

# Performance Efficiency of OLSR and AODV Protocols in Manets

P. T. Kasthuri Bai\* and M. Sundararajan

Bharathiar University, Coimbatore - 641 046, Tamil Nadu, India; kasthuript@rediffmail.com,  
drmsrajan23@yahoo.com

## Abstract

**Objectives:** Comparison of performance efficiency of AODV and OLSR routing protocol in MANETs using NS2 tool. The parameters considered and compared for throughput, packet delivery ratio, energy spent and delays. **Methods/Analysis:** Using NS2, first a sample of 50 nodes was generated and moved randomly. Dynamic clustering was done within the sample area of 500x500sq.m. 50 nodes were set up as sink nodes and attached a local agent and loss monitor for each node. These nodes were positioned in the sample area. The nodes 17, 28, 35 were set up as source and nodes were set up as destination for transmission of packets, respectively. **Findings:** The four performance measures were: Energy spent, PDR, end-to-end delay and throughput with number of nodes as constant (50) and with different speed (time) of node like 2,4,6,8,10s are taken for comparison. Transmission of packet was tested using AODV and the performance metrics are traced. Similarly the performance metrics were tested with OLSR protocol. The values were tabulated and a graph was generated for each metric in Y-axis and time in X-axis. **Novelty of the Study:** A VMware workstation was installed and tested in unix environment using tool command language the modules were created in vi editor. They were executed using ns command. This paper is main module. Further malicious node detection and elimination was done to still prove OLSR outperforms than AODV. **Conclusion:** In all the above four metrics the OLSR protocol performance is efficient than AODV when data transmission occurs between nodes in MANETs. From the results obtained we can observe OLSR outperforms AODV in all four parameters irrespective of different speed (time).

**Keywords:** AODV (Adhoc on Demand Distance Vector), MANET (Mobile Adhoc Networks), NS (Network Simulator), OLSR (Optimized Link State Routing Protocol), PDR (Packet Delivery Ratio)

## 1. Introduction

Adhoc networks are unplanned or spontaneous networks which do not have a pre-existing infrastructure or base station. Routing should be more efficient so that data and node will not be affected by attackers. The nodes in the MANETs are self-configuring networks. Due to the lack of infrastructure, the nodes in the MANETs act both as a router as well as a host. As MANETs are self-developing and highly dynamic, some special ad-hoc routing protocols have been developed. Ad hoc routing protocols should have the properties like Distributed Operation, loop free, demand based and unidirectional link support.

A Mobile Ad-Hoc Network (MANET)<sup>1</sup> is a collection of mobile nodes which communicate with each other via wireless link either directly or relying on other nodes as

routers. Since the nodes are movable from one network to another they are known as mobile adhoc networks or MANETs. Network nodes in MANETs are free to move randomly. Network topology of MANET may change dynamically without turning to any existing centralized administration<sup>2</sup> because of the mobility of nodes. All network activities such as discovering the topology and delivering data packets have to be executed by the nodes themselves, either individually or collectively. In MANETs every node acts as a potential router for other nodes. There are two types of protocol used for routing in the networks. They are: Reactive and Proactive. Reactive protocols are on demand routing protocol. In Proactive routes are set up or maintained all the time. Dynamic Source Distance Vector routing protocol (DSDV) and Adhoc On-demand Distance Vector (AODV) are reactive protocols. Link

\* Author for correspondence

State routing protocol is a proactive protocol. This paper analyses the performance efficiency of the optimized link state routing protocol with AODV using ns2 simulator.

To support robust and efficient operation in ad hoc networks Routing-based approach, Information-theoretic approach, Dynamic control approach or Game-theoretic approach has been implemented<sup>2</sup>. Based on the design goals of minimal control overhead, minimal processing overhead, multi hop routing capability, dynamic topology maintenance and loop prevention<sup>3</sup> routing protocols were formulated. Secure Efficient Adhoc Distance Vector (SEAD) is a proactive routing protocol, it is designed based on the Destination Sequenced Distance Vector routing protocol (DSDV). The SEAD protocol<sup>4</sup> uses one-way hash chains to prevent an attacker from forging better metrics or sequence numbers. In<sup>5</sup> provides the authentication mechanism to prevent the malicious node from tampering the next hop or destination field in route update. A comparison of the performance of DSDV, AODV and DSR Routing Protocols in MANET was done in<sup>6</sup>.

In<sup>7</sup> discussed some of the threats to wireless ad hoc networks, and, specifically, some attacks against the AODV routing protocol. The local and distributed attacks within its radio range are detected using a tool which provides effective intrusion detection. OLSR is an optimization of pure link state algorithm<sup>8</sup>. Denial-of-Service attacks and countermeasures are dealt in the paper<sup>9</sup> for IEEE 802.11 wireless networks. A considerable reduction in processing time and delay on the network was done using the combination of SHA-1 (Secure Hash Algorithm-1) and AES (Advanced Encryption Standard)<sup>10</sup>. In<sup>11</sup> proposed on demand delay and bandwidth based Quality of Service (QoS) routing protocol (AODV-D) to ensure that delay does not exceed a maximum value and the minimum available bandwidth to send the packets. In<sup>12</sup> reported the use of MD5 along with secure Key management technique sustain low energy consumption, less packet drop and increases the packet delivery ratio of the network. Two well-known MANET routing protocols (AODV and OLSR) and has been considered for their most popular properties in routing messages towards their destinations and have combined to formulate a Hybrid MANET routing protocol using the tool Exata Cyber 1.1 Emulator<sup>13</sup>. In<sup>14</sup> QoS of MANET through cryptography and routing protocol enhancement were analyzed. In the paper<sup>15</sup>, method to detect the malicious nodes using valid and invalid addresses, without triggering false detection across the network was proposed.

## 2. Proposed System

AODV is a reactive routing protocol. As and when required the routes are created so as to minimize the number of broadcasts. When the source wants to communicate it broadcasts a route request packet (RREQ) to the destination. The intermediate nodes in turn broadcast the packet to their neighbour nodes until it reaches the destination. While forwarding the route request intermediate nodes record the address of the neighbour from where the first copy of the packet is received. This detail is stored in their route tables which can be used while establishing a reverse path. If the same RREQ is later broadcasted they are ignored. Using the reverse path the reply is sent. In order to maintain the route, a route discovery process is re-initiated when the source node moves. The upstream neighbour receives a link failure notice through the neighbour of the drifting node. This process continues until the source node receives the failure notification. The source might decide to re-initiate the route discovery phase depending upon the received information.

The proposed system compares AODV with OLSR. An LSR algorithm optimized for mobile adhoc network is the OLSR (which can also be used on other wireless ad hoc networks). OLSR is proactive protocol. It uses Hello and Topology Control (TC) messages to find out the link and hand over the link state information to the mobile ad hoc network. <sup>16</sup>Using the Hello messages two hop neighbour information is revealed by every node. A set of Multipoint Relays (MPRs) are elected. The MPRs makes OLSR unique from other link state routing protocols.

OLSR does a Periodic exchange of control messages. Some messages are sent locally to enable a router to discover its neighbourhood. Some messages are sent in entire network to distribute the knowledge of topology. The routes are immediately available when needed (no delay is caused by route discovery). Each node floods a message with the list of the addresses of its interfaces and associated networks and/or hosts. <sup>17</sup>This paper deals with ant based routing optimization in MANETs.

## 3. Performance Parameter and Metrics

Using ns2 simulator, the two protocols are tested<sup>18</sup>. Steps involved in this are:

1. create a .tcl [tool command language file]

2. run ns <filename>
3. trace out the .tr files
4. create an awk file
5. run the graph file

In the .tcl file set up the simulator parameters initially as given in the table.

To achieve the required Quality of Service (QoS) various performance metrics are considered. The parameters considered and compared are throughput, PDR, energy spent, delay.

- a. Packet delivery Ratio:

PDR = The total data bits received / total data bits sent from source to destination. Figure 1 shows Packet Delivery Ratio.

- b. Energy Consumption: During transmission and receiving the amount of energy consumed by nodes in the networks through radio communication and processing is called as Energy consumption. Figure 2 shows Energy Consumptions.

- c. Throughput: Throughput is the average rate of successful data packets received at destination. It is usually measured in bits per second (bit/s or bps). Figure 3 shows the average throughput rate.

- d. Average end to end delay of data packets: It is the time taken by the packets to reach from source to destination.

## 4. Result Analysis

In this work the performance analysis is carried out in an adhoc network by varying pause time and keeping network area and no. of nodes as constant. Two protocols i.e. AODV and OLSR are considered for the comparison purpose on the above performance. In the Figure 1, the graph is plotted by taking time in x axis and PDR (packet delivery ratio) in y-axis. PDR = No. of bits received/ No. of bits sent. The redline shows performance of AODV in which PDR degrades when the time increases. The Greenline shows the performance of OLSR which increases the PDR when the time factor increases. In the Figure 2, the graph is plotted by taking time in x-axis and energy consumed in y-axis. The redline shows performance of AODV in which energy consumed increases as time increases. The Greenline shows the performance of OLSR in which energy consumed remains the same as the time increases also.

In the Figure 3, the graph is plotted by taking time in x-axis and throughput in y-axis. The redline shows

performance of AODV in which average packets received at the destination increases and at one point it starts decreasing as the time increases. The Greenline shows the performance of OLSR in which average packets received at the destination increases remains the same as the time increases also. In the Figure 4, the graph is plotted by taking time in x-axis and end-to-end delay in y-axis. The redline shows performance of AODV in which delay increases gradually and at one point it starts decreasing as time increases. The delay is not uniform. The Greenline shows the performance of OLSR in which delay remains the same as the time increases also. Table 1 shows Simulation parameters for MANETs

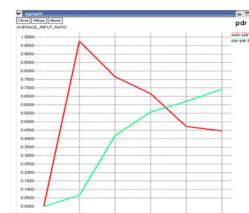


Figure 1. Packet delivery ratio.

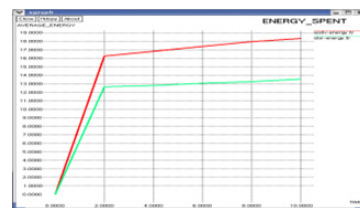


Figure 2. Energy consumptions.



Figure 3. Average throughput rate.



Figure 4. End-to-end delay.

**Table 1.** Simulation parameters for MANETs

| Simulation parameters | Value            |
|-----------------------|------------------|
| Network Type          | Mobile Adhoc     |
| No. of nodes          | 50 nodes         |
| Time Duration         | 0,2,4,6,8,10 s   |
| MAC Protocol          | MAC 802.11       |
| Simulation area       | 500x500sq.m      |
| Channel type          | Wireless Channel |
| Antenna type          | Omni Directional |
| Routing methods       | AODV & OLSR      |

## 5. Conclusion

Before designing a protocol in a Network in real environment simulation tools like NS2, MATLAB and WEKA can be used to test the performance of the network. In this paper using NS2 the analysis of OLSR and AODV protocol is done for the four parameters namely energy spent, PDR, end-to-end delay and throughput. Initially using AODV protocol the performance of the network is run in NS2 and then using OLSR protocol the same performance is tested with the same parameters. Finally the values are taken from both the output and a graph is plotted. In all the above four metrics the OLSR protocol performance is efficient than AODV when data transmission occurs between nodes in MANETs. From the results obtained we can observe OLSR outperforms AODV in all four parameters irrespective of different speed (time). Further wormhole and black hole attacks can be imposed on the routing protocol which degrades the performance of OLSR and these malicious nodes are then detected and dropped to improve the performance and further signature method is used to overcome the performance degradation to achieve better QoS and efficiency.

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