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Trust based Routing in Mobile Ad Hoc Networks using Ant Colony Optimization

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Abstract—Mobile ad hoc network (MANET) is a kind of wireless network, which can change the locations and configure them in order to transfer the data from source to destination. They need to be capable of forming temporary network without any centralized device as shown in FIGURE1. For these efficient transformations we need some special optimization technique to find the shortest path between source and destination. Here, in this paper we are going to see in detail about Ant Colony Optimization [ACO] which was derived from the behavior of ants. This optimization can be a combination of reactive and proactive path setup. Additionally trust is also calculated in order to show its effectiveness.

Keywords— *ACO, Ad Hoc, MANET, Routing algorithm*

1. Introduction

A mobile ad hoc network is a collection of wireless mobile nodes which allows the systems to be communicated without any wired infrastructures. Security plays a major role in mobile ad hoc networks [7]. Here, in routing algorithms we basically speak about optimization which means to find the most heuristic path. The solution which was found should be cost effective, minimize the failure and maximize the security for reliable transformations. For these reasons it should be capable of forming dynamic and self-constructing according to the changes. In this paper, we deeply learn about ant colony optimization which is purely based upon the behavior of ants. How ants collect the food from source to destination, is the concept behind this ACO. This concept is implemented here to find the shortest path as shown in FIGURE 2. Initially ants spread randomly to find their food from their source. While travelling they spread out an agent named "pheromone"[9], which serves as an indirect communication between ants. These behaviors of species related algorithms are named as 'Evolutionary algorithms' [2]. When an ant finds the food they return back to the destination leaving the pheromone in that path. Ants which later needs to find the destination look at the path where pheromone agent is left more and that path is carried out by other ants because it is considered to be the shortest path.[1]. ANTNET and ANTHOCNET are two well known ant colony based routing algorithms. ANTNET is a proactive and ANTHOCNET is a reactive routing algorithm. They have a very high delivery rate and find routes whose lengths are very close to the length of the shortest path. The drawback of ANTHOCNET is the number of routing messages that needs to be sent in the network for establishing routes to the destination and the disadvantage of ANTNET is the time needed before a system of paths between the nodes of the network is established.

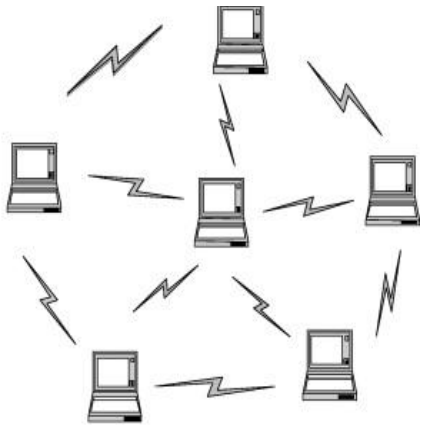

Fig.1: MANET's

1.1 MANET's

In mobile ad hoc network (MANET), the nodes work together in a distributed manner to enable routing among them .Because of the lack of centralized control, routing becomes a central issue and a major challenge is that it should have the capability to change according to the dynamic changes. It is a collection of mobile nodes that are dynamically and arbitrarily located in such a manner that the interconnections between nodes are capable of changing on a continual basis. Each node can act as a receiver, transmitter or router. The main problem of the ad-hoc network is mobility of the nodes resulting in fast variations of their availability. At one time the node is in range and while at other that node is out of the range. Another problem is the power and battery lifetime of each device in the network.

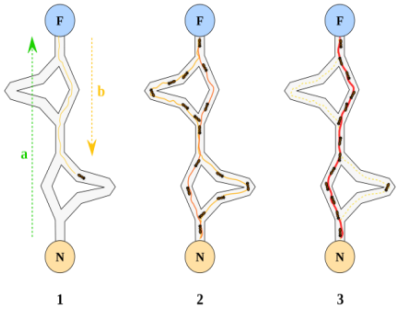

Fig.2 Shortest path taken by ants after initial search

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2. Ant Colony Optimization Routing

ANT Colony Optimization (ACO) was first put forward by Dorigo M.in the early 1990's, and it was designed to simulate the foraging behavior of real ant colonies.[10]Basically, ACO routing was first developed for wired communications and that is named as Ant Net [5]. But the drawback is that it cannot change according to the dynamic conditions for better transformations. This setup is named as 'Proactive path setup'. Due to the above reasons 'Reactive path setup' evolved, which can act great according to the dynamic changes. Using the ACO technology we can make complex task in distributed manner. This makes the network from overloaded network to a traffic free one. We use routing tables to know about entries. The routing table which has most entries will be chosen as the good path and the modifications take place in the table. Usually in ACO we use two agents in routing. (i) Fant (Forward ant agent) which is source to destination.(ii) Bant (Backward ant agent)which is destination to source.(iii) Sagent (Service agent)which is used to update the routing table. Using all these, we finally update the routing table using pheromone concentration and trust also need to be calculated [8].

1.2 Routing Table Setup

Always in network we have n number of nodes. Initially create a routing table for each node which can store all the information about the pheromone calculations and transformations which took place.

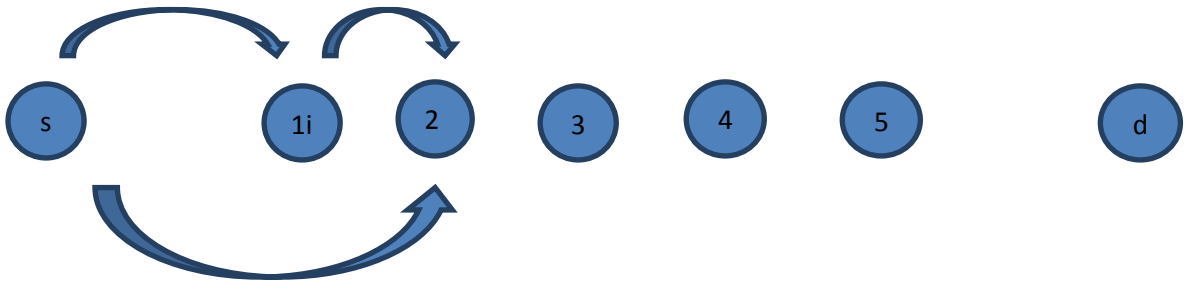

Fig.3: Hopping method

$P_{1,1}$	$P_{1,2}$	……..	……	$P_{1,D}$
$P_{2,1}$	$P_{2,2}$	……..	……	$P_{2,D}$
$P_{N,1}$	$P_{N,2}$	……	……	$P_{N,D}$

Table1. Specifies the path possibilities according to the pheromone value

The circle represents the node and (s) denotes source and (d) denotes destination and the arrows represents the hop of one node to other. The hop is usually carried out by the pheromone values. the path is the shortest path it chooses that node If it found that otherwise move on to other. This work is done continuously until it reaches the destination as shown in the table1.

3. Algorithm Design

Representing the design in graphical model where G represents graph, A represents all nodes, E denotes edges which connects two nodes. For each node routing table T is constructed. The ant agent (a) chooses the heuristic path according to the information provided by the routing table. $\Phi^{i}_{n,d}$ (pheromone value showing goodness from node to node up to destination)

Where i is the starting node to its neighbor n and move on until it reaches the destination d.

$P_{n,d}$(Probability of next hop)Where P denote the probability.

$$P_{n,d=} \quad \frac{(\Phi^{i}_{n,d})^{\alpha}}{\sum N^{i}_{d}(\Phi i_{j,d})^{\alpha}}$$

α which always need to be >=1.It shows the neighborhood nodes to reach the destination.Fant holds a stack with more probability P of nodes.

$$P=((s,d^{s}_{s,j1}),(j1,d^{j1}_{j1,j2}),\ldots\ldots(j_{k},d^{jk}_{jk,d\ldots..}h_{k}))$$

j1, j2 (sequence no of nodes)

$d^{j1}_{j1,\,j2}$(delay from one node to another node)

Sagent records the in and out time of Fant.Bant have information about Fant to return back to the source and it reads the delay between nodes.

$$d^{i}_{j1,d}=d^{i}_{i,j1}+d^{j1}_{j1,j2}+\ldots\ldots\ldots d^{jk}_{jk,d}$$

Calculate the total delay from source to destination.These information is send to Sagent to update the routing table.

$$\Delta\Phi^{i}_{j}=\frac{(d^{i}_{j1,d}+Thop).e^{\beta}}{2}$$

The above equation is used to increase the pheromone information. Where Thop represents the time taken for one hop as shown in the Figure 4, β denotes the available pheromone and e^{β} denotes the ratio of ant agent.

$$\Phi^{i}_{j1}=\Phi^{i}_{j1}+\Delta\Phi^{i}_{j1}$$

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The above equation is used as pheromone updating formula [1].

4. Proposed Work

To find the shortest path, algorithm is used. Using that we can move on to next nodes and reach the destination. The drawback here is trust is not calculated. If a shortest path is found information passes through it. We don't know whether the information reaches the destination or tampered or modified by some others. The aim of this project is to overcome these drawbacks .This can be done by a trust level which needs to be introduced in the algorithm design. Trust level which calculates the security and trust on that specific node .After checking all these things, information is passed through the nodes [3].
The proposed work is to calculate the trust to ensure the security while transformations are made.

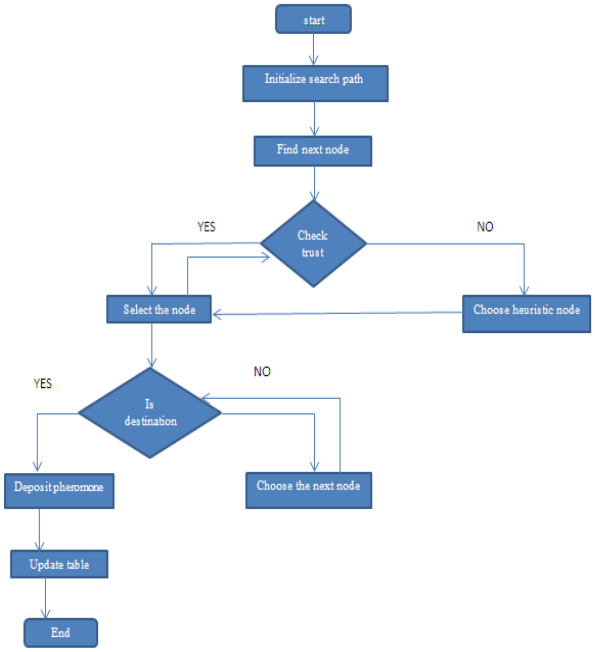

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Fig. 4: Trust calculation

5. Conclusion

The proposed routing algorithm is actually used to find the trust level while hopping from one node to another node in order to secure our data packets or transmissions without any fail or any tampered data. In future these kinds of trust values can be implemented in a better way.

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