

MOBILE ADHOC NETWORKS USING ANT BASED ROUTING ALGORITHM

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Abstract- The solution uses many ants of simple nature and limited memory requirements. The intelligence of this heuristic is not portrayed by individual ants, but rather is expressed by the colony as a whole. Careful presentation of the problem to the ant colony model facilitates the close biological solution derivation. The solution obtained by this method will be evaluated against the one obtained by other traditional heuristics. This research article presents a mobile node Routing Problem of MANET'S. The problem was formulated as an Integer Programming Model and an Ant Colony Based Meta-heuristic for the Travelling Salesman Problem was used to solve the problem. Data on distances were collected and coded using MAT-lab. Our proposed model revealed a tremendous improvement in the total route length by approximately 32 percentages.

Index Terms- MANET'S, MATLAB7.2b, ACO algorithm

I. INTRODUCTION

Mobile ad hoc Networks are infrastructure less and there is no Base Transceiver Station. This simplicity is an advantage in critical situations like, emergency relief, war and earthquake. Mobile nodes in MANET have two roles, router and terminal or host. If there is a link between two nodes they communicate directly otherwise, intermediate nodes help in communicating [1]. With above explanations, routing is essential task in MANETs. An appropriate routing should be able to find a good path according to many parameters like, transmission power, traffic, dynamic topology and so on. But due to updating routing information and consuming resources in the network, the routing algorithm should also be dynamic and common rate of the routers.[2].

The idea behind ant algorithms is to adapt and use their communication style which has been proven to be so good in nature, rather than truly mimic the behavior of real ants. A real foraging ant spends all its life travelling between its nest and some food source. It does not then come as a surprise that

the first problem solved with an ant algorithm, called Ant System (AS), was the Travelling Salesman Problem (TSP), a well-known combinatorial problem, where the shortest route (path) that visits exactly once each city of a given set of cities, starting and ending at the same city, is to be found. The very good results that were being achieved with ant algorithms pointed to the broadening of the definition of *path* therefore allowing for the use of this method to solve other problems.

Some adaptations of the algorithm had to take place, resulting in the so called Ant Colony Optimization metaheuristic, which is based on the ant system. The definition of the ACO metaheuristic, as a series of generic guidelines that could be very easily adapted to almost all types of combinatorial optimization problems, allowed a boost in the use of this methodology and in the number of researchers and publications in the area. Since then, ACO procedures have been applied to solve a broad set of problems, including: Network Flow Problems, Network Design Problems, Assignment Problems Facility Location Problems, Transportation Problems, Covering Problems, Location Problems, just to mention but a few in the area of combinatorial optimization. Curiously enough, although the TSP was the first problem to be solved by the AS and ACO metaheuristics, it still inspires researchers such as Garc'ia-Mart'inez et al (2007), for instance, that have recently used ACO to solve a bi-criteria TSP to test an evolving strategy to update pheromone trails.

II. ROUTING BASED ON ANT MOVEMENT

In nature, real ants during moving deposit substances called pheromone. For finding food when the first ants reach an intersection, select a path randomly. After finding food, each ant begins returning to the nest and consequently deposits more pheromone on that path. Next ants in at least two-way point will

select an outgoing route based on the more pheromone that will lead to finding the shortest path. Ant based routing in MANET has inspired from ant routing in nature. So like real ants some mobile agents called Forward Ants (FA) and Backward Ants (BA) discover the route. For finding and updating a route to the destination FAs are created and according to goal function will be broadcast in the networks. After finding destination or a node with a proper route to the destination, BAs are generated and sent toward source node for updating the intermediate nodes in the route and notifying the source. When source node receives BA starts sending data packets. Some FAs during sending data are distributed for maintaining the route and link error detection

III. ANT COLONY PRINCIPLES

Ant Colony Optimization principles are based on the natural behavior of ants. In their daily Life, one of the tasks ants have to perform is to search for router node, in the vicinity of their nest. While walking in such a quest, the ants deposit data substance called *pheromone* in the Ground. This is done with two objectives. On the one hand, it allows ants to find their way back to the nest, and on the other hand, it allows other ants to know the way they have taken, so that the others can follow them. The curiosity is that, because hundreds or even thousands of ants have this behavior, if one could see the pheromone laid in the ground as a kind of light, the ground would be a large network with some of the arcs brighter than the others. Within the paths created by those arcs would surely be the shortest path between the nest and the node source. This behavior can be seen as a kind of communication between the ants. If the path has a large concentration of pheromone, this is probably due to its shorter length that allowed ants to travel faster, resulting in a larger number of travels through the path therefore with much more ants depositing pheromone on it. Furthermore, over time the pheromone evaporates and thus its concentration reduces. The more time it takes for the ant to travel from the nest to the router node source and back to the nest, the more time the pheromones have to evaporate. This system is thus based both on the positive feedback, i.e. depositing of pheromone attracts other ants to use the same path which will increase the pheromone quantity, and on negative

feedback, i.e. dissipating of the pheromone through evaporation leads to lower levels of pheromone thus discouraging other ants. Deneubourg et al (1990) and Goss et al (1989) performed some experiences with real ants and they were able to show that foraging ants can find the shortest path between their nest and some source, by the use of a node substance called pheromone that they deposit while walking. After these experiments the authors proposed a stochastic model to describe what they had observed. This was the first step leading to an optimization algorithm based on the foraging behaviour of ants. Some years later, Dorigo et al (1996) developed the first foraging ant's algorithm which was called *Ant System* and that was firstly proposed to solve the travelling salesman problem.

IV. ANT SYSTEM

An AS algorithm considers a single ant colony with m artificial ants cooperating with each other. Before the algorithm starts to run each arc linking two different cities is given a certain quantity of pheromone τ_0 . This is usually a very small value just enough to ensure that the probability of each arc to be chosen is different from zero. Also, the ants are created. The algorithm has two main phases, the construction of the tour/solution and the pheromone update. Other important decisions have to be made before the ants can start finding a solution, such as defining the structure (representation) of the solution, or the initial pheromone quantity to be given to each arc. These questions will be discussed further ahead. At each iteration each ant is randomly placed in a city, from the set of n cities. That city will be the starting point of the tour that is to be constructed by the ant. A solution to the TSP can be represented by a set of n consecutive cities. Therefore, at each step of the construction the ant has to choose, with a given probability, the next city to travel to. This choice is made by using a *transition rule*, the short expression for *random proportional transition rule*, that uses a combination of attractiveness of the city, which is given by the heuristic information η_{ij} of the problem, and of the fitness of the move, i.e. past usage, which is given by the pheromone quantity τ_{ij} . The transition rule quantifies the probability of ant k , positioned at city i , travelling to city j and it is given by:

$$P_{ij}^k(t) = \frac{[\tau_{ij}(t)]^\alpha \cdot [\eta_{ij}]^\beta}{\sum_{l \in J_i^k} [\tau_{il}(t)]^\alpha \cdot [\eta_{il}]^\beta},$$

where η_{ij} , the *heuristic information* or *visibility* of arc (i, j), is the inverse of the distance between city i and city j, i.e.

$$\eta_{ij} = 1/d_{ij}$$

J_i^k is the set of cities not yet visited by ant k while at city i, and α and β are parameters weighting the relative importance of the pheromone and of the heuristic information, respectively. Therefore, the closest cities, that is, the ones that the ant can see from where it is standing, will have a higher visibility value, whereas the others will have a lower one. The values α and β are two tunable parameters that weight the pheromone information and the heuristic information on the transition rule.

V. PROPOSED ANT COLONY OPTIMIZATION ALGORITHM

Some improvements were inserted into the AS such as the introduction of elitist ants into the colony, the ranking of ants, and the bounding of the allowed accumulated pheromone in each path. Nevertheless, the most important development is the description of the Ant Colony Optimization. The ACO, which is described in Algorithm 1, is made of general guidelines for the development of algorithms based on foraging ants to solve combinatorial optimization problems.

Algorithm 1: Pseudo-code for Ant Colony Optimization.

- 1: Initialize parameters
- 2: Initialize pheromone trails
- 3: Create ants
- 4: **while** stopping criteria is not reached **do**
- 5: Let all ants construct their solution
- 6: Update pheromone trails
- 7: Allow Daemon Actions

8: **end while**

The main difference from the basic structure of the AS algorithm is the introduction of a *Daemon*. The daemon can perform problem specific operations or centralized operations, which use global knowledge of the solutions, thus having a very active and important role in the algorithm. The daemon can control the feasibility of each solution or give an extra pheromone quantity to the best solution found from the beginning of the algorithm or to the best solution in the current iteration.

Another important feature, frequently used on ant based algorithms is the introduction of Local Search procedures following the construction of the solutions. This is an optional feature that has been proved to be very important in the exploitation of the search space near to good solutions, leading almost always to better performances of the ACO.

AD HOC ROUTING PROTOCOLS

A routing protocol for ad hoc networks is composed of a routing algorithm with a set of rules that monitor the operation of the network. On demand protocols do not store all paths, but paths are created each time they need to send a data. If source node wants to send a data to destination node then this source node evokes process to search a path. After the path is created, it is maintained by nodes. These are DSR, AODV, ABR, TORA, DYMO and others [5]. In a proactive routing protocol, each node periodically broadcasts its routing table to its neighbors, allowing all nodes to have a consistent network view. Due to the up to date network topology in each node these protocols have the short response time in determining a good route from source to destination. Protocols such as DSDV, WRP fall into this category. A hybrid protocol, such as Zone Routing Protocol (ZRP) combines the advantages of both proactive and reactive protocols [6]. Each node proactively maintains a routing table for nodes within its zone and reactively finds a route to its destination if the destination node lies beyond its zone [7].

A. Proactive Protocols

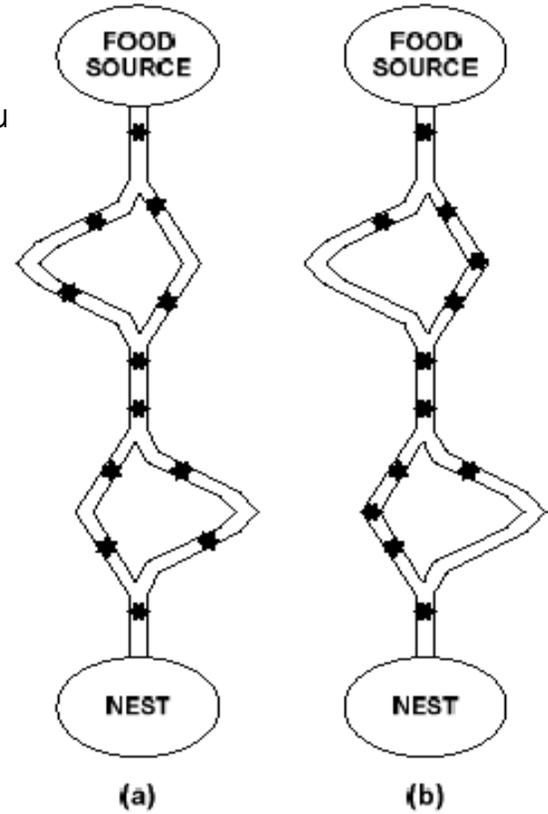
Proactive protocols continuously learn the topology of the network by exchanging topological information among the network nodes. Thus, when there is a need for a route to a destination, such route information is available immediately. These protocols require each node to maintain one or more tables to store up to date routing information and to propagate updates throughout the network. As such, these protocols are often also referred to as table-driven. These protocols try and maintain valid routes to all communication mobile nodes all the time, which means before a route is actually needed. Periodic route updates are exchanged in order to synchronize the tables. Some examples of table driven ad hoc routing protocols include Dynamic Destination Sequenced Distance-Vector Routing Protocol (DSDV) [8], Optimized Link State Routing Protocol (OLSR) [9] and Wireless Routing Protocol (WRP) [10]. These protocols differ in the number of routing related tables and how changes are broadcasted in the network structure.

TABLE II: PROACTIVE PROTOCOLS COMPARISON

Protocol	Routing tables	Route Updates	Route metric	Overhead
DSDV	2	Periodic	Shortest path	Low
OLSR	3	Periodic	Shortest path	High
WRP	4	Periodic	Shortest path	Low
CGSR	2	Periodic	Shortest path	Low

ACO (Ant Colony Optimization):

ACO, a famous swarm intelligence approach, has taken the inspiration from real ants which are wandering around their nests to forage for search of food [2]. Upon finding food they will return back to their nests and simultaneously deposit pheromone trails along the paths. The ant selects its next hop based on the amount of pheromone deposited on the path to the next node. The problem of finding shortest paths maps quite well to the problem of routing in networks. The ants are nothing but small control packets, which have the task to find a path towards their destination and gather information



about it. In recent years, the interest of the scientific community in ACO has risen sharply. Because of its robustness, and adaptive nature, ACO can find its applications in routing, assignment & scheduling [3].

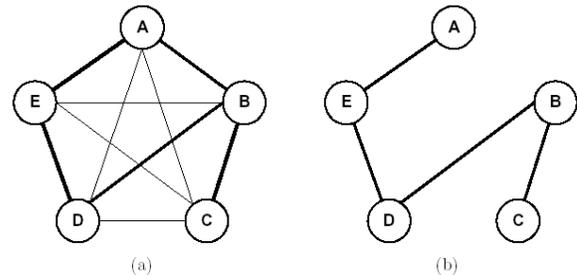


Figure 2: Double bridge experiment. (a) Ants start exploring the double bridge. (b) Eventually most of the ants choose the shortest path .

Figure 2 shows the behavior of ants in a double bridge experiment [38]. In this case, because of the same pheromone laying mechanism, the shortest branch is most often selected. The first ants to arrive at the food source are those that took the two shortest branches. When these ants start their return trip, more pheromone is present on the short branch than the one on the long branch. This will stimulate successive ants to choose the short branch. Although a single ant is in principle capable of building a solution (i.e., of finding a path between nest and food resource), it is only the colony of ants that presents the “shortest path finding” behavior. In a sense, this behavior is an emergent property of the ant colony.

This behavior was formulated as Ant System (AS) by Dorigo et al. [39]. Based on the AS algorithm, the Ant Colony Optimization (ACO) algorithm was proposed [41]. In ACO algorithm, the optimization problem is formulated as a graph $G = (C; L)$, where C is the set of components of the problem, and L is the set of possible connections or transitions among the elements of C . The solution is expressed in terms of feasible paths on the graph G , with respect to a set of given constraints. The population of agents (ants) collectively solves the problem under consideration using the graph representation. Though each ant is capable of finding a (probably poor) solution, good quality solutions can emerge as a result of collective interaction amongst ants. Pheromone trails encode a long-term memory about the whole ant search process. Its value depends on the problem representation and the optimization objective.

Simulation and discussion

We proposed algorithm is simulated in MATLAB7.5b. before comparing algorithm is individual nodes power consumes ion and data retrieving the more bandwidth of the MANET. Now proposed algorithm was multi nodes less time discovering and high performance performed in sending through routers. Using adhoc networks. Each parameter detecting the neighbour nodes and sending maximum energy level s of the nodes. In below table shows the energy levels of each parameter.

Network size	100m x 100m
Transmission range	350m
MAC Protocol	IEEE802.11g
Mobility Model	Random way Point
Path length	Free Space
Initial Nodes	50
Packet size	128bytes
Traffic model	CBR
Bandwidth	2.5Mb/s
Simulation Time	100 s

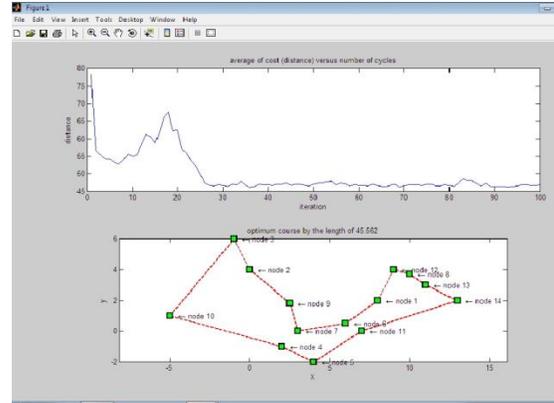


Fig 1: Avg cost(distance) vs no of cycles

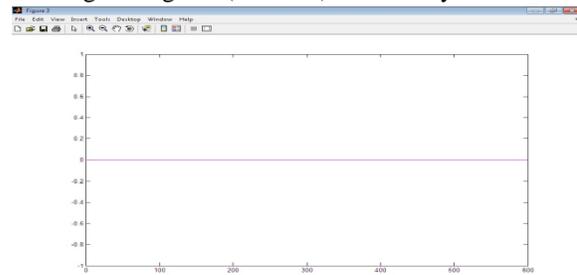


Fig 2: ACO Optimization

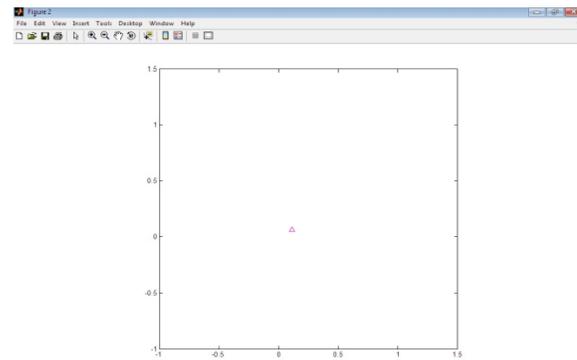


Fig 3: Distance calculation

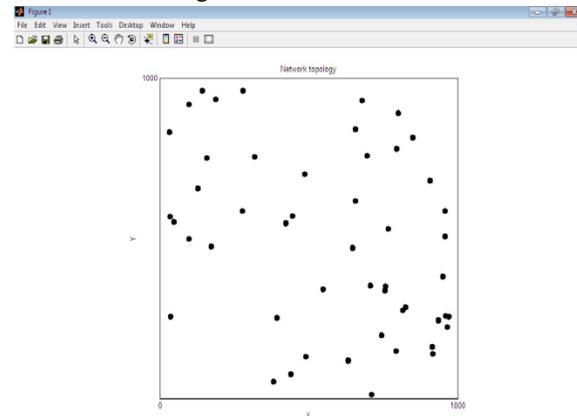


Fig 4 Network topology

VI. CONCLUSION AND FEATURE ENHANCEMENT

In this we provide simple Service is available to only nodes whose residences are not within walking distances from the destination point. All nodes to be serviced must travel to an allowed halt point. A node must visit a given stop only once. Capacities of nodes must not be exceeded approximately less length of routings of each node. It will better performance given between intermediate nodes by using ant based algorithms in MANETS.

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