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# Comparative Analysis of Enhanced Routing Protocols for Manets

[1]**Megha D R**

[1]Research Scholar, Department of Computer Science & Engineering, Mansarovar Global University, Sehore, Madhya Pradesh

[2]**Dr. G Somasekhar**

[2]Supervisor, Department of Computer Science & Engineering, Mansarovar Global University, Sehore, Madhya Pradesh

**ABSTRACT**

To increase performance in mobile ad hoc networks (MANETs), this paper presents and assesses two upgraded routing protocols, UAEROR and UAROR, which are built around the PLA-DSR protocol. While UAROR takes mobility speed and direction into account to improve routing performance and node stability, the suggested protocols use sophisticated algorithms for link prediction and topology management. A neighbor discovery approach is introduced by UAEROR to better improve routing and decrease control overhead. These protocols outperform PLA-DSR and UAROR on important network metrics according to the results of the NS2.35 performance study. Throughput, end-to-end latency, packet delivery ratio, network lifespan, energy consumption, and control overhead are some of the metrics that the simulation results compare the proposed protocol against.

**Keywords:** Network, Power, Routing, Nodes, Protocol

## I.INTRODUCTION

In mobile ad hoc networks (MANETs), nodes talk to one other without using any kind of pre-existing infrastructure like routers or access points. The network itself organizes itself. There are substantial obstacles to efficient communication in MANETs due to their changing architecture, decentralized governance, and limited resources. Reliable data transmission, efficient networks, and the ability to react to frequent topology changes are all made possible by routing protocols in this setting. Research on reliable MANET routing protocols has been crucial due to the growing need for autonomous communication systems in many domains, including but not limited to military operations, disaster recovery, vehicle networks, and the Internet of Things (IoT).

With their dual functionality as hosts and routers, mobile nodes make up a MANET, allowing it to dynamically configure itself. These networks are perfect for situations where traditional networks wouldn't function since they don't rely on a permanent infrastructure. This means they can operate in varied and unexpected circumstances. Consistent route maintenance, energy consumption optimization, and security threat mitigation are some of the difficulties introduced by these similar qualities. For this reason, MANET routing protocols need to be scalable, energy efficient, and resistant to malicious actions and node mobility.

There are three main types of routing protocols used in MANETs: proactive, reactive, and hybrid. Through the periodic exchange of control packets, proactive routing protocols—also called table-driven protocols—keep all nodes informed of the most recent routing information. Proactive protocols include ones like DSDV and OLSR, which stand for Destination-Sequenced Distance Vector. Although proactive protocols guarantee minimal route formation delay, they often exchange control messages, which drains the limited energy resources of mobile nodes and causes them to suffer from high overhead.

When new routes are needed, reactive routing protocols (also called on-demand protocols) create them. They dynamically find routes, unlike proactive protocols, which decrease control overhead. Some well-known reactive protocols are Ad Hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR). Since these protocols do not need updates on a regular basis, they function especially well in settings where the network topology is subject to frequent changes. However, applications that are sensitive to delays may not be a good fit for the first route discovery process because of the delays it may impose. Hybrid routing systems use the best features of reactive and proactive methods and combine them. The Zone Routing Protocol (ZRP) is one such protocol. It uses reactive routing for communication between zones and proactive routing inside each zone. A potential option for large-scale MANETs with varied mobility patterns, this hybrid technique aims to reduce control

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overhead while assuring speedy route construction.

When it comes to scalability and flexibility, MANETs' dynamic nature poses special difficulties for routing protocols. Link failures are more common in networks with high node mobility, hence routing techniques need to be flexible to keep networks connected. Since nodes are usually powered by batteries, protocols also need to limit energy usage. Because of this, optimizing the exchange of control messages and using methods that use less energy are essential for keeping the network running for longer. Eavesdropping, impersonation, and denial-of-service attacks are just a few of the security dangers that MANETs are susceptible to. In order to keep networks running smoothly, secure routing protocols need to include features that can identify and counteract these types of attacks.

The capacity of the network to provide dependable and predictable communication is known as quality of service (QoS), and it is an additional crucial component of MANET routing. From multimedia streaming, which requires low latency and high throughput, to emergency response, which requires assured delivery of essential data, the criteria for quality of service vary widely. These quality of service needs must be carefully considered by MANET routing protocols as they strike a balance between security, energy efficiency, and performance.

New opportunities for enhancing MANET routing protocols have arisen with the emergence of cutting-edge technology like machine learning and artificial intelligence (AI). Methods powered by AI may improve decision-making, dynamically adjust routing techniques, and forecast network circumstances. Nodes may learn the best routes to take based on their previous experiences using reinforcement learning methods, and neural networks can evaluate complicated network dynamics to increase the accuracy of route predictions. Intelligent routing protocols like these have the potential to make MANETs even more reliable and efficient in a wide variety of contexts.

Ad hoc networks in certain domains, such VANETs, UANETs, and FANETs, have discovered specific uses for MANETs in recent years. There are specific needs and difficulties for routing protocols brought forth by each of these variants. For instance, in order to provide real-time traffic control and safety applications, VANETs need low-latency communication in addition to high dependability. Underwater UANETs have similar challenges, including significant propagation delays and limited capacity, which call for unique routing protocols. Protocols that can manage high mobility, three-dimensional topology changes, and energy limits are required for FANETs, which include UAVs.

Studies using simulation-based tools such as NS-2, NS-3, or OPNET are often used for the assessment of MANET routing protocols. Researchers may test how well protocols operate in diverse scenarios by running them through these simulations with varying mobility models, traffic patterns, and network sizes. Energy consumption, average end-to-end latency, packet delivery ratio, and routing overhead are important performance measures. By comparing various measures, we can find out where protocols excel and where they fall short, which in turn helps us create better, more efficient solutions.

## II.REVIEW OF LITERATURE

Soomro, Abdul et al., (2022) An MANET is a situationally appropriate kind of wireless ad hoc network that is decentralized, self-organizing, and self-managing. Because the design and number of nodes in a network are always evolving, a routing protocol is required to guarantee efficient data transfer from sources to destinations. Because of its ad hoc and non-identical usage, MANET manipulates several sectors of life, including rescue and emergency operations, real-time information, interpersonal communication, network portioning, and disaster management. An important aspect of efficient time management is research on MANET communication, which includes routing and maintenance. In order to expedite data delivery, this research zeroes in on MANET routing and maintenance procedures, which are subject to dynamic topology and node changes. Several methods have been suggested for route discovery, the research-motivating component of MANET. Both are more demanding than one another. The comparison sheds light on questions about route discovery and MANET connection maintenance, such as which method performs better under certain network circumstances. Finding and maintaining MANET routes is the focus of this research review. This led to an analysis of several routing protocol approaches. A few recommendations for better performance using routing protocols, particularly in disaster management, are part of these approaches to improvement. The findings of this research will guide future experiments that aim to determine the optimal set of strategies for handling different types of applications.

Mishra, Aastha et al., (2019) Ad-hoc networks are self-sufficient, mobile networks that may be set up instantly and in any location without the need for a pre-existing infrastructure. Nodes in an ad hoc network connect with one another and function as mobile routers, sending and receiving packets. Groups of mobile nodes that share a wireless channel for communication are called wireless ad hoc networks. The packets go from their source to their destination via each node using a routing mechanism. The acronym MANET stands for

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"mobile ad hoc network," and it describes a collection of mobile nodes linked over a wireless medium that may quickly change topologies without any dedicated infrastructure. Scientists are interested in MANETs because of how quickly they can be put into operation. Investigators have suggested a number of MANET routing protocols. An overview of these several MANET routing protocols is provided in this article. The study went on to compare several protocols based on a few chosen performance characteristics, including scalability, overhead, dependability, and more.

Devi, Munisha & Gill, Nasib. (2019) The Mobile Ad Hoc Network (MANET) is an ad hoc network that can quickly adapt to new circumstances; it is topologically random and self-adjusting. Everyday problems encountered by humans may be better handled with the help of MANET's guidance across a wide range of smart environment and application domains. One of the most intriguing subfields in mobile network research is routing. Although many academics have offered their thoughts, it remains a challenging question to answer on which protocol works best in various network conditions, such as increased overload or growing load density. This paper presents many types of protocols, compares their performance, and makes an effort to recommend one that could operate well in a big network. The following criteria are used to assess various routing protocols: Routing Table, Routing Approaches, Operation, Advantages, Disadvantages, Protocol Type, Route Discovery, Route Maintenance, and more. The researchers may learn a lot about the various types of routing protocols by comparing their performance indicators and traits.

Abdullah, Muthana et al., (2015) A mobile ad hoc network, or MANET, is a collection of nodes that may be rapidly and easily deployed in any environment without the need for a fixed infrastructure. This topology is dynamic since these nodes are self-aware and may migrate in any direction. When compared to static wired networks, MANET routing is far more difficult due to its inherent dynamic nature. With the goal of conducting a comparative research, this article will compare and contrast the three types of MANET routing protocols, looking at their features, operations, strengths, and flaws.

Dwivedi, Anuj Kumar & Kushwaha, Sunita. (2009) Wireless sensor networks (WSNs) and mobile ad hoc networks (MANETs) have similar problems, such as slow node speeds, high overhead, and inadequate capacity. The characterization study between MANETs and WSNs environments with regard to various routing protocols is this research contribution. The routing protocols that are associated with packet delivery ratio, routing overhead, throughput, and average to end-to-end latency are examined in this study. Three protocols—AODV, DSDV, and TORA—are chosen for MANETs, and their performance is evaluated. In MANETs, the AODV outperforms TORA and produces superior results, however TORA is unreliable and has extremely low performance. We identified and assessed four protocols for WSNs: AODV, DSDV, TORA, and LEACH. While both the AODV and LEACH are superior, the latter is more trustworthy due to its consistent results while the former is more prone to fluctuations. We find that, as compared to DSDV and TORA, AODV performs better in both settings. However, when contrasted with MANETs, WSNs exhibit substantially greater average end-to-end latency.

## III.PROPOSED METHODOLOGY

To improve the stability and routing performance of the node, UAROR, which takes into account both mobility speed and movement direction, is suggested as an algorithm to combine with the PLA-DSR for link prediction and topology management. Subsequently, the protocol is improved as UAEROR to lower the control overhead with the implementation of the neighbor discovery technique. We evaluate the UAEROR protocol's performance to that of other protocols, including UAROR and PLA-DSR, using Network Simulator version 2 (NS2.35). Throughput, end-to-end latency, PDR, network longevity, energy consumption, and control overhead are some of the network parameters used for the comparison.

## IV.RESULTS AND DISCUSSION

**Throughput**

**Table 1: Results of Throughput**

| Number of Nodes | PLA-DSR | UAROR | UAEROR |
|---|---|---|---|
| 25 | 0.8 | 0.89 | 0.90 |
| 50 | 0.91 | 0.85 | 0.91 |
| 75 | 0.82 | 0.88 | 0.87 |
| 100 | 0.85 | 0.79 | 0.81 |
| 125 | 0.75 | 0.80 | 0.81 |
| 150 | 0.77 | 0.73 | 0.79 |

Table 1 shows the results of the throughput analysis, which show that at a smaller size (25 nodes), the top three networks are UAEROR with 0.90, UAROR with 0.89, and PLA-DSR with 0.8. Despite UAROR's performance dropping to 0.85 as the network capacity rises to 50 nodes, UAEROR maintains a high throughput of 0.91, matching PLA-DSR. Throughput starts to drop for all protocols in medium-sized networks (75 to 100 nodes) as a result of greater communication problems. When compared to PLA-DSR and UAROR, UAEROR always shows greater performance, with 0.87 and 0.81 at 75

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and 100 nodes, respectively. Even in networks with 125–150 nodes, UAEROR outperforms UAROR and PLA-DSR in terms of throughput (0.81 and 0.79, respectively).

**End-to-end Delay**

**Table 2: Results of End-to-end Delay (sec)**

| Number of Nodes | PLA-DSR | UAROR | UAEROR |
|---|---|---|---|
| 25 | 13 | 12 | 9 |
| 50 | 27 | 18 | 16 |
| 75 | 53 | 47 | 42 |
| 100 | 69 | 63 | 55 |
| 125 | 122 | 112 | 100 |
| 150 | 148 | 141 | 132 |

Table 2 displays the end-to-end delay findings for different network sizes (25 nodes). At this scale, UAEROR's 9 seconds is much lower than UAROR's 12 seconds and PLA-DSR's 13 seconds. As the size of the network rises, the routing difficulties cause all protocols to have an increase in latency. However, when comparing 125 and 150 nodes, UAEROR continues to be the most efficient, with delays of 100 and 132 seconds, respectively, compared to UAROR and PLA-DSR, which all have larger delays.

**Packet Delivery Ratio (PDR)**

**Table 3: Results of PDR (%)**

| Number of Nodes | PLA-DSR | UAROR | UAEROR |
|---|---|---|---|
| 25 | 89 | 89.5 | 90.5 |
| 50 | 87 | 96.7 | 89.1 |
| 75 | 85 | 95.7 | 86.5 |
| 100 | 80 | 93.2 | 84.2 |
| 125 | 78 | 91.2 | 82.8 |
| 150 | 75 | 78.9 | 81.0 |

Table 3 shows that at lower node densities (25 nodes), UAEROR obtains the greatest Packet Delivery Ratio (PDR) of 90.5%, which is slightly better than UAROR (89.5%) and PLA-DSR (89%). While both UAEROR and PLA-DSR achieve better PDRs at lower node counts, UAROR continues to outperform them as the node count grows, with 96.7% at 50 nodes and 95.7% at 75 nodes, respectively. Even though PLA-DSR's PDR reduces to 78% and 75% as node density increases, UAEROR still beats it, reaching 82.8% and 81.0% at 125 and 150 nodes, respectively.

**Energy Consumption**

**Table 4: Results of Energy Consumption (J)**

| Number of Nodes | PLA-DSR | UAROR | UAEROR |
|---|---|---|---|
| 25 | 43 | 41 | 37 |
| 50 | 51 | 50 | 45 |
| 75 | 54 | 56 | 54 |
| 100 | 66 | 64 | 60 |
| 125 | 70 | 72 | 69 |
| 150 | 82 | 79 | 76 |

According to Table 4, the energy consumption findings show that at lower node densities (25 nodes), the least energy is consumed by UAEROR (37 Joules), followed closely by UAROR (41 Joules), and PLA-DSR (43 Joules). While other protocols see an increase in energy usage with increasing node counts, UAEROR persistently has the lowest energy consumption. Just to give you an idea, at 150 nodes, UAEROR utilizes 76 Joules, UAROR 79 Joules, and PLA-DSR 82 Joules.

**Network Lifetime**

**Table 5: Results of Network Lifetime (sec)**

| Number of Nodes | PLA-DSR | UAROR | UAEROR |
|---|---|---|---|
| 25 | 81.2 | 82.8 | 84 |
| 50 | 77.5 | 78.2 | 81 |
| 75 | 74.6 | 75.9 | 78.5 |
| 100 | 71.2 | 73.1 | 75.8 |
| 125 | 68.4 | 69.5 | 70.8 |
| 150 | 65.0 | 66.6 | 68.4 |

Based on the data in Table 5, the network lifespan at 25 nodes is 84 seconds for UAEROR, which is somewhat better than UAROR (82.8 seconds) and PLA-DSR (81.2 seconds). Every protocol has a decline in network lifespan as the number of nodes grows, mostly because of the increasing communication cost and strain. On the other hand, UAEROR maintains its superior performance, outperforming UAROR (69.5 s at 125 nodes and 66.6 s at 150 nodes) and PLA-DSR (68.4 s and 65.0 s) in terms of network lifespan.

**Control Overhead**

**Table 6: Results of Control Overhead (packets)**

| Number of Nodes | PLA-DSR | UAROR | UAEROR |
|---|---|---|---|
| 25 | 96 | 95 | 90 |
| 50 | 105 | 100 | 96 |

| | | | |
|---|---|---|---|
| 75 | 109 | 105 | 104 |
| 100 | 115 | 117 | 108 |
| 125 | 122 | 124 | 119 |
| 150 | 137 | 130 | 125 |

According to Table 6, with a network size of 25 nodes, the control overhead is 90 packets for UAEROR, 95 packets for UAROR, and 96 packets for PLA-DSR. Control overhead is proportional to network size; it rises for all protocols as network size increases since maintaining bigger networks is more complicated. With 119 packets at 125 nodes and 125 packets at 150 nodes, UAEROR keeps the lowest overhead, in contrast to UAROR's 124 and 130 packets, and PLA-DSR's 122 and 137 packets, respectively.

## V.CONCLUSION

When comparing the three protocols, UAEROR provides a well-rounded improvement across several network performance parameters, whereas PLA-DSR and UAROR fall short. Although UAROR is the best in bigger networks when it comes to packet delivery ratio (PDR), UAEROR is always the best when it comes to throughput, energy consumption, network longevity, and control overhead, among other important metrics. Based on the data, UAEROR has the longest network lifespan due to its low energy usage and greatest throughput. Particularly in larger-scale networks, its superior efficiency is due to its ability to keep control overhead to a minimum. In conclusion, UAEROR is a viable option for mobile ad hoc networks as it is an effective upgrade of the conventional PLA-DSR and provides significant gains in energy economy, network lifetime, and routing consistency.

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