# Simulation of ACO Technique Using NS2 Simulator

Shruthi V Raj[#1], Hemanth S R[#2]

*[#1]M.Tech student,Computer Science,Maharaja Institute of Technology,Mysore*
*Karnataka,India*

*[#2] Asst, Professor,Computer Science,Maharaja Institute of Technology,Mysore*
*Karnataka,India*

***Abstract*— A wireless network such as mobile ad-hoc network consists of a collection of mobile nodes where the communication is not limited to a certain region. The network is a infrastructure less or without central administration, its a kind of very flexible network. Where nodes are freely moving and its difficult to locate the path between two nodes. Mobile ad-hoc network are suitable for temporary communication links. Therefore it is one of the big challenge to locate a path between communication end nodes. where as in order to fulfil this task suitable routing protocol is needed. This paper presents a solution for discovering path between source & destination nodes in the mobile-ad hoc network. And the protocol is based on swarm intelligence which especially on ant colony metaphor. Termite is an innovative algorithm for routing in communication network, it is well known swarm intelligence algorithm. Termite is an adaptive, distributed, mobile agents based algorithm which enables the swarm to become more intelligent & serve the purpose. Some of parameters which is used to examine are packet delays, throughtpu, Shows better results of throughput as compared to other existing algorithm. so termite algorithm is promising for routing of data in communication network.**

***Keywords*—Routing algorithm, Swarm intelligence, Mobile agents, Pheromone, MANET, ant colony optimization.**

## I. Introduction

A mobile ad hoc network called as a mobile mesh network, it is a self-configuring network of an mobile devices connected by wireless links-which together form topology. And the nodes keeps on moving without having any self control and it moves randomly. These kinds of networks are very flexible and do not require any existing infrastructure or central administration and are suitable for temporary communication and transaction.

MANET(fig1) are infrastructure less network where nodes can move freely. If the node exist without radio communication range it can directly communicate with one node to another node.

In this network the biggest challenge in to find a path between the communication end points of nodes that are highly mobile in nature. Since it as limited transmission range of wireless interfaces, the traffic will rely on multiple intermediate nodes to enable successful communication. And here every node acts as both, a host and as a router.

**Fig-1**: Mobile ad-hoc

Here below is the figure shows how ant colony system works (fig2). The two ants start from their nest in search of food source at the same time to different directions. One of them chooses the path that turns out to be shorter while the other takes the longer sojourn. The ant moving in the shorter path returns to the nest earlier and the pheromone deposited in this path is obviously more than what is deposited in the longer path. Other ants in the nest thus have high probability of following the shorter route. These ants also deposit their own pheromone on this path. More and more ants are soon attracted to this path and hence the optimal route from the nest to the food source and back is very quickly established. Such a pheromone-meditated cooperative search process leads to the intelligent swarm behaviour.

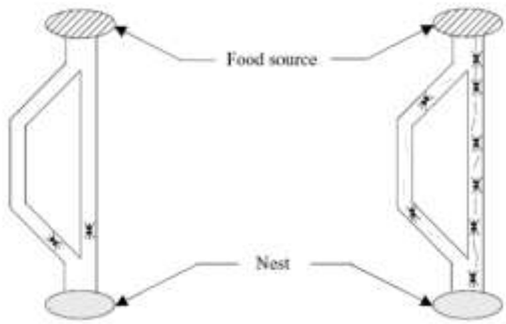


**Fig-2**: Movement of ant algorithm from nest -food source and back

Swarm intelligent solutions are, both for wired and wireless networks. The variety and similarities between approaches will be highlighted, and a general implementation for SI routing is revealed as well. Lastly, some approaches related to swarm intelligent routing are explained. These are ideas which come close to SI routing, but are not quite the same. This includes probabilistic routing, gossiping, routing with agents, and routing with reinforcement learning. The concludes the review of previous work. Future will be concerned only with the development and analysis of the Termite routing algorithm.

## II. RELATED WORK

Some of the algorithms used for routing in ad hoc networks are destination-sequenced distance vector routing, wireless routing protocol, ad hoc on-demand distance vector routing and dynamic source routing protocol . The algorithm presented in this paper has the following difference compared to the existing ones.

• All the above mentioned algorithms have a lot of overhead involved as they have to transfer their routing tables to other nodes over the network. They either transfer them on time-based approach or event-based approach. This problem does not exist with the Termite as there is no need for the transfer of the routing tables in the network.

• Some of the currently used algorithms do not support multiple paths and hence there is no possibility of load balancing in case the optimal path is heavily congested. The Termite algorithm supports generation of multiple paths and it also supports load balancing if the optimal path is congested.

• The above algorithms also require special packets for the purpose of the Route Maintenance. This is not the case with the Termite algorithm where the Route Maintenance is done by the data packets themselves and the termite algorithm is more robust and scalable than the current algorithms due to the inherent behavior as seen in biological insects.

Mesut G¨unes et.all., proposed[1] ARA – The Ant-Colony Based Routing Algorithm for MANETs, a new on-demand routing algorithm for mobile, multi-hop ad-hoc networks. The protocol is based on swarm intelligence and especially on the ant colony based meta heuristic. These approaches try to map the solution capability of swarms to mathematical and engineering problems. The introduced routing protocol is highly adaptive, efficient and scalable. The main goal in the design of the protocol was to reduce the overhead for routing. We refer to the protocol as the Ant-Colony-Based Routing Algorithm (ARA) The performance for the considered simulation scenarios is very close to the performance of DSR, but generates less overhead.

Iliya Enchev Pervasive et.all., proposed[2], MANET routing protocols based on swarm Intelligence, this work the ant-inspired protocols - ARA, SARA, ANSI, AntHocNet, HOPNET and the bee-inspired protocol - BeeAdHoc are regarded and their main features, advantages and disadvantages are compared between each other as well as to some well established non swarm intelligence protocols, like AODV. It is shown that by using ideas taken from the simple behaviour of ants and bees optimization and innovations in routing protocols can be done, that help outperform the standard MANET routing protocols like AODV, DSDV, DSR. Depending on application needs the presented protocols provide also customizing and tuning capabilities that can make them suitable for a wide range of MANET applications.

Sharvani.G.S et.all., proposed[3], Development of Swarm Intelligence Systems for MANETs, predictive preemptive based local route repair strategy is applied using Lagrange's Interpolation formula for termite algorithm. When a node is failing, it is preempted i.e. the node tells its upstream neighbor about its failure. With this information, there is an opportunity for the swarm to repair itself by finding alternate path to the destination. The concept of local repair is being used. When the point of failure is highly localized, the swarm takes up the responsibility of repairing and ensures successful data transmission. On the other hand, if the point of failure is global i.e. it is more near to the source node, the source is informed and allowed to fend for itself, as local repair is highly unfeasible. The application is designed with a prediction part which predicts the link failure before it actually happens giving enough time for the predecessor node to find an alternative path without bothering the source node. This reduces the overhead of sending unnecessary warning message.

## III. PROPOSED METHODOLOGY

### *A. Termite hill building process:*

A simple example of the hill building behavior of termites provides a strong analogy to the mechanisms of Termite routing algorithm. Consider a flat surface upon which termites and pebbles are distributed. The termites would like to build a hill from the pebbles. A termite is bound by these rules:

1) A termite moves randomly, but is biased towards the locally observed pheromone gradient. If no pheromone exists, a termite moves uniformly randomly in any direction.

2) Each termite may carry only one pebble at a time.

3) If a termite *is not* carrying a pebble and it encounters one, the termite will pick it up.

4) If a termite *is* carrying a pebble and it encounters one, the termite will put the original pebble down. The pebble will infuse with a certain amount of pheromone

Termite's hill building process involves, collecting the pebbles spread over an area and place it in one place. The cooperation between Termites will lead to constructing of a huge hill (as big as 7 Feet). This is achieved by Termites moving on locally observed pheromone trails (laid by other Termites).If no trails are found, it moves randomly in any direction.

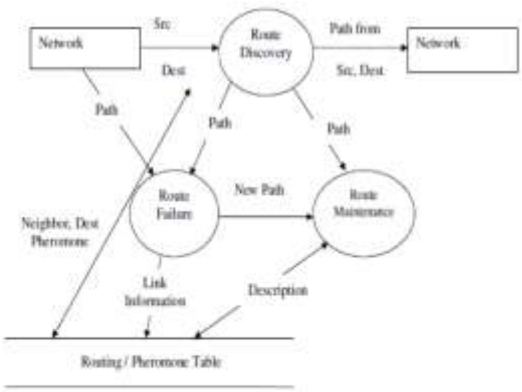


**Fig-3**: Process of termite algorithm

These processes work together to achieve the desired result. The first process here is the Route discovery which takes the source and destination node from the network. It searches for a path from source to destination. Once the path is discovered, the best path is maintained by sending data on that path by the Route maintenance module. The third module is for Route Failure to detect for any link failure and to find the new path. This approach reduces control overhead and maximizes routing performance focusing on the routing metric estimator "pheromone." The pheromone is adjusted in such a way that the best possible utility link is chosen for delivering the packets to the destination.

This paper proposes a termite routing algorithm. The proposed approach has two routing namely route discovery, route maintenance and route failure handling. When a source node has to pass data to a destination node with QoS requirements it starts with the path discovery phase. Once the path is found, the data transfer will take place. While data transmission is going on, it is also required to maintain the path to the destination. This is very much desirable and required in mobile ad hoc networks and hence is done in the route maintenance.

*A. Route discovery module*

Route discovery is responsible for generating route between source and destination..

*B. Route maintenance module*

Route maintenance module is responsible for the maintenance of the path generated during the discovery phase.

*C. Route failure handling module*

This module is responsible for generating alternative routes in case the existing route fails.

## IV.EXPERIMENTAL RESULTS

Termite is a biologically inspired routing protocol for mobile wireless ad-hoc networks. It works on the principle of swarm intelligence and is derived from the behavior of the real Ants. As packets are dispatched from a source to a destination, each follows the pheromone for its destination through the network while depositing Pheromone on the path between nodes. Packets are biased towards strong pheromone concentrations but the next hop is always randomly decided. While depositing source pheromone along the same path increases the possibility of packets following that reverse path to the source. This is positive feedback. In order to prevent previous routing solutions from remaining in the network memory, exponential pheromone decay is introduced. This is negative feedback. Pheromone increases linearly per packet, but decreases exponentially over time.

We used network simulator to simulate the protocol in manets and the findings of which are presented below(fig4). We used xgraph utility of the simulator to generate the graph based on the data generated by the nodes during simulation. The graphs are included in the report below. The simulation environment is a flat grid topology as shown below.

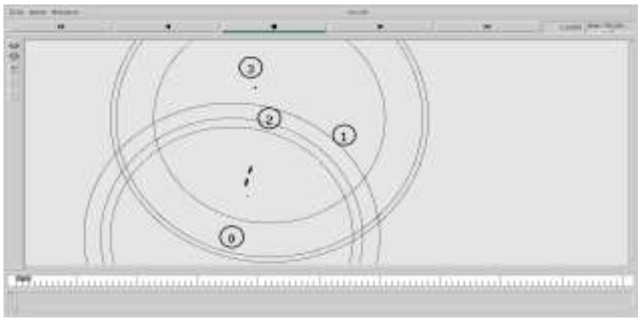

**Fig-4**: Nodes Creation

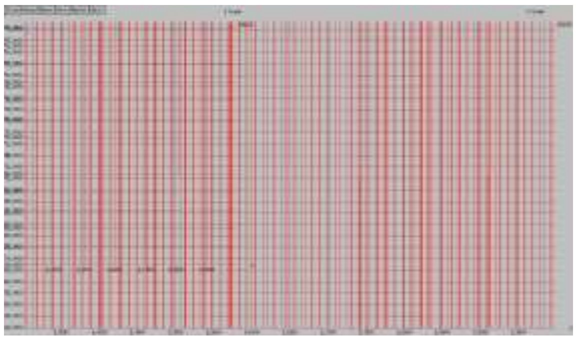

**Fig-5**:The graph show the data generated by the nodes during simulation.

## V. CONCLUSIONS

A routing algorithm for mobile wireless ad-hoc networks has been presented. Swarm intelligence is used to build an emergent routing behavior. Packets probabilistically follow pheromone trails to their destination while laying pheromone for their source. Passive route marking reduces the need for explicit routing traffic and maximizes the network resources available to carry user data. Nodes determine network conditions by monitoring traffic flow and make adjustments to their routing tables. Simulations show that Termite is able to maintain reasonable data good put over a variety of mobility conditions. Control bandwidth overhead is minimized and remains constant across several degrees of network volatility. Further work exploring the characteristics of the underlying algorithm is warranted. Termite is in the first generation of biologically inspired MANET routing algorithms.

## ACKNOWLEDGMENT

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