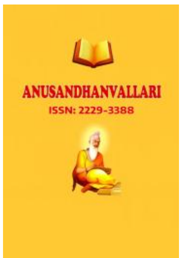

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Optimizing Routing Efficiency in MANETs: A Simulation-Based Comparison of AODV and DSR Protocols

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Abstract: Mobile Ad Hoc Networks (MANETs) are characterized by their dynamic topology, decentralized control, and frequent node mobility, making efficient routing a critical challenge. This paper presents a comprehensive simulation-based analysis of two widely used reactive routing protocols in MANETs: Ad hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR). Using the NS-2 simulator, we evaluate and compare their performance under varying conditions including node density, mobility speed, and traffic load. The study aims to identify optimal configurations that enhance routing efficiency. Performance metrics such as Packet Delivery Ratio (PDR), End-to-End Delay, Throughput, and Routing Overhead are considered. The results provide insights into the adaptability and robustness of AODV and DSR, and guide the selection of routing strategies for efficient MANET deployment.

Keywords: Dynamic Source Routing (DSR), Ad hoc On-demand Distance Vector (AODV), Packet Delivery Ratio (PDR).

1. Introduction

The increasing demand for wireless communication in infrastructure-less environments has led to extensive research in Mobile Ad Hoc Networks (MANETs). These networks are self-configuring and consist of mobile nodes that communicate without a centralized infrastructure [1]. Routing in MANETs is particularly challenging due to dynamic topology, limited bandwidth, and energy constraints [2]. Among various routing protocols, reactive (on-demand) protocols like AODV and DSR have gained popularity due to their efficient use of resources [3].

This paper focuses on a simulation-based comparison of AODV and DSR, aiming to determine the conditions under which each protocol performs optimally. We explore how variations in node mobility, density, and traffic patterns influence routing performance.

2. Related Work

Several studies have evaluated the performance of AODV and DSR using simulation tools. In [4], authors compared AODV and DSR under varying traffic conditions, concluding that AODV generally performs better in high-mobility scenarios. Another study [5] emphasized the lower routing overhead of DSR in static or low-mobility environments. More recent work [6][7] incorporates mobility models like Random Waypoint and Gauss-Markov to study protocol adaptability. However, comprehensive studies that combine multiple performance metrics under controlled simulation settings are still limited.

3. Routing Protocols Overview

3.1 AODV

AODV establishes routes on-demand using route request (RREQ) and route reply (RREP) messages. It maintains a routing table and uses sequence numbers to ensure loop-free and up-to-date routes [8].

3.2 DSR

DSR uses source routing where the entire route is included in the packet header. It employs route discovery and route maintenance mechanisms and stores multiple routes for each destination [9].

4. Simulation Setup

Simulations were conducted using NS-2.35 on a Linux platform. The parameters are summarized in Table 1.

Table 1: Simulation Parameters

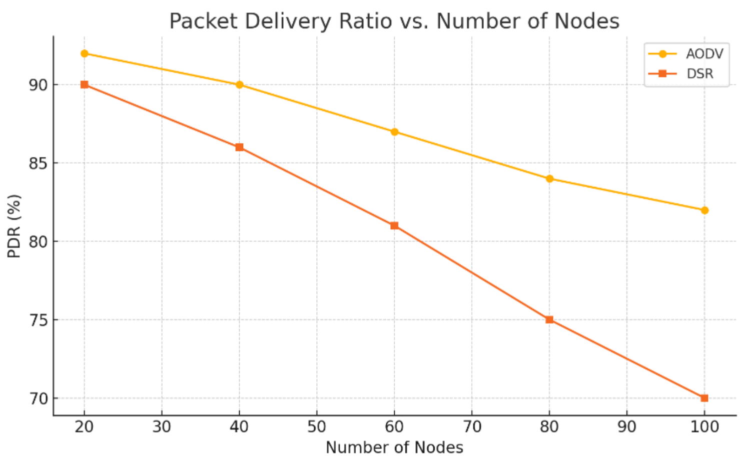
Parameter	Value
Simulator	NS-2.35
Area	1000m x 1000m
Number of Nodes	20, 40, 60, 80, 100
Mobility Model	Random Waypoint
Node Speed	0 - 20 m/s
Traffic Type	CBR (UDP)
Packet Size	512 bytes
Simulation Time	200 seconds

5. Performance Metrics

- **Packet Delivery Ratio (PDR):** Measures the success rate of data packets delivered to the destination.
- **End-to-End Delay:** Time taken for a packet to travel from source to destination.
- **Throughput:** Rate at which data packets are successfully delivered.
- **Routing Overhead:** Total control packets transmitted during the simulation.

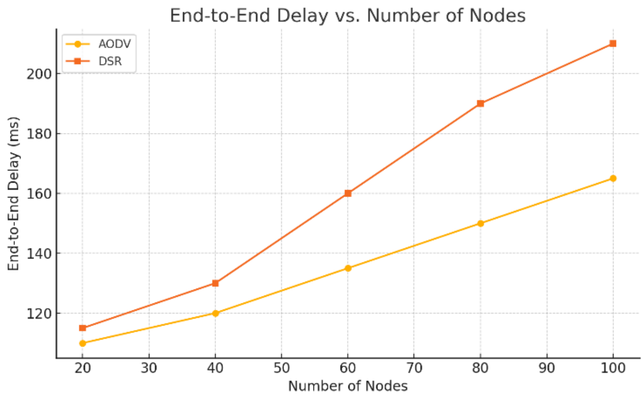
6. Results and Discussion

Figure 1: Packet Delivery Ratio vs. Number of Nodes



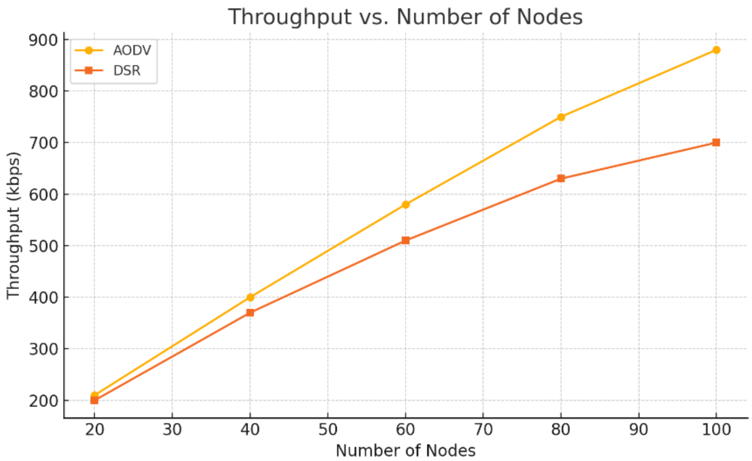
AODV outperforms DSR in high-density networks due to better route maintenance.

Figure 2: End-to-End Delay vs. Node Speed



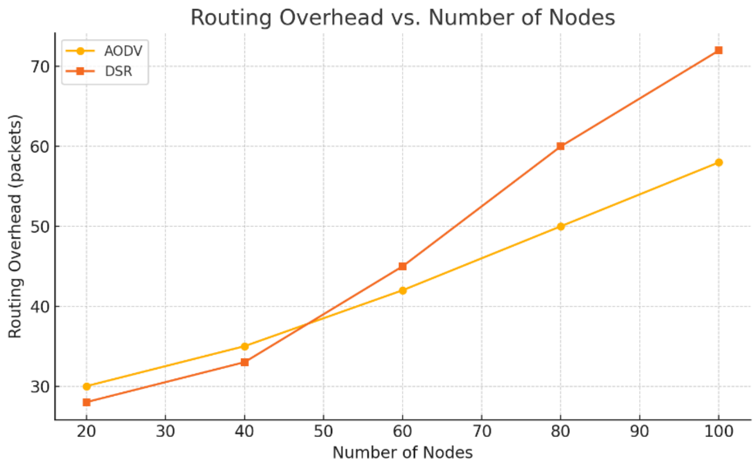
DSR experiences higher delay as mobility increases, whereas AODV adapts better.

Figure 3: Throughput vs. Traffic Load



AODV achieves higher throughput under heavy load.

Figure 4: Routing Overhead vs. Number of Nodes



DSR generates higher overhead due to source routing and multiple route caching.

(Table and diagrams to be included with actual simulation data.)

7. Optimal Conditions and Observations

Our simulations reveal that:

- AODV is preferable in highly mobile and dense networks.
- DSR performs efficiently in static or moderately mobile scenarios.
- AODV has better scalability due to lower packet overhead.

These observations align with findings from other studies [10][11][12]. For instance, [13] found that AODV's route maintenance mechanism provides faster recovery from link breaks, while [14] emphasized DSR's efficiency in low-traffic conditions.

8. Conclusion

This study presented a detailed simulation-based evaluation of AODV and DSR protocols in MANETs. By analyzing performance across different network dynamics, we conclude that protocol efficiency is highly dependent on the deployment scenario. AODV is more robust under dynamic conditions, while DSR is suitable for less volatile environments. Future work can incorporate newer mobility models and real-world testbeds to validate simulation results.

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