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Improving the Quality of QOS using Ant Colony Optimization

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Abstract: A MANET is a gathering of wireless MN that self-regulate adaptively to shape an random as well as transitory system. The mobile nodes are connected with one another without the need for a fixed infrastructure. MANETs could be rapidly fix up to easier interaction in a hostile surrounding, including a battlefield or an actual difficulty. The complexity of routing in MANETs grows because of factors like dynamic topology, time-varying QoS necessities, limited sources & energy, and so on. QoS routing is critical to delivering QoS in MANET. The most significant task in these channels is determining a path among interaction end points that meets the user's QoS requirements. Intelligent routing methods, like ACO approaches, have proven to be a better method for making MANET routing approaches. A new QoS enhancing method for MANET is suggested in this study. QoS integrates the goal of ACO protocol to find multiple stable routes among the source and destination nodes make an effort to improve QoS.

Keywords: MANET , QOS , Optimized Link State Routing, Meta-heuristic Approaches, Ant Colony Approaches (ACO) , NS2.

I. INTRODUCTION

As a MANET is a selection of MN that interaction via radio, routing is a dynamic optimization technique. Because these channels are extremely adaptable, they do not involve any current facilities or centralized administration. As a result, MANET are appropriate for provisional communication links. The most important activity in these networks is establishing a route between interaction end points, which is made more difficult using node mobility[1].Routing methods in traditional wired networks might take advantage of the high processing capacity as well as bandwidths obtainable to them to incorporate broadcasting link-state procedures or high-process demanding AI based approaches for solving QoS related optimization issues. However, QoS-based routing will become difficult in MANETs because nodes must maintain up-to-date data about link status. Furthermore, given the dynamic essence of MANETs, it is difficult to guarantee exact link state information.

Routing is required in communications systems because nodes are not always intimately related. The primary problem that any routing approach solves is directing traffic from sources to destinations, but due to the rising complexity of modern networks, routing approaches face significant issues [2]. Due to system model is changing continually & device origins are finite, the routing feature is especially difficult in these channels. This is especially in wireless ad hoc systems, where NM as well as link breakage cause frequent modify in system topology. The inability of routing approaches to adjust to common topology changes, resource limitations, as well as power usage diminishes network performance. As the internet grows in size, so does the demand for real-time as well as QoS in the system.

QoS is a routing method in which routes are predicated on few awareness of network accessibility and the QoS requirements of the flows. The primary goals of QoS-based routing are as obeys[3]:

Dynamic path motivation to accommodate the QoS of a provided flow under policy restrictions including route price, provider selection, and so on, optimal resource usage to improve overall network throughput, and elegant performance degradation all through peak load supply better throughput. There are three types of QoS routing strategies: SR, DR, & HR. In MANETs, QoS-BR has become hard because nodes must maintain up-to-date data about link status. Furthermore, because of the dynamic nature of MANETs, it is extremely difficult to maintain precise link state information. Eventually, the restrained resource may not be assured due to path breakage induced by mobility & energy usage of mobile hosts. QoS routing must figure out a better latest path to restore the service as soon as possible.

The article is structured as obeyed: Section II explains ACO. Section III & IV literature survey and proposed methodology the proposed work. Section V explains results. At end, conclusion is in Section VI.

II. ACO

It is a stochastic solution to tackling combinatory development issues such as network routing. This improvement is derived from studies of how ants adjust food collecting in the wild. Artificial ants are used in ACO algorithms to iteratively create an answer to an optimization process. In figure 1[4,] researchers could indeed clarify an ACO algorithm as obeys:

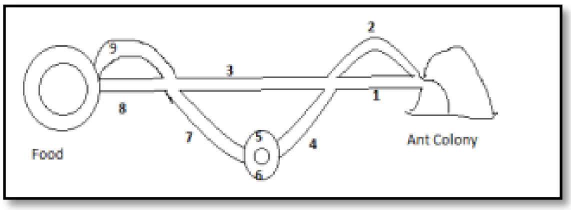

Figure 1: Ant Colony Network

The lowest route among the above 12 is 1-3-8. Although a few ants would then pass via another routes, the pheromone trail rate of evaporation on the 1-3-8 path is lesser than on other routes, so the ant obey rate on this path is the highest. Because this is the quickest route, the ants who travel on could return previously, leaving a stronger impact of the pheromone trail, & another ants would obey this lowest route with the most pheromone.

Whatever information moving from its origin to its destination will have to pass through an amount of intermediary nodes (these nodes could be servers or any service units). This could be compared to ants moving from their colony to a food source. Our top prime concern is to develop a method that allows the natural phenomenon of trail to be artificially applied for our purposes[5]. A proactive prototype will be followed for our data packets In this framework, the packet of data will be a result of its selection, judgment, or self-awareness predicated on our pheromone trail design procedure, rather than a feature of training and circumstances. In diagram 2 depicts the ACO metaheuristic, which is predicated on generic issue description as well as the description of the ant's behaviour. ACO mimics the foraging habits of real ants. When there are different routes from the nest to the food, ants take a random walk at first. All through their journey to food and come back to the nest, the ants deposit a chemical material named pheromone, which provides as a route mark that the ants have taken [4]. As a result, the latest ants should choose a path with greater pheromone focuses but will reinforce the route they have chosen. The answer arises quickly as a result of this autocatalytic impact.

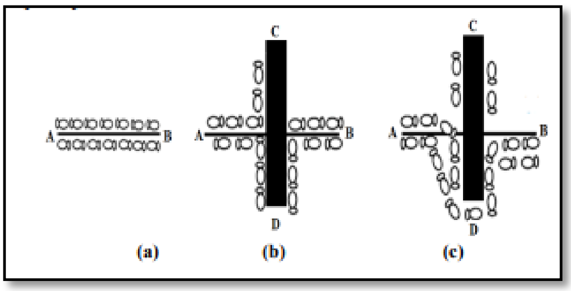

Figure 2: Ants, searching for food[5]

A. Network Routing Using ACO

Since network features including traffic load as well as system configuration can vary stochastically or over time, MANET routing is a tough issue. The multi-agent nature of ACO approaches complements the stochastic nature of system routing. The provided system could be depicted as a building graph, with the vertices representing a collection of routers as well as the links representing connectivity among those routers. Presently, the system path finding problem is obviously discovering a amount of basic price paths between nodes in the corresponding graph description, which could be simply achieved through ant methodologies.

B. Basic Features of ACO approaches for routing

ACO occurrences for routing issues have the following key characteristics:

1) Providing multipath as well as traffic-adaptive routing.
2) Using both active and passive data monitoring as well as gathering techniques.

3) Employing stochastic elements.

4) Preventing local forecasts from creating a global effect.

5) Configuring routes in a far less selfish manner as compared to in pure shortest path strategies that favor load balancing.

III. LITERATURE SURVEY

Deepika Dhawan et al (2019) introduced a procedure that greatly enhances the energy efficiency component in the optimization method while enhancing other variables like PDR , E2E delay, or at the very minimum protecting it at the same stage. The writers also explained on the ABR Approach, which increases lifetime of the system while being energy efficient. The researchers suggested an ACO-ECSRA and contrasted it to other reactive methodologies such as MDSR as well as FEAR. MDSR is an instance of a reactive method, which implies it creates a path to a destination on the fly. The researchers evaluate the suggested approach results to those of the FEAR algorithm as well as the MDSR, as well as the outcomes show that the suggested method outperformed the 2 techniques, MDSR & FEAR[6].

Burhan U. et al (2020) developed a novel as well as smart packet forwarding strategy based on game theory, in which trust assessment in relation to node perception component also plays a vital role. The suggested model may resolve the problem of interrupted connections that arise within one-hop interaction, which raises the chances of packet drop occurrences & also rises the re - transmission situation, which impacts the channel's resource efficiency. The writers also suggested that the suggested method employs an opportunity modeling to encourage cooperation among MN throughout the MANET routing circumstance. The authors described that with evolutionary game perspectives the system is designed and developed to arrange the QoS needs. The findings revealed, via exploration, that the reputation as well as trust-based game rises the functionality of a packet-forwarding technique with maximum bandwidth as well as minimal system overhead[7].

Mani Bushan Dsouza et al (2020) EASARA, a technique that recognizes remaining energy when choosing a route all through route discovery, has been suggested. The researchers mentioned the fact that the methods differ depending on how FANT is published as well as how pheromone density at the pheromone table is modified. The altered procedures' achievement was applied to the actual procedure. The author suggested that The suggested approach EASARA was simulated in a sparse to dense surroundings, as well as the outcomes were contrasted with other method SAR, & it was discovered that EASARA gives excellent throughput & lower delay, but has been better at providing packet delivery as the amount of nodes increased. The resulting procedure was modeled utilizing

NS2 using the suggested method & it was discovered that it performs reasonably well in accordance with the original approach[8].

Rajanigandha Metri et al (2014) characterized that preserving QoS due to frequent mobility as well as creation of dynamic relationships in MANET is very complicated as well as the QoS is examined with the use of performance matrices such as E2E delay, bandwidth, throughput, possibility of packet loss, delay variance (jitter) and so on. As a result, the researchers suggested QAMR, an unique procedure focused on an ACO algorithm that offers a believable route for transmitting data out of multiple paths, as well as the suggested methodology is expandable, flexible & efficient. The researchers also proposed that the ACO approach take QAMR into account. With its adaptive nature, the ACO method optimizes protocol consistency as well as makes the procedure smart in terms of building verdicts all through link failures. The results depicts that the performance has been evaluated using NS[9].

B.Nancharaiah et al (2014) ACO was adapted for use in AODV routing. In terms of E2E delay, route acquisition time, throughput, total cache responses, as well as PDR, the suggested approach outperforms current methods (AODV as well as CORMAN). The authors formulate the task of MANETs, namely discovering paths among the source & the destination, which relates to a wide variety of routing protocols. The article also mentions AODV that is optimized utilizing ACO in order to reduce routing costs & delays, as well as the measuring performance measures used to verify the suggested optimized AODV are throughput & E2E delay[10].

Davulluri Parvathi et al (2018) suggested a subterranean insect-based routing agreement for MANETs, which has a strong research opportunity or may progressively be used in combinatorial improvement as well as related organize problems. The researchers also clarified that the ACO-meta-heuristic method could be used to find the shortest route between the source & destination nodes on the overview or could fix combinatorial upgrade problems using meta-heuristic ACO. The researchers also mentioned the fact that MANETs suffer from the negative effects of benefit constraints in criticalness, computational breaking points, as well as data transmission restrict. According to the authors' strategy, ACO-based estimations have a specific character to provide complex and adaptable responses for network routing, as well as Subterranean insect Colony estimations are especially adaptive to changing environments[11].

IV. PROPOSED METHODOLOGY

- **PROBLEM FORMULATION**

Existing work focuses on improving the quality of service parameters and reducing energy consumption of the mobile nodes in the system. The RR packet is sent through all nodes against the destination during the route finding procedure. However, some nodes may have lesser energy and may not be suitable for information transmission process, such nodes should be avoided. This process is however, carried out in the existing system during the route scanning process by forward ants. This step can be merged during the route formation only, thus avoiding unnecessary energy consumption.

In the route selection process, the routes are scanned according to energy and load levels of the nodes. However, mobility of the node is not considered while selecting the optimal routes. This may lead to the nodes (moving at higher speeds in the network) to be part of destination route; it eventually results in the link breakages.

- **OBJECTIVES**

1. To study various algorithms which focus on improving standard of service parameters for MANETs.

2. To optimize the route selection process by using fitness function and implement the same in NS2.35.

3. To evaluate and compare the production of the suggested approach with current method depend on throughput, PDR and delay.

- **RESEARCH METHODOLOGY**

In order to select path from S2D node, the residual power level of all the nodes should be considered in the broadcasting process.

This will be considered by using the concept of threshold value; if any node has remaining energy less than 90% of the initial energy then the node can be skipped in the route formation process. Therefore, all the nodes while forwarding the route request to their one hop neighbors will check their remaining energy levels with the threshold energy; if the levels are below then they will not relay the route request packet further in the network.

Once all the routes have been formed from source to destination node, all the routes will be scanned at the destination node itself. The fitness function of all the routes will be computed. This fitness will be the sum of individual fitness of the nodes; it will be based on power level of the nodes, pheromone value of the links and mobility values.

The nodes having higher remaining energy, having higher pheromone levels and moving at lesser speeds will be front runners for being selected in the final route. The destination node will filter out the routes having fitness less than average fitness of all the routes and will send RR to the SN.

The SN would select the optimal path having accurate fitness value and forward the data to the destination node.

V. RESULTS

The suggested device was built with NS2.35. NS 2 is a free and open-source computation model for examining the complex nature of interaction systems. The network's performance was evaluated based on the Average E2E delay, throughput , & the PDR. The X axis varies speed .i.e (5,10,15,20).

- **Delay:** It is the amount of time it takes packets to move from the source to the destination node in the route.

End-to-End Delay = $\sum_{i=1}^{n} \frac{Delayi\ -Delay\ \ i-1}{n-1}$

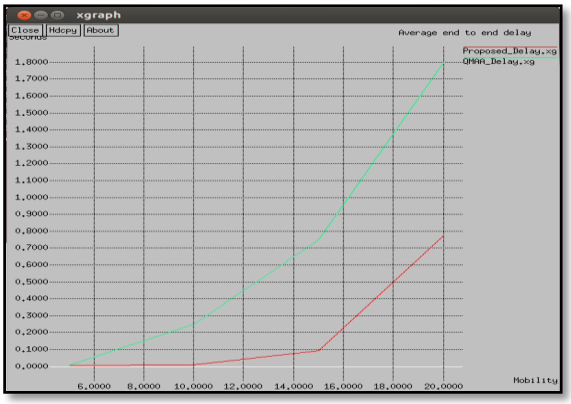

Figure 3:Average End to End Delay

In Fig 3, when we increased the speed, the delay decreased although when we increased the speed, the link break, which caused the data to arrive slow at the destination, but the delay should be lesser as contrasted to the existing technique.

- **Throughput:** The quantity of successful data transmission in the system is typically characterized as throughput. Kbps is the unit of measurement. The mentioned equation is used to determine efficiency in this regard:

$$\textbf{Throughput} = \frac{\text{Sum amount of packets accurately transferred}}{\text{Total amount of packets transferred}}$$

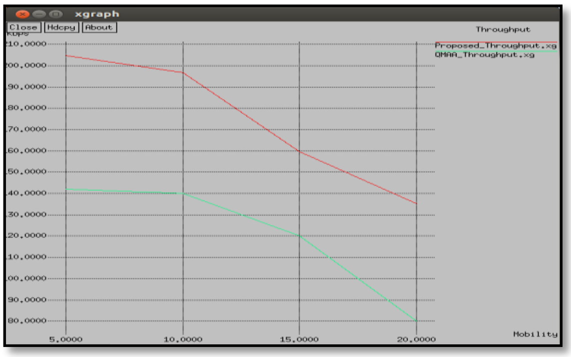

Figure 4:Throughput

Figure 4 shows that as the speed increases, the link breaks as well as packets are not delivered properly to the destination. As the speed increases, our throughput decreases, but it is still better than the previous method.

- **PDR:** It is calculated as the proportion of transmissions to packets across the system.

$$PDR=\frac{Total\ \ Packets\ \ Recieved}{Total\ \ Packets\ \ Sent*100}$$

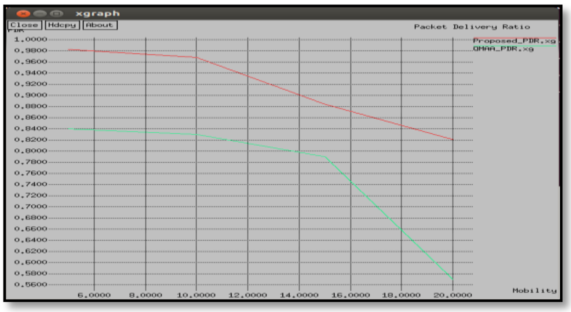

Figure 5: Packet Delivery Ratio

Diagram 5 depicts When the speed is increased, the link breaks as well as packets are not delivered perfectly to the destination. Our PDR in the network is lesser, but it is higher than the existing method due to the fitness function as well as Mobility. Mobility is a speed-based mobility estimation notion that is utilized and the best route across the challenge is chosen based on its mobility forecasting represent, connection time, system linking, as well as route accessibility.

The above experiments demonstrated that the suggested approach reduces delay when compared to the existing framework because nodes in MANET move individually, and when nodes move, the link breaks. When a link fails, it takes longer to send packets from the source to the destination. When we pick a route for a source destination using the proposed scheme, we concentrate on 3 parameters: the energy of the node, the pheromone level i.e distance between two nodes. We also pick nodes that move slowly in the system. And if we choose slowly moving nodes here, there is less chance of link breakage than information moving easily to the destination, which is superior to the existing method.

VI. CONCLUSION

The suggested approach could be developed to assist multimedia interactions in Ant Colony-based MANET. The main challenge in MANET is maintaining QoS characteristics in the existence of dynamic topology, the lack of central power, time-varying QoS specifications, and so on. The difficulties in ad hoc networks are to create a route among interaction end points that meets the user's QoS requirements while maintaining continuity. This proposal uses ant-like MA to generate new reliable routes among S2D nodes. Ant participants are utilized to access many nodes, & all these nodes in turn utilize AA to communicate to relay node. The findings indicate that the ACO, as a routing method , is best suited for enhancing QoS in MANETs. In the future, this work could be advanced to multicasting by combining several techniques with other QoS goals like load balancing and energy conservation.

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