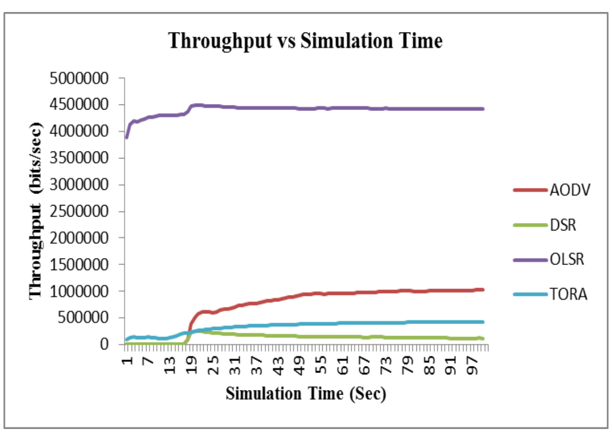

Figure 9. Throughput at node speed 10m/s and node size of 60 nodes

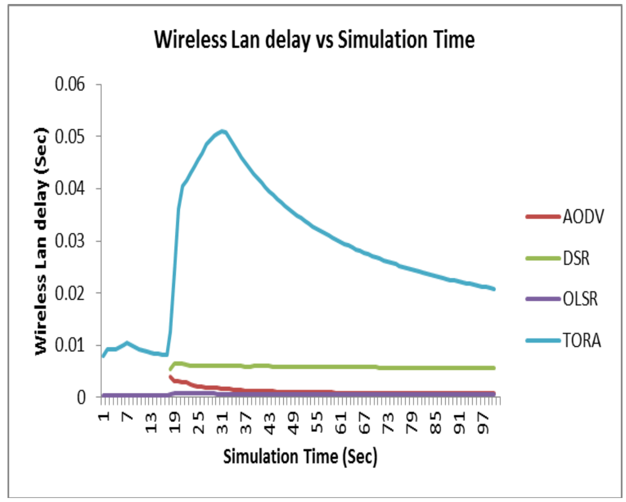

Figure 10. Wireless Lan delay at node speed 20m/s and node size of 30 nodes

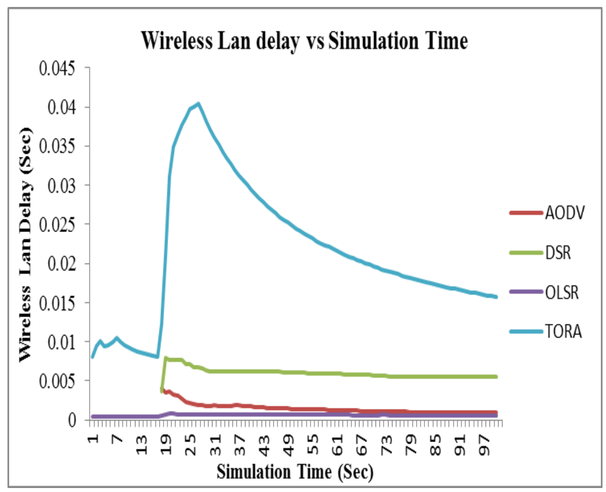

Figure 11. Wireless Lan delay at node speed 30m/s and node size of 30 nodes

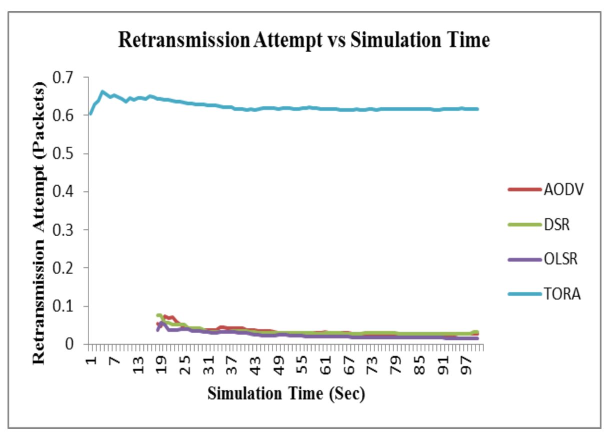

Figure 12. Retransmission Attempt at node speed 20m/s and node size of 30 nodes

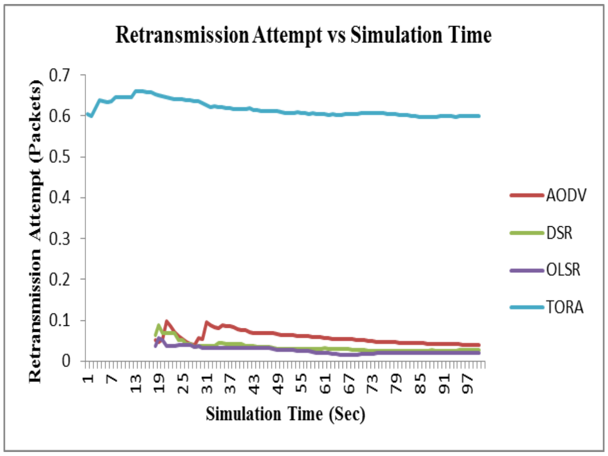

Figure 13. Retransmission Attempt at node speed 30m/s and node size of 30 nodes

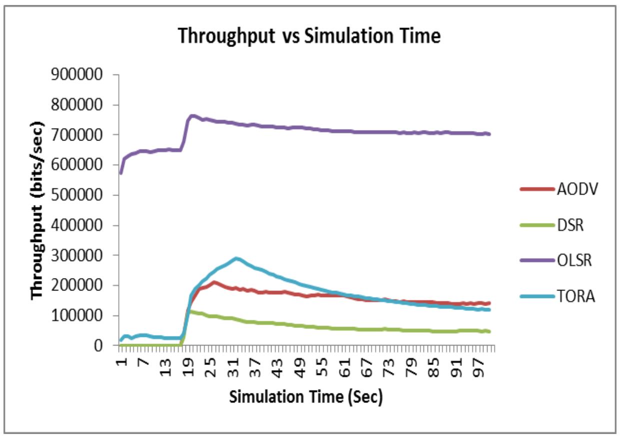

Figure 14. Throughput at node speed 20m/s and node size of 30 nodes

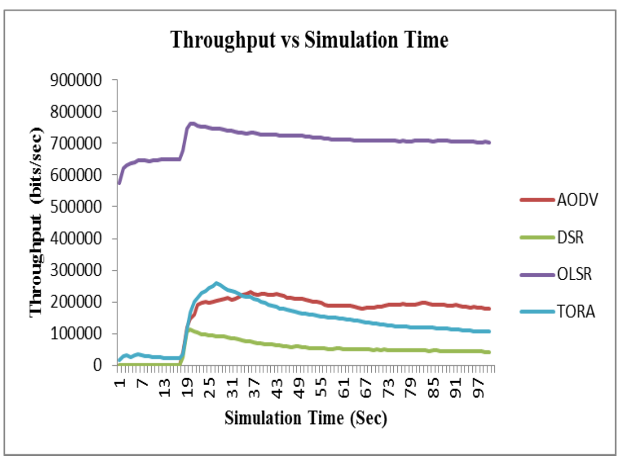

Figure 15. Throughput at node speed 30m/s and node size of 30 nodes

V. CONCLUSION

Performance of four different routing protocols is evaluated using wlan delay, retransmission attempt and throughput. Performance evaluation is analyzed using variation in the network size and mobility rates. To evaluate the performance of different routing protocols in terms of network size, the node size is varied from 15 to 60 nodes whereas to determine the impact of mobility, node speed is varied from 10 m/s to 30 m/s.It is obeserved that all the four routing protocols get adversely affected with the addition of number of nodes. However, degradation in case of OLSR is found out to be least among all the protocols. Packet delivery must be high which is higher in case of OLSR in comparison to other three protocols when all the results were concluded Performance of routing protocols is improved when mobility rate is increased to 30 m/s. OLSR best suited the conditions as compared to other protocols.

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