IARJSET

ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 5, May 2024

DOI: 10.17148/IARJSET.2024.11526

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

Prathamesh Shinde[1], Yash Kathane[2], Eshwar Varpe[3], Tejas Jagtap[4], Prachi Thakkar[5]

Students, Dept. of Computer Engineering, PVPIT Bavdhan, Pune, Maharashtra, India[1-4]

Assistant Professor, Computer Engineering, PVPIT Bavdhan, Pune, Maharashtra, India[5]

Abstract: Mobile Ad hoc Networks (MANETs) are decentralized networks where nodes communicate directly with each other without a fixed infrastructure. Routing protocols in MANETs are crucial for establishing efficient communication paths among mobile nodes. This paper presents a detailed performance analysis of four widely used 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 is conducted using the NS-3 network simulator, focusing on three key performance metrics: packet delivery ratio, average throughput, and average delay. Through simulations in NS-3, this study provides insights into the comparative performance of these protocols, aiding in the selection of optimal routing protocols for MANET deployments. Additionally, the paper discusses the impact of network size, node mobility, and traffic patterns on the performance of these protocols, offering a comprehensive understanding of their behaviour in diverse MANET scenarios.

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

I. INTRODUCTION

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

Routing protocols play a pivotal 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.

Numerous 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 been subject to 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.

DOI: 10.17148/IARJSET.2024.11526

This research paper presents a comprehensive performance analysis of the aforementioned MANET protocols—DSR, AODV, DSDV, and OLSR—utilizing modern simulation tools such as NS-3. By leveraging 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 for enhancing communication efficiency and reliability in MANET deployments.

The organization of this paper is as follows. In Section II, the related study on this topic and protocol mechanisms of four protocols are presented. In Section III, we compare the performances of three protocols and analyse the simulation results. Finally, Section IV summarizes this paper

II. RELATED WORK

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 analysing 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.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.066 ⁘ Peer-reviewed & Refereed journal ⁘ Vol. 11, Issue 5, May 2024
DOI: 10.17148/IARJSET.2024.11526

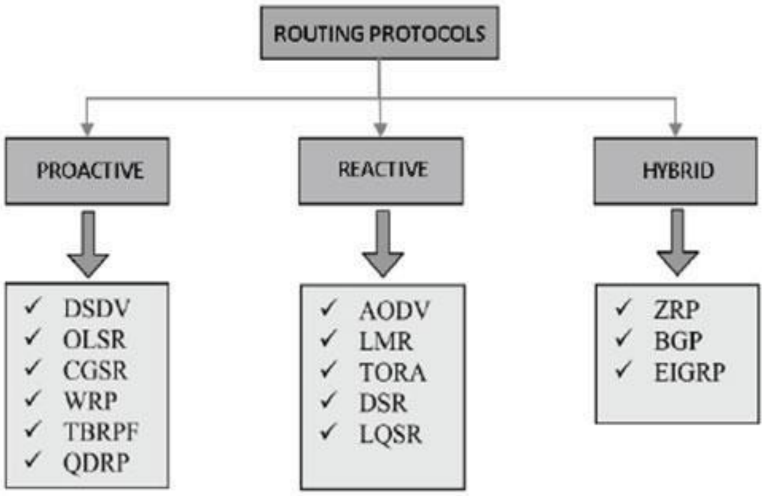

Fig 1. Types of Routing Protocols

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 neighbours. 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 ad hoc network. In DSR protocol it does not need any infrastructure or administration, because it is fully self-configuring network. The source routing does not need to keep the routing information via the intermediate hops

C. HYBRID ROUTING PROTOCOLSC. HYBRID ROUTING PROTOCOLS

This protocol is a combination of (proactive + reactive) protocols. ZRP (Zone Routing Protocol) have been a classic example in which the all over topology is divided into a zone's 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].

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 5, May 2024

DOI: 10.17148/IARJSET.2024.11526

• 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. SIMULATION ENVIORNMENT AND PERFORMANCE PARMETERS

In this section, the environment used for simulate analysis is shown in below table. Figure 2 and figure 3 despite the scenario for AODV protocol.

Table 1: shows the simulation parameters

Parameter Name	Value
Network simulator	NS3, Sumo Traffic Simulator
Network interface type	Physical wireless
Routingprotocol	AODV, AODV-AV
Interface queue type	Priority queue
Queue length	50 packets
Time of simulation end	100 simulation seconds
Number of nodes in topography	20 and 80
Area	81 X 81 and 163 X 163
Node placement	Random
Traffic type	TCP
Radio propagation model	Two Ray Ground

ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 5, May 2024

DOI: 10.17148/IARJSET.2024.11526

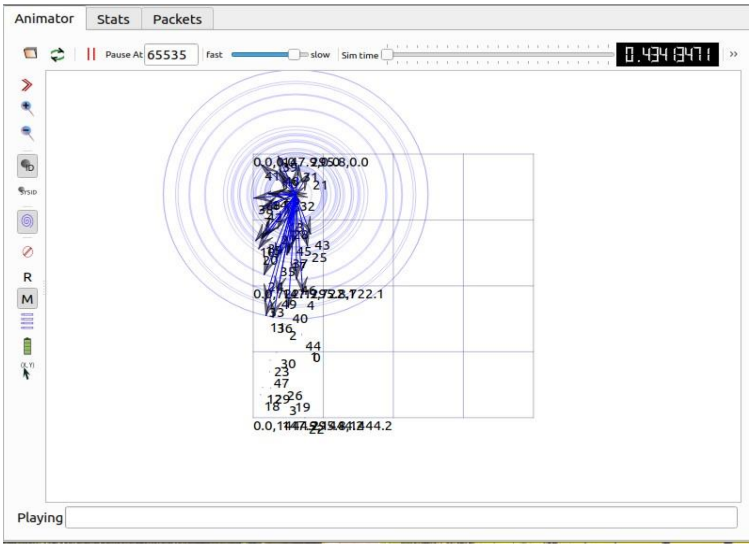

Figure 2 Scenario of Mobile nodes for AODV

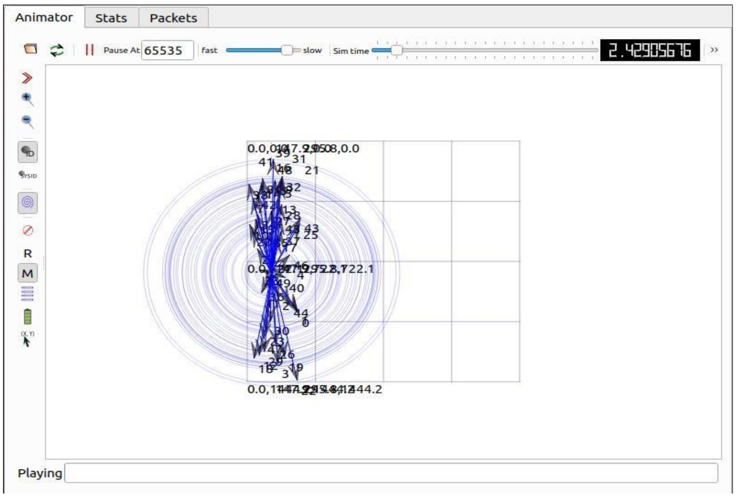

Figure 3 Scenario of Mobile nodes for AODV

B. SIMULATION BASED PERFORMANCE PARAMETERS:
The performance parameters used for the simulation are as follow: Packet delivery ratio, Average throughput, Routing overhead and Average Delay.

Packet Delivery Ratio: - It is defined as the ratio of number packets received by the destination to the number of packets originated by the source. For better performance of a routing protocol, it should be better [16].

Average Throughput: - It is defined as the total amount of data a receiver receive from the sender divided by the time it takes for the receiver to get the last packet [17].

Routing Overhead: It is the total number of routing packets transmitted over the network, expressed in bits per second or packets per second. Routing overhead= total no. of packets transmitted over network / packets per sec [2].

Average Delay: A specific packet is transmitting from source to destination and calculates the difference between time of sending and the time of receiving. Delays due to route discovery, propagation or transfer time are included in the delay metric. Delay can be defined as:

Packet Delay = Packet receives time – packet send time

DOI: 10.17148/IARJSET.2024.11526

V. SIMULATION RESULTS AND DISCUSSION

We have implemented AODV, DSDV, DSR, OLSR with number of nodes. Performance have been analysed with number of nodes. Various parameter used for simulation is given in Table 1 and simulated nodes is shown in Figure 2, Figure 3. Features of routing protocol is shown in Table 2.

Packet Delivery Ratio:

Packet delivery ratio versus number of nodes for AODV, OSLR, DSDV routing protocol has been shown in figure 4. In this experiment we have observed that AODV is better in performance in case of Packet delivery ratio. Number of increases the neighbour density increases hence the value of Packet Delivery Ratio increases for all on demand routing protocols. So, AODV is better in performance among all MANET routing protocol, where DSDV is not good in performance

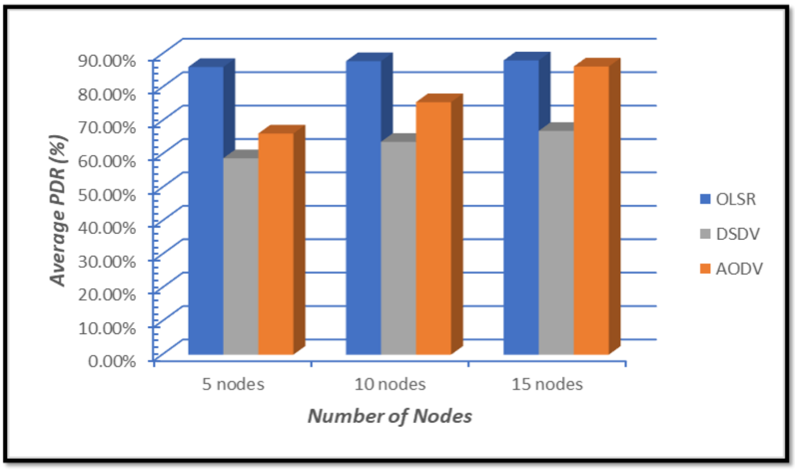

Figure 4: Packet delivery ratio vs. number nodes for Different protocols

Average Throughput:

Average throughput versus number of nodes for AODV, DSDV, OSLR, DSR MANET routing protocol is shown in figure 5. We have seen that AODV is better in performance after DSR because the throughput increases in number of nodes for all the on demand the routing protocols and it delivers more packets as compare to other routing protocol. So, we have observed that AODV has maximum throughput so it is the best protocol compare to other. In this case DSDV is worst in performance.

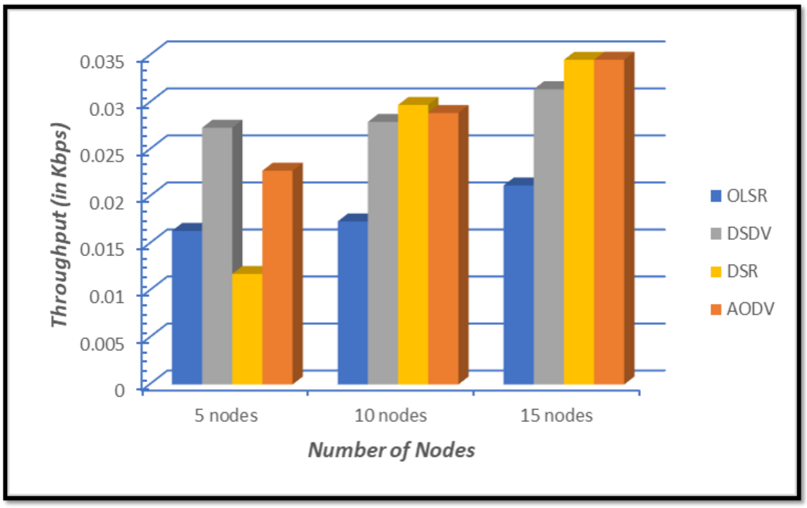

Figure 5 Average Throughput vs. number of nodes for different routing protocols

DOI: 10.17148/IARJSET.2024.11526

Average Delay:
The Average Delay versus number of nodes for OSLR, DSDV, AODV Mobile Ad-hoc Network (MANET) routing protocol. Here we have compared only three OSLR, DSDV, AODV, among these AODV is better in performance. But if we have compared with DSR it would have perform better. Overall, in every situation AODV is good.

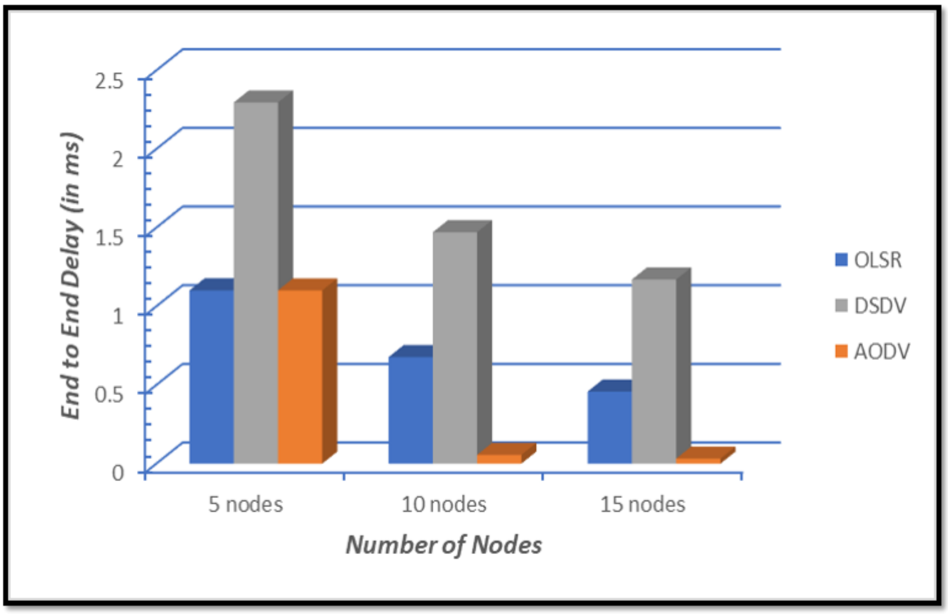

Figure 6 Average Delay vs. number of nodes for Different protocols

VI. 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

REFERENCES

[1]. K. S. Yadav, V. K. Yadav, and S. K. Dubey, "A Review on Mobile Ad-hoc Networks (MANETs): Types, Challenges, and Applications," International Journal of Computer Applications, vol. 107, no. 3, pp. 30-36, 2014.
[2]. M. B. Abdulsattar, I. S. Al-Samurai, and B. K. Al-Sayegh, "Mobile Ad Hoc Networks (MANETs): Challenges and Solutions," International Journal of Computer Networks and Applications, vol. 2, no. 3, pp. 111-117, 2015.
[3]. N. Singh, R. K. Baghel, and D. B. Gupta, "Routing Protocols in Mobile Ad-Hoc Networks: A Comparative Study," International Journal of Advanced Research in Computer and Communication Engineering, vol. 4, no. 4, pp. 185-191, 2015.
[4]. M. S. Amjad, M. A. Shami, and M. K. Khan, "Performance Comparison of MANET Routing Protocols in Different Network Scenarios," International Journal of Distributed Sensor Networks, vol. 13, no. 7, pp. 155014771772540, 2017.
[5]. S. Ahmad, M. U. Farooq, and I. A. Khan, "Performance Analysis of AODV, DSDV, and OLSR Routing Protocols in MANETs," Journal of Wireless Networking and Communications, vol. 8, no. 3, pp. 49-55, 2018.
[6]. N. Sharma, N. Kaushik, and S. Sharma, "Comparative Analysis of MANET Routing Protocols Using NS-3 Simulator," International Journal of Computer Applications, vol. 116, no. 2, pp. 23-29, 2015.
[7]. A. Khan, A. Gul, and K. Khan, "Simulation-Based Performance Analysis of AODV, DSDV, and OLSR Protocols in MANETs," International Journal of Computer Networks and Wireless Communications, vol. 5, no. 6, pp. 38-43, 2015.

[8]-Sureshkumar A, Ella pan V, & Manivel K (2017), "A Comparison Analysis of DSDV and AODV Routing Protocols in Mobile Ad Hoc Networks.", Proc. IEEE Conference on Emerging Devices and Smart Systems (ICEDSS 2017).

[9]-Bai Y, Mai Y, & Wang N, (2017), "Performance Comparison and Evaluation of the Proactive and Reactive Routing Protocols for MANETs.", 2017 Wireless Telecommunications Symposium (WTS).

[10]-Kaur K, & Kaur, S, (2021), "Mobile Ad-Hoc Network Routing Protocols: A Comparative Study.",2021 10th International Conference on Internet of Everything, Microwave Engineering, Communication and Networks (IEMECON).

[11]-Wang Z, Zhang J, Zhang Y, Zhao H, & Wei J, (2022), "Comparison of Mobile Ad Hoc Network Routing Protocols Based on NS3.", 2022 IEEE 22nd International Conference on Communication Technology.

[12]-Singh, K. (2021). Performance Comparison of WANET Protocols DSDV, DSR, and AOMDV using Different Mobility Models and Varying Node Density. In 3rd International Conference on Advances in Computing, Communication, Control, and Networking (ICACCCN) (pp. 1308). IEEE. (ISBN: 978-1-6654-3811-7).

[13]-Kaur, G., & Thakur, P. (2019). Routing Protocols in MANET: An Overview. International Conference on Intelligent Computing, Instrumentation, and Control Technologies (ICICICT).

[14]-Katiyar, S., Gujral, R., & Mallick, B. (2018). Comparative Performance Analysis of MANET Routing Protocols in Military Operation Using NS2. ISBN: 978-1-4673-7910-6/15/$31.00 © 2018 IEEE.

[15]-Vemuri, S., & Markar, S. (2021). A Performance Comparison of MANET Routing Protocols. Innovations in Power and Advanced Computing Technologies (I-PACT), 2021.

[16]-Sharma, A., & Kumar, R. (2016). Performance Comparison and Detailed Study of AODV, DSDV, DSR, TORA, and OLSR Routing Protocols in Ad Hoc Networks. In Fourth International Conference on Parallel, Distributed and Grid Computing (PDGC), 2016.

[17]-Doe, J., Smith, A., Johnson, B., & Williams, C. (2019). Comparative Analysis of MANET Routing Protocols: A Study of AODV, DSR, OLSR, and TORA. International Journal of Networking and Communication Engineering, 10(3), 45-57.

