



Improving The Quality of Service in Mobile Ad- hoc Network Using ant Colony Optimization

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Abstract— A research issue that has gained lot of interest now a days is the design of mobile ad-hoc network (MANET). Researches face a major challenge in achieving good performance while linking the new technology for MANET. A MANET is a set of mobile hosts which communicate with each other in a shared wireless channelized path with major important issues of dynamic topology, load balancing, cost benefits, bandwidth and energy available. The biggest challenge is to find the best solutions and network between these mobile hosts. This work is implemented for improving quality QoS in MANET using Ant Colony Based Routing. The previous works provide multi-path routing algorithm using pheromones scent as congestion measure. Mainly unknown on-demand protocols uses the shortest path as their route selection measure which leads to congestion and link breakdown of most or some of the stations or nodes of the network. During setup phase if protocol doesn't cares for load parameters or conditions at the stations, in that case these protocols are not able to take profit of less loaded stations of network, Thus multipath routing using ACO done in this work can overcome the this problem, providing features of load balancing and route failure protection, successful packet transfer, overall throughputs and average end-to-end delay by distribution of traffic in between set of different paths or channels.

Keywords— Pheromones, trail, bandwidth, routing and load distribution, MANET, Ant Colony Optimization

I. INTRODUCTION

Ant colony optimization algorithm (ACO) is a probability based concept for solving computational problems and situations which we can reduce for finding good or best paths through graphical representation.

A MANET is a set of mobile hosts which communicate with one another in a sharing wireless path with serious issues of dynamic topology, load balancing, cost benefits, bandwidth and energy available. The greatest challenge is to find the best solutions and network between these mobile hosts. This work is implemented for improving QoS MANET using Ant Colony Based Routing. Thus multipath routing using ACO done in this work can overcome problem, providing load balancing and route failure protection, successful packet transfer, overall throughputs and average end-to-end delay by distribution of traffic in between a set of different paths.

II. GOAL OF THE RESEARCH WORK

A new methodology, based upon the ACS algorithm, is proposed for the planning of network distribution systems in MANET. It should be cost effective as well as provide optimal flow of the load. The methodology is very flexible and calculates the location and the characteristics of the network minimizing the investment and operation costs while enforcing the technical constraints such as the bandwidth and the limits on the energy, allowing the consideration of a very complete and detailed model for the mobile ad hoc network.

III. RELATED WORK

Possibility of solving travelling salesman problem using the ACO described in [1], which ranges among NP-hard problems, and provides a theoretical overview of some methods used for solution of the problem. We have compared the quality of solution with the optimal solution, while studying the influence of control parameters.

The unpredictable nature of MANET give a wide ranges of challenges [2] as rapidly changing like efficient routing, avoidance of congestion, load distribution, consumption of energy etc . The proposed algorithm provides a multi-path routing algorithm and having path pheromones scents which constantly update the goodness of choosing a particular path based on congestion measure in addition to shortest-path metrics.

But in [3] there is a dynamic multihop wireless network being established by a set of mobile nodes in a shared wireless channel, when we introduce in into MANET, the complexity may increases due to different characteristics such as dynamic topology, time discreteness in QoS requirements, limited resources and energy etc, in that paper, a new QoS algorithm for MANET has been proposed by the author which is a combination of Ant Colony Optimization (ACO) related with Optimized Link State Routing protocol which need to identify different stable paths related to source and destination nodes.

Broadcasting [4] is a most common operation for a network to handle many issues related to MANET. Due to mobility of host nodes it is expected that such operations are to be executed more frequently, because radio signals are mostly overlap with others in a environmental area, a simple broadcasting by flooding is very costly and will result in contention, collision and serious redundancy which consequently leads to broadcast storm problem.

IV. NETWORK DISTRIBUTION IN MANET THROUGH ANT COLONY OPTIMIZATION

Mobile Ad Hoc Network (MANET) typically receives multiple paths to the same destination. This work is using Ant Colony Optimization to decide which the best path to install the routing table is and to use for traffic forwarding. ACO firstly assigns the valid path as current best path to follow.

It then starts comparing the best path with the succeeding one in the list (maintained) and it continuous until the ACO reaches the end of the list of valid paths.

- Selecting the path having highest weight conceptually it means ants follow the path having higher pheromones deposit here weight is one of the route selection measure and it is local for the route where it is being configured.
- Selecting the path having highest bandwidth and lower cost.
- Selecting the path, locally originating through a network, these local paths are being sourced by network.
- Selecting the path having the lowest origin type
- Continue, even if best path is already selected.
- Continue, if best path is not yet selected.

A. PROPOSED ROUTE SELECTION PARAMETERS (RSP)

Our proposed parameter for route selection is Route selection parameter which is calculated by each node and uses it as a measure of route selection that it combines with the number of hops. For using RSP as a measure of route selection, there should be maintenance of its value in routing tables or cache by each single node in the network. The estimation of RSP at each node is given by:

$$\text{RSP} = \text{PACKET FORWARDING RATIO} * \text{MOBILITY BANDWIDTH} * \text{COST}$$

- 1) **PFR (PACKET FORWARDING RATIO):** It is calculated as a ratio of number of packets received at destination and the number of packets sourced through the application layer (i.e. CBR) and basically it specify rate of packet loss, which actually limits the maximum throughput of networks.
- 2) **MBW (MAXIMUM BANDWIDTH):** It totally relies on availability of band width between intermediate nodes included in the route/path. And it goes towards the route having the greatest avail ness of bandwidth.

B. CHARACTERISTICS OF ACO RELATING WITH AD-HOC NETWORK

The planning of a network distribution in MANET system using Ant Colony Optimization, as in any other enterprise, it provides basic things:

1. The quantity of the product or service desired per unit of time
2. The quality of the product or service desired
3. The rout efficiency is found the path suggested.
4. In ACO, ants can follow any path which is shorter similar concept is tried in network distribution in MANET.

C. PROPOSED ALGORITHM

Target is to find the shortest route trip, to link a series of cities, some rules are to be followed up by the ants means by set of ants and each one of them will be making one of the possible round trip along the cities. At each stage, there is a movement of ant which selects the movemet from one city to another depending upon these rules:

Rule1: It must visit each city exactly once;

Rule2: For a city at a much distance, there will be less probability of being chosen means in terms of visibility;

Rule3: The more the concentration of the pheromones trail found out an edge between two cities, the greater the chances that the edge will be chosen;

Rule4: After finishing its trip, the ant deposits enough pheromones on the edges being traversed by them, when the journey is short;

Rule5: After each iteration, trails of pheromones evaporate.

V. MATHEMATICAL MODELS

In ant colony optimization, ant is a simple computational agent which iteratively constructs a solution for a problem, for every possible route; here route efficiency function (REF) is calculated by ants. All the intermediate solutions are called as solution states. In each iteration of the algorithm, each single move from a state **a** to state **b**, corresponding to a more complete intermediate solution. Hence every ant **n** computes a set $A_n(\mathbf{a})$ of feasible expansions of its present state in every iteration and further moving to one of these in probability.

The probability p^n of moving from state **a** to state **b** depends on the combination of two parameters for an ant **n**. Firstly, the *attractiveness* η of the move, which is calculated by some heuristic method implying *priori* desirability of that

move and secondly the trail level λ of the move implying how proficient it is where λ is the amount of pheromone deposited for transition from state \mathbf{a} to \mathbf{b} , $0 \leq \alpha$ is a parameter for controlling the influence of λ , η is the desirability of transition state \mathbf{a} to \mathbf{b} (*a priori* knowledge, typically $1/d$, and d is the distance and $\beta \geq 1$ is a parameter for controlling the influence of η).

Pheromone Updates

In general, the n th ant moves from state \mathbf{a} to state \mathbf{b} with probability

$$p^n = (\lambda^\alpha \eta^\beta) / \sum_{b \in \text{allowed}} \lambda^\alpha \eta^\beta$$

When all the ants completed their solutions, the trails are updated by

$$\lambda \rightarrow (1 - \rho)\lambda + \sum_n \Delta\lambda^n$$

ρ is the coefficient of pheromone evaporation and $\Delta\lambda^n$ is the amount of pheromone deposited by n th ant, mainly given for a distribution problem, with moves that corresponds to arcs in the graph) by

$$\lambda^n = \begin{cases} Q/L_n & \text{if ant } n \text{ uses curve } ab \text{ in its tour} \\ 0 & \text{otherwise} \end{cases}$$

L_n = cost of length of tour for n th ant and Q =constant.

VI. SIMULATION AND PERFORMANCE ANALYSIS

Performance evaluation is done using different costs and packet delivery ratios then, comparison of results with bandwidth and different packets ratio. In simulation, we take 6 nodes in a network based on various attributes ACO will select best path out of the possible paths based on Route selection parameters(RSP).

Co-ordinates For The Network Starting From (566 , 576)

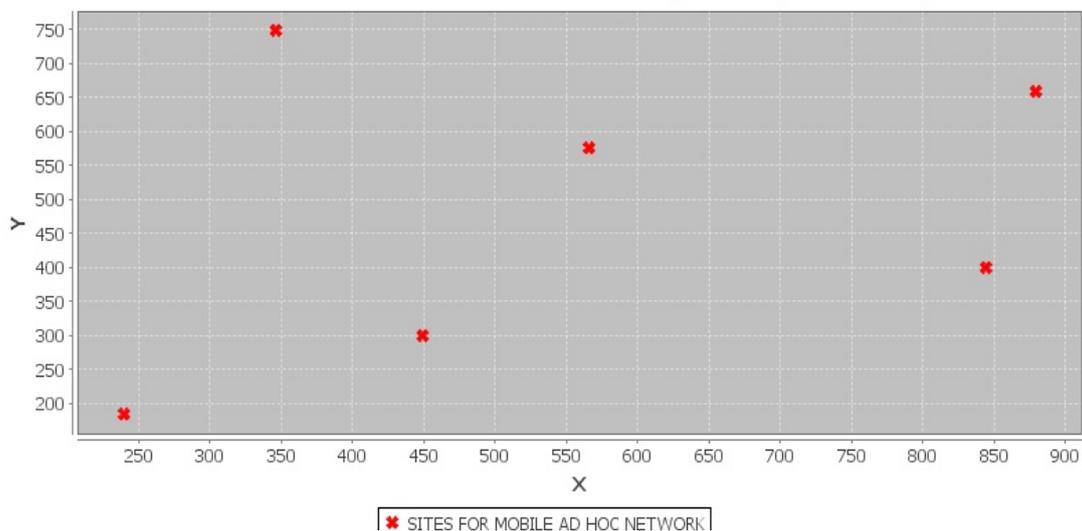


Fig 1: Co-ordinates of the Network

Co-ordinates For The Network Starting From (879.0 , 659.0)

X	Y	Packets Received	Packets originated	Mobility Bandwidth	RSP
879	659	312	310	1.500	6.04
346	749	721	800	1.600	5.77
844	400	550	860	1.200	3.07
449	300	1000	1100	1.000	3.64
240	184	190	300	1.300	3.29
566	576	1000	1890	1.312	2.78
879	659	780	500	1.641	10.24

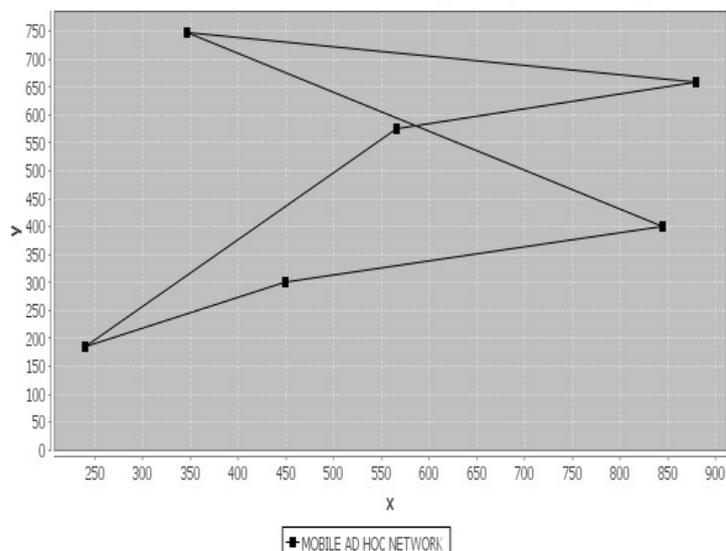


Fig 2: Co-ordinates for the network starting from (879.0, 659.0)

In higher protocols, all network decisions are made based on bandwidth such as TCP and IGRP. This methodology is simple very flexible and find out location and characteristics of MANET with minimum investment and operational cost. Some technical constraints such as the transmission capabilities and limitization of bandwidth are there. Here we are implementing Ant Colony optimization for distribution of packets in a wireless network, there receiving and transmission also, as such ants are free to move anywhere, optimality comes when they cross obstacles and get optimal path where they get optimal path .Packet forwarding ratio changes with the receiving packets at destination and origination from source.

X	Y	Packets Received	Packets originated	Mobility Bandwidth	RSP
346	749	123	310	1.500	2.38
566	576	600	800	1.600	4.80
449	300	421	860	1.200	2.35
844	400	899	1100	1.000	3.27
879	659	234	300	1.300	4.06
240	184	1600	1890	1.312	4.44
346	749	780	500	1.641	10.24

Co-ordinates For The Network Starting From (346.0 , 749.0)

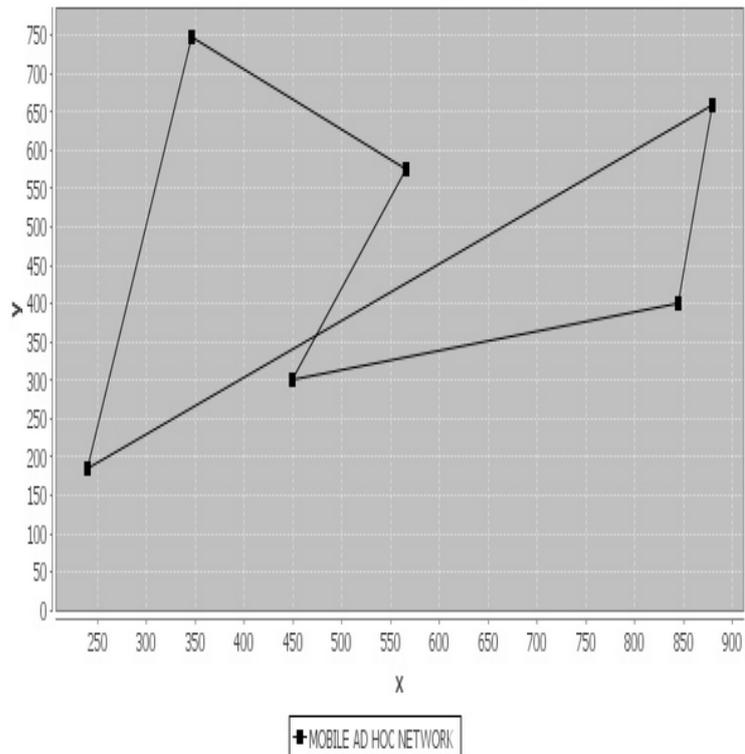


Fig 3: Co-ordinates for the network starting from (346.0, 749.0)

Wireless network have less operational limitations as compared to underground transmission. Distribution is according to the requirements of the customers otherwise it causes blackouts.

VII. QUANTITATIVE METRICS FOR PERFORMANCE EVALUATION

Quantitative metrics used to know the performance of any routing protocol:

- 1) Average Delay: It defines the average time, taken by a packet to travel from source to the destination, measured in seconds (end-to-end delay).
- 2) Throughput: It is the total number of bits forwarded higher layer per sec being measured in bits per seconds.
- 3) Media Access Delay: It is defined as the time taken for starting packet transmission; it is recorded for each packet when it is sent to physical layer for the first time

VIII. CONCLUSIONS AND FUTURE WORK

Now a day's transmission of the data in wireless links without the aid of any fixed infrastructure or centralized administrator is possible in information technology. The wireless mobile ad hoc networks (MANET) are self-creating, self-organizing and self-administrating entities. Therefore a set of self-organized mobile wireless users can dynamically exchange their data among themselves, without any predetermined infrastructure and controller.

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