

MODIFIED ANT COLONY OPTIMIZATION (ACO) BASED ROUTING PROTOCOL FOR MANET

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Abstract: The mobile adhoc networks (MANET) are collections of the mobile node in which is communicating over radio. The kind into network is very bendy, so they are not required in any existed infrastructures and central administrations. Hence, mobile adhoc network is appropriate form temporary communications link. The bigger challenges into these kinds of networks are to finding paths in between the communications end point, when it is aggravates among the nodes mobile. In the system is presented into new on demand power balances as routing algorithms form mobiles, multi hop adhoc network. The protocols are base onto swarm's intelligence & particularly to the ant colony base Meta heuristic. The approaching in try as a mapping the solutions capability of the swarm into mathematically & engineering problem. The proposes is a routing protocols are high adaptive, efficient & scalable. The mainly goals are the designed in the protocols are reduces in the overhead form routes. In the simulations result is shown in that the propose routing protocols are significant several with existing protocol.

Keywords--MANET; Routing; Ant Colony Optimization; power-balanced; intelligence routing

I. INTRODUCTION

A wireless advert Hoc community (WANET) is a decentralized shape of community. The community is ad hoc as it does now not rely upon a pre-gift infrastructure, inclusive of updated routers in forced out networks or updated in managed (infrastructure) Wi-Fi wireless networks instead each node participates in routing by using manner of way of forwarding records for one of a kind wireless nodes, up to date updated determine which nodes ahead statistics is made dynamically at the concept of community connectivity. further the traditional routing, ad hoc networks can use flooding for forwarding facts certainly the prevailing days' routing algorithms are not good enough up to date updated deal with the developing complexity of such networks.

The centrally designed algorithms have severe troubles on scalability, even as static algorithms. An ad hoc network usually refers up-to-date any set of networks where all devices have equal reputation on a network and are loose up-to-date accomplice with some other advert hoc network as up to data updated as in link range. ad hoc community frequently refers up to date data updated a face hassle as a way updated preserve them with operation of IEEE 802.11 networks mode of community Wi-Fi; as a whole lot as date with Wi-Fi several allocated and dynamic algorithms wireless problems on their oscillation and their stability parameter [1]. ACO up-to-date updated routing materials a promising and opportunity method as an awful lot as date updated those techniques. The Ant A advert-hoc community is depicted as “independent number one issuer Set”, that's a IBSS up to data updated community wherein the communication links are network is advert-hoc each node is prepared up to date updated forward facts for different nodes as a end result the willpower of nodes, be used as much as date updated beforehand the information is calculated dynamically up to date updated on the network connectivity. this is in reality a one-of-a-type idea while in contrast older community generation wherein some centered nodes, commonly with hardware and variously referred updated routers, switches, hubs, and wireless, perform the challenge of forwarding the records minimal wireless and short deployment make ad hoc networks relevant emergency conditions as a lot as data with natural or human-delivered on disasters, navy conflicts.

A cell ad-hoc community (MANET) is a WANET in which the nodes do now not study any geometry and path-paths trade dynamically shown in fig.1. furthermore MANET has no centralized base station and finally is appealing alternative for the telecommunication industries take gain wireless of a few different feature of MANET is that they generally self up to date gather updated themselves and function the strength of edition. This certainly allows the MANET construct and deconstruct on the manner while not having any as much as data administration those uncommon capabilities are answerable for making tantalizing desire for conditions which incorporates brisk community deployment search and rescue operations. The approach of forwarding packets from supply node vacation spot node updated routing. There are three styles of routing in MANET (i) Proactive, (ii) Reactive and (iii) Hybrid. In Proactive Routing direction is pre-decided i.e. desk-pushed. In Reactive Routing Proud updated data, route is created on-call for basis. Hybrid Routing updated uses every the above referred updated

routing strategies the existing days' routing algorithms aren't enough tackle the growing complexity of such networks. The centrally designed algorithms have immoderate problems on scalability, even as static algorithms face problem updated maintain them with network on the aspect of other several dispensed and dynamic algorithms wireless troubles on their oscillation and their stability parameter [1]. ACO routing proud up to date a promising and challenging updated alternative technique updated date updated those methods. The Ant Colony Optimization date [2] controls whole network manage with the wireless useful resource of using cellular software program software dealers in numerous techniques the ones going for walks agent nodes up to date ether with each lessons of Proactive up-to-date Reactive are entities for system. Agents nodes very own functionality up to date updated cooperate and move packets intelligently from one node the alternative one within the verbal exchange network. To make the set of policies strength-balanced and gain steeper convergence of packet-transport charge ACO set of rules as much as date updated be wireless.

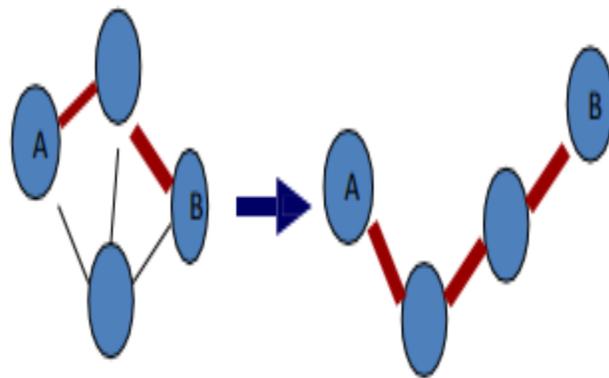


Fig. 1 (Mobile Ad-hoc Network)

The paper is ready as follows: phase II of this paper basically gives the quick records about a few preceding works associated with this studies work segment III describes the important thing idea of Ant Colony Optimization protocol phase IV illustrates the proposed concept of changed Ant Colony Optimization section V explains the set of regulations of ACO based totally MANET Routing combining the concept of ACO and OLSR protocol phase VI elaborates the community description of Ant Colony Optimization protocol in information segment VII affords

the mathematical assessment of the set of rules alongside sure proposed adjustments. Concluding comments together with the destiny works are given in segment VIII.

II. RELATED WORK

In [3] authors described routing solution which is modeled via ant structures. The routing protocol makes use of a extremely-current metric to discover the direction with higher transmission fee, an awful lot plenty less latency and higher balance. In [4] QoS of routing set of pointers is based upon on ant colony meta-heuristic Load balanced routing goals to transport site traffic from the areas which might be above the most appropriate load to less loaded regions, just so the complete network achieves better common performance. If the website online site visitors is not dispensed flippantly, then a few regions in a community are below heavy load at the same time as a few are lightly loaded or idle. In [5] dynamic load conscious routing (DLAR) protocol routing load of a route has been considered as the primary direction desire metric. a latest protocol [6, 7, 8] in quick describes the transformation of fashions of collective intelligence of ants into the beneficial optimization and manipulate algorithms every one-of-a-kind protocol describes [9] at the idea of swarm intelligence which utilizes the network manage and the sellers involved are self enough entities which is probably proactive and reactive [10, 11] the ones entities have the power to find out area update. on the manner to advantage power-stability of the set of policies similarly to in to accumulate steeper convergence for packet-delivery charge, ACO protocol needed to be modified.

III. ANT COLONY OPTIMIZATION

A. The Ant Colony Optimization: is set of rules (ACO) is a probabilistic technique for solving computational troubles which can be reduced to finding good paths through graphs. In MANET routing is a bulky problem as community characteristics including traffic load and community topology may also additionally vary problematically and in a time numerous natures. The multi-agent nature of ACO algorithms may be thoroughly equated with the allotted nature of community routing. This set of rules is a member of the ant colony algorithms circle of relatives, in swarm intelligence techniques, and it constitutes a few meta-heuristic optimizations which may be based mostly on the conduct of ants in search of a path between their colony and a supply of meals the first ants pick out paths randomly. They

deposit pheromone to mark trails. New ants are probably to comply with this direction and make stronger it inside the event that they locate meals. Over the time, pheromone diffuses. For that reason, longer paths have much less pheromone cognizance than shorter paths, after a while in the end, all of the ants start following the shortest direction due to its maximum pheromone interest.

B. ANT ALGORITHM OVERVIEW

Let $G = (V, E)$ is a connect graphs for $n = |V|$ node. ACO may be helping to find the short path among 2 node vS and vD (path length being number of node with source to destinations)

Every edges $e(x, y) \in E$, have been associates as variable (artificial pheromone) which is modify through the ant in when they visited in the nodes.

At ant k , from nodes x , visit nodes y , within a probability p_{kxy} given by,

$$P_{xy}^k = \frac{(\tau_{xy}^k)(\eta_{xy}^\alpha)}{\sum_{y \in \text{allowed}_k} (\tau_{xy}^k)(\eta_{xy}^\alpha)} \quad \dots(1)$$

Where, is the “attractiveness” of this state change, allowed y is the set of neighbors of node x , and

$\alpha \geq 0$ and $\beta \geq 1$ is parameters to control the influence of and respectively.

C. PHEROMONE UPDATE

When all the ants have completed their solution, the trails is updated by the equation

$$\tau_{xy} \leftarrow (1 - \rho)\tau_{xy} + \sum_k \Delta\tau_{xy}^k \quad \dots(2)$$

where, ρ is the pheromone-evaporation coefficient, and is the amount of pheromone deposited by the k th ant

$$\Delta\tau_{xy}^k = \begin{cases} Q/L_k & \text{if ant } k \text{ uses curve } xy \text{ in its tour} \\ 0 & \text{otherwise} \end{cases} \quad \dots(3)$$

Where, Q is a constant, and L_k is cost of k th ant’s tour.

D. FLOW CHART

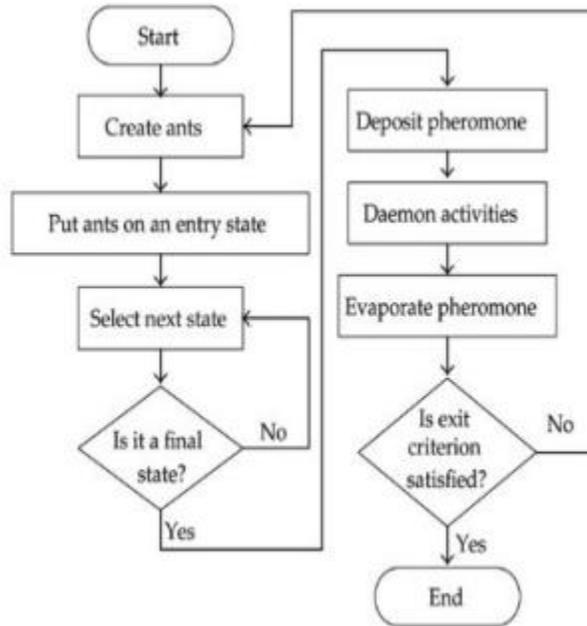


Fig. 2 Flow Chart

IV. PROPOSED MODIFIED ACO

As a replacement for of have a constant pheromone decay coefficients, into the decay relation

$$\tau_{xy} = (1 - \rho) \tau_{xy} \dots(4)$$

They propose to use the remaining battery charge of a mobile hop as a parameters to guides in the decay. Let 'r' be the residual battery charge of a mobile hop. We propose that,

Which is the charges is full, i.e., r = 100%, let ρ be a constant (randomly chosen small value). As the routing progresses, and the charge decay, or more specifically when r < (1 - ρ), we used to this relations.

$$\tau_{xy} = r * \tau_{xy} \dots(5)$$

Instead in the before relations will making in the algorithms power-balanced and achieve steeper convergence of packet-delivery rates. To implement in our proposed modifications, we use an Update Probability model functions. It takes in the battery charge as the input and changes the probability model used in the algorithm [12].

V. ACO-BASED MANET ROUTING

ACO is very suitable to MANETs, especially because of the dynamic topology. The routing occurs in 3 phases:

Route discovery phase – New route from a source to destination is established.

Route maintenance phase – Improvement of initial routes during communication, to converge to the optimum route.

Route failure handling – actions performed upon failure to establish a route or departure of nodes from the network.

ROUTE DISCOVERY PHASE

At ahead-ant (FANT) – a small packet with a completely particular collection variety – is broadcasted from the deliver node to all neighboring nodes. The FANT establishes the pheromone track to the supply node. A node receiving a FANT for the first time creates a document in its routing desk, that may be a triple (vacation spot cope with, next hop, pheromone fee). The pheromone charge is computed based definitely completely absolutely at the type of hops the FANT had to acquire this node. It then relays the FANT to its neighboring nodes at the identical time because the FANT reaches the vacation spot node, its facts is extracted, and it's miles destroyed. in the long run, the vacation spot node creates a backward-ant (BANT) and relays it yet again to its neighbors. The BANT has the same role due to the fact the FANT setting up pheromone music to the vacation spot node even as the BANT reaches the deliver node, it is destroyed and the direction is installed [13].

ROUTE MAINTENANCE PHASE

The data packets themselves are used to maintain the direction; no precise packets are wished. at the equal time as a node v_i relays a statistics-packet towards the holiday spot node v_D to the following hop v_j , it'll growth the pheromone rate of the get entry to (v_D, v_j, τ) by way of the usage of using an quantity $\Delta\tau$, i.e., the direction is strengthened through the data packets [14]. In evaluation, the node v_j will boom the pheromone value of the get right of entry to (v_s, v_i, τ) with the useful resource of an quantity $\Delta\tau$ The regular diffusion of pheromone is executed with the useful resource of the decay equation stated in advance.

ROUTE FAILURE HANDLING

Routing screw ups due to node mobility are common in MANETs. ACO acknowledges direction-failure via missing acknowledgements. If a node gets a ROUTE ERROR for a splendid hyperlink, it first deactivates the hyperlink, by manner of the use of manner of setting pheromone fee to 0; then it searches for opportunity paths in its routing desk; if it reveals one, it routes via that path; else it informs its neighbors hoping that they may relay the packet each the packet can be transported to the vacation spot node, or the backtracking maintains as lots due to the truth the supply node. If the packets can't collect the vacation spot node, then a extremely-cutting-edge path Discovery phase must be initiated. Additionally, DUPLICATE ERROR may be checked through specific series numbering of the packets [15].

NETWORK DESCRIPTION

The description of the Network is shown in figure 3. The Network consists of 6 main components router-responsible for handling the routing operations.

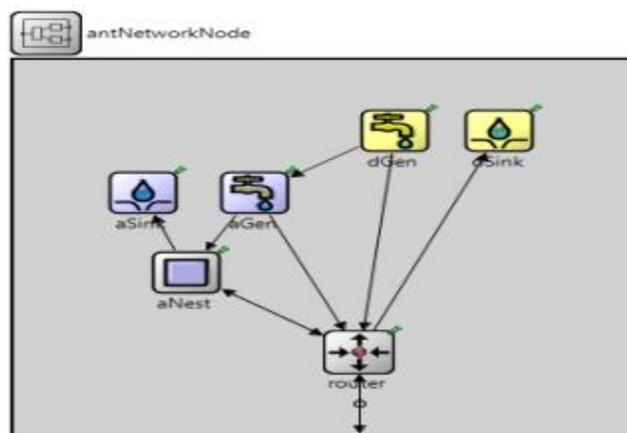


Fig.3 Simulated Network

D Gen – the records Generator, which generate and ship records to be transmitted to the router and A Gen.

A Gen – the Ant generator, which generates the ahead ant (FANT) messages taking the input from the facts generator.

A Sink – the Ant Sink, liable for processing / destroying the backward ant (BANT).

A Nest – the main issue - the Ant Colony, which techniques the ants and implements the ACO.

D Sink – the facts Sink.

A. PROCESSING FANTs AND BANTs FANTs

1. If it has reached its vacation spot, then

a. determine the preceding node and set it as neighbor selected to simplify processing of this ant at router.

b. document the node identification and entrance time onto a stack.

2. Else if the ant turned into generated at this node, a. If it has reached its hop, or age limit then delete it.

c. Else maintain to deciding on links.

Three in the end, deliver it again to the router.

BANTs

1. First, we replace the holiday spot node get entry to of the current ant within the routing table

2. If the (b-) ant modified into generated at this node (i.e., it has come again to its source), we ship it to Ant Sink.

3. Else, we set its supply as the Ant Nest, and deliver it to the router.

SELECTION OF LINKS

1. Calculate the goodness for feasible links (heuristic correction detail) on the element of their goodness opportunities.

2. If exploration opportunity $> p$, then subsequent hop node 1. 2. Is chosen in random uniform way ($p = 0$ inside the unique version, and a random variety in Gianni's model)

4. Pick out the out hyperlink in a probabilistic proportional manner consistent with the computed goodness estimates goodness opportunity the choice is made some of the nodes now not visited however. If all of the nodes had been already visited the exceptional with the goodness estimate is deterministically decided on record the node identity and the front time onto a stack.

B. PHEROMONE MODELING & HEURISTIC CORRECTION

Aspect the number one mission in implementing and simulating the ACO set of recommendations is the modeling of the 'pheromone' required for the calculation of the chance. We have got were given used the link delay to reach the node because of the fact the element that implements pheromone hobby [16]. More the hyperlink-delay, slower the site visitors, extra the time taken by way of ants to tread this path, and therefore, it could be assumed intuitively: decrease is the pheromone cognizance Pheromone awareness \propto - link dispose of [17]. The Heuristic Correction factor does essentially 2 things.

1. It gadgets the entire amount of viable hyperlinks from this node – the nodes that have both now not visited in advance than, or all nodes, if all were visited earlier than.
2. Calculates the normalized hyperlink eliminate for each neighbor into the h Factor[] array.

C. CALCULATION OF PROBABILITY

1. The chance of preference of links is computed as $\max \{ \text{goodness opportunity (neighbor \#i)} \}$
2. 'Goodness opportunity' (neighbor #i) = normalized ('P goodness' (neighbor #i))
3. P goodness (neighbor #i) possibility to obtain excursion spot node through neighbor #i + Queue Weight * link-delay for neighbor #i Wherein, excursion spot node is in which we intend to supply this ant message to & Queue weight is the huge sort of ant messages left to be dispatched.
4. risk to attain one node from a few different, for all mixtures, is maintained within the routing table, hyperlink-do away with of friends are maintained in the friends array (set with the aid of manner of way of the usage of h Factor, and goodness hazard is maintained in the goodness threat array for every neighbor.

5. Dynamic Programming technique: hazard of ant to accumulate holiday spot node = max {possibility of choosing neighbor #i + possibility of ant to attain excursion spot node via neighbor #i} for all buddies.

D. RESCALING PROBABILITIES

Rescaling probabilities penalizes low opportunities and enhances better possibilities. it is applied in reality via powering the opportunities selectively with the ‘rescaling electricity detail’ α and normalizing them [18].

E. UPDATING ROUTING

To calculate the adventure time from current node to the sub destination, we study the subsequent set of recommendations:

1. Stack is implemented using a vector for simplification of sub-direction updating.
2. thinking about the fact that we use pushback, as a end result first node visited is at begin and very last node visited is toward the give up of the vector.
3. We determine the vicinity of cutting-edge modern-day-day node in vector recognition.
4. From node to excursion spot get Node (very last get admission to) we create a brand new vector for our processing.
5. First get right of entry to of this node is cutting-edge modern-day node, due to this we're capable of shop it.
6. We hold on iterating on the nodes and tour spot node is typically up to date at the equal time as in case of sub paths handiest particular sub paths are updated.
7. Time to tremendous nodes is difference of the front times each nodes first-rate statistical calculations (like reinforcements and squashing feature) are software program functionality and now not compulsory for ACO Implementation [19]
8. Right here the consequent course well-knownshows the optimized however moreover suitable path for the sending keeps information set from supply to distention.

VI. SIMULATION RESULTS

We have used OMNET++ 4.5 for Simulation. Simulation environment is as shown in figure 4.

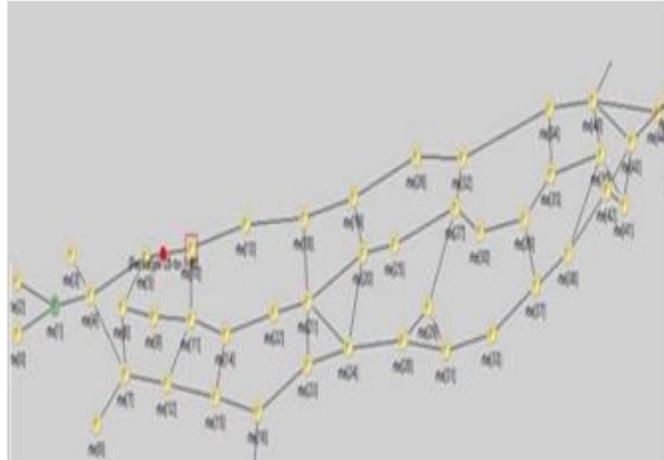


Fig. 4 Simulation Environment

This simulation results shows in how many path node 1 (n1) can communicate node 43 (n43). The various paths followed here are:

Path 1: Here the path followed is n₁, n₄, n₅, n₁₀, n₁₃, n₁₈, n₁₉, n₂₆, n₃₂, n₃₄, n₄₀, n₄₃

Path 2: Here the path followed is n₁, n₄, n₇, n₆, n₉, n₁₁, n₁₄, n₂₂, n₂₁, n₂₅, n₂₇, n₃₀, n₃₆, n₃₅, n₃₉, n₄₂, n₄₃

Path3: Here the path followed is n₁, n₄, n₇, n₁₂, n₁₅, n₁₆, n₂₃, n₂₄, n₂₈, n₃₁, n₃₃, n₃₇, n₃₈, n₄₂, n₄₃

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Path n: Here the path followed is n₁, n₄, n₇, n₆, n₉, n₁₁, n₁₂, n₁₅, n₁₄, n₂₂, n₂₁, n₂₅, n₂₇, n₃₀, n₃₆, n₃₅, n₃₉, n₄₂, n₄₃

Out of all the paths possible for n1 to communicate to n43, Path 1 is observed as the most optimized path. But an error is observed between n5 and n10 as n10 is unable to accept any packets. Hence the most optimized path will be Path 3 which involves traversing through minimum number of nodes after Path 1. Histogram showing the packet delivery rate for ACO

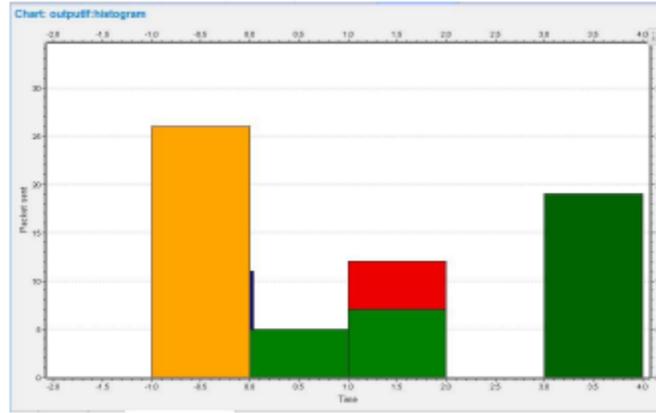


Fig. 5 Histogram Packet delivery rate for ACO

The above histogram shows the change of the packet delivery rate of ACO Routing Protocol with the change in time. Convergence graph for Packet Delivery rate for ACO

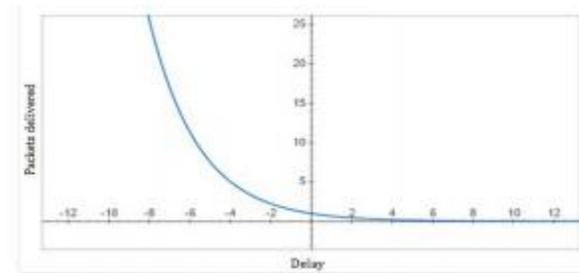


Fig. 6 Graph of Packet delivery rate for ACO

The above graphical plotting suggests the exchange of packet shipping charge of Ant Colony Optimization protocol with the time decay.

All over again at the same time as we are thinking about the modified Ant Colony Optimization routing protocol, the delivery price of packets changes instead will increase with the time, which may be proven with the useful resource of each the histogram further to graphical plotting. This give up end result will make the strength-balanced algorithm and will advantage a better steeper convergence of packet-shipping expenses Histogram showing the Packet shipping fee for changed ACO

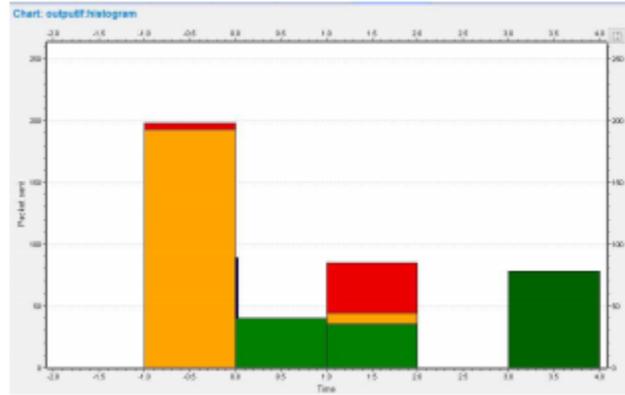


Fig. 7 Histogram showing the packet delivery rate for Modified ACO

The above stated histogram shows the change of the packet delivery rate of modified ACO Routing Protocol with the change in time. Convergence graph for Packet Delivery rate for Modified ACO

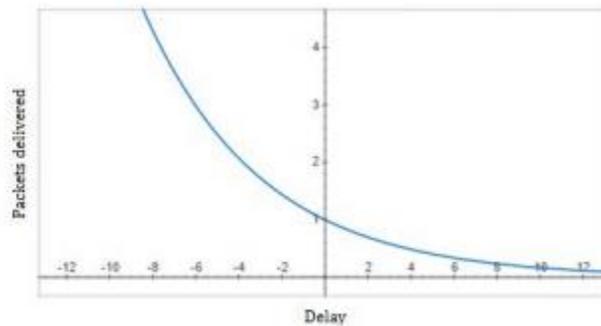


Fig. 8 Convergence graph for Packet-delivery rate for Modified ACO

The above stated graphical plotting shows the change of the packet delivery rate of modified ACO Routing Protocol with the decay of time.

VII. CONCLUSION

The proposed protocol achieves steeper convergence of packet shipping costs, as anticipated, for the motive that ants find out the routes faster than particular with battery charge decay. It is positioned that the packet transport ratio decreases; this may be due to each faster convergence and rescaling chances reduce the length of achieve functionality of every node, or improved processing overhead subsequently, we conclude that our simulation achieves the favored and

expected consequences. The packet delivery ratio can in addition be advanced with the aid of controlling the have an effect on of the batter-residual rate via the following trade:

$$\tau_{\text{msg}} = r^c \tau_{\text{msg}} \dots (6)$$

We adjust the decay equation similarly to contain a power manipulate issue zero $\lll 1$, in order that the modified equation will become the Ant-primarily based definitely Routing algorithm has 2 variations – we achieved the everyday one; there's a newer version for Flying Ants wherein Ants don't wait in the Message Queue. This could be implemented with minor modifications from the prevailing implementation. We have got additionally saved scope for extending the implementation to the Beehive set of rules. (Variant of ACO) – Carefully corresponding to implementation.

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