Various Optimized Techniques comparison & Optimized Cost Function Using QoS Parameters

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Abstract— **In the field of information technology wireless communication is most important part of it. Design of the wireless network can be formulated, by optimizing the objective function with the help of various set of constraints like total cost, data rate enhancement, throughput etc. The biggest challenge is to deal with optimizing problem. This paper focuses on optimizing or minimizing the cost function of the wireless networks by improving the performance of the network i.e. maximizing throughput, minimizing end to end delay, jitter and bit error rate. The goal is to apply such an ACO algorithm that optimizes the cost by improving the performance of the network and the effect of ACO parameters on that optimized cost and the comparison between various optimization techniques.**

Keywords— **ACO, Wireless Network, Quality of Service, throughput, BER, end to end delay, jitter, cost.**

I. INTRODUCTION

In the previous papers various new algorithms are proposed in which multiple constrains are considered to optimize the cost of the wireless network [1]. Communication can be done with the help of mobile nodes (which are large in number) in wireless network. As per the mobile nodes increases complexity/ difficulty also increases.
In the field and computer science, the traffic handling term known as quality of service (QoS) which refers to resource control mechanisms rather than the service quality or network improvement which can be achieved. With the help of Quality of service priority can be assigned to various applications, users, or data flows, or to assure a level of performance to a data flow.
There are many QOS metrics and those metrics are divided into two parts additive and concave in which throughput is the concave metrics i.e. non additive metrics whereas others are the additive metrics. Finding the best path i.e. the shortest path between the sources to destination is a difficult problem and to deal with additive and concave metrics optimization technique is used.
In this paper, we propose an algorithm to optimize the cost using QOS parameters as a set of constraints and effect of ACO parameters on the optimized cost.

II. METHODOLOGY

Ant colony optimization i.e. ACO is the technique which has been implemented for solving various optimization problems with best results as compared to the other. Ants use indirect communication instead of direct communication with the help of solution process known as stigmergy to improve the cost of the network.

Problem Formulation

To formulate an algorithm and objective function, first of all consider a simple network in which nodes and vertices i.e. connection between the nodes are referred as objects. In this simple network, let us consider N be the number of nodes (N1, N2, Nq) and Q be the number of connections. Let Ct is the optimized cost of wireless network. Now how the packet should be reached from source to destination by finding the shortest path using ACO.

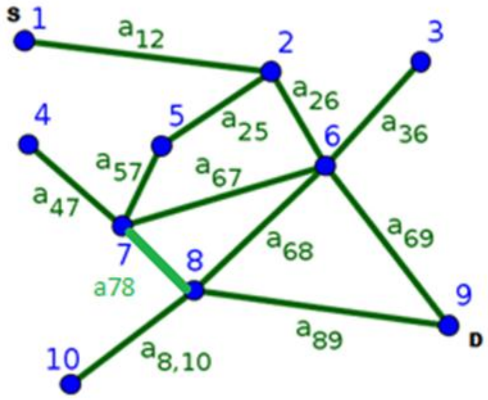

Figure 1. Simple Network consist of nodes and vertices

Ant Colony Optimization

The main source from where this ACO comes is the behavior that is displayed by species of ants in nature but the difficult task is the cooperation between the ants in the colony. To find out the shortest path the volatile chemical i.e. pheromone is used that is secreted by the ants in order to attract the other ants.

With the help of this chemical substance what happens what happens ants start from their nest and move towards their food and laying down pheromone trails while going back towards their nest. If other ants find such a path, then they attracted towards the trail of pheromone and follow that path rather than travelling here and there.

In the Ant Colony Optimization, problems are usually modeled in the form of graph or tree like structure. Let G (E, V) be a graph. Thus the components c34 are denoted by either the edges or the vertices of the graph. The objective is to find a shortest path between the source node and destination node. Each edge of G maintains the value of chemical substance i.e. artificial pheromone concentration over the node and modified whenever an ant travel through it.

Solving Networks using ACO Algorithm

The optimized cost is written as Cpq which can be written in the form of matrix

$$(Cpg)_{a\times b} = \begin{matrix} c10 & c11.......c1b \\ c20 & c21.......c2b \\ . & . \quad\quad . \\ . & . \quad\quad . \\ . & . \quad\quad . \\ Ca0 & ca1.......cab \end{matrix}$$

A network can be defined as:

$$(yij)_{a\times b} = \begin{matrix} y10 & y11.......y1b \\ y20 & y21.......y2b \\ . & . \quad\quad . \\ . & . \quad\quad . \\ . & . \quad\quad . \\ Ya0 & ya1.......yab \end{matrix}$$

where yij is defined as

yij = {1 if node 3 is connected to 4 and so on

0 if node is not connected

Algorithm proposed for optimizing the cost

Algorithm in Pseudo code

- Trail is initialized
- Do While (Criteria of stopping is not Satisfied) – Cycle Loop
- ✓ Do Until (Route is completed by each ant) – route Loop
- ✓ Local Trail Update
- ✓ End Do
- ✓ Analyze Routes
- ✓ Calculate routing metrics
- ✓ Global Trail Update
- ✓ Calculate Throughput, delay and jitter
- ✓ Determine the objective function
- ✓ End Do

Key Parameters

- Trail intensity t56 which indicates the intensity of the pheromone on the trail segment, (56)
- Trail visibility is h56 = 1/d56
- The importance of intensity is given by a
- The importance of visibility is given by b
- The trail persistence or evaporation rate is given as r

Edge Selection

In the ant colony optimization algorithm, an ant is a simple communicating agent who communicates indirectly. It iteratively constructs a solution to any type of problem whereas solution states are given by intermediate solutions and in this algorithm, each iteration ant moves from colony to food in order to complete the intermediate solution. Thus, each ant computes a set of feasible solutions. For ant n, the probability p of moving from one state to another i.e. from state 5 to state 6 depends on the combination of two values, the attractiveness η_{56} of the move, and the trail level τ_{56} of the move.

The nth ant moves from state 5 to state 6 with probability i.e. the probability of moving towards next node is given by

$$p_{56}^{n}=(\tau_{56}^{\alpha}\times\eta_{56}^{\beta})/(\Sigma\, \tau_{56}^{\alpha}\times \eta_{56}^{\beta}) \quad (1)$$

Pheromone update

When all the ants have completed a solution i.e. reach towards their food from nest then the trails are updated by

$$\tau_{56}^{n} = (1-\rho)\, \tau_{56}^{k} + \Delta \tau_{56}^{k} \quad (2)$$

Where τ_{56}^{n} is the amount of pheromone deposited for a state transition 56, ρ is the pheromone evaporation coefficient and $\Delta\tau_{56}^{k}$ is the amount of pheromone deposited.

Objective Function

The network cost D is defined as:

D = sum (C×m1)+ (C×m2) + (C×m3) + (C×m4)

where m1, m2, m3 and m4 are the performance metrics i.e. throughput, delay, jitter and bit error rate

D should be minimum.

III. SIMULATION MODEL

Cost is evaluated using QUALNET 5.0.2 and MATLAB 7.0.

Performance metrics throughput, average end to end delay and average jitter are used to evaluate the cost of the wireless network.

Optimized parameters alpha, beta and rho are considered for finding the minimum cost.

Simulation Parameters

Table1: Beta =5 and rho = 0.65

Alpha	Delay and Jitter	Throughput	Cost
0.2	24.0022	1208	15
0.5	34.0022	1298	133
1	30.0022	1402	355

Table 1 shows that at beta =5 and rho = 0.65 but with increase in alpha cost increases by 70%.

Table2: Alpha =1 and rho = 0.65

Beta	Delay and Jitter	Throughput	Cost
1	40.0022	1422	274
2	44,0022	1446	262
3	44.0022	1268	192

Table 2 shows that at alpha =1 and rho = 0.65 but with increase in beta cost decreases by 70%.

Table3: Beta =5 and alpha = 1

Rho	Delay and Jitter	Throughput	Cost
0.1	30.0022	1904	239
0.2	28.0022	1212	217
0.3	40	1358	78
0.4	30	1198	96

Table 3 shows that at alpha =1 and beta = 5 but with increase in rho cost varies firstly it decreases and then increases by 70%

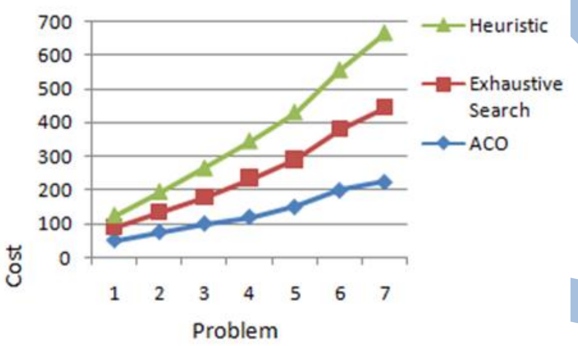

Figure2. Comparison of various optimization techniques

Figure 2 show that ACO gives the best result with respect to the problem i.e. finding the shortest path and the objective function.

IV. CONCLUSION AND FUTURE SCOPE

From the above results it is concluded that wireless network is proposed to optimize three performance metrics i.e. throughput, end to end delay and jitter and determines the optimized cost of the network. Results also show that optimized cost effected by the change of optimized parameters i.e. alpha, beta and rho. The cost will be optimized at alpha = 2, beta= 2 and rho = 0.4. Further it can be implemented using tabu search method and by considering more than three parameters.

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