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Cluster Head Selection and Optimal Multipath detection using Coral Reef Optimization in MANET Environment

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Abstract: Mobile Ad-hoc Network (MANET) data transfer between nodes in a multi-hop way offers a wide variety of applications. The dynamic feature of ad hoc network mobile nodes is primarily influenced by safety issues, which limit data forwarding rate in multipath routing. As a supplementary method to improve safe data delivery in a MANET, this paper proposes and analyse the cluster head (CH) selection and optimum multipath scheme. The CHs are chosen based on the possibility values of each node in MANET, which are considered from the residual energy of each node. During the present phase, the total remaining node energy is used to calculate the mean energy of the entire network. The most likely nodes are picked as the CH, which gathers packets from the cluster members through multi-hop communication. The fundamental idea is to partition a top-secret communication into several shares and then forward the shares via numerous routes to the destination. The Coral Reef Optimization method is used in this work to perform optimum multipath routing. The thorough simulation findings validate the feasibility and efficacy of the suggested strategy in comparison to Butterfly optimization algorithm (BA), Whale Optimization algorithm (WOA) and BAT algorithm techniques.

Index Terms: Coral Reef Optimization, Cluster Head Selection, Mobile Ad-hoc Network, Optimal Multipath Scheme, Secret Message.

1. Introduction

The mobile nodes are particularly clever for modifying or adjusting and reconfiguring situations. Mobile nodes communicate via a direct wireless path or wireless cross-path in MANET. The selective node communicates with each other using reduced medium infrastructure on collective mobile devices. MANETs allow resilient communication between senior officers and low-level hierarchically-based officials in a range of hostile circumstances, in the military sector to retain info and network detail [1]. In enterprise environments for external organizations and where people need to take part in/conduct meetings/forums on projects, collaborative computing work is used [2]. This network can individually connect through desktop computers to all participating users of a liberated network [3, 4] with a neighbouring network. The Bluetooth linked device has a short range of mobile networks, allowing easy communication with additional mobile nodes and laptops [5]. Earthquake, Fire, flood, etc. and rescue processes must require mobile nodes to handle public applications in emergencies [6, 7].

MANETs are mainly autonomous, decentralized and mobility-friendly. Only communication radio ranges from dynamic communication among collective nodes. Intermediate nodes serve as routers which transport information provided by other nodes to enable communication between not directly interconnected nodes. The dynamic character of

MANETs usually fluctuates because of mobile node mobility. Thanks to the flexibility of mobile nodules, the attackers can simply influence the process of data transit and reception. If the ad hoc network does not have some type of security for a network or a link layer, a MANET routing protocol is more exposed to numerous forms of malicious assaults. Multi-talented routing methods have suggested reducing unnecessary losses in data transport during recent years. The first improved MANET routing protocol termed an Optimized Connected State RP (OLSR) version [8] is provided by the International Engineering Task Force. OLSR version 2 has a high level of performance compared with other routing protocols, such as AODV, TBRPF and DSR [9]. This malicious system can damage RP (AODV) [10], modifying the IP address and sequence numbers, changing route request packets, sum of hops behaviour in packets forwarding) by various actions. On-demand protocols use a search strategy to choice multiple disjoint paths to develop the dead node, avoiding the pathetic node on dead situations. The search-based routing procedure is implemented by use of DSR [11] standard dynamics. Message verification systems and cryptography systems joint with the SRDP to maintain safe transfer of data [12].

A vital service in MANET and in every network is secure data transmission from one node to another. Sensitive information should be protected from passive eavesdropping assaults such as tactical military data delivered through hostile MANET. The wireless channel is susceptible to hostility because of its broadcast nature. Data privacy is usually achieved using cryptography. The safety of cryptographic procedures depends, however, primarily on the trustworthy and secure key organisation system. In particular, several computationally effective cryptographic methods such as the RC4 stream cipher, which is ideal for MANET restricted resource, are highly sensitive to and vulnerable to keying materials. There have been a lot of efforts to design safer and more reliable key management systems [13,14,15,16,17,18,19,20]. To date there is no absolute safe and trustworthy key management method. The gap between theoretical design and real application would further decrease this option.

The end-to-end data transmission service could have been interrupted or seriously degraded before the efficient prevention/response/recovery system comes into operation. Therefore it is very vital to build a resilient security protocol, i.e. the protocol should work well in adverse settings when a certain percentage of nodes are affected. The dynamic feature of ad hoc network mobile nodes is primarily influenced by safety issues, which limit data forwarding rate in multipath routing. In that work, the suggested OMP-CRO provides a more secure data delivery service within a MANET, and the Coral Reef Optimization (CRO) system provides the cluster head selection and optimal multi-path (OMP) system. The basic notion of OMP-CRO is based on two methods: cluster head selection and optimal multi-way routing. We offer optimum path selection with CRO that offers a particular level of reliability without losing safety.

The remaining paper is arranged as follows: Section 2 deliberates the related work of multi-path routing cluster head selection. Section 3 clarifies the recommended practise. The validation of OMP-CRO in several metrics with existing methodologies is described in Section 4. Finally, Section 5 describes the end of this work with its future work.

2. Related Works

Mahadev A. Gawas, Lucy J. Gudino, K. R Anupama[21] presented a new cross-layer technique known as the MANETs adaptive congestion and delay-sensitive routing protocol (CADM). The CADM protocol is used for linking the network layer, the MAC and the physical layer to the cross-layer. In latency sensitive applications, the CADM explores the relationship among data rate and MAC delay, to ensure better network enactment in MANETs. The protocol specifies several node-disjuncture paths and supports optimal data speeds across the connections to build a flow, depending on the anticipated time lag in multi-rate MANETs with particular latency constraints. The suggested CADM protocol manages the route through less overfilled nodes and frequently efficiently controls the congestion.

The Low Overhead Localized Flooding (LOLF), on the basis of the question localization (QL) RP, is a major expansion of overhead reducing routing is the work of Sumet Prabhavat et.al.[22]. This study helps monitor the distribution of routing packets in path and route maintenance procedures, however the scope of packet management information is only slightly increasing. Simulation data from comprehensive research indicate that our method is to decrease overall overhead routing, energy usage and end-to-end latency without reducing the packet distribution ratio comparing to prevailing protocols.

S.Venkatasubramanian et.al [23] suggested a scheme to overcome energy consumption issues and reduce CH effort, a cluster management solution based on TICKET-ID is used. The CA (cluster agent) is responsible for controlling and supervising the functionalities of the nodes as well as reporting to TID-CMGR. The cluster head manages and distributes packets to network nodes. To demonstrate the scheme's performance, a simulation exercise with 20 to 100 nodes was carried out. The recommended method is used to conduct experiments using the NS-simulator. TIDCMGR's clustering method will efficiently regulate power consumption between clusters and cluster managers. The solution handled the complexity of multipath routing protocols as well as overhead concerns.

Bakar, A. H. Mohsin, A Zainal [24]. Two protocols are suggested to optimally influence usable network possessions and to clearly differentiate high quality links. These are the Hybrid Geo-cast Routing Protocol (HGR) and the protocol for signal extension and prevention (SSCA). The optimal and flexible HGR methodology uses locations to limit the search area during the entire route discovery procedure by leveraging talented search paths to reduce overall capacity. In the meantime, adaptive SSCA employs the SSCA technology in order to increase compatibility, precisely detect nodes and reduce packet reductions.

S. Mostafavi et al. in [25] proposed a QoS-assured Mobility-Aware RP (QMARAODV) that is an enhanced model of the AODV to overcome mobility management challenges. The QMAR-AODV protocol supports QoS-guaranteed routing by analysing a combination of stability and quality metrics. The metrics include the mobility ratio between two nodes within a path, power efficiency, and overcrowding burden to discover the steadiest and QoS-guaranteed paths. The proposed protocol in [24] has been simulated by the OPNET 14.5. The Route instability, data reception ratio, E2E delay, PLR, re-transmission level, and throughput are the proposed performance evaluation metrics. These metrics have been utilized for evaluation and comparison to E2E Link Reliable Energy Efficient Multipath Routing (E2E-LREEMR) protocols. The results show that the QMAR-AODV protocol is more efficient than E2ELREEMR. QMAR-AODV improves data reception by 5.1% and enhances throughput by 4.8% compared to the E2E-LREEMR. QMAR-AODV decreases route instability by 8.3%, E2E delay by 10.9%, data retransmissions by 10.6%, and packet loss by 5.4%.

Salama[26] et al. have examined the AODV and the DSDV performance by mapping the network power consumption through changing the QoS parameters . The proposed QoS parameters for the analysis are the average throughput, PDR, and energy consumption. Three different simulation scenarios have been directed to evaluate the influence of network size, mobility, and packet size on network performance. The simulation results show that there is not any protocol realizes the comprehensive network performance and achieves the full energy consumption optimization. Moreover, no protocol can fully overcome network load effects and completely manage network high-mobility. The DSDV presents a reliable performance at high-mobility networks, while the AODV is better in heavy-traffic networks.

S.Venkatasubramanian et.al.[31] have proposed a Ticket-ID based routing to provide QoS in MANET. It is based on the information gathered from nodes, such as energy, node position, speed, and so on. The proposed routing system allows for the most short and reliable communication path. The system balances bandwidth distribution based on application type, ensuring consistent bandwidth across the network and making it ideal for large-scale mobile ad hoc networks. Furthermore, there is no room for error when routing. The technology delivers the least amount of energy while maximizing network lifespan.

3. Proposed Method

3.1. Cluster formation

The nodes are positioned at random locations in MANET and they are grouped together to form different clusters. The nodes are formed into a cluster based on some criteria and the nodes that do not fall into the criteria are included in another cluster. Each node in the cluster is assigned with any one of the functions such as member node, CH and gateway node. The CH coordinates the intra-cluster communication, whereas the gateway coordinates the inter cluster communication. The CHs communicate with each other through the gateway node to reduce the traffic overhead. Generally, the clusters are formed by broadcasting the beacon messages to the neighbours. This generates more traffic and leads to congestion. The proposed method utilised the bat characteristics and the status of the nodes is gathered from their neighbours to reduce the number of beacon transmission. A threshold RSSI value is estimated and the nodes lie in a certain cluster based on their transmission range.

A node adds a unique identification number to the network (UID). The nodes transmit HELLO message across their respective range of transmission. The CH is chosen on the basis of the highest neighboring nodes. The CH sets the parameters below:

- Maximum number of nodes in the cluster is equal to the maximum size of the cluster.
- Maximum number of levels in cluster is equal to the maximum hop limit.
- The UID of the CH is its ID.
- The CH acts as the advertising node.

The advertising node advertises the ID in its neighbourhood range. If any neighbour node wants to link the cluster, it sends a linking request to the CH through the advertising node. The CH receives the request and accepts the node, only if:

- The maximum size of the cluster is less than the total amount of nodes in cluster.
- The maximum hop limit is less than the level of requesting nodes.

If the requesting node satisfies the above criteria, the CH accepts it as a Cluster Client (CC) and allocates an ID. The CH registers the CC and updates the routing table. If the CC has further than one Cluster ID, it is marked as a node on the border or gateway. The CH converts the advertisement node as a new CC. If the CC contains more than one identification of the same cluster, the least length ID will be advertised. The stages are continued until the cluster is as big as possible. When a node joins the network during the cluster formation, a UID is assigned. Then, the nodes broadcast HELLO message to preserve the neighbour table. The CH is selected based on threshold value, which is defined in the following section. Once a CH is chosen, it remains for a predefined period, until it dies [26].

3.2. CH selection

At first, all nodes are casually placed with various energies. The node is picked as a cluster head depending on each node's threshold value. The protocol computes d_0 for each node using the following equation (1)

$$\mathrm{d}_0 = \sqrt{\frac{\in \mathrm{fs}}{\in \mathrm{mp}}} \quad (1)$$

Where, $\in fs$ the upper ends and $\in mp$ the upper ends are the released breaks and multi-path distance among node and sink sensor. d_0 is used to compute each node's P_{opt} value. The P_{opt} equation is followed by Equation (2)

$$\mathrm{P}_{\mathrm{opt}} = \frac{1}{0.765} * \sqrt{\frac{2}{\mathrm{N}\pi} * \mathrm{d}_0} \quad (2)$$

Where 1/0.765 is base station distance, N is the total sum of network nodes. P_{opt} Value is the final threshold value calculation. Each node computes the threshold value and examines whether or not the node is chosen as a CH. Each node's final threshold value is computed using the following formula.

$$T_s = \frac{P_{opt}}{1 - P_{opt} * (r \bmod (\frac{1}{P_{opt}}))} \left[\frac{E_i}{E_{avg}} + (r \bmod (\frac{1}{P_{opt}})(1 - \frac{E_i}{E_{avg}})) \right] \quad (3)$$

Where r is the present network round, E_i is the sensor energy; E_{avg} is the average network energy. Each node's threshold value is compared to that of other nodes. The cluster head is the node with the highest threshold value. The pseudo code is displayed in algorithms 1 and 2.

Algorithm 1: Creation of Node Information.

```
Tm Message Time Duration
NMsg Maximum number of messages in Tm
-----------------------------------------
Node Information creation (Message M)
  If (maxTime < Tm) then
    If ((CntHop) > M.CntHop + 1) then
        CntHop = M.CntHop + 1
        UpdateInfo
   Else
        Sendinfo(PID, NodeID)
   End if
  For each value x of Nodeinfo
    NodeinfoTable[Nodeinfo.id][paren[x]] = Nodeinfo.CntHop[x]
  End
```

Algorithm 2: Cluster Head Selection.

```
Ts(i)threshold value of the sensor node
Nun: number of nodes
-----------------------------------------
Cluster Head Selection
For (i = 0; i < nun; i + +)
        Calculate Ts(i);
End for
For (i = 0; i < nun − 1; i + +)
   For j = i + 1; i < nun; j + +
        Tss = Ts(j); Ts(j) = Ts(i); Ts(i) = Tss;
End for
Select node on Tss as cluster head;
End
```

3.3. Multipath routing

The second challenge is the multi-way routing: how do I locate the numerous paths in a MANET, Routing in a MANET is a big difficulty since the nodes can move and the architecture of the network can change rapidly and abruptly. There has been a lot of effort in building ad hoc RP to respond to the rapid topological variations, which include the multitrack routing technique. One benefit is the ability to reduce the impact of intermittent wireless connections and frequent topological changes by using several routes in a MANET system. Additional benefit is that the nodes in network are generally battery powered, so the energy ingesting in each node can be increased evenly by distributing the traffic load carefully on multiple tracks, so the overall lifetime is extended.

As we said, ad hoc routing is a huge challenge. Two elements provide the major challenge: continual movement of nodes frequently produces topologic changes, whereas limited network capacity limits topological updates in good time. On-demand routing has been widely used on MANET, because of its bandwidth effectiveness in response to the bandwidth constrictions. The multitrack routing strategy is another promising technology to address frequent topological changes, as the usage of many pathways might reduce the effect of possible link disasters. Numerous multi-path routing techniques were suggested for finding node in an ad hoc network [27,28,29]. Several protocols presented are on-demand and use source routing techniques to manage the path split in the source node. For a routing protocol on demand, when a path to a convinced destination is needed, but not known, a process of routing discovery is initiated by transmitting routing discovery messages across the network and the endpoint will reply by returning the route. A certain category of cache is essential to keep the previously identified routes so that the node does not have to discover the costly route on each particular packet. The routes responded to the source comprise a complete list of nodes from the basis to the endpoint in various routing protocols. A "path cache" group can be created by independently caching all of these routes. This form of cache has been extensively used. However, these paths might not be most useful to us, since they are frequently chosen on the basis of hop sum or propagation delay, not always the security. In [30], we created another cache organization, dubbed a link cache, where routes are deconstructed into links and shown in a united graphical data, as shown in Fig. 1.

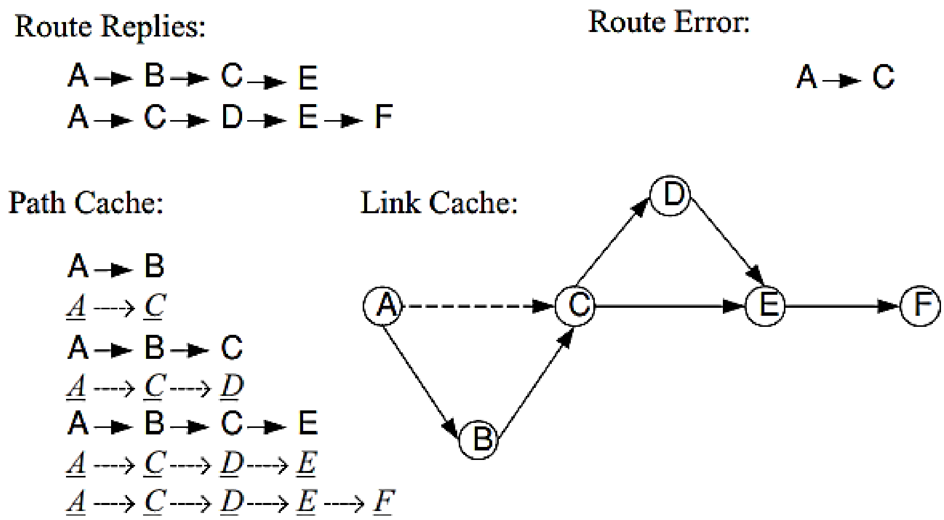

Fig.1. Link cache and Path cache.

Due to the quantity of route response data, routes in a path cache are continuously discovered in a link cache, however a link cache is able to make more efficient use of route info by connecting separate links to novel paths not in the path cache. We have also created an adaptive stale link removal system to operate with the cache. In order to give a partial opinion of Network Topology the suggested link caching system could be included into any underlying multi-path routing protocols such as [27,28,29]. Then the optimization of a path set can be carried out independently from the routing protocols used to distribute the message shares, only based on the identified partial network topology, where CRO is utilized for optimal path selection.

A. Coral reefs optimization (CRO) technique

The optimisation of the coral reefs is a meta-heuristic method that replicates the coral development behaviour in reefs. This algorithm begins with a first population of various coded solutions such as its corals, which are produced randomly and arranged in a reef square grid. The square grid cells are primarily unfilled and the corals of the original population are placed arbitrarily in the cells of the grid. There should be less ways to leave a few cells unfilled than the number of cells in the quadratic grid and so novel corals can grow in the reef in the next stage. A health purpose is also necessary to monitor the excellence of the solutions and to identify better alternatives. This health purpose can be the same independent optimisation function. The method is based on the reproduction of coral and the creation of coral reefs. Coral reproduction with different operators is regularly performed to obtain improved results. The reproductive operators of corals include exterior sexual breeding (broadcasting), internal sexual breeding and asexual reproduction. A segment of the corals is picked using a even random mechanism for external reproduction. The reproduction pairs of these solutions are then selected. These pairings of solutions will generate new solutions by conducting cross-over operators. Pairs of solutions, such as roulette wheel, can be randomly or by other techniques. In this step, just one new solution is produced from each pair. New solutions produced at this point are not instantly deposited in the square grid and discharged into the water. The solutions created at this phase, identical to the previous step, are discharged into the water. There is a kind of struggle to take space to produce coral reefs. Each phase of the algorithm tries to set the corals to the reef. Success be contingent on the power of the coral or on the possibility of finding an empty spot. The solutions produced by interior and exterior reproductive operators are placed to reef for this purpose. First, for each new solution, the value of the health purpose is determined.

Every solution is then assigned to a randomly designated cell in the square grid. If this cell is empty, it contains the solution. If the cell is engaged, then the rate of the new solution's health function is larger than that of the cell's old solution, the new solution will be swapped in the cell. The novel solution cannot otherwise be placed in the cell. A higher bound is set for each solution for the amount of placing attempts and, after beyond the stated upper bound, the solution is depredated. The following stage consists of the asexual reproductive operator using the grid solutions. To this goal, all solutions are sorted in the decreasing order of health values and a portion of the best solutions themselves duplicate (replicate). Novel solutions (replications of the best solutions) try to reef, like the previous step. The coral depredation procedure (to reject inadequate solutions) is implemented at the end of each stage of the algorithm to ensure that sufficient space in the reef is available for the following step. A small fraction of the worst answers is reserved for this purpose with a certain probability. Until termination conditions are established, the algorithm is repeated. For example, generating the number of generations provided by the user might be regarded as the algorithm's termination condition. The health function in various stages of the procedure determines the fitness of the solutions for the coral reefs procedure. The CRO technique steps are as follows.

B. Initialization

First, the matrix called R is generated as a reef, with rows and columns (N = M). A random solution population is then constructed and placed casually in the matrix cells. Only one solution can be found in each cell. The inhabitants should not be higher or equal to the number of cells in the matrix of the reef. As all matrix cells are occupied and the new results will have a slight probability of assignment and growth in the matrix in the next steps of the algorithm. To that end, the ratio of the number of empty cells to the number of cells engaged by the matrix R shall be determined after each random solution is created and inserted into the matrix. If this ratio is less than 0.4, the first population generation process will be stopped. For example, 72 random solutions may be created for a 10 to 10 matrix containing 100 cells (28/72 < 0:4). After each solution has been generated, this solution is added to the list and an identification is assigned to it. This ID is randomly inserted of the R matrix cells. Furthermore, the value of its health function is determined by the procedure after generating any solution.

C. External reproduction operative

This operator is applied to the solutions in two steps. In the first stage, some of the matrix solutions are selected arbitrarily. The proportion of the solutions to be chosen is a user-specified restriction called Fb. In reality, Fb is equal to the ratio between the number of solutions picked for external reproductive operators and the number of all matrix solutions. The number of designated solutions should be equal, so that separate pairs of solutions can be reproduced externally. The solutions picked and unselected in this stage are listed in two different lists. The second stage is to select separated list of designated solutions by means of the roulette wheel approach, and each of them will be cross-operated to generate new solutions. Three different random points are considered in the solutions of each pair for the application of a crossover operator. These three points divide the pair's solutions into four pieces. Two larger pieces (parts with more bits) of the better solution. If the parts' sizes are equal, the priority is the superior option. The best solution. Each pair of selected solutions produces a novel solution. They are not placed in the matrix in this stage after creating new solutions. They are included in the novel solutions list, so they can be put on the reef later.

D. Internal reproduction

This operator provides a grade of solutions which the external reproduction operator did not employ. The ratio of numerical solutions functioned with the internal reproduction operator to all solutions is therefore 1-Fb. The internal reproduction operator mutates each answer randomly. A random bit of a solution is inverted for that purpose and a novel solution is generated.

E. Setting new solutions

In this step, each answer tries to be placed in a matrix cell. For this drive, each solution calculates the value of the health purpose, and examines the odds of all the solutions being put in the matrix cells. This determines a random matrix cell for one of the new alternatives. If the health function of the novel solution surpasses the cell solution's health function however, the novel solution can be swapped inside the cell if the cell is not empty. If not, the new response is not placed in the cell and another random cell should be tested again. Each solution may attempt to position h times in the matrix where h is a parameter defined by the user.

F. Asexual reproduction

This operator duplicates some of the reef's finest solutions. The set of matrix solutions is sorted for this purpose in descendant order of the health values of their functions. A fraction of the initial memberships of the sorted list are then picked for replication. Each of these solutions is reproduced and a novel solution produced that is identical to the parent. The quantity of the percentage chosen for reproduction is governed by the parameter Fa, extra user-specified factor. Lastly, the novel solutions are tested identical to the previous stage in the matrix.

G. Depredation

In this phase, few weak keys are eliminated from the reef so that the number of empty matrix cells is increased and new solutions can be put into the matrix and expanded. The ordered list of the earlier step is employed for this purpose, and a fraction Fd of the worst answer is picked. Fd is also a parameter user-specified. A random number between 0 and 1 is created for each of these chosen solutions and if this amount is smaller than the Pd parameter value, the solution will be removed from the matrix and its cell is released. The Pd is the probability set by the user. Since the matrix still has many vacant cells, new solutions can be put into its free cells and developed. However, a bigger number of poor solutions should be depredated after numerous iterations. The Pd is set to 0, and after each iteration 0.1/k is added to it. As an asexual reproductive operator achieves the finest solutions, and the worst possible solutions depredation, the values of Fa and Fd should be selected so that Fa+Fd is 1. To avoid overlapping these operations,

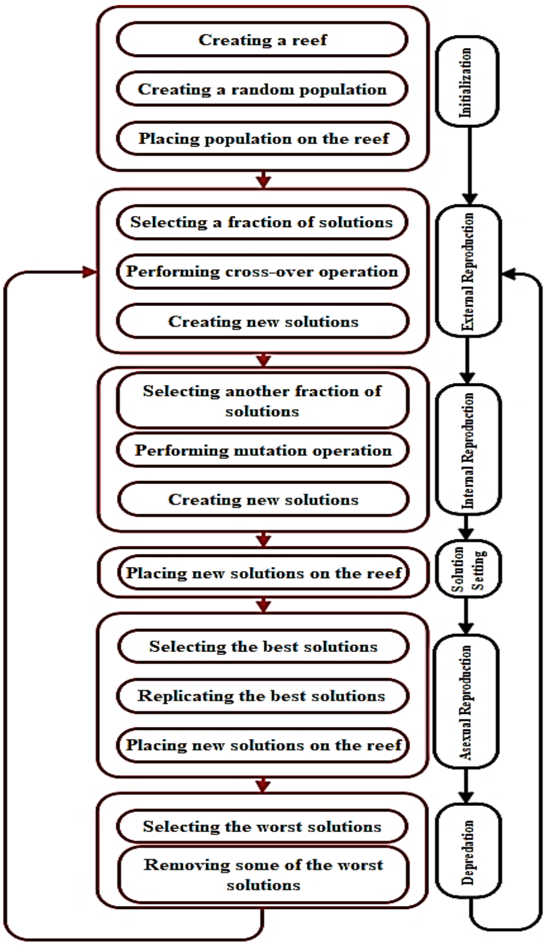

Fig.2. The overall process of *Coral* reefs optimization

After user set k iterations of population's generation, CRO will be terminated. The best matrix solution is deemed the ultimate CRO solution. The entire procedure and a synopsis of each phase of the suggested scheme is presented in Fig. 2. The main idea of the algorithm is not simply to remove nodes along the selected paths; instead, the selected nodes and links can be temporarily reused by applying graph transformation; then after deinterlacing, when the graph is converted back to its original format, the maximum number of paths can be found by rearranging the selected links.

4. Results and Discussion

Performance of the proposed algorithm and existing techniques like Butterfly optimization algorithm (BA), Whale Optimization algorithm (WOA) and BAT algorithm. These techniques are evaluated with OMP routing in numerous simulated scenarios. Varying numbers of nodes, node mobility, traffic volume, and halt duration have developed different simulated situations. Implementation of the planned NS-2 simulator in C++.

4.1. Experimental Setup

Table 1 lists the simulation parameters. Nodes are randomly positioned in all scenarios in a 1000 m / 1000 m region. Each mobile node's maximum transmission range is 250 m. Generally, nodes move at a speed of [0, 10] m/s rendering to the random mobility point model. In this concept of mobility, every node moves into a novel destination and remains there for a set duration, termed pause.

The 2 Mbps and IEEE 802.11 channel capacity is power conservation mode is used for the MAC protocol. Window size and beacon interval for the ad hoc traffic indicator mode are 0.05s and 0.25s. Each simulation is performed for 900 s. The propagation model utilized is a model with two rays. The examination includes overhead routing, power consumption, PDRs, lifecycle analysis and the average packet latency analysis. After 10 runs, the simulation results were taken for a stable status value.

Table 1. Simulation setup.

Parameter	Value
Data Size	5 Mbytes
Traffic Type	CBR
Data Rate	2 Mbits/s
Packet Size	256 bytes
Initial Energy	180 J
Network Area	1000 m × 1000 m
Traffic Load	1–5 packets
Pause Time	0–600 s
Number of Nodes	100–150
Simulation Time	900 s

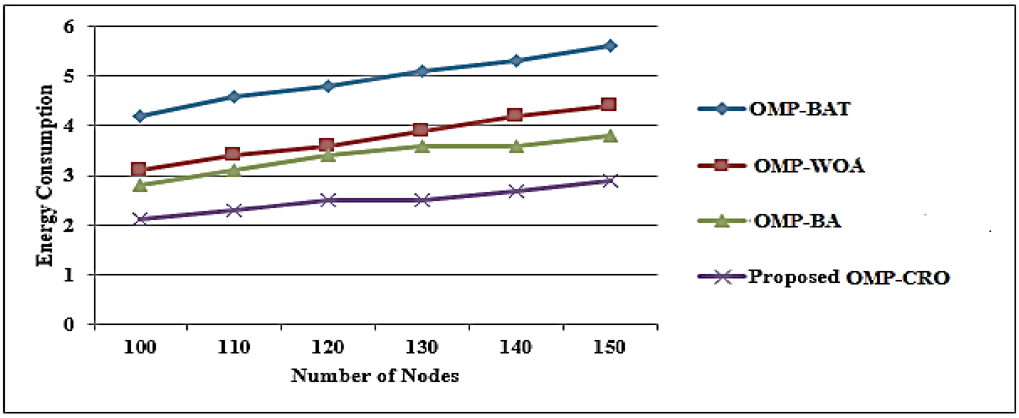

Fig.3. Energy Consumption Investigation based on Number of Nodes.

The proposed method utilizes far less energy than all the previous ways, as illustrated in Fig. 3. The BAT, WOA, BA and proposed CRO achieved 4.8J, 3.6J, 3.4J and only 2.5J, when the node is 120. However, when the sum of nodes increases, the energy consumption of each technique is also increased. For instance, the BAT, WOA, BA and proposed CRO achieved 5.6J, 4.4J, 3.8J and only 2.9J, when the node is 150. The reason for this reduction is that the data transmission via the designated route uses less power, less hops and less traffic. Furthermore, energy is likewise proportional to hops. The optimization of hop counts hence leads to decreased energy use. Traffic load. Fig. 4 shows the PDR of the projected protocol to network size.

The proposed CRO has better PDR than BAT, WOA and BA. It is observed. When the number of nodes rises, the PDR increases. The BAT, WOA, BA and proposed CRO achieved PDR of 69, 79, 88 and 95, when the node is 110. In addition, these techniques achieved PDR of 70, 80, 89 and 96, when the node is 140. The amount of backup paths and the lifetime of the path are also increased. Fig. 5 displays an average packet latency for different network sizes of the system proposed.

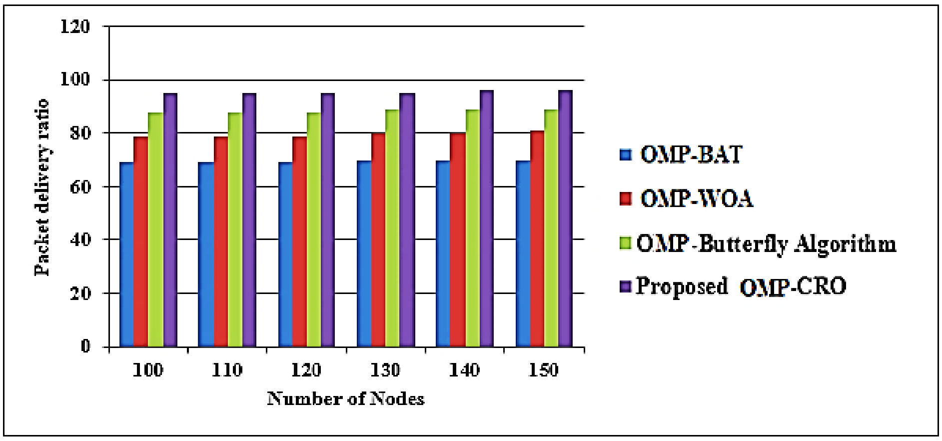

Fig.4. PDR Exploration based on Number of Nodes.

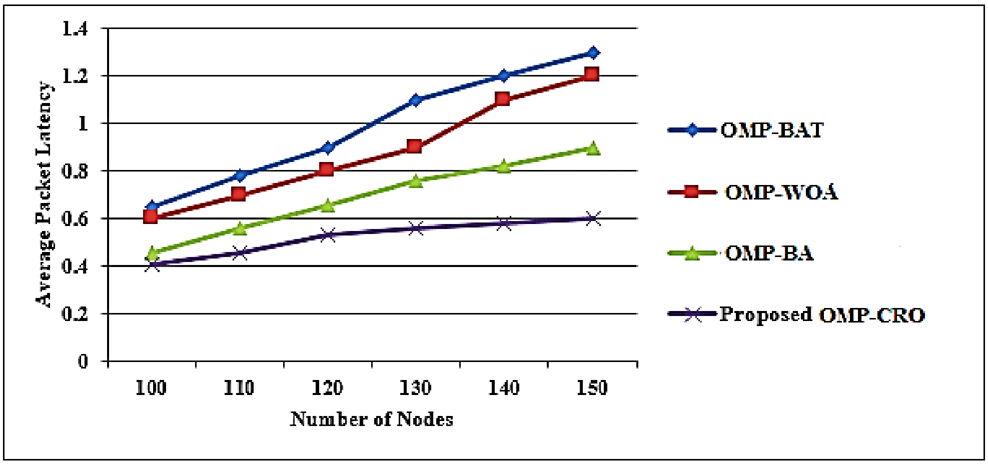

Fig.5. Average Packet Latency Exploration based on Number of Nodes.

When the node is 100, the average packet latency of BAT, WOA, BA and CRO is 0.65, 0.6, 0.46 and 0.41. The same techniques achieved 0.9, 0.8, 0.66 and 0.53 of average packet latency, when the node reaches 120th level. But, the existing technique BAT and WOA reaches high packet latency i.e. nearly 1.2 to 1.3, where BA achieves 0.9 and proposed CRO achieved 0.6 of average packet latency, when the node is 150. It is shown that the proposed OMP-CRO is less time-consuming compared to all the other approaches. The nodes lead to the selection of the best path with fewer hop counts and node sharing. This approach has a shorter latency and uses bandwidth better. Fig. 6. shows the overhead routing for the CRO architecture for different network sizes.

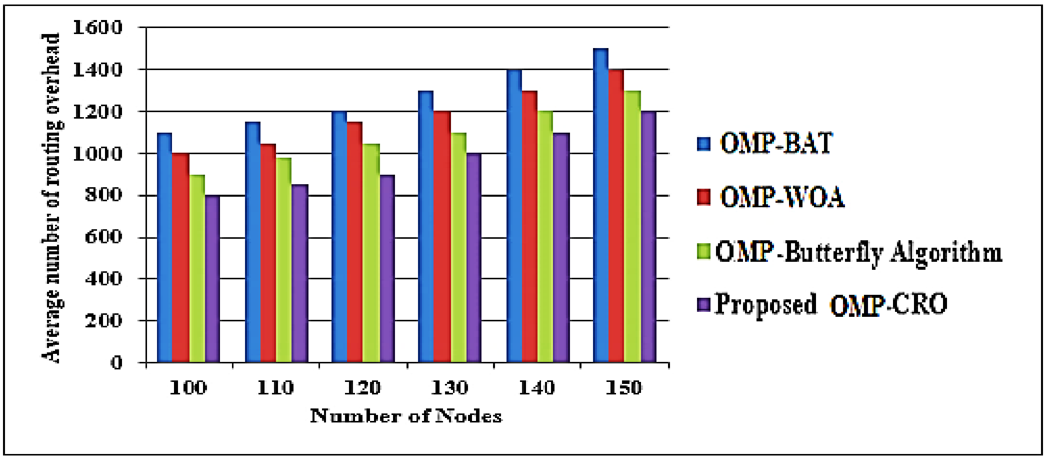

Fig.6. Routing Overhead Study based on Number of Nodes.

When the node is 100, the average routing overhead of BAT, WOA, BA and CRO is 1100, 1000, 900 and 800. The same techniques achieved 1200, 1150, 1050 and 900 of average routing overhead, when the node is 120. But, the existing technique BAT and WOA reaches high routing overhead i.e. nearly 1400 to 1500, where BA achieves nearly 1200 to 1300 and proposed CRO achieved 1100 and 1200 of average routing overhead, when the node is 140 and 150. It displays that the overhead increases with the number of nodes. The CRO optimization technique in the multi-path network is used to locate the pathways among source and destination. The analysis of path lifetime is exposed in Fig. 7.

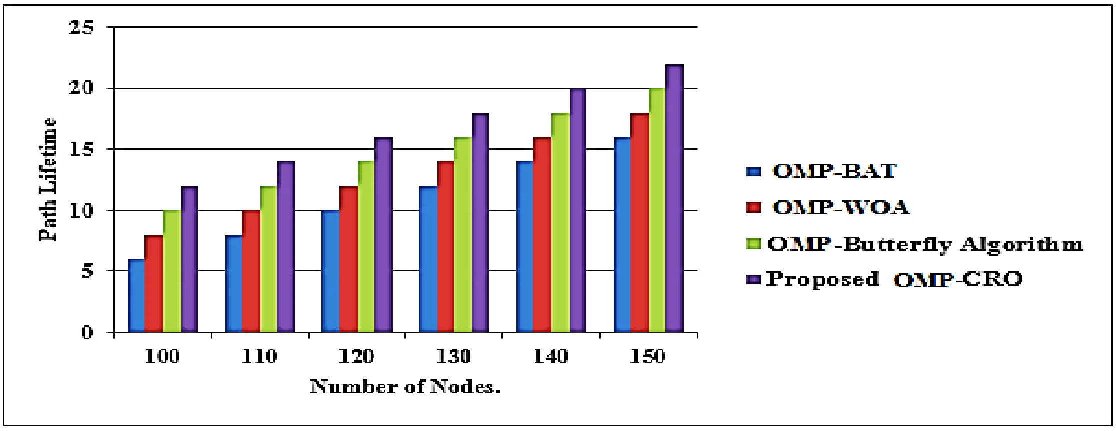

Fig.7. Path Lifetime Analysis based on Number of Nodes.

The life span of the path is dignified as the time among the commencement of transfer in a certain path and the death of some of the nodes in the path. When the node is 100, the average path life time of BAT, WOA, BA and CRO is 6, 8, 10 and 12. The same techniques achieved 8, 10, 12 and 14 of average path life time, when the node is 110. The average path life time of BAT, WOA, BA and CRO is 12, 14, 16 and 18, when the node is 130. But, the existing technique BAT and WOA reaches less path life time i.e. nearly 14 to 17, where BA achieves nearly 18 and 20 and proposed CRO achieved 20 and 22 of average path life time, when the node is 140 and 150. The lifetime of the proposed CRO in comparison with all is better. The high energy node and circulation queue will not participate in the transfer of data. High traffic loss will lead to packet loss and a needless usage of energy. The OMP CRO exhibits enhanced path life relative to BA, WOA and BAT, given the dependable paths.

5. Conclusion

MANET is a self-configuring network with high location independence. The mobility of the nodes causes serious issues during routing of packets from the source to destination. To address the routing issues, the cluster-based routing is introduced. The energy consumption is high in the traditional clustering techniques and CH selection seems to be a challenging task. The threshold value for the cluster heads for the creation of clusters is computed. In order to offer reliable routing. Our technique measures the distance to a base station, energy and queue length of a designated CH node. Cluster heads are chosen to extend the network life based on high energy nodes, minimal distance to base station and a greater queue length. By multi-way communication the burden of a network of sensor nodes can be greatly condensed. After the cluster head selection, optimal multipath routing is selected by proposed CRO scheme. We investigate the main strategy issues of the OMP-CRO. Extensive simulated findings display that when messages are sent through the unsafe network, OMP-CRO can guarantee better secure data delivery. The proposed CRO achieved 2.9J of energy, 98 of PDR, 0.6 of average packet latency, 22 of average path life time and 1200 of average routing overhead, when the node is 150, where the existing BA achieved 3.8J of energy, 92 of PDR, 0.9 of average packet latency, 19 of average path life time and 1300 of average routing overhead, when the node is 150. It is especially more resilient to the problem of cooperated nodes. We also show that a redundant OMP-CRO system can be developed to ensure a certain level of reliability without losing safety. The OMP-CRO notion is therefore an appropriate and hopeful way to improving network security in the extremely dynamic MANET context. In the future we will look at a new data aggregation approach in the energy efficient routing protocol with private communications security techniques.

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