An Improved Whale optimization Algorithm for Cross layer Neural Connection Network of MANET

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***Abstract*—**The connecting of numerous remote mobile nodes is known as a mobile ad hoc network. These networks are dynamic and self-contained, allowing them to move about freely. It is referred to as a structure-less network since it lacks a central controller. MANET(Mobile ad hoc network) is one of the most recent developing technologies to gain popularity. This research presents a improved Whale Optimization is enabled for the best feasible solution of the CNCN.The improved whale optimization uses a probability function to determine the best communication path in the network. According to a comparative examination of research, Improved WOA gives significant performance. A two-layer Neural Connection Network model with a cross-layer structure. Physical layer and data link layer. Then in the Physical Layer the load balancing as well as the packet specification is happensso we go for optimization technique. In Data Link Layer the Packet with huge amount of network path is enabled and the packets are delivered with the help of the Connector. The improved whale optimization is enabled in order to achieve the highest level of overall performance such as Waiting time, reliability, failure probability, throughput, and Instantaneous Throughput.

Index Terms—MANET, cross layer neural connection network, improved whale optimization, data link layer, physical layer.

I. Introduction

Mobile Ad hoc Networks are self-configuring, decentralized, adaptable, and randomly moveable groups of nodes that may communicate without the use of access points. These characteristics make them extremely adaptive networks that can be used quickly in sensitive and difficult contexts. Military activities, as well as civil, emergency, and rescue operations, are the most important applications of Mobile Ad hoc Networks [2].

Each node in a MANET has varied capabilities, such as transmitting, receiving, and routing data packets to other destinations. MANET nodes are highly mobile, allowing them to be added to and removed from MANETs at any time [13]. MANETs face a number of issues as a result of their unique characteristics, of energy conversion, the need of specialized routing protocol to manage the star topology, recognizing and isolating problematic nodes, afew factors to consider.

The MANET environment must overcome some limitations and inefficiencies. The properties of the wireless link range over time. Transmission hurdles such as fading, path loss, obstruction, and interference exist on these lines. The reliability of wireless transmission can be influenced by a variety of factors. When compared to other wireless networks, the limited radio frequency results in lower data speeds [5]. As a result, making the best use of bandwidth while keeping overhead to a minimum is essential. Cross-layer design is a new promising strategy for modern communication systems to produce high-performance protocol layers. Under this methodology, protocols are established and optimised simultaneously, or they are permitted to make communication to meet performance goals. This solution deviates from the standard design practise of operating every tier of the protocol stack separately.

This study suggests a Improved WOA, a new routing system for extending the lifetime of a network. Mirjalili *et al*. introduced the Whale Optimization Technique (WOA) as a new swarm intelligence optimization algorithm in 2016. Because the original WOA algorithm is sluggish to convergence and easy to slip into the local optimal during the search process, an IWOA algorithm is developed in this study [6]. The Improved WOA multipath optimization technique is used to find the optimum path between the nodes. Route optimization uses fitness functions including waiting time, dependability, failure probability, throughput, and Instantaneous Throughput to discover the optimal possible way.

II. Literature Review

Although the annals are rapidly fluctuating, AMC with GMSK delivers remarkable spectral efficiency because to its Bandwidth and Time restriction. GMSK has a higher spectral efficiency and can cut down on bandwidth waste during transmission. Even though its error rate is minimal in comparison to other modes, it can be solved by using an adaptive equaliser with precise design[1]. In MANET, energy-efficient mobility routing is a critical concern. With the help of an optimum clustering process, it is the need of the hour for successful communication in MANET. The optimum distance between cluster members and their associated s total distance between cluster members and their associated s is used to calculate.Our strategy minimises the amount of packets that are dropped in the network, hence boosting the

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network's overall performance. The suggested routing protocol consumes very less energy as compared to existing energy-aware routing protocols [2].

In network operation, the transmission model involves three steps. The network layer, data link layer, and physical layer are the three layers. The suggested transmission model, according to concept and simulations, has energy efficiency, transmission performance in terms of throughput, PDR (Packet delivery rate), latency, and CPR(Critical path routing). Furthermore, CEE(Core-Edge Elimination) addresses the issue of energy consumption in mobile wireless sensor networks while not jeopardising other transmission characteristics [3]. An intercity protocol was proposed as a solution to this problem, with the purpose of achieving the core aim of Vehicular networks, which really is patient care and satisfaction, by providing global coverage of vehicle routes while saving time. To route packages in the approved protocol, static or dynamic RSUs(roadside unit) were employed, and a ns2 simulators has been used to mimic it. The proposed protocol was analyzed to two intercity routing protocols. In terms of latency, packet delivery rate, and throughput outperform [4].

Artificial neural networks were used to build a cross-layer adaption system, and its comprehensive structure and algorithm were given. The proposed solution is for wireless connections with guaranteed Quality of service traffic[5] solves the difficulty of optimising the AMC(Advanced multi-hop clustering)method at the physical layer while also optimising the shorter protocol at the data link layer. The main purpose of this research is to reduce response time and energy consumption while increasing accuracy and convergence speed for the offload process. As an outcome, the suggested method enhances the accuracy and speed of convergence [6]. The Internet of Things (IoT) is still in its infancy. AddressResolution Protocol assaults are particularly vulnerable to IoT systems dependent on the local area network, and their anti-preventions need to be improved. Collect the Address Resolution Protocolpackets supplied by Kali Linux to the singleip microcomputer and study them with Wireshark to discover the attacker. After that, use the arptables programme to intercept malicious address resolution protocol packets and defend the Internet of Things from Address Resolution Protocolattacks [7].

We offer a decision tree-based IDS based on maine learning and a P methodology. For the detection technique, it uses a small number of labelled instances in a time-varying way. Both strategies would contribute in the creation of a reliable Intrusion detection system that complies with the rigorous requirement of MANET and WSN settings, limited power availability and the requirement for rapid deployment.Both strategies capture first-hand data using the promiscuous mode capabilities, which prohibits a rogue node from relaying bogus data to a DS [8].

In any system, there is always a desire, if not a must, to improve performance. As a result, there is usually a tradeoff between performance and architecture. When we talk about cross-layer design in wireless networks, we can observe this tension/trade-off. The architecture is upgraded or modified in the cross-layer design, which necessitates a thorough redesign and replacement. Interactions are created by the cross-layer design, some of which are intended and others which are not. We must investigate the interdependencies and their repercussions, as well as construct some mathematical proofs in the form of theorems[9].

Smart tags are the devices that are used in Internet of thingsconnectivity. Smartphones, Nano-things, and other less technologically advanced devices Furthermore, Internet of things permits heterogeneous connections in order to provide good performance versus interface and connectivity in order to provide high-quality service. User-demanded services must be available in such an Internet of things setting in order to collect acceptable replies for service reception, emphasising the need of strong internet of things communication performance. The most effective network path can be chosen to meet this user demand [10]. Various machine learning algorithms' effectiveness and performance have been verified using various parameters. The findings show that no single machine-learning system can successfully block all forms of attacks. The tree had a minimum false negative rate of zero percent and a maximum accuracy of 99.99 % for all kinds of attacks tested, excluding infiltrating, that had an accuracy of 86.57 %. Stochastic Naive Bayes has the lowest average accuracy and the highest negative predictive value of all the ML classifier [11].

Quality of Service (QoS) is a combination of technologies and processes that work together on a network to ensure that it can continue to run high-priority applications while avoiding congestion, even when network capacity is constrained.Whale Optimization Routing System, motivated by whale foraging behaviours, a QoS-enabled routing protocol has been developed. is suggested in this work. The natural characteristics of whales are used to discover the best route to the objective. Routes are chosen solely on the basis of fitness, resulting in reduced delay [12]. By broadcast the HELLO, the established protocol locates their neighbours. Only neighbours with a good signal intensity will be added to the list of neighbours based on expected RSSI value. The Link Expiring Time was designed to obtain a more accurate path. No Route Request packets are issued if residual energy falls below a certain threshold, prohibiting reduced energy node from participation in the route discovery process [13]. Cross-layer design technologies are used in radio resource management mobile ad hoc networks to construct an effective quality-of-service routing scheme that avoid the impacted area of a secondary users. In forward route request (RREQ) operation, the recommended QoS routing unicasts an

RREQ message to its neighbour with a minimum Q value that meets energy and cognitive radio requirements, based on the chosen deep reinforcement learning model.The aggregate remaining velocity of all node in the link are used to determine the Q value for link [14]. The suggested model outperformed earlier research' models and a single deep learning component, demonstrating that advanced metering infrastructure communication security is attainable. The following topics should be the focus of future research. (1) The detecting effect of the U2R assault was not perfect because to the reduced sample size in the datasets; as a solution, a small-model intrusion detection study must conducted. (2) Because experimental datasets differ from a real advanced metering infrastructure communication database should be produced, and the model should be updated to better meet advanced metering infrastructure intrusion detection demands based on the experimental results [15].

A. Section Association

The remaining sections of the paper are organized as follows. Section 3 introduces the suggested cross-layer neural network and whale optimization. The experimental results and discussions are presented in Section 4. Section 5 finishes with a summary of the findings as well as research recommendations for the future.

Overview of the Proposed System:

- The proposed CNCNprotocol specifies the layer level integration with the neural networks, with this two layer specification occurs. Data link and Physical layer
- In Data Link Layer the Packet with huge amount of network path is enabled and the packets are delivered with the help of the Connector.
- Then in the Physical Layer the load balancing as well as the packet specification based on the lcm value happens(System performance is 86%)so we go for optimization technique.
- Whale Optimization is enabled for the best feasible solution of the CNCN.

III. Proposed Method

The data-link layer is responsible for the network's physical address system, often known as the MAC address, as well as the physical medium access of different network components. A unique device address assigned to search device or component in a network is known as a media access control address.It is based on the MAC address that we may uniquely identify a network device. It's a 12-digit address with no duplicates.

The importance of network load balancing cannot be overstated. Furthermore, the amount of energy used for data transmission is a key issue that must be addressed in order to extend the network's lifespan. Many research projects for load balancing and energy efficient routing have recently been completed. A Cross layer Neural Connection Network's performance parameters include waiting time, reliability, failure probability, throughput, and Instantaneous Throughput. The optimal is found by evaluating multiple constraints such as waiting time, and throughput in a clustering-based routing system. The required parameter analysis is carried out in cross layers: the physical layer evaluates the waiting time and dependability of node serve as head, while the data link layer evaluates the latency.

A. Cross-layer Neural Connection Network

The network layer can now access the node's remaining energy and received signal strength information because the physical and data link layers have connected. Both the data link layer and the MAC layer have similar interfaces for receiving queuing up info from bandwidth data from the MAC layer. The work uses the approximate to estimate path stabilization probabilities and recover meaningful information across layers.The data link layer requests the node's available resource information through the cross-layer interface after receiving the RREQ packet, and loads it into the RREQ. The RREQ package will supply the destination node with all available resource information,that will be used as parameter in the path selection phase. A cross-layer neural connection network design must be constructed to acquire this information. The best positioning model could conserve energy and allow us to transmit more data. As a result, might be considered a node with waiting time, failure probability, and throughput. Fig. 1 depicts the cross-layer network design.

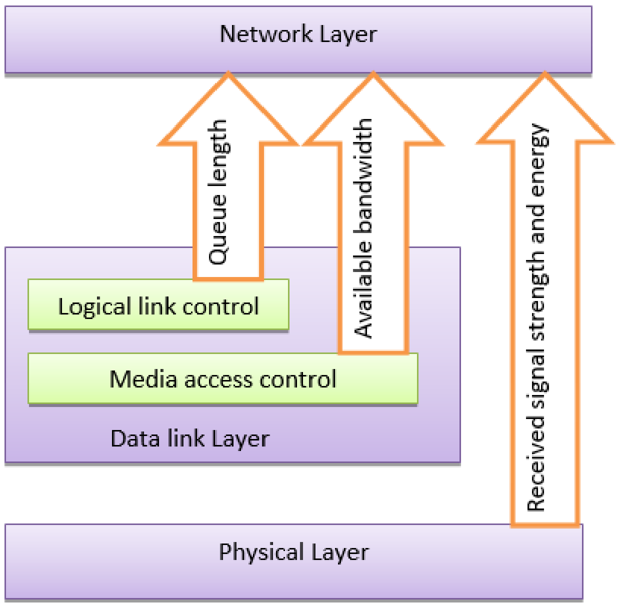

Fig. 1. Cross layer neural connection architecture

The physical layer and the network layer have formed a connection, and the network layer can now access the node's remaining energy and received signal strength information. The network layer and the MAC layer both have similar interfaces for getting queue length information from the LLC layer and available bandwidth information from the MAC layer. The model is used in this research to calculate the probability of path stability and acquire useful information across layers. The network layer requests the node's available resource information through the cross-layer interface after receiving the RREQ packet, and loads it into the RREQ.

1) Routing discovery process

The purpose of Optimal multipath routing with WOA route discover is to design routing paths that are long enough telecommunications services and keep them for communications systems with a variety of service requirements. There are two stages to the route discovery phase:routing request and route reply.

2) Routing request phase

Before delivering the packet, the source node looks for the destination address in the route record, and if there isn't one, it starts the route discovery operation. When a route request (RREQ) packet is delivered, the route request phases begin when the RREQ packet reaches by the destination network. The RREQ package is generated by the source node at the start of the route request.Several more fields in the new RREQ package collect information on the communication technologies along the route. The source node loads the TR field, while the node that received the RREQ updates the other data. Depending on the info in these variables, the path finding algorithm at the destination point can choose the best transmitted path for information with various priorities.

3) Routing reply phase

The destination starts the timer and reads and stores the communications resources in the RREQ field when it gets the first RREQ. The destination node stops receiving RREQ and performs the path-selection operation when the timeout expires.The cost function of varied suppliers for seach path is first calculated using the path selection approach. Energy, network throughput, and waiting time are all calculated using the path j functions.

$$C_j^{En} = \frac{\overline{En_{path}^{residual}}}{En_{min}^{residual}}$$

$$C_j^{En} = \frac{\overline{BW_{path}}}{BW_{min}}$$

$$C_j^{En} = \frac{\overline{QL_{path}^{idle}}}{QL_{min}^{idle}}$$

$$C_j^{hop} = \frac{H_j}{H_{max}}$$

The most essential drivers of the data's integrity are these three indicators. The time delay is affected by the following three metrics, as well as the number of hops along the route. The path selection algorithm will calculate the total cost of each path based on the QoS criteria, and the way with the lowest cost value will be better equipped to meet the related QoS standards. The three types of data QoS requirements are delay sensitive data, integrity sensitive data, and common data.

0	7 8 9	10	18 19	23	24 31
Type	R	A	Reserved	Prefix Sz	Hop Count
RREQ Broadcast ID					
Destination node IP address					
Destination Sequence Number					
Originator system IP address					
Lifetime					
First Hop Address					
Path Priority type			Path Residual Energy		

Fig. 2. Format of new RREP packet.

Immediately inform the forwarding table data and reroute the queuing system path interfaces if the source node receives an RREP, once all RREPs have indeed been received, the route discovering process is completed. The new RREQ packet gathers information about path's communication resources. The source node loads the TR field, while the node that received the RREQ updates the other data. The destination node can choose the best transmission path for data with varied priorities. PRMR prioritises available bandwidth, queue length, residual energy, and path stability likelihood while choosing a path. These measurements are taken at various tiers of the network. A cross-layer network architecture must be created in order to acquire this information.

4) Cluster head selection

The fundamental purpose of the S effort is to reduce the distance between the elected and the nodeas well as the time it takes to transport data between these[2]. The suggested technique's objectives function is given in Eq (1) γ_1 , γ_2 and γ_3 cause a delay, energy, and distance module, respectively. These module' criteria is written as $\gamma_1 + \gamma_2 + \gamma_3 = 1.Z^z - B_s$addresses the distances between the normal and sink nodes in Eq.(2).

$$K_n = \eta o_n + (1-\eta) o_m \quad (1)$$

$$o_n = \frac{1}{b}\sum_{z=1}^{b} \|Z^z - B_s\| \quad (2)$$

where $o_{(m)}^{dis}$ corresponds to packet forward from the normal node to, and subsequently from to BS. o_i^{dis}must remain in the range [0, 1]. When there is a considerable gap between the and the normal node, the value of o_i^{dis} is higher.

$$o_i^{dis} = \frac{o_{(m)}^{dis}}{o_{(n)}^{dis}} \quad (3)$$

$$o_{(m)}^{dis} = \sum_{z=1}^{n_z}\left[\|CH_z - B_s\| + \sum_{x=1}^{n_x}\|CH_z - z_z\|\right] \quad (4)$$

$$o_{(n)}^{dis} = \sum_{z=1}^{N_z}\sum_{x=1}^{N_x}\|z_z - z_x\| \quad (5)$$

The descriptions of $o_{(m)}^{dis}$) and $o_{(n)}^{dis}$ are expressed as follows: $z_z$indicates the ordinary node in z^{th} cluster, CH_z denotes the of x^{th} cluster, $CH_z - B_s$denotes the distance between the BS and , $CH_z - z_z$ signifies the distance between the normal node and , and $z_z - z_x$ denotedistance between two normal nodes, n_z and n_x denotes the node counting..

As an outcome, when the node own the fewest nodes, the delay is reduced. The fraction denotes the bigger count of, while the denominator n_s reflects the total number of nodes in WSN. Furthermore, the value of$o_i^{del}$is between [0, 1].

$$o_i^{del} = \frac{MAX\left(\|CH_z - z_z\|\right)_{z=1}^{n_{CH}}}{n_s} \quad (6)$$

B. Optimal Multipath Route Selection Utilising the WoA

The initial stage of multipath communication in MANETs is the selection of legitimate nodes so that a method of communicating between the source and destination node may be formed. Because successful communication demands an effective path, the optimum path is determined based on criteria including trust, energy, throughput, and path node connectivity. As a result, the RPL routing idea is used to build the path, resulting in a multi-path connection between the source and destination nodes. WOA is used to oose the best path out of the ones that have been constructed. The maximum value of the fitness metric is used to determine the communicative multi-path between the source S and destination D nodes.

1) Steps for calculating fitness measure

Step 1: Calculate sear agent's $\emptyset^*$ fitness and determine which one is the best.

Step 2: When the current iteration r is smaller than just the maximal iteration updates vector coefficients F,L, and the probabilities of circumferential path pr for ea iteration of the algorithm are smaller than the maximal iteration updated vector coefficients F,L.

Step 3: The encircling meanism update is termed the positional update if the probability is less than 0.5 and $|F|$is less than (hj). Where$\emptyset$ and $\emptyset^*$is the multiplied of elements one by one and * is the location vector.

$$\vec{\emptyset}(r+1) = \vec{\emptyset}^*(r) - \vec{F}.\vec{V} \quad (7)$$

Step 4: Eq(7) anges the sear area location by randomly $|F| \geq 1$ selecting agent with an arbitrarily selected values from whales in a recent court case run($\emptyset_{rand}$),.

$$\vec{\emptyset}(r+1) = \vec{\emptyset}_{rand} - \vec{F}.\vec{V} \quad (8)$$

Step 5: A new spiral update is performed when the likelihood is larger than 0.5., Eq(8), is used to update the position. In which the values of $\vec{\emptyset}_1, \vec{\emptyset}_2 and\, \vec{\emptyset}_3$ are assessed.

$$\vec{\emptyset}(r+1) = \frac{\vec{\emptyset}_1 + \vec{\emptyset}_2 + \vec{\emptyset}_3}{3} \quad if\ pr \geq 0.5 \quad (9)$$

Step 6: Calculate each sear agent's fitness and update $\emptyset^*$ according to the best solution.

Algorithm 1: Improved whale optimization Algorithm
Create the initial random population
Estimate each individual fitness value
Initialize the whale populationfrom scrat. $\emptyset_i(i = 1,2, \dots \dots n)$
While the stop condition is not fulfilled do
$\emptyset^*$=the most effective sear agent
While(r<max iteration)
For each and every sear agent
Update F,L, and pr $if(pr < 0.5$
$if(\|F\| < 1)$
$\vec{\emptyset}(r+1) = \vec{\emptyset}^*(r) - \vec{F}.\vec{V}$
Else if($\|F\| \geq 1$)
Pick a random sear agent. ($\emptyset_{rand}$)
$\vec{\emptyset}(r+1) = \vec{\emptyset}_{rand} - \vec{F}.\vec{V}$
End if
Else if($pr \geq 0.5$)
$\vec{\emptyset}(r+1) = \frac{\vec{\emptyset}_1 + \vec{\emptyset}_2 + \vec{\emptyset}_3}{3}$ $if\ pr \geq 0.5$
End if
End for
check to see whether any sear agents left after the sear space was completed, and if so, range it.
Assess each sear agent's suitability.
Update $\emptyset^*$according to the best solution
$r = r + 1$
End while
return $\emptyset^*$

In terms of local search optimization, unpredictable convergence time, cost-effectiveness, higher execution time, implementation issues, weaker exploration and exploitation ability, and so on, the traditional IWOA face a few challenges [6]. The exploitation of IWOA are integrated and employed in this paper. We suggested IWOA as a method for finding the best answer and improving precision.

IV. Result and Discussion

The performance of the proposed cross layer neural connection network and other traditional methods of whale optimization is assessed using MATLAB respectively. The cross layer neural connection network have five parameters they are Waiting time, Reliability, Failure Probability, Throughput, Instantaneous Throughput.

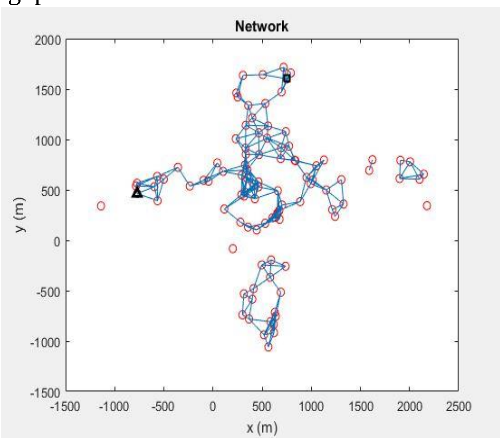

Fig. 3. Packet data send over the data link layer

Networks are a set of algorithms that imitate actions in order to detect layer relationship between massive volumes of data. Layers of connecting nodes make up a network. The perceptron feeds the data layer created by a multiple level into an activation function, the packet determines the data to be sent in the data link layer, and the network initially has a large number of interconnected paths. Each node needs to set a path for that group of network assembling is generated as shown in Fig. 3, ($\Delta - defines\ next\ group\ to\ set\ a\ path$) & ($\blacksquare - defines\ destination$)

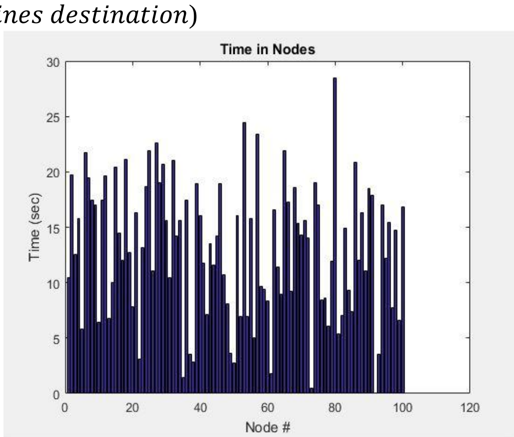

Fig. 4. Time management in node

Time management in nodes specifies that packets are to be delivered within seconds based on the crosslayer network connection, together with variations in node stability, allowing the node to transfer packets as soon as possible. Layer processing variations of Time and Energy in the network. In Fig. 4 the analysis of processing time between layers from source and destination.

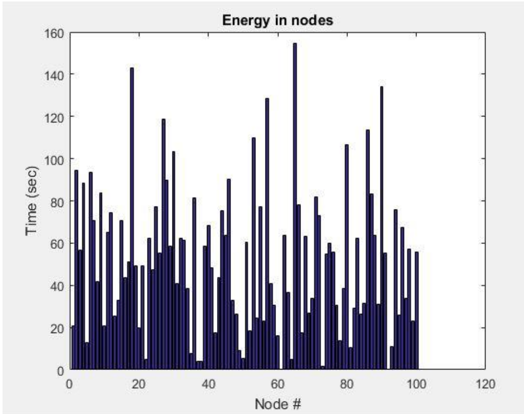

Fig 5. Energy in nodes

Sensor nodes in wireless sensor networks require a lot of trial and error interactions with the environment, whi results in high energy consumption and low energy efficiency. In comparison to standard methods, the proposed method delivers improved energy efficiency, lower routing latency, and a higher packet delivery ratio. The analysis of processing time between layers from source and destination is summarized, In Fig. 5.

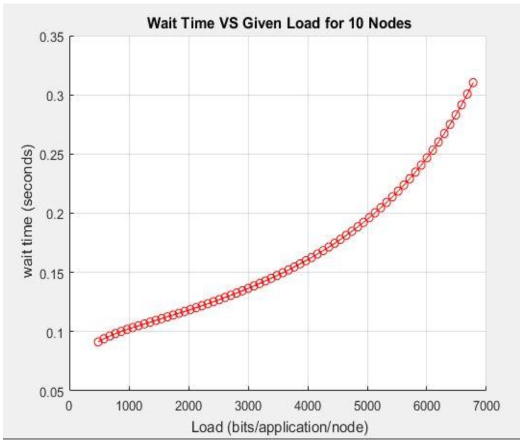

Fig. 6. Waiting time

There is only one request type in phase, and the data length increases with ea data length, causing all nodes to order data packets in a very short period of time. There is a bigger influence of time in the node that specifies packets due to delay. In Fig. 6, the load to be transferred between each layers with the network path but there exist some network group that enables the load with huge delay(waiting time) and takes much time, inorder to process the load in fast accessing the energy is calculated, by this the average waiting time is calculated

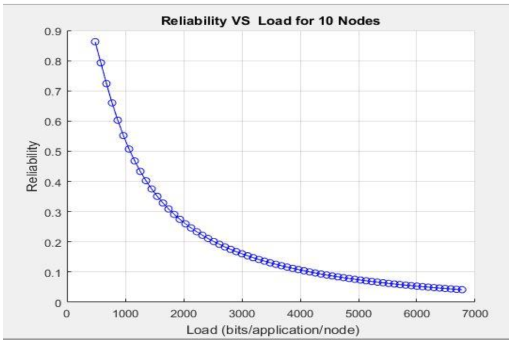

Fig. 7. Reliability

The measure is defined as having high reliability if it delivers similar findings under consistent settings, as shown in the above figure, and the load testability is completed. It is a property of a series of tests that refers to the amount of measurement inaccuracy that may be embedded in the test. The tests are consistent from one test to the next.

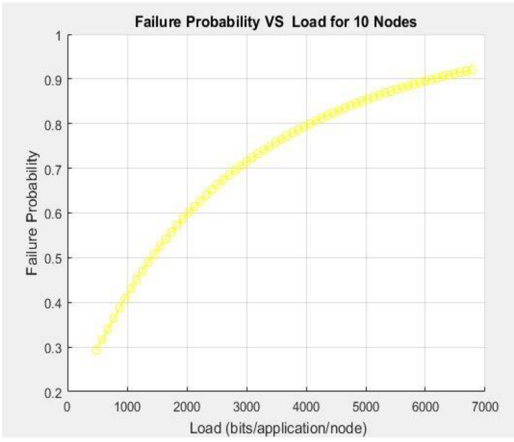

Fig. 8. Failure probability

The likelihood of exceeding a limit state during a particular reference time period, which is the data packet to be conveyed within the specified frame set, is characterized as the failure probability. An accidental condition of a contemplated building component is attained when this happens.

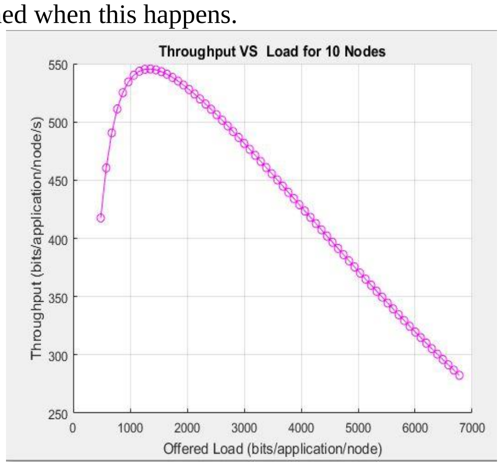

Fig. 9. Throughput

The rate at which a message is successfully delivered via a communication link is known as network throughput. These messages' data can be sent through a physical or logical link, or it can be routed through a network node. Bits per second (bit/s or bps) is the most common unit of measurement, however data packets per second (p/s or pps) and data packets per time slot are also used.

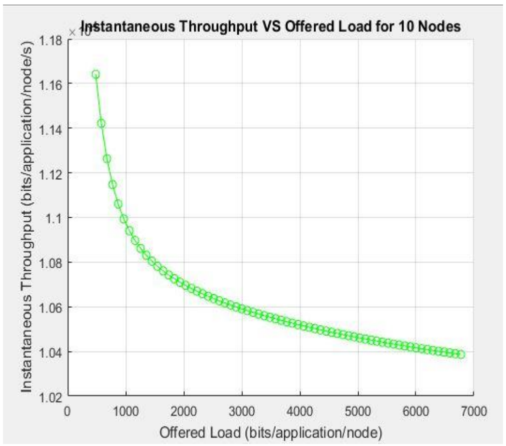

Fig. 10. Instantaneous throughput

We are evaluating the instantaneous throughput by which the nodes will check that the data packet to be sent within a frequent time access if the measurement is conducted over a very short time interval.

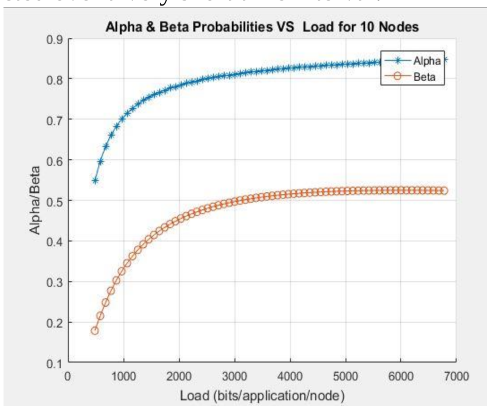

Fig. 11. Alpha and beta

When the linkage of packets within each node is true, the assumptions of data packets may be detected by minimizing the error with the aid of the PHY layer in the crosslayer, and when the linkage of packets within ea node is true with the use of Alpha and Beta.

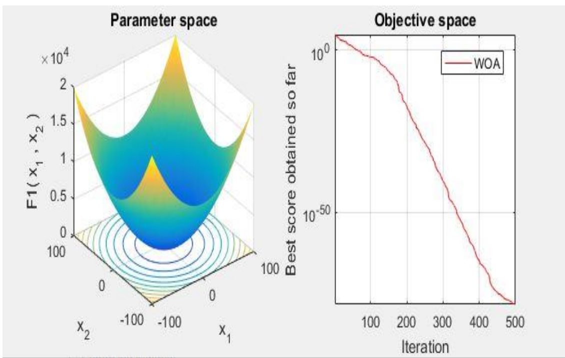

Fig. 12. WOA(whale optimization)

It has a simple structure, employs fewer operators, is faster to convergence, and does a better job of balancing the exploration and exploitation stages. The WOA algorithm starts with a set of solutions that are created at random. At the end of ea cycle, sear agents compare their positions to a randomly selected sear agent or the best answer found thus far. To make exploration and exploitation easier, the value is reduced from 2 to 0. When the optimum method for updating the positions of the sear agents has been discovered, a random sear agent is osen.

V. Conclusion

The proposed IWOA is used to execute multipath routing in this study, which tackles the key disadvantages associated with existing multipath routing algorithms. The network's nodes are initially set up with their energies and trust factors in such a way that effective multipath routing based on optimization is guaranteed. Through a path discovery algorithm, the protocol may estimate the proportion of different priority traffic, reserve the path to fulfil different service quality needs, and provide differential service and load balancing through packet scheduling. In additional, the destination node monitors changes in the high-priority data flow and takes countermeasures before path congestion occurs to further improve service quality.Waiting time, dependability, failure probability, throughput, and Instantaneous Throughput are all performance parameters for a better whale optimization. The proposed system is further developed in the future to improve the network's system performance by integrating the Intrusion Response System (IRS) with a dynamic response method.

Conflict of Interest

The authors declare no conflict of interest

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