

Performance Analysis of MANET Protocols: A Comparative Study of DSR, AODV, DSDV, and OLSR Based on Packet Delivery Ratio, Average Throughput, and Average Delay

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Abstract: Mobile Ad hoc Networks (MANETs) are decentralized networks where nodes communicate directly with each other without a fixed infrastructure. Routing protocols in MANETs play a critical role in establishing efficient communication paths among mobile nodes. This survey paper offers a comprehensive review and comparative analysis of four widely utilized MANET protocols—Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector (AODV), Destination-Sequenced Distance Vector (DSDV), and Optimized Link State Routing (OLSR). The evaluation encompasses an extensive examination of existing literature and research findings regarding the performance of these protocols. Rather than implementing new solutions, this study synthesizes the results from various sources to provide insights into the comparative performance of these protocols. Through a systematic review of literature, this paper discusses the key performance metrics, such as packet delivery ratio, average throughput, and average delay, associated with each protocol. Furthermore, it examines the impact of network size, node mobility, and traffic patterns on the performance of these protocols, offering valuable insights into their behavior in diverse MANET scenarios. The findings of this survey aim to assist researchers and practitioners in making informed decisions regarding the selection of optimal routing protocols for MANET deployments.

Keywords: MANET protocols, NS-3 simulation, performance analysis, packet delivery ratio, average throughput, average delay

I. INTRODUCTION

Mobile Ad hoc Networks (MANETs) have attracted considerable attention in recent years due to their distinct characteristics and versatile applications across various domains, including military operations, disaster management, and IoT deployments [1]. MANETs comprise self-organizing networks of mobile nodes that communicate wirelessly without relying on a pre-established infrastructure. This inherent flexibility and adaptability make MANETs suitable for scenarios where traditional wired or infrastructure-dependent networks are impractical or unavailable.

Routing protocols play a crucial role in MANETs by dynamically establishing and maintaining communication paths among mobile nodes, facilitating efficient data transmission in dynamic and resource-constrained environments [2]. These protocols must address challenges such as node mobility, limited bandwidth, energy constraints, and network topology changes to ensure reliable and timely data delivery.

Several routing protocols have been developed for MANETs, each with distinct mechanisms for route discovery, maintenance, and data forwarding. Among the widely studied and implemented protocols are Dynamic Source Routing (DSR) [3], Ad hoc On-Demand Distance Vector (AODV) [4], Destination-Sequenced Distance Vector (DSDV) [5], and Optimized Link State Routing (OLSR) [6]. These protocols have undergone extensive research and evaluation to assess their performance, scalability, and suitability for various MANET scenarios.

Performance evaluation and comparison of MANET routing protocols are critical for understanding their behaviour under different network conditions and selecting the most appropriate protocol for specific deployment scenarios [7]. Key performance metrics such as packet delivery ratio, average throughput, and average delay are commonly used to quantify the efficiency, reliability, and latency aspects of routing protocols.

This survey paper presents a comprehensive review and comparative analysis of the aforementioned MANET protocols—DSR, AODV, DSDV, and OLSR—leveraging modern simulation tools such as NS-3. By synthesizing recent research advancements and empirical studies, this analysis aims to provide valuable insights into the comparative performance of these protocols, considering factors such as network size, node mobility patterns, and traffic variations. The findings of this study can guide network designers, researchers, and practitioners in selecting optimal routing protocols to enhance communication efficiency and reliability in MANET deployments.

II. LITRATURE SURVEY

In the realm of Mobile Ad Hoc Networks (MANETs), the selection and performance evaluation of routing protocols play a pivotal role in ensuring efficient data transmission.

Various studies have delved into this domain, comparing and analyzing different routing protocols to ascertain their effectiveness under diverse conditions. Here is an overview of the key findings from recent research papers related to routing protocol comparisons in MANETs:

Sureshkumar et al. (2017):

This study compared two prominent routing protocols in MANETs, namely DSDV and AODV. The focus was on understanding how these interest/reactive protocols perform under varying conditions. The key result from this study was the observation that AODV showed continuous improvement with denser mediums and higher speeds, making it a preferable choice for such scenarios.[8]

Bai et al. (2017):

Bai and colleagues evaluated the performance of AODV, DSR, and DSDV routing protocols in MANETs. They found that AODV demonstrated superior throughput and lower average end-to-end delay compared to DSR, which exhibited a better packet delivery ratio (PDR). As the network size increased, AODV, being a reactive protocol, became more dominant across performance metrics.[9]

Kaur & Kaur (2021):

This study conducted a comparative analysis of recent routing protocols in MANETs, focusing on throughput, PDR, end-to-end delay, and energy efficiency. The researchers emphasized the dynamic nature of reactive protocols like AODV, which showcased better functionalities and performance compared to proactive protocols such as DSDV.[10]

Wang et al. (2022):

Wang and team explored the mechanisms and performance of AODV, OLSR, and BATMAN protocols in MANETs. Their simulations revealed that BATMAN and OLSR performed well in scenarios with dynamic network topology changes, while AODV demonstrated robustness in mobile MANET networks. OLSR, on the other hand, showed better adaptability to changes in network scale.[11]

Singh (2021):

Singh's research focused on comparing WANET protocols, specifically AOMDV, DSDV, and DSR, under different mobility models and node densities. The study highlighted that DSR outperformed in terms of throughput, PDR, and packet loss ratio (PLR) across varying scenarios, indicating its suitability for specific network load conditions.[12]

III. OVERVIEW OF ROUTING PROTOCOLS IN MANET

MANET routing protocols is a type of protocols who doesn't need any centralized tower for establish a connection. Node connects directly to each other. MANET is effective for local areas.

There are three types of routing protocol first proactive second reactive and last hybrid protocol.

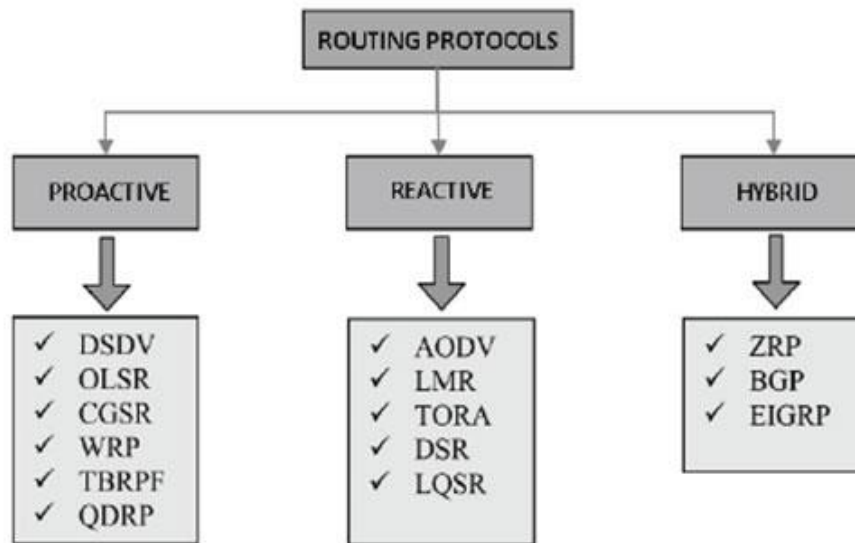


Fig 1. Types of Routing Protocols

A. PROACTIVE ROUTING PROTOCOLS

Proactive routing protocol is a type of routing protocol where each node knows the entire topology of the network. Every node knows the all-latest information required for routing. There are many examples of this such as: Destination Sequenced Distance Vector (DSDV), Optimized Link State Routing (OLSR).

- **DSDV (Destination Sequenced Distance Vector)**

DSDV is one of the popular once reactive protocol or on-demand routing protocol. DSDV is used widely it is also known as table-driven routing protocol for MANET. DSDV is depend on number of hops to reach destination node. DSDV protocol is has several Major characteristics one of these are every node in DSDV protocol has entire topology and other information required for routing.

- **Optimized Link State Routing (OLSR)**

OLSR stands for Optimized Link State Routing protocol. In OLSR each node re-broadcasts link state information received from its neighbors. Each node keeps track of information received from other nodes. And that node use received information for determine next hope to each destination. It is proactive and table-driven.

B. REACTIVE ROUTING PROTOCOLS

Reactive routing protocols are on demand routing protocols and the route information continually updates with the latest route topology. It floods a query into the network to obtain the path to destination instead of the source node wants to transmit a packet. There are several examples for Reactive routing protocols such as: Ad-hoc on demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR)[2].

- **AODV (AD-HOC ON DEMAND DISTANCE VECTOR)**

AODV does not know the topology of the whole network. It only knows the next node and last node. So when node wants to send packets to destination. Node sends a route request (RREQ) and when the route is discovered destination node sends a route reply (RREP). If destination node is not found it can reinitiate route when route error (RERR) message is received by source node. AODV is a loop free protocol and it avoids count infinity problem by using sequence number.

- **DSR (DYNAMIC SOURCE ROUTING)**

DSR is also reactive or on-demand routing protocol. DSR is designed for reducing bandwidth wasted via the packets in wireless adhoc network. In DSR protocol it does not need any infrastructure or administration , because it is fully self-configure network. The source routing does not need to keep the routing information via the intermediate hops

C. HYBRID ROUTING PROTOCOLS. HYBRID ROUTING PROTOCOLS

This protocol is a combination of (proactive + reactive) protocols. ZRP (Zone Routing Protocol) have been a classic example in which the allover topology is divided into a zones hierarchy. Proactive routing is used within each zone locally, while reactive routing protocol used beyond the zone. All nodes within r hops radius are considered a zone [2].

- **Enhanced Interior Gateway Routing Protocol (EIGRP)**

Enhanced Interior Gateway Routing Protocol (EIGRP) is a Cisco proprietary enhanced Distance Vector routing protocol. EIGRP is based on IGRP, hence the configuration is similar. Enhanced Interior Gateway Routing Protocol (EIGRP) is considered as a Hybrid Routing Protocol because EIGRP has characteristics of both Distance Vector and Link State Routing Protocols.

Table 2: Features of Routing Protocols

Features	Reactive	Proactive	Hybrid
Routing Structure	Flat	Flat/Hierarchical	Hierarchical
Route Acquisition	On demand	Table driven	Combination of both
Routing Overhead	Low	High	Medium
Latency	High due to flooding	Low due to routing tables	Inside zone Low outside similar to reactive protocols
Scalability	Not suitable for large networks	Low	Designed for large networks
Routing information	Available when required	Always available	Combination of both
Periodic Updates	Not needed	Yes whenever the topology of the network changes	Yes
Mobility	Route Maintenance	Periodic updates	Combination of both

IV. CONCLUSION

In conclusion, this study delved into the realm of Mobile Ad-Hoc Networks (MANETs), focusing on the comparative analysis of several routing protocols including AODV, DSR, DSDV, and OSLR. Through an extensive literature review and related studies, we explored the performance metrics and characteristics of these protocols based on packet delivery ratio, overhead, throughput, and average delay. Our research findings indicate that the DSR routing protocol demonstrates better overhead performance as the number of nodes increases. On the other hand, the AODV routing protocol exhibits higher Packet Delivery Ratio and Average Throughput as the number of nodes increases, while also maintaining a reasonable Average Delay. These insights provide valuable guidance for network designers and researchers in optimizing MANET performance based on specific network requirements and objectives

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