

A Comparative Study of Ga-Based and AOMDV Routing Protocols in Mobile Ad Hoc Networks

Pullela Neelima¹

¹ Research Scholar, Department of Computer Science & Engineering, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P, India

Dr. Harsh Lohiya²

² Research Supervisor, Computer Science & Engineering, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P, India

ABSTRACT

Mobile ad hoc networks (MANETs) have been the subject of much study because to their meteoric rise in popularity in the last few years. This paper compares the performance of the well-established Ad hoc On-demand Multipath Distance Vector (AOMDV) protocol with that of a new GA-based routing protocol using a thorough simulation analysis. The simulations were run in a dynamic setting using Network Simulator 2 (NS2), with nodes dispersed across a 1250m × 1250m area with numbers ranging from 40 to 120. A variety of traffic sources, including as CBR, video, and TCP, were accommodated by the network setup, which made use of IEEE 802.11 as the media access control protocol. The transmission range was 250 meters, and each packet was 512 bytes in size. The simulations included node mobility at 10, 20, 30, and 40 m/s speeds, starting with 10.3 joules of energy, 0.660 W of transmission power, and 0.395 W of reception power. Throughput, Packet Delivery Ratio (PDR), and End-to-End Delay were the primary performance measures examined in the research. Throughput, packet delivery ratios, and latency are all improved upon by the suggested GA-based protocol compared to AOMDV, according to the simulation results, which hold true for different node densities and mobility patterns.

Keywords: Genetic algorithm, Throughput, Packet delivery ratios, Delay, Nodes

I. INTRODUCTION

The use of wireless networks has skyrocketed in the IT sector. Adaptations to wireless networks allow for mobility. Two distinct kinds of mobile networks exist. An infra-structured network, which includes both wireless and wired gateways, is the first kind. A network's "base stations" are its connecting nodes. In a network, a mobile node finds the closest base station (within the communication radius) and establishes a connection with it. Office WLAN is one use case for this network. Our second network type is the infrastructure-less mobile network, or AD-HOC network for short. The routers are not permanent. Every node has the ability to move and may be linked in whatever way they choose. These nodes find and keep track of paths to other nodes in the network; they are the routers. The 4G design is anticipated to use non-infrastructure based MANETs.

In places where traditional communication methods are either too costly or too cumbersome to operate, ad hoc networks may step in and fill the void. Students engaging

in interactive lectures on laptops, business colleagues exchanging data during meetings, troops communicating situation awareness on the battlefield, and rising rescue efforts after natural disasters like hurricanes and earthquakes are all examples of ad hoc network applications. One form of ad hoc network is spontaneous networking, which occurs when a group of individuals utilize wireless connectivity to do computer-based collaborative tasks.

The term "ad hoc network" refers to a transitory network that is formed by a collection of mobile nodes that do not have a centralized administrator or the usual support services that are offered on traditional networks. The wireless architecture of the network may change quickly and unexpectedly since the nodes can move about and arrange themselves whatever they like. A network like this may function alone or it can be linked to the wider internet.

Infrastructure free networks is another name for mobile ad hoc networks since these networks may operate even

in the absence of a fixed infrastructure, such as a base station. One name for ad hoc networks is "multi-hop wireless ad hoc networks" due to the fact that links between nodes in such a network may frequently involve more than one hop. Nodes can conduct a one-on-one chat if their transmission ranges are close enough. Sending and receiving messages from nodes beyond of this range requires the use of intermediate nodes.

Every node in a mobile ad hoc network uses an antenna to send and receive wireless signals. These antennas can be highly directional (point-to-point), omni directional (broad-cast), or even potentially steerable. Various circumstances, including as the locations of the nodes, the patterns of their transmitter and receiver coverage, the levels of communication power, co-channel interference, and other considerations, might cause a wireless link among the nodes to exist in what is called a "ad hoc" network at any given time. Changes to this ad hoc architecture may occur over time when nodes move or adjust their transmission and reception settings.

II. REVIEW OF LITERATURE

Thamizhmaran, K. & Charles, A. (2022). Ad hoc networks are now the main focus of many young researchers, and among the most promising kinds of temporary research networks is mobile ad hoc networks (MANET). In a mobile ad hoc network, each node performs the functions of a transmitter, receiver, and router. The network enables nodes to establish wireless connections with each other in real-time, regardless of the surrounding environment, even when things become chaotic. Traffic, latency, throughput, energy, security threats, bandwidth, and storage are just a few of the problems that might arise in this self-configured infrastructure less network because of its dynamic nature, battery power, packet loss, misbehavior attack, conjunction, and mobility. The primary focus of this research paper was on energy efficiency, specifically using one of the most popular simulation models, Network Simulator (NS2), to draw conclusions about the importance of reducing energy consumption and how doing so can improve network lifetime, delivery ratio, and throughput.

Zhang, De-gan et al., (2019) When it comes to mobile ad hoc networks with limited resources, geographical routing algorithms are a good option. Node motion, energy depletion, and obstructions are three potential causes of routing holes. The current routing algorithm simply takes into account right-hand and left-hand requirements for avoiding routing voids, and data is sent

at the hole's border. But the routing hole could grow or the network might become paralyzed if this approach is used. In order to enhance mobile ad hoc network routing, this research suggests a novel greedy forwarding improvement strategy. The connection quality is evaluated by comparing the relative displacement of the nodes and the link maintenance time after the reliable communication region has been determined in the greedy forwarding phase. It then takes into account the candidate node's distance from the destination node, the quality of the connection, and the number of neighbor nodes to determine the metric value. The next hop is selected as the node with the highest metric value. The waiting forwarding mode is temporarily used if a routing hole is detected. We may utilize the right-hand rule and the left-hand criteria to run bypass mode simultaneously after some time has elapsed and the current node is still a routing complete node. The deflection angle, the link maintenance time, and the node's remaining energy are the three criteria that are considered to calculate the next hop in each direction for the forwarding node. The suggested method enhances the network's energy consumption, data packet delivery rate, network latency, and longevity compared to the current GPSR, EMGR, and EDGR, according to the experimental findings.

Tozan Hasdemir, Songül et al., (2019) When it comes to developing efficient, scalable, and adaptable routing protocols, MANETs provide a formidable obstacle. So far, most proposed MANET routing systems have focused on determining the shortest path between two communication nodes. A new routing metric based on evolution is proposed in this article, EVO. Automatic creation of this metric is achieved via the application of genetic programming. The creation of these measures makes use of features related to traffic and mobility. The metrics employed in this work are applied to the AODV protocol, which is an on-demand routing method for MANETs that is extensively utilized. Newly improved AODV, EVO-AODV, uses an evolved multi-featured measure across communication endpoints to determine route ranking and selection. To evaluate the effectiveness of the suggested metric, networks with varying levels of mobility and traffic patterns were used. There are also new proposed routing metrics—the encounter-based routing measure (PER) and the hop change meter (HOC)—as well as more comparisons with AODV. Specifically on medium-traffic networks, the proposed strategy improves packet delivery ratio while decreasing end-to-end latency, packet loss rate, and routing overhead, according to extensive simulation findings.

Uddin, Mueen et al., (2017) MANET is an autonomous group of wireless nodes that may quickly and easily establish a network on the go, bypassing the need for fixed infrastructure and a governing body. The lack of a fixed power source means that mobile nodes in a MANET must depend on batteries, which reduces the network lifespan due to the fast depletion of the batteries caused by the constant movement and positioning changes. By optimizing the AOMDV routing protocol's energy consumption using the Fitness Function approach, this study proposes research that sheds light on this particular topic of MANET energy consumption. The proposed protocol is called FF-AOMDV, which stands for Fitness Function Ad Hoc on Demand Multipath Distance Vector. In multipath routing, the fitness function is used to ascertain the optimal path from the source to the destination in order to reduce energy consumption. The proposed FF-AOMDV protocol was tested in comparison to AOMDV and the two most popular protocols in this area, Ad Hoc on Demand Multipath Routing with Life Maximization (AOMR-LM), using Network Simulator Version 2. We monitored energy consumption, throughput, packet delivery ratio, end-to-end latency, network lifetime, and routing overhead ratio by adjusting the node speed, packet size, and simulation length. When evaluating network performance, the proposed FF-AOMDV performed better than both AOMDV and AOMR-LM.

Ema, Romana et al., (2014) We compared DSDV, Ad-hoc On Demand Multiple Distance Vector, and Ad-hoc On Demand Distance Vector to find the best routing protocol. We looked at the protocols' end-to-end latency, throughput, normalized routing load, and network energy consumption to assess their overall performance. Wireless sensor networks (WSN) may potentially self-assemble while no person is around to facilitate the process. Each node in a WSN acts as a router, relaying information to other nodes throughout the network. Without routing protocols, these routers would be unable to coordinate their activities. The development of routing protocols capable of efficiently locating paths inside a network is an important aspect of WSN design. When deciding on a routing protocol, which of these three considerations should take precedence: security, bandwidth, or energy consumption (battery life)? We chose to zero down on energy usage as our primary emphasis since it is the single most important component in WSN. We compared DSDV, Ad-hoc On Demand Multiple Distance Vector, and Ad-hoc On Demand Distance Vector to find the best routing protocol. We looked at the protocols' end-to-end latency, throughput,

normalized routing load, and network energy consumption to assess their overall performance. The IEEE 802.11 Network Simulator, specifically version NS-2.34, was used to do this. Among the routing protocols evaluated, AOMDV had the lowest energy consumption.

Shaikh, Arshad et al., (2013) MANETs' focus on efficient routing is nothing new. While proactive and reactive protocols are at odds with one another, hybrid protocols have sought to combine their greatest features. Under various conditions (changing number of nodes, mobility, traffic type, and load), this study compares and contrasts the performance of several MANET routing protocols, including AODV, DSR, DSDV, FSR, ZRP, and others. It also examines a selection of relevant literature on the topic. After that, graphs comparing the quality of service characteristics are created from the combined findings of these articles. The research showed that there was no "one size fits all" solution. The scenario's mobility, size, and necessary QoS will determine the protocol that is used.

Yadav, Rajendra. (2007). A collection of wirelessly interacting mobile nodes forms a mobile ad hoc network; this kind of network does not rely on any preexisting infrastructure and does not have centralized control. Due to the limited transmission range of wireless network interfaces, data sharing across the network may take a number of "hops." A routing protocol aids network communication by discovering pathways between nodes. For messages to be delivered quickly in an ad hoc network, the primary goal of the routing protocol is to establish routes between nodes as accurately and efficiently as possible. Reduced bandwidth consumption and associated overhead should guide route building efforts. Based on parameters such as packet delivery percentage, average delay, throughput, normalized routing load, speed, and stop time, this research analyzes and contrasts two mobile ad hoc network routing protocols, DSDV and AODV. DSDV is a table-driven protocol, whereas AODV is an on-demand protocol.

III. SIMULATION SETUP

This research utilizes Network Simulator 2 (NS2) to simulate outcomes and compares the suggested evolutionary algorithm with the AOMDV. The situation and parameters for the simulation are shown in figure 1.

No. of Nodes	40, 60, 80, 100, 120
Area Size	1250 X 1250
Mac	IEEE 802.11
Transmission Range	250m
Simulation Time	50 sec
Traffic Source	CBR, Video and TCP
Packet Size	512
Routing Protocol	AOMDV and GA based Protocol
Speed	10,20,30 and 40 m/s
Rate	250kb
Initial Energy	10.3 J
Transmission Power	0.660
Receiving power	0.395

Figure 1: Simulation parameters

The following metrics are used to compare the AOMDV with the proposed genetic algorithm based routing system.

- **Packet delivery ratio**, which compares the total number of packets delivered and received.
- **Throughput**: A packet's throughput is the number of successfully delivered packets divided by the total transmission time.
- **Delay**: The time it takes for data to travel from one location to another is known as delay.

IV. RESULTS AND DISCUSSION

A range of 40, 60, 80, 100, and 120 nodes may be used in this simulation experiment. Using metrics like packet delivery ratio, throughput, and delay, we can compare the AOMDV protocol's performance to that of a genetic algorithm based one.

The situation for AOMDV and protocols based on genetic algorithms is shown in Fig. 2. Looking at the example above, it is clear that the genetic algorithm based protocol outperforms AOMDV in terms of the delay metric. Compared to AOMDV, it produces less delay.

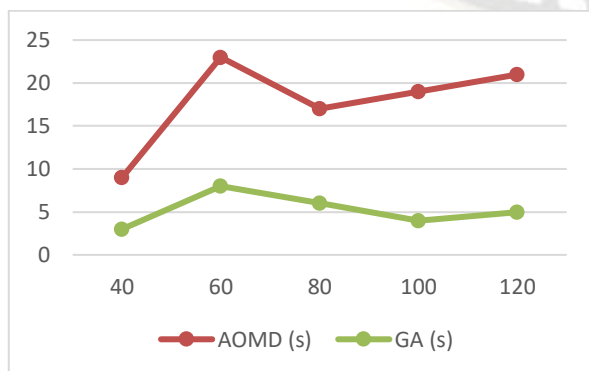


Figure 2: Variation of Delay with Number of Nodes

Figure 3 displays a comparison between AOMDV and protocols based on evolutionary algorithms with respect to packet delivery ratio vs number of nodes. Based on the above example, it is clear that the genetic algorithm based protocol outperforms AOMDV in terms of the Packet Delivery Ratio measure. Compared to AOMDV, it provides a higher packet delivery ratio.

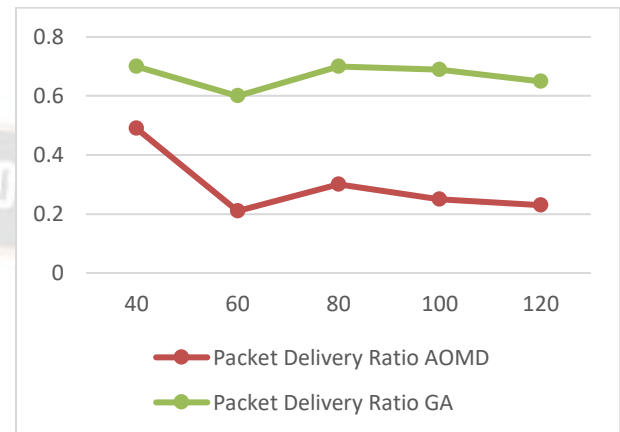


Figure 3: Variation of Packet Delivery Ratio with Number of Nodes

With regard to the ratio of throughput to the number of nodes, Figure 4 compares AOMDV with protocols based on evolutionary algorithms. It is clear from the foregoing that, in terms of the Throughput measure, the genetic algorithm based protocol outperforms the AOMDV. It outperforms AOMDV in terms of throughput.

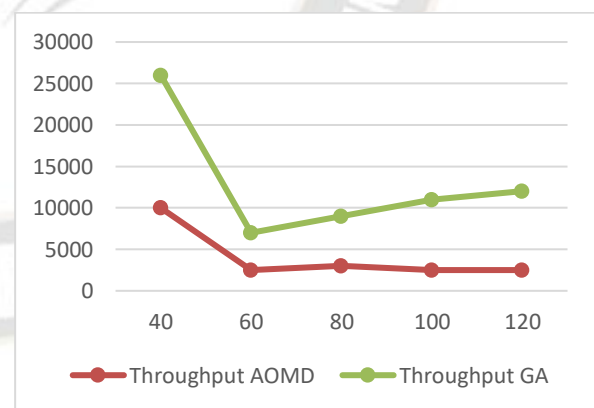


Figure 4: Variation of Throughput with Number of Nodes

In Fig.5, we can see how AOMDV and protocols based on evolutionary algorithms compare in terms of delay vs node speeds. Looking at the example above, it becomes clear that the genetic algorithm based protocol outperforms AOMDV in terms of the delay metric. Compared to AOMDV, it produces less delay.

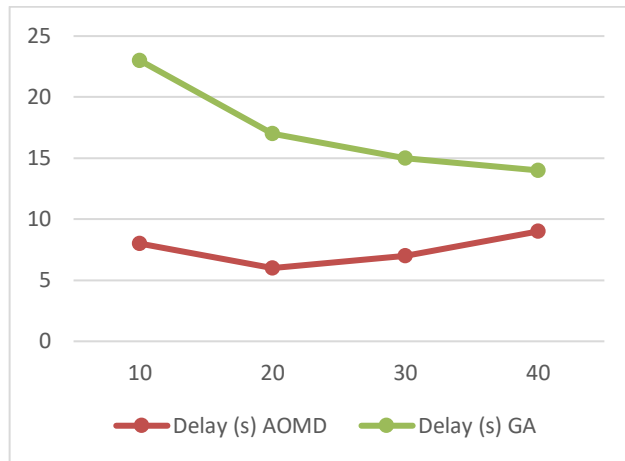


Figure 5: Variation of Delay with Node Speeds

Protocols based on genetic algorithms and AOMDV are compared in Fig. 6 with respect to packet delivery ratio vs node speeds. Based on the above example, it is clear that the genetic algorithm based protocol outperforms AOMDV in terms of the Packet Delivery Ratio measure. Its Packet Delivery Ratio is higher than that of AOMDV.

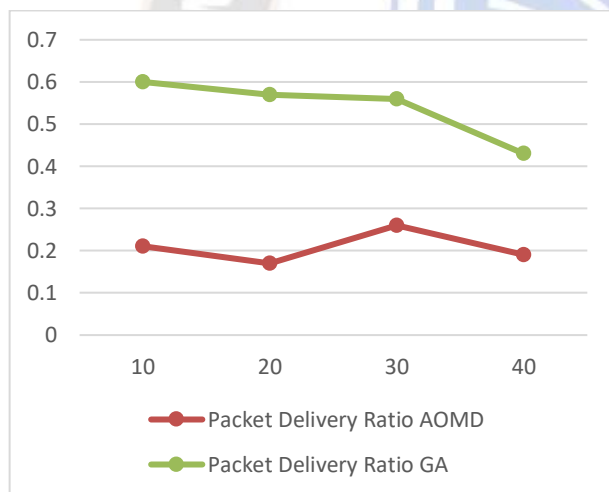


Figure 6: Variation of Packet Delivery Ratio with Node Speeds

Figure 7 displays a hypothetical comparison between AOMDV and protocols based on evolutionary algorithms with respect to throughput against node speeds. It is clear from the foregoing that, in terms of the Throughput measure, the genetic algorithm based protocol outperforms the AOMDV. It outperforms AOMDV in terms of throughput.

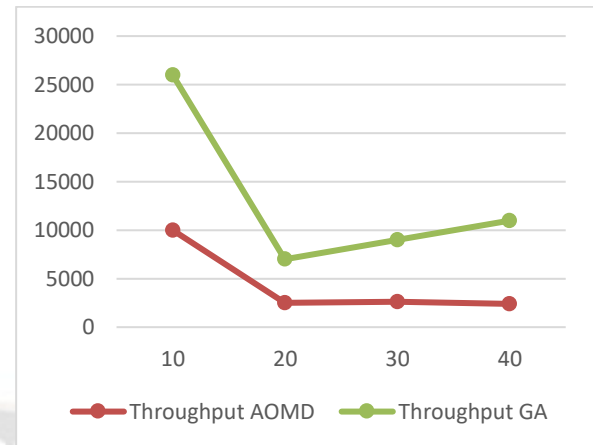


Figure 7: Variation of Throughput with Node Speeds

V. CONCLUSION

Regardless of the network size or the speed of the nodes, the GA-based protocol improved packet delivery ratios, increased throughput, and decreased end-to-end delays. These enhancements demonstrate the efficacy of incorporating intelligent optimization methods, such as genetic algorithms, into wireless network routing schemes. With its impressive performance, the GA-based method proves it can improve network stability, efficiency, and scalability. This makes it a great choice for wireless situations that are both dynamic and limited in resources. Further investigation into hybrid optimization techniques and adaptive mechanisms may enhance routing performance even in the face of increasingly difficult environmental constraints in future studies.

REFERENCES: -

- [1] H. Khudayer, B. Alzabin, L. Anbar, M. Tawafak, R. Tawafak, T.-C. Wan, A. Al Sideiri, S. I. Malik, and T. Al-Amiedy, "A Comparative Performance Evaluation of Routing Protocols for Mobile Ad-hoc Networks," vol. 14, no. 4, pp. 438–446, 2023.
- [2] M. S. Avhankar, D. J. A. Pawar, S. Majalekar, and S. Kedari, "Mobile Ad Hoc Network Routing Protocols Using OPNET Simulator," International Journal on Recent and Innovation Trends in Computing and Communication, vol. 10, no. 1, pp. 1–7, 2022.
- [3] K. Thamizhmaran and A. Charles, "Comparative Study of Energy Efficient Routing Protocols in

- Manet," WSEAS Transactions on Communications, vol. 21, no. 1, pp. 55–67, 2022.
- [4] V. K. Quy et al., "Survey of recent routing metrics and protocols for mobile Ad-hoc networks," *Journal of Communications*, vol. 14, no. 2, pp. 110–120, 2019.
- [5] S. T. Hasdemir, S. Yilmaz, and S. Sen, "A Novel Multi-Featured Metric for Adaptive Routing in Mobile Ad Hoc Networks," *Applied Intelligence*, vol. 49, no. 8, pp. 2823–2841, 2019.
- [6] D.-g. Zhang, P.-z. Zhao, Y.-y. Cui, L. Chen, T. Zhang, and H. Wu, "A New Method of Mobile Ad Hoc Network Routing Based on Greed Forwarding Improvement Strategy," *IEEE Access*, vol. 7, pp. 1–4, 2019.
- [7] A. Kout, S. Labeled, and S. Chikhi, "AODVCS, a new bio-inspired routing protocol based on cuckoo search algorithm for mobile ad hoc networks," *Wireless Networks*, vol. 24, no. 7, pp. 2509–2519, 2018.
- [8] A. Bhattacharya and K. Sinha, "An efficient protocol for load-balanced multipath routing in mobile ad hoc networks," *Ad Hoc Networks*, vol. 63, pp. 104–114, 2017.
- [9] G. A. Walikar and R. C. Biradar, "A survey on hybrid routing mechanisms in mobile ad hoc networks," *Journal of Network and Computer Applications*, vol. 77, pp. 48–63, 2017.
- [10] A. Taha, R. Alsaqour, M. Uddin, M. Abdelhaq, and T. Saba, "Energy efficient multipath routing protocol for mobile ad-hoc network using the fitness function," *IEEE Access*, vol. 5, pp. 10369–10381, 2017.
- [11] A. Ghaffari, "Real-time routing algorithm for mobile ad hoc networks using reinforcement learning and heuristic algorithms," *Wireless Networks*, vol. 23, no. 3, pp. 703–714, 2017.
- [12] M. Uddin, A. Taha, R. Alsaqour, and T. Saba, "Energy Efficient Multipath Routing Protocol for Mobile Ad-Hoc Network Using the Fitness Function," *IEEE Access*, vol. PP, no. 99, pp. 1–4, 2017.
- [13] T. A. Murshedi, X. Wang, and H. Cheng, "On-demand multipath routing protocols for mobile ad-hoc networks: a comparative survey," *International Journal of Future Computer and Communication*, vol. 5, no. 3, pp. 148–157, 2016.
- [14] R. Ema, A. Akram, M. A. Hossain, and S. Das, "Performance Analysis of DSDV, AODV AND AOMDV Routing Protocols based on Fixed and Mobility Network Model in Wireless Sensor Network," *Global Journal of Computer Science and Technology*, vol. 14, no. 6, pp. 1–10, 2014.
- [15] A. Shaikh, D. Vasan, and K. Mohammadani, "Performance Analysis of MANET Routing Protocols A Comparative Study," *International Journal of Computer Applications*, vol. 83, no. 7, pp. 31–35, 2013.
- [16] S. Kim, "An ant-based multipath routing algorithm for QoS aware mobile ad-hoc networks," *Wireless Personal Communications*, vol. 66, no. 4, pp. 739–749, 2012.
- [17] R. Yadav, "Performance Comparison and Analysis of Table Driven and On-Demand Routing Protocols for Mobile Ad-hoc Networks," *Information Technology - IT*, vol. 4, no. 2, pp. 101–109, 2007.
- [18] J. Hong, "Efficient on-demand routing for mobile ad hoc wireless access networks," *IEEE Journal on Selected Areas in Communications*, vol. 22, no. 1, pp. 11–35, 2004.