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Minimizing End-To-End Time Delay in Mobile Ad-Hoc Network using Improved Grey Wolf Optimization Based Ad-Hoc On-demand Distance Vector Protocol (IGWO-AODV)

N. Kanimozhi[1], Dr. S. Hari Ganesh[2], Dr. B. Karthikeyan[3]
[1]N. Kanimozhi, Research Scholar, Department of Computer Science, H.H The Rajah's College (Affiliated to Bharathidasan University, Tiruchirappalli), Pudukkotai – 622 001.nkanimozhimphil@gmail.com.
[2]Dr. S. Hari Ganesh, Assistant Professor, Department of Computer Science, H.H The Rajah's College (Affiliated to Bharathidasan University, Tiruchirappalli),Pudukkotai – 622 001.
hariganesh17@gmail.com.
[3]Dr. B. Karthikeyan, Associate Professor, Department of Computer Science, Bishop Heber College (Affiliated to Bharathidasan University, Tiruchirappalli), Trichy – 620 017. bkarthikeyanphd@gmail.com.
*Correspondence: nkanimozhimphil@gmail.com

Abstract— Mobile Ad-Hoc network is one of the instant network with unknown mobile devices. Each and every node in the network may act differently. Because of this time taken to travel packet from source to destination will take more time. This work proposes Improved Grey Wolf Optimization Based Ad-Hoc On-Demand Distance Vector routing protocol for reduce the End-to-End time delay in MANET.

Index Terms—AODV,End-To End Time Delay, Improved Gray Wolf Optimization.

I. INTRODUCTION

Mobile Ad-Hoc Network is one of the Any Where Any Time(AWAT) network. In this network collection of mobile device connection together and form one self-organized temporary network. This paper utilized Ad-Hoc On-demand Distance Vector (AODV) routing protocol. This AODV routing protocol comes under reactive routing protocol category. This temporary network forms with unknown mobile device so the trust of the node is very less. In addition AODV routing protocol doesn't have any mechanism for provide security and reduce time complexity.

This work try to reduce the AODV's time complexity using Improved Gray Wolf Optimization over AODV.

II. LITERATURE REVIEW

It is suggested to use advertising, trust data, and table updates to compress the sparse neighbourhood data using "Neighbourhood Compressive Sensing (NCS)" [1]. The DSR protocol efficiency, packet dropping ratio, network longevity, and energy usage are validated using the GloMoSim platform. Both the amount of resources consumed and the amount of data transmitted over the network were decreased.

To deliver the packets to the relay nodes utilising MANET source and destination nodes, a "multicast algorithm" [2] is proposed. In order to send the chosen packets to the other node, probability is used. The packet delivery in the Markov chain theoretical architecture is based on a cooperative multicast topology.

The variance and mean were measured analytically using derived equations. It is suggested to construct the cross-layers to optimise the data from the Transport, Physical, Media Access Control, and Application layers using "Ant Colony Ad-Hoc On-Demand Routing" [3]. When transmitting the data, the MAC scheduling technique based on Particle Swarm Optimisation (PSO) is employed to assign the slot.

It is suggested to use "Multi-path Enhanced OLSR" [4] to take use of multi-beam transmission's advantages in airborne networks. The broadcast messages for each node in the network are chosen using Multi-Point Relays, and social network-based strategies were utilised to improve the LPD needs.

For establishing lower and upper bounds and abstracting utilising case-by-case with mobility structure and decision procedures, "Decision-Related Event Occurrence Times" [5] is presented. The Random Direction mobility framework is used to determine the neighbour node's movement and its positions for forwarding the subsequent hop.

For choosing the routes to improve the Quality of Services (QoS), "Enhanced-Ant-AODV" [6] is suggested, especially for MANET. Based on the path value, the route that offers the most delicate data delivery is fetched. To send the packets with end-to-end reliability, the route value with the highest pheromone value is chosen.

The "Wormhole Attack Detection" [7] technique is suggested to lessen MANET false alerts. Wormhole Attack Tree is constructed based on its history of symptoms and the resources are safeguarded. In order to lessen the vulnerability and security concerns, the re-establishment of routes is examined, and results are shown using a simulator.

It is suggested that "Fungi Networks-Based Routing" [8] demonstrate MANET optimisation and route selection. Using increased data flow and fungal mycelium, many parallel pathways are chosen. Every data packet is transported along the proper paths, and the path's quality between the source and destination is improved. The method is contrasted with the current SARA and AODV algorithms using the NS2-2 simulator.

The best packet delivery in MANET is proposed by "Efficient Dynamic-Power AODV Routing" [9]. When nodes are more than 200 in number, the performance improves and the transmission range of its reliance is used for enhancement. Throughput is increased while the control overhead and jitter are decreased.

Suggested enhance real-time communication between the control station and its nodes using the "Q-Learning Algorithm" [10]. Q-FANET, an algorithm, is used to decrease network delay. The evaluation of the WSNET simulator, which outperforms learning-based routing protocols in terms of improving packet delivery, compares it to other standard techniques.

This work is suggested for Multi-Path Transmission Control Protocol (MPTCP) to be assembled with "Adaptive Cluster-based Data Scheduling" [11] in the network. A technique known as Delay-Variation-Based Adaptive Fast Retransmission was used to exploit the MAC layers after the path's unfamiliar features were chosen. In order to lessen the burden of routing, the network's overload is dynamically decreased and compared to traditional algorithms.

To reduce energy usage in peer-to-peer networks, "Mobility Aware Cross-layer Routing" [12] is suggested. Using routing protocols, cross layers are used to improve communication. For enabling data transmission, better routes and dependable communication are improved. Scalability is offered, and low path stretch is ensured by maintaining O (n) for each node.

The quantum genetics technique combined with "Optimised Link-State Routing" [13] is suggested to be improved. The best end-to-end path is chosen while the topology of the MANET is altered. By integrating the strategy into the network to enable global optimisation, the Q-learning technique enhances the strategy.

For distributing ad hoc network control among data-plane nodes and Software-Defined Networking, the "Flexible SDN Prototype" [14] is suggested. When the controller's instructions are followed, performance is improved to that of the traditional Open Flow technique. For evaluation, actual tactical ad hoc network-based datasets are employed, which lowers overhead.

"Ad-hoc Network Routing - Review" [15] to address the network's issues in order to improve its stability and reliability. Security problems were resolved while exploring routing protocols, mobility, and trajectory optimisation approaches. The efficiency of the networks is elaborated using the current communication architecture.

By using clustering, the "Affinity Propagation-Driven Routing Protocol (APDRP)" [16] is suggested to find the optimum route in MANET. The network's topology is optimised using map evolution and local optima logic. The node's movement structure is determined by Gauss Markov (GM), which is optimised using a modified version of affinity propagation. An analytical model represents the propagation technique's nodes and timeframes. It evolves prior to making clustering decisions, and is then further optimised utilising the temporal dependency of the GM distribution. To better comprehend the operation of a cluster and a node's APDRP, a number of events that take place over time are explained using an analytical model. Another way to look at it is that the APDRP clustering algorithm aims to depreciate the dominant set.

In an ad-hoc network, "Multi-Adaptive Routing Protocol (MARP)" [17] is recommended to find the best path to the target. When a node's priority changes or fails, which may be brought on by problems with nodes or network components, multi-adaptive routes choose the most economical route. Multi-adaptive routes check the network's connectivity and efficiency before sending a data packet. MARP is intended to follow the natural tendency of fish to search for food in groups. When a node fails or loses priority, MARP is responsible with successfully and rapidly restoring it. Before sending a data packet, the network is tested for connectivity and functionality.

In order to create a new connection architecture that allows complex devices linked to the network to communicate successfully, "Adaptive Traffic Routing Approach (ATRA)" [18] is offered. Due to the cloud network's high scalability, determining the ideal route in a smart device network is very different from determining the optimal route in other networks. In MANET, ATRA offers efficient load balancing and adaptive network traffic management. One of ATRA's key capabilities was its ability to identify numerous alternate routes between two nodes and evaluate their costs, traffic loads, and link stability.

The Ingenious Grey Wolf Optimization-based Routing Protocol (IGWORP) [19] is suggested in this work. The grey wolf's typical hunting techniques are imitated by the proposed routing protocol IGWORP. Instead than concentrating on a number of local routes, IGWORP concentrates on a single global route. NS3 simulations are used to compare the performance of IGWORP to different routing protocols. Results indicate that although APDRP, MARP, and ATRA consumed 61.969%, 53.277%, and 46.285% of the total energy, IGWORP used 40.399% of it. It is possible to predict the future of

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IGWORP by experimenting with other bio-inspired strategies that use less energy.

A greater variety of protocols are being put forth by various works to shorten MANET's end-to-end time. However, the needs of the current MANET cannot yet be met by the current protocols.

III. PROPOSED SOLUTION

The natural behaviours and dynamics of the grey wolf pack are used in the GWO to illustrate social interaction and dominating leadership. A pack of grey wolves prefers to maintain discipline and order by dividing the wolves into four groups, namely:

- Alpha Wolf (*AW_W_I*): This wolf is in charge of making all of the crucial choices for the pack.
- Beta Wolf(*BW_W_B*): It serves as Alpha wolf's backup. When the dominant wolf is absent, this kind of wolf steps in.
- Delta Wolf(*DW_W_D*): These wolves serve as sentinels, wise wolves, and pack watchdogs.
- Omega Wolves(*OW_W_D*): Only wolves of this kind are allowed to consume food at the conclusion.

It is claimed that the alpha, beta, and delta wolves (sometimes referred to as the "leading hunters") are solely responsible for prey hunting. A grey wolf's hunting cycle has three phases:

- Prey detection and pursuit
- Encirclement of prey
- Assaulting the prey

IGWO Algorithm

Step 1: Initialize Running Variable i

Step 2: Reputation Counter =i
Step 3: Apprise Wolves Location

Step 4: Evaluate fitness of the network

Step 5: Recognize Prey Location

Step 6: Inform Prey Location to all Wolves

Step 7: Hunt the Prey

Step 8: RC=RC+1

Step 9: Check RC reached maximum True goto Step 10
Else goto Step 3

Step 10: End

IV. METHODOLOGY

4.1. Simulation Parameters

Table 1 Simulation Parameters

Parameters	Values
Simulator	OmNet++ 6.0
Number of nodes	10,20,30,40,50
Area Size of Simulation	$1250 \times 1750\ m^2$
Mobility Speed	5 m/s to 32 m/s
Packet Size	256kb
Range of Transmission	250m
Traffic Type	CBR
Model of Mobility	Random way Point

4.2. Evaluation Metrics

The following metrics are employed to compare the IGWO-AODV protocol to other protocols already in use, such as APDRP, MARP, IGEOEP, and ATRA:

Packet Delivery Ratio (*PDR*) is the ratio of data packets delivered by the source node to the number of packets that are received by the destination node.

PDR=No. of Packet Received / No. of Packets Send

End-to-End Time Delay(*EETD*) is the amount of time data packets take to get from one place to another.

V. RESULT AND DISCUSSION

According to the results table and graph, IGWO-AODV outperforms all other routing protocols.

A. Packet Delivery Ratio

Table 2. Comparison of Packet Delivery Ratio

Nodes	APDRP	MARP	IGWORP	ATRA	IGWO-AODV
10	74.839	84.897	88.046	79.844	79.2414
20	73.675	81.417	85.774	47.867	77.1966
30	70.421	78.14	82.52	72.843	74.268
40	67.309	74.985	79.379	70.932	71.4411
50	63.968	69.452	77.628	66.867	69.8652

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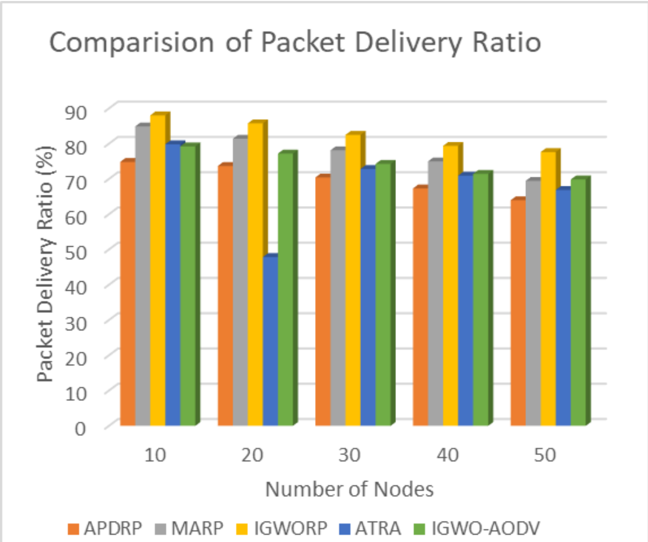

Figure 1. Comparison of Packet Delivery Ratio

Table 3. Average of Packet Delivery Ratio

Protocols	Average(PDR)
APDRP	70.0424
MARP	77.7782
IGWORP	82.6694
ATRA	81.32525
IGWO-AODV	79.84233

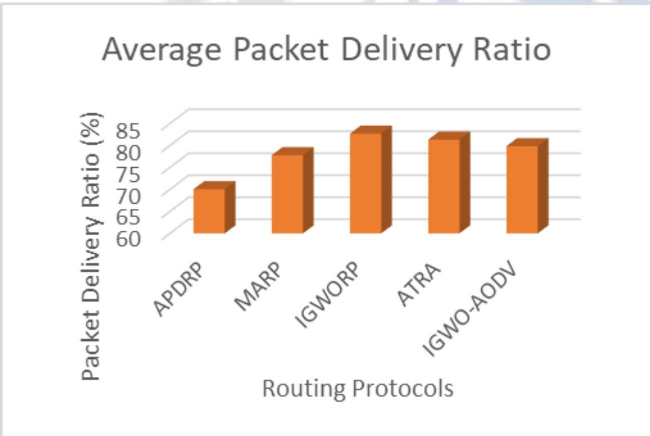

Figure 2. Average of Packet Delivery Ratio

Little bit lower packet delivery ratio when compared to IGWORP protocol. But compared to other protocols, it offers a modest PDR. This work contends that PDR is not a concern. Even so, this method outperforms all other protocols in terms of results.

B. End-to-End Time Delay

Table 4: Comparison of End-to-End Time Delay

Nodes	APDRP	MARP	IGWORP	ATRA	IGWO-AODV
10	1344	1300	1200	1343	1080
20	1388	1321	1253	1365	1128
30	1440	1364	1279	1401	1151
40	1483	1380	1302	1284	1172
50	1500	1427	1341	1440	1207

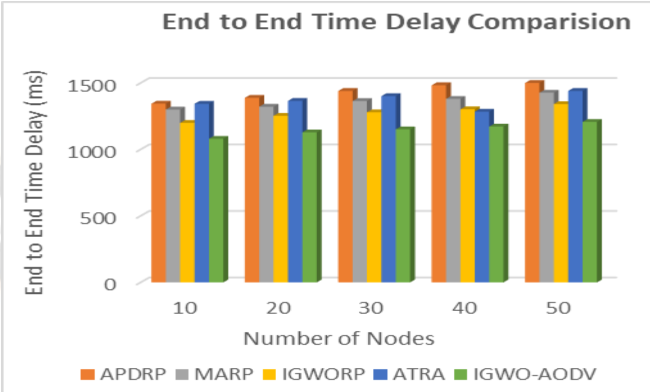

Figure 3. End-to-End Time Delay Comparision

Table 5. Average End-to-End Time Delay

Protocols	Average(EETD)
APDRP	1431
MARP	1358
IGWORP	1275
ATRA	1367
IGWO-AODV	1148

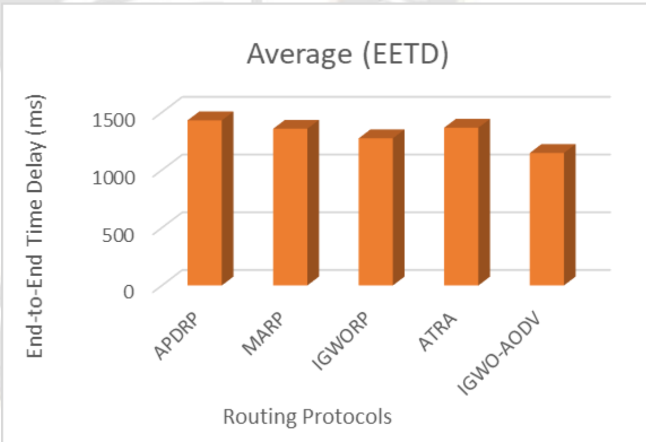

Figure 4. Average End to End Time Delay

The End-to-End Time delay results produced by this technique are excellent. The suggested IGWO-AODV offers significantly less travel time between the source and the destination.

VI. CONCLUSION

The suggested IGWO-AODV algorithm offers good Packet Delevery Ratio and low End-to-End Time Delay. Future ML algorithms that use this work could give an automated way to reduce end-to-end time delays..

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