# PERFORMANCE EVALUATION OF AODV AND DSR ROUTING PROTOCOLS IN MANET NETWORKS

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## ABSTRACT

   *Extensive use of wireless networks in different fields increases the need to improve their performance, as well as minimize the amplitude of loss messages. Device mobility, where there is no standard topology that can be applied or fixed routing that can be designed, is a topic that received recent attention in wireless networks.*
*In a Mobile Ad Hoc Network (MANET), some nodes may join the network while others may leave. In this paper, we analyze a MANET's performance for two proactive protocols; Ad Hoc On-Demand Distance Vector (AODV) Protocol, and Dynamic Source Routing (DSR) Protocol.  By using network simulator NS2, we setup and evaluate the performance of AODV and DSR protocols with respect to the packets' size.*

## KEYWORDS

*Routing Protocols, Wireless Network, Mobile Network,Ad Hoc, MANET, NS2, DSR, AODV, Simulation.*

## 1. INTRODUCTION

### 1.1. Background

   Wireless networks provide connection flexibility between users in different places. Moreover, the network can be extended to any place or building without the need for a wired connection. Wireless networks are classified into two categories; Infrastructure networks and Ad Hoc networks as shown in Figure 1.
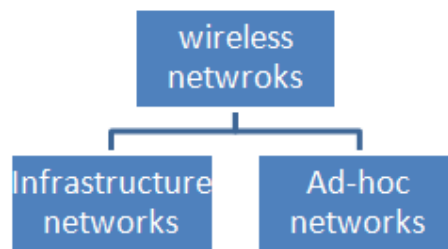


Figure1: Wireless Networks Categories

### 1.1.1. Infrastructure networks

An Access Point (AP) represents a central coordinator for all nodes. Any node can be joining the network through AP. In addition, AP organizes the connection between the Basic Set Services (BSSs) so that the route is ready when it is needed. However, one drawback of using

an infrastructure network is the large overhead of maintaining the routing tables. Figure 2 shows an infrastructure network.
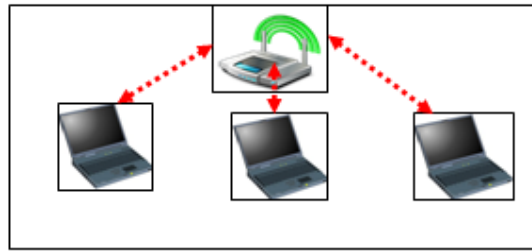


Figure 2: An Infrastructure Network

### 1.1.2. Ad Hoc networks

Ad Hoc networks do not have a certain topology or a central coordination point. Therefore, sending and receiving packets are more complicated than infrastructure networks. Figure 3 illustrates an Ad Hoc network.
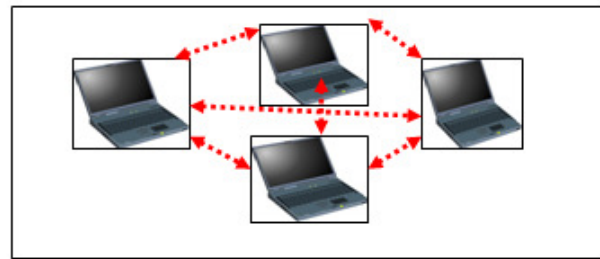


Figure 3: An Ad Hoc Network

Nowadays, with the immense growth in wireless network applications like handheld computers, PDAs and cell phones, researchers are encouraged to improve the network services and performance. One of the challenging design issues in wireless Ad Hoc networks is supporting mobility in Mobile Ad Hoc Networks (MANETs). The mobility of nodes in MANETs increases the complexity of the routing protocols and the degree of connection's flexibility. However, the flexibility of allowing nodes to join, leave, and transfer data to the network pose security challenges.

### 1.2. Motivation

A routing protocol plays a key role to measure the performance of a MANET. Routing protocols are classified under two categories;proactive protocols and reactive protocols as shown in Figure 4. When nodes move over time from one position to another, it's less efficient to use proactive(Table driven) protocols where route will be already established before a packet is sent. Therefore, reactive (On-Demand)protocolssuch as Dynamic Source Routing (DSR)protocol are more appropriate to be used in MANET networks.

In our research, we present two well-known reactive routing protocols; AODV and DSR. We evaluate the effect of packets' size on a MANET performance.
This paper is organized as follows; section II discusses some prior works for measurement of MANET performance, some performance metrics applied in our simulation are discussed in section III and in section IV, we present experimental results of AODV and DSR protocols. Finally, a conclusion is presented in section V.
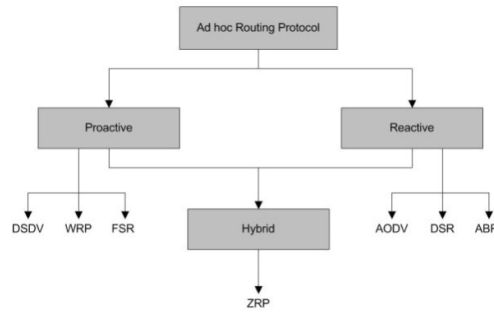
Figure 4: Routing Protocols

## 2. PRIOR WORK

Verma et. al. [1] discusses the MANET performance over AODV protocol. The authors focus on two parameters, Packet Delivery Fraction (PDF) and Average End to End Delay.

Where

$$PDF= (Actual\ Received\ Packet/Actual\ send\ packet)*100\% \quad (1)$$

$$Average\ End\ to\ End\ Delay= End\ to\ End\ delay/\ Received\ Packet \quad (2)$$

The authors conclude that the performance of AODV routing protocol over Transmission Control Protocol (TCP) is more efficient than Constant Bit Rate (CBR). Thus, TCP traffic is better than CBR traffic.

A comparison among AODV, DSR and ADV (proactive protocols) is presented in [2]. The authors conclude that an Adaptive distance vector (ADV) protocol provides lower connection time for TCP connection. Also, it provides higher throughput than DSR and AODV protocols with respect to the number of TCP connections over CBR traffic. On the other hand, ADV has higher overhead in bps than DSR and AODV [3].

Paul *et. al.* [4], include an interesting analysis of AODV and DSR performance over Vehicle Area Network (VANET) by studying the node density and node speed. The lower density and speed produce higher packet delivery ratio (PDR). Moreover, packet loss delay is reduced.The authors discuss the variation of DSR and AODV with respect to TCP and CBR. For example, when the node speed is high, the packet delivery ratio for AODV under TCP is average.

Asma *et. al.* [5] evaluate three routing protocols which are DSDV, AODV and DSR. The DSDV has low throughput but also has high routing load compared to AODV and DSR. Both AODV and DSR protocols perform very well. Although in some situations AODV outperforms DSR, DSR has the best performance especially when evaluated based on the average end to end delay. Moreover, changing the packet size doesn't affect the performance of DSDV but affects the performance of AODV and DSR. All protocols perform well when they are evaluated based on the mobility of the nodes.

 In the Monarch Project [6], the authors provide a comprehensive study about AODV, DSDV, TORA and DSR protocols. The study considers the periodic advertisements, On-demand route-discovery, hop-by-hop routing and source routing, and the usage of the feedback from MAC layer when there is a failure. The authors conclude that DSR is performing better than the other routing protocols at different mobility factors such as the mobility rate and the movement speeds.

In [7] the authors compare two routing protocols. The first protocol is the reactive Dynamic MANET On-demand (DYMO). The second protocol is the proactive Optimized Link State Routing (OLSR). The comparison is based on the packet delivery ratio, the average end-to-end delay and the normalized routing overhead. The results show that the performance of DYMO is better than OLSRin both MANET and VANET networks.

In [8], the authors study DYMO routing protocol with respect to average end-to-end throughput, average end-to-end delay, packet delivery ratio, routing overhead and path optimality. The authors compare AODV and DYMO routing protocols. They conclude that DYMO routing protocol performs better than AODV as it is being able to handle different mobility ranges and various traffic patterns.

## 3. Performance Metrics

The following parameters are used in our simulation to compare the performance of AODV and DSR routing protocols over a MANETnetwork.

- Sending time: time consumed to send packet from MAC to application layer.
- Accessing time: waiting time at MAC layer to access the transmission channel.
- Transmission time: time required to send a packet from the transmitter to the receiver through the physical layer.

    *Packet transmission time = Packet size / Bit rate*

- Propagation time: the time required for the signal to traverse through wireless link from transmitter to receiver.

    *Propagation time = distance / Speed Of Light*

- Reception time: the time when a packet is received at MAC layer of the receiver side.
- Receive time: the time when a packet is received at the application layer of the receiver side.
- Aggregate throughput: is the average of successful packets delivery via a communication link.
- Drop packet: it occurs when packet loss during travelling from source to destination.
- Efficiency of routing protocol

    *Efficiency = (No. of acknowledged packets / No. of transmitted packets) * 100*

## 4. Simulation and Results

This section describes the experimental tools setup and parameters used in simulation of a MANET network. Ubuntu 11 is used as the operating system because it is user friendly which makes it easy to manage. Network Simulation 2 (NS2.35) is used as simulation software which runs smoothly over Ubuntu 11. In Table 1, we describe MANET parameters that are used in this simulation to measure its performance and compare it with different protocols over a MANETnetwork.In our simulation, we are studying the relation between different MANET performance parameters with respect to packets' size.

Figure 5 shows the relation between packets' size and sending time. As the packets' size increases, the sending time increases. In the simulation, AODV protocol uses less amount of sending time compared to DSR.

In Figures 6, 7 and 8 AODV and DSR protocols achieve comparable results in accessing time, transmission time, and propagation time as the packets' size increases.

In Figure 9, we observe that throughput rapidly increases when the packets' size increases. On the other hand, in Figure 10 the amount of dropped packets increases when the packets' size increases.
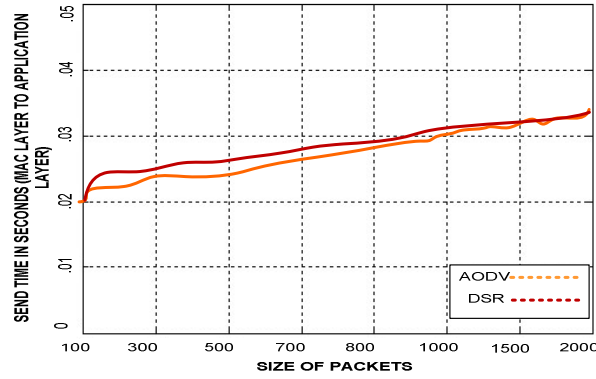
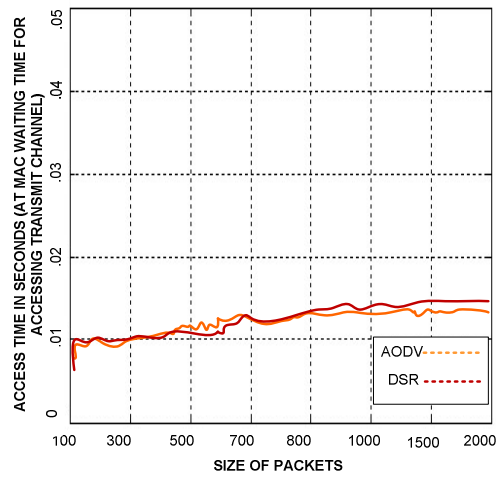Figure 5: Relation between packets' size and sending time over AODV and DSR



Figure 6: Relation between packets' size and accessing time over AODV and DSR

Table 1: Parameters used in simulation

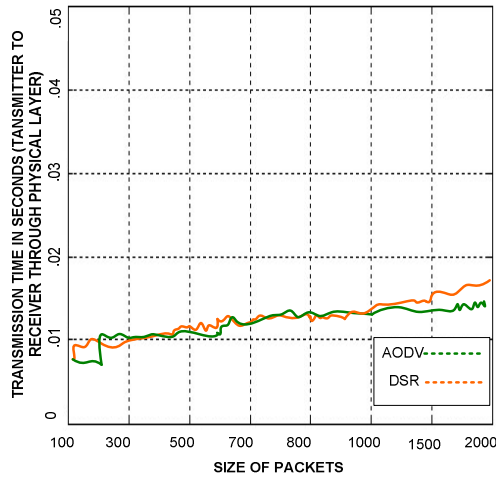| PARAMETER | VALUE |
|---|---|
| Operating system | Ubuntu 11 |
| NS2-2 Version | 2.35 |
| Channel type | Wireless Channel |
| Number of nodes | 15 |
| Speed | 3,5,7,10,20,25 |
| Data type | UDP/CBR |
| Simulation Time | 160 seconds |
| MAC protocol | MAC/802.11 |
| Data packet size | 100, 300, 500, 700, 800, 1000, 1500, 2000 |
| Area of simulation | 700*700 |
| Radio Propagation Model | TwoRayGround |
| Routing Protocol | AODV/DSR |

Figure 7: Relation between packets' size and transmission time over AODV and DSR
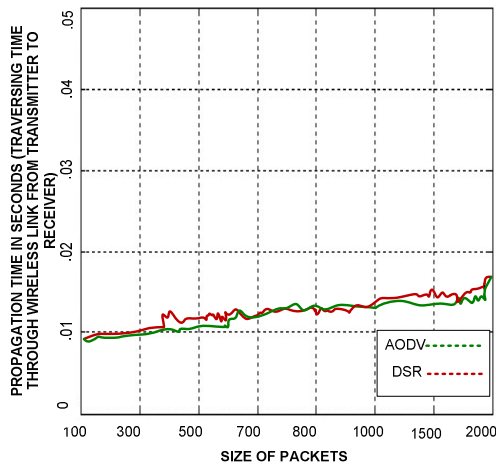


Figure 8: Relation between packets' size and propagation time over AODV and DSR
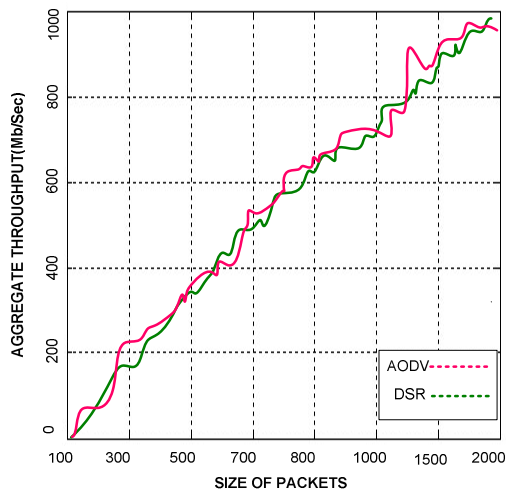


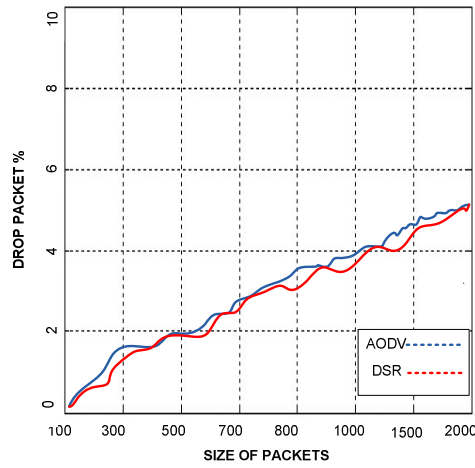Figure 9: Relation between packets' size and throughput over AODV and DSR

Figure 10: Relation between packets' size and dropping packets over AODV and DSR
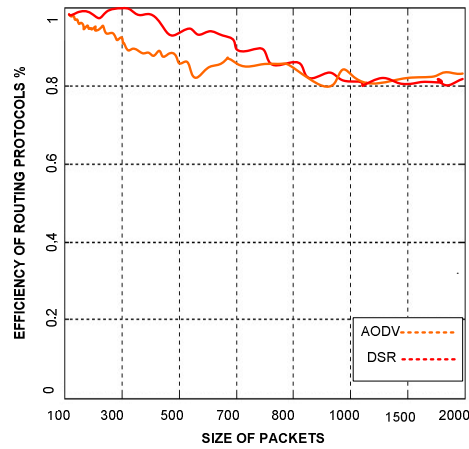


Figure11: Relation between packets' size and efficiency over AODV and DSR

Figure 11 shows the protocols' efficiency where a small packet size leads to better performance and an increase in the packets' size decreases the efficiency.

Figures 12 and 13 show the relation between packets' size, and transmitted and received traffic for DSR and AODV protocols respectively. It can be observed that the performance of both protocols is comparable.
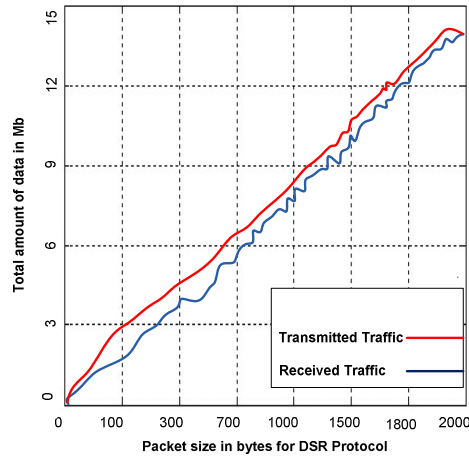
Figure12: Relation between packets' size and transmitted and received traffic for DSR protocol
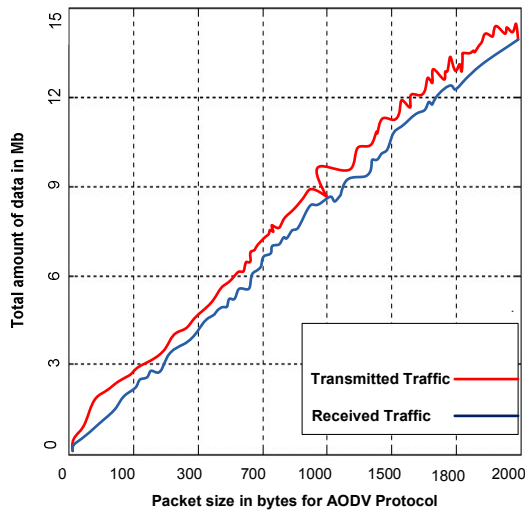


Figure13: Relation between packets' size and transmitted and received traffic for AODV protocol

## 3. CONCLUSIONS

In this paper, we studied the performance of two MANET reactive routing protocols; AODV and DSR. The different performance metrics were investigated with respect to packets' size.

In our experiments, DSR has shown better performance in terms of efficiency for a packet size less than 700 bytes. However, both protocols have illustrated comparable results for other performance metrics.

It is expected that our future studies will investigate the performance of proactive protocols versus the performance of reactive protocols and the possibility of introducing a new hybrid protocol that capitalizes on the strengths of both categories.

## ACKNOWLEDGEMENTS

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