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A Review on Quality of Service Routing In Mobile Ad Hoc Networks Using Ant Colony Optimization Techniques

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ABSTRACT

Mobile Ad-hoc network is a collection of wireless mobile nodes which are connected in dynamic manner and these nodes acts as routers and communicate to each other. Routing is one of the major issues in MANET due to the mobility of the nodes. Routing means the act of transmission of information across an internet work from a source to a destination by connecting various types of nodes. For routing in MANETs, the complexity increases due to various characteristics like dynamic topology, time varying Quality of Service (QoS) requirements, limited resources and energy etc. QoS routing plays an important role for providing QoS in mobile ad hoc networks. The greatest challenge in this type of networks is to find a path between the communication end points satisfying user's QoS requirement. Intelligent routing such as ant colony optimization (ACO) algorithms have shown to be a good technique for developing routing algorithms for MANETs. In this paper, a different ant colony optimization based routing protocols are studied.

Keywords: Ant Colony Optimization, Mobile Ad Hoc Network, Quality of Service.

I. INTRODUCTION

A mobile ad hoc network (MANETs) is a number of wireless mobile nodes which dynamically shared data among themselves without any constant station or a wired backbone network [1]. A MANET is a type of ad hoc network that can change locations constantly and configure itself on the network. Because MANETS are mobile, they use wireless connections to connect to various networks. This may be connections of standard Wi-Fi, Bluetooth or another medium, such as a cellular or satellite transmission [2].

Mobile Ad-Hoc Networks nodes are typically differentiated by their limited power consumption, data processing, and memory resources as well as high degree of versatility. In such networks, the wireless mobile nodes may dynamically enter the network as well as leave the network. Due to fluctuation of transmission range of wireless network nodes, multiple hops are cannot be clearly connected to a node for interchange information with any other node in the network. Routing algorithms in wired networks are basically depends upon either the well-known distance vector or link state routing algorithms [3]. These algorithms established the routing notification messages to be broadcasted by each router or network, which allow the declaration of new routes to other routers in the network. In distance vector routing, each router broadcasts to only its neighboring routers the distance to all other nodes, then on the receiving this information the neighboring routers recomputed the shortest path to each node [4].

In link-state routing, each router broadcasts to all routers in the network the status of each of its neighboring connections, then routers of the network discovered the shortest distance to each node based upon the complete topology of the network [4]. The above two ways are utilized for how routes are found are clearly not efficient for the type of dynamic changes which may occur in an ad-hoc network. Due to human interference routers can only leave or connect in the wired network. In an environment, with mobile

nodes moving constantly, the changing topology will cause continuous establishment of routes due to the high-level of mobility and it also cause the network become complicated by routing information packets. So there are some issues are occurs like unpredictable behavior, unreliable communication links, limited resources and unstable topology [5]. Routing protocols for mobile ad hoc networks must deal with these issues to be effective.

In recent years, several wireless routing protocols are designed to provide communication in wireless environment, such as AODV [6], DSDV [7], ZRP [7], LAR [8], OLSR and DYMO [9] etc. Comparative study among some set of routing protocols are already performed by the researchers such as among DSDV, DSR, AODV, and TORA among DSR and AODV, among LAR, AODV and DSR among DSR, TORA and AODV among DSDV, DYMO and AODV and many more in [10] These comparative are carried out on ad hoc networks. Therefore, evaluating the performance of reactive routing protocols in wireless network environment is still an active research area.

Ant Colony Optimization (ACO) Algorithm has been inspired by the behaviour of a real ant colony. ACO first put forward by Dorigo M. in the early 1990‟s, first developed for wired communications and that is named as Ant Net. Using ACO algorithm we can make complex task in distributed manner. This makes the network free from the overloaded network.[11] The principle of the ACO is that ants can release some special chemical substance which is named pheromone. Moving ants deposits a certain amount of pheromone in the environment thus making the path by a trail of substance. First ants can choose random way for nest to food. After that if we put the obstacle on the way of nest to food as mention based on ant colony optimization principles. Then ants can select the shortest path. The longer the route ants gained the smaller amount of pheromone they deposited. Then, when ants for a second time arrive at the intersection later, each of them prefers in possibility to choose the path richer in pheromone rather than the poorer one. So, the pheromone trail on the better paths gets stronger and stronger, and ants that choose those paths get more and more, while that of other paths fades away by iteration gradually, and ants choose them get less and less. Finally the ants get shortest path from nest to food.[12]

Recently, several routing protocols have been proposed inspired from social insects behavior for fixed, wired AntNet have been described in [13], Ant based control has been described in[4], other approaches also address MANETs such as ARA in [14], Termite in [2] and PERA in [7]. The basic principle of all these algorithms is that current traffic conditions and link costs are measured by transmitting “artificial ants” into the network. These ant packets mark the travelled path with an “artificial pheromone,” that is, update the routing table depending on the collected information. Therefore, they increase the probability of choosing a certain link for a given destination. Results from ant based routing applications in fixed and wired network are very promising.

II. LITERATURE SURVEY

Miss Sayali R. Parate, *et al.* [15] Routing is one of the major issues in MANET due to the mobility of the nodes. Routing means the act of transmission of information across an internet work from a source to a destination by connecting various types of nodes. Due to dynamic topology, time varying Quality of Service(QoS) requirements, limited resources and energy etc complexity of MANET is increases.

Because of that there may be networking is suffering from various problems like packet loss, congestion in network, traffic loading, etc. A nature-inspired algorithm (swarm intelligence) such as Ant Colony Optimization is one of the solutions for such problems. Ant Colony Optimization (ACO) can be used to dynamically route traffic efficiently. This paper shows reformation of mobile ad hoc network with the help of routing protocol to use the well-known ant colony optimization Meta heuristic technique and also to find multiple disjoint routes between a source node and a destination. Observed the performance of this protocol which finds the solutions in terms of end-to-end delay, throughput, network load, sent routing traffic, received routing traffic, number of dropped data packets, and simulation duration for both cases when the nodes are stationary and when they are moving and so on. For degradation of such problems ACO is utilized. In this algorithm, with the help of ant and their phenomenon concentration there efficient shortest path would be found out. It is most applicable in the Load Balancing and travelling salesman problem.

Mahboobeh Parsapoor, *et al.* [16] this paper presents an ant colony optimization (ACO) method as a method for channel assignment in a mobile ad hoc network (MANET), where achieving high spectral efficiency necessitates an efficient channel assignment. In this paper, first developed an ACO-based method for the standard graph coloring problem; then it is extended for the channel assignment problem. Evaluated this method in the MANETs with different numbers of clusters. The results have verified that the proposed ACO algorithm has the capability to find a scheme with a minimum number of assigned channels. The results have also indicated that the ACO-based method provides a stable and scalable solution; the performance of an ACO-based channel allocation scheme does not seem to be dependent on the size of MANETs (e.g., the number of clusters in MANETs). Developing an ACO-based distributed scheme has been considered as future works. Also replace the lowest ID clustering algorithm with an ACO-based clustering method to effectively address the channel assignment problem.

Zulfiqar Ali, ***et al.*** [**17]** there are various bio inspired and evolutionary approaches including genetic programming (GP), Neural Network, Evolutionary programming (EP) exploited for routing optimization in MANETs and WSNs. The Swarm Intelligence based algorithmic approaches; Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) are more promising in providing loop free, energy-aware, and multi-path routing in mobile ad hoc and wireless sensor networks.We study in this research work a probabilistic performance evaluation frameworks and Swarm Intelligence approaches (PSO, ACO) for routing protocols. The performance evaluation metrics employed for wireless and ad hoc routing algorithms is , (a) routing overhead, (b) route optimality, and (c) energy consumption. This survey provides collection of Swarm Intelligence based algorithms for mobile ad hoc and sensor networks and their critical analysis. The study concludes that PSO and ACO based protocols are advantageous than other approaches applied for the routing optimization in ad hoc and wireless sensor networks.

R.Geetha, *et al.* [18] Routing, the act of moving information across an Internet work from a source to a destination is one of the major issues in computer network literature. Recently nature inspired algorithms have been explored as means of finding an efficient solution to this routing problem. Ant colony optimization (ACO) is a probabilistic technique used for solving complex computational problems, such as finding optimal routes in networks. In the natural world ants (initially) wander randomly and upon finding food return to their colony while laying down pheromone trails. If other ants find such a path, they are likely not to keep travelling at random, but to instead follow the trail, returning and reinforcing it if they eventually find food. These pheromones are attractive, nearby ants will be inclined to follow, more or less directly the track. The short route will be increasingly enhanced and therefore become more attractive. This paper surveys the ACO based routing in various Networking domains like Wireless Sensor Networks and Mobile Ad Hoc Networks.

D. Karthikeyan, *et al.* [19] MANET is a group of mobile nodes which communicate with each other without any supporting infrastructure. Routing in MANET is extremely challenging because of MANETs dynamic features, its limited bandwidth and power energy. MANET nodes operating on battery try to pursue the energy efficiency heuristically by reducing the energy they consumed. Literature shows though they maintain acceptable performance of certain tasks, for multi-hop routing this is not optimal strategy. Swarm intelligence is a computational intelligence technique that involves collective behavior of autonomous agents that locally interact with each other in a distributed environment to solve a given problem in the hope of finding a global solution to the problem. We propose an energy efficient algorithm for MANETs based on ACO for minimizing energy consumption of the nodes and prolong the life of overall communication system.

Ms. **Shradha**, ***et al.*** **[20]** says that Mobile Ad Hoc Networks (MANETs) are infrastructure less network consisting of mobile nodes, with constantly changing topologies that communicate via a wireless medium. Therefore, routing is a challenging issue in MANETs. Swarm Intelligence (SI) is an artificial intelligence technique based around on the study of collective behavior in decentralized, self-organized systems. Ant Colony Optimization is popular among other Swarm Intelligent Techniques. In this paper a detailed comparison of different Ant based algorithms is presented. The algorithms discussed here are Ant Net Routing, Ant Colony based Routing Algorithm Routing,

Ad hoc Networking with Swarm Intelligence Algorithm.

Javad Pashae Barbin, *et al.* [21] Mobile Ad-hoc Networks have recently attracted a lot of attention in the research community as well as the industry. Quality of Service support for MANETs is an exigent task due to dynamic topology and limited resource. It is important that MANETs should provide QoS support routing, such as acceptable delay, jitter and energy in the case of multimedia and real time applications. One of the meta-heuristic algorithms which are inspired by the behavior of real ants is called Ant Colony Optimization algorithm. In this paper, proposed an ant based routing protocol for mobile ad hoc networks. ACO based algorithms have specialized to provide adaptive and efficient solutions to network routing. AMPC provides multiple paths with comparatively less overhead in the network. The simulation results indicate that proposed scheme can perform better than AODV and AOMDV under high mobility because of alternate route maintenance scheme.

Sunita Prasad, *et al.* [22] the paper proposed a novel ant colony based algorithm for unconstrained Steiner tree in wireless ad hoc networks. The proposed ant based algorithm uses problem relaxation to incorporate the structural information into the heuristic value for node transition. The algorithm was tested on the standard test data set of the OR-library. The results suggest that the proposed algorithm is able to find the optimal results with high success rate. The future work is to further enhance the algorithm for constrained Steiner tree in wireless ad hoc networks and also extend it for dynamic multicast groups.

P.Deepalakshmi , *et al.* [23] Routing, the act of moving information across an internet work from a source to a destination is one of the major issues in computer network literature. When it comes to mobile ad hoc network, the complexity increases due to various characteristics like dynamic topology, absence of centralized authority, time varying QoS Requirements etc. In this paper, proposed an ant based routing protocol for mobile ad hoc networks which can effectively fine the globally best solution in terms of routing for a given ad hoc network that can further satisfy users need for higher bandwidth, shorter delay and also shorter distance path in terms of hopcount. The simulation results indicate that proposed scheme can perform better than AODV under high mobility because of alternate route maintenance scheme.

M. Subha, *et al.* [24] in this paper presents a new routing algorithm ACORA for mobile, multi-hop ad-hoc networks. The ACORA is referring to the protocol as the Ant Colony Optimization Routing Algorithm (ACORA). The proposed protocol improves the performance metrics such as: Packet Delivery Ratio, Packet Drop Rates, Delay, Bandwidth and Energy Consumptions of the existing protocol DSDV in MANET. ACORA is based on swarm intelligence and especially on the ant colony (Ant Colony Optimization) based meta-heuristic routing algorithm. The ACORA routing protocol is highly adaptive, efficient and scalable.

Shahab Kamali, *et al.* [25] previously proposed position based routing algorithms may fail to find a route from a source to a destination in some types of ad-hoc networks and if they find a route, it may be much longer than the shortest path. On the other hand, routing algorithms which are based on ant colony optimization find routing paths that are close in length to the shortest paths. The drawback of these algorithms is the large number of control messages that needs to be sent or the long delay before the routes are established from a source to a destination. In this paper proposed POSANT **(Position based Ant Colony Routing Algorithm)**, a new ant colony based routing algorithm that uses the information about the position of nodes to increase the efficiency of ant routing. In contrast to other position based routing algorithms, POSANT does not fail when the network contains nodes with different transmission ranges. Unlike the previously defined position based routing algorithms which are single path, POSANT is a multipath routing algorithm. While in some cases regular position based routing algorithms find a route which is much longer than the shortest path, POSANT converges to routes which are close in length to the shortest path.

Manjula Poojary, *et al.* [26] in this paper first presented on-demand routing algorithm Enhanced Ant Colony Optimization (ACO) for Mobile ad-hoc networks (MANETs). Ant Colony Optimization, a swarm intelligence based optimization technique, is widely used in network routing. These approaches try to map the solution capability of swarms to mathematical and engineering problems. Second,

presented AntHocNet, a hybrid routing algorithm for MANETs that is based on ACO routing. AntHocNet is a concrete example of how ACO routing techniques can be adapted to work in highly challenging environments. Concretely, the algorithm combines ACO routing with other approaches to learning in order to get adaptively and robustness while maintaining an efficient working.

Nishitha Taraka, *et al.* [27] Ant Colony Optimization is an algorithm to solve problems like routing in MANETs based on food searching behavior of ants. AntHocNet [1] is based on ideas from Ant Colony Optimization. AntHocNet is a hybrid algorithm consisting of both reactive route set-up and proactive route maintenance. It does not maintain routes to all possible destinations at all times but it sets up paths when they are needed at the start of a data session. In this paper, performance evaluation of AntHocNet, AODV and DSR routing protocols is done using the simulator ns2.34. Simulation results demonstrate scalability of AntHocNet when compared to AODV and DSR i.e., AntHocNet performs better at high data rates and at large number of nodes. Its performance is low when compared to AODV and DSR at low data rates and at less number of nodes.

Amit Chandra Pathak , *et al.* [28] In this paper analyze an ACO (Ant Colony Optimization) based routing algorithm with AOMDV protocol for load balancing to route packets through shorter and feasible routes. In general, note that it is very difficult to design routing protocols which are scalable under extreme traffic conditions, but incorporating congestion awareness complicates the problem by incurring overheads in an already heavy loaded network. In ACO technique Ants leave pheromone trails at nodes or edges which increase the likelihood of other ants to follow these trails. In proposed scheme routing paths are then selected on the basis of traffic density, using this to balance the load in network traffic. The trade-off between the amount of overhead expended in finding congestion-free paths and data delivery is very delicate at high traffic loads. However, the proposed scheme is able to achieve this balance and perform better than AOMDV in higher traffic load conditions and improving the routing capability in network.

Rajanigandha Metri, *et al.* [29] A new QAMR protocol based on ACO algorithm is introduced having properties like multipath routing, path preference probability which make the protocol intelligent and adaptive. The path with higher path preference probability offers an optimized consideration of multiple QoS metrics delay, bandwidth, and shortest hop count. ACO algorithm increases reliability of protocol along with adaptive nature and makes the protocol smart to build verdict during link failures.

R.Asokan, *et al*. [30] the existing QoS routing solutions were dealt with only one or two of the QoS parameters. It is important that MANETs should provide QoS support routing, such as acceptable delay, jitter and energy in the case of multimedia and real time applications. This paper proposes a QoS Dynamic Source Routing **(**DSR) protocol using Ant Colony Optimization (ACO) called Ant DSR (ADSR). In this paper, DSR based on-demand routing algorithm ADSR is proposed to optimize three QoS parameters delay, jitter and energy using Ant Colony Optimization (ACO). This avoids the overhead of having three independent routing algorithms, one for each QoS metric. The mechanism was based on the Forward ant (FANT) and backward ant (BANT) packets added in the route request and route reply. The proposed protocol selects a minimum delay path with the maximum residual energy at nodes. Even though ADSR results in a slightly high routing overhead than DSR, it performs well in route discovery with dynamic changes in the network topology and produces much better throughput with very low variance in the delay.

III. CONCLUSION

Mobile multi-hop ad-hoc networks are flexible networks, which do not require pre-installed infrastructure. With upcoming wireless transmission technologies and highly sophisticated devices their application will increase. However the main challenge in mobile multi-hop ad-hoc networks is still the routing problem, which is aggravated by the node mobility. Various approaches were introduced in the recent years which try to handle the problems in this kind of networks, but no one fits best for all applications. In this paper studied the different ant colony optimization protocols in section 2. Ants-based routing algorithms have attracted the attention of researchers because they are more robust, reliable, and scalable than other conventional routing algorithms. The researches done

have shown that ant based routing protocols can remove at least one or several problems in the area such as battery life, scalability, maintainability, survivability, adaptability and so on. As such, ant based approaches are attracted by much researchers than other approaches.

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