IMPROVE THE QOS AND POWERLOSS MINIMIZED USING JOHNSON ALGORITHM IN MANET

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Abstract

A mobile ad hoc network (MANET) is a self-organized system comprised by multiple mobile wireless nodes. It is a collection of mobile nodes and is widely used where network establishment is challenging. Wireless ad hoc network makes available multiple paths for data transmission, but it is necessary to choose most efficient path and provide better Quality of Service (QoS). This problem can be solved effectively by using a technique called network reconfiguration. It is useful to reduce the real power loss and to keep the voltage magnitude within the limits. The proposed work is presented by using Johnson's algorithm which is used to calculate the total minimum impedance to reach the destination feeder. The main purpose of the proposed work is to obtain the shortest path, so that the real power loss can be minimized and voltage regulation can be improvement.The radial distribution system and their performance is tested with distribution load flow analysis for comparing the real and reactive power loss before and after network reconfiguration.

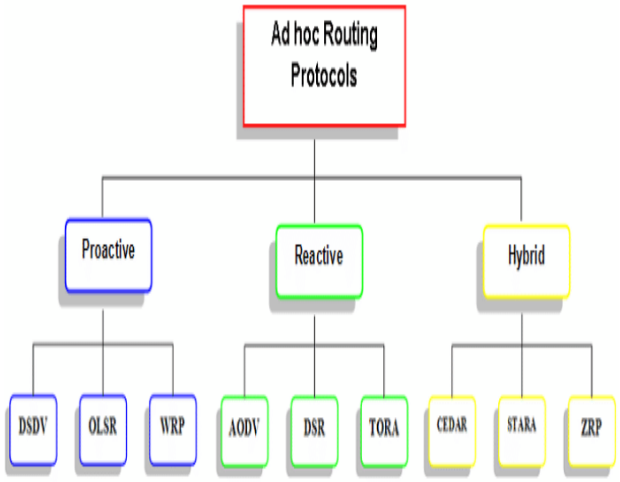
Keywords: MANET, Quality of services, Ant colony optimization, QAMR

I. INTRODUCTION

A network is a link launched among nodes i.e. electronic devices which can be wired or wireless. This connection establishes communication between nodes. In today's life wireless networks has gained popularity over traditional wired connection because it can be deploy anywhere and convenient to use. In wireless networks, it is necessary to set up routes from one host to another to exchange information. Routing is the process of finding an efficient path to forward data from source to destination maintaining Quality of Service. Quality of service is set of pre defined services to fulfill the needs of end users. Now a day's wireless ad hoc network is in demand. Meaning of Ad hoc is "for this purpose only" which implies that this can be implement where construction of network is a challenge.

Mobile Ad Hoc Networks (MANETs) are an emerging class of network with self configuring and dynamic topology properties. It does not hold specific infrastructure to establish connections due to mobile nodes. These nodes can move randomly and simultaneously establish links between source and destination as per requirement. As MANET is an autonomous system it is only suitable for temporary communication links because it has dynamic topology and has no centralized control. So the base stations do not exist in the network topology and each node acts as a host. Due to such properties it is applicable in military operations, disaster relief situations, video conferencing and emergency rescue operations. To perform such operations MANETs have protocols which are classified into three categories: 1) table driven or proactive protocol (DSDV)which maintains up to date information of nodes for fixed interval of time. 2) On demand or reactive routing protocols (ad hoc on demand vector routing protocol) establish routes as per requirement. 3) Hybrid protocols (ZRP) are the combination of reactive and proactive routing protocol.

Proactive protocol	Reactive protocol
Maintain consistent, up-to-date routing information between every pair of nodes	Establish a route to a destination when there is a demand for it
Route updates at fixed intervals	There are no periodic updates
A route to each other node in ad-hoc network is at all times available	Route to all nodes not available all the time



II. RELATED WORKS

Ant Colony Based QoS Routing Algorithm for Mobile Ad Hoc Networks is an on-demand QoS routing algorithm [2] proposed by P.Deepalakshmi. This algorithm is adaptive in nature and reduces the end to end delay in high mobility cases. But the other QoS constraints i.e. other network layer or link layer metrics like energy, jitter, link stability etc. are not considered here. Furthermore, here link failure is not handled properly.

Metrics in Mobile Ad Hoc Networks proposed by R. Asokan [3] and it performs well in route discovery phase with dynamically changing topology and produces better throughput and low delay variance. Again flooding of route request may potentially reach all nodes in the network, so bandwidth wastage increases and efficiency degrades. Besides this, it is a collision and contention prone routing protocol. Thus, packet delivery ratio decreases, congestion increases and throughput also become very poor in case of multimedia. The routing overhead is also increased.

An on-demand routing protocol Ant-E [4] is introduced by Srinivas Sethi which is based on Blocking Expanding Ring Search (Blocking-ERS) to control the overhead and local retransmission to improve the reliability. It resumes its route discovery process to discover a route to the destination node from the place where it ended in the last round following a failure. More energy is consumed because of this routing process.

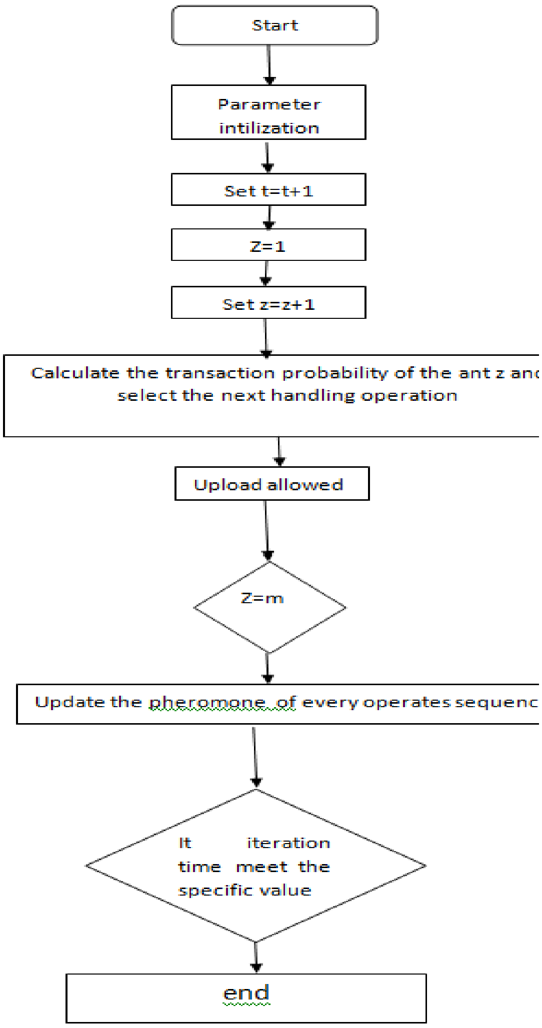
S.Kannan has projected a multi agent ant based routing algorithm for MANET [5]. It is a hybrid algorithm which combines the concepts of multi agents and ant algorithm. This technique increases node connectivity and decreases average end to end delay and increase packet delivery ratio. But complex optimization problems are not considered in algorithm.

B. R. Sujatha has proposed a PBANT algorithm [6] which optimizes the route discovery process by considering the position of the nodes which can be obtained by GPS receiver. But here energy parameter is not taken into account.

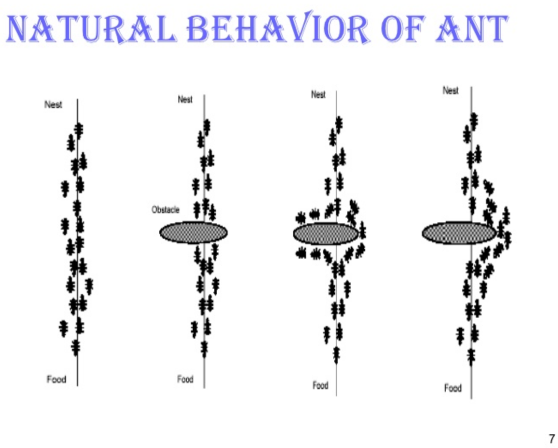
III. ANT COLONY OPTIMIZATION

Ant Colony Optimization (ACO) is subset of swarm intelligence uses the Ant's behavior to find an optimal path successfully in real time. It is inspired by the foraging behavior of real ants, where they are able to find shortest path to food source [7]. When multiple paths are available from nest to food, ants do random walk initially to find out most probable path. While roaming in search of food, ants deposit chemical substances named pheromone to mark the path which is traced by new ants. During return journey ants follow the laid pheromone marks. The ants follow the highest pheromone concentration and fortify it to communicate with each other. Such kind of indirect communication is known as

Stigmergy. Since in mobile ad hoc networks the existence of links are momentary ACO mainly suits for ad hoc networks due to link quality, local work and support for multipath [2]. To select a reliable path from multiple paths algorithm makes use of intelligence of ants. Ant colony optimization algorithm withstands for dynamic topology of network and also supports multipath routing which makes algorithm adaptive.



$$\Delta\tau_{ij}^{k} = \begin{cases} \dfrac{1}{L_k} & \text{if ant } k \text{ used edge } (i,j) \text{ in its tour,} \\ 0 & \text{otherwise,} \end{cases}$$



where Lk is the tour length of the k-th ant.

When constructing the solutions, the ants in AS traverse the construction graph and make a probabilistic decision at each vertex. The transition probability p(cij|spk) of the k-th ant moving from city i to city j is given by:

$$p(c_{ij}|s_k^p) = \begin{cases} \dfrac{\tau_{ij}^{\alpha} \cdot \eta_{ij}^{\beta}}{\sum_{c_{il} \in N(s_k^p)} \tau_{il}^{\alpha} \cdot \eta_{il}^{\beta}} & \text{if } j \in N(s_k^p), \\ 0 & \text{otherwise,} \end{cases}$$

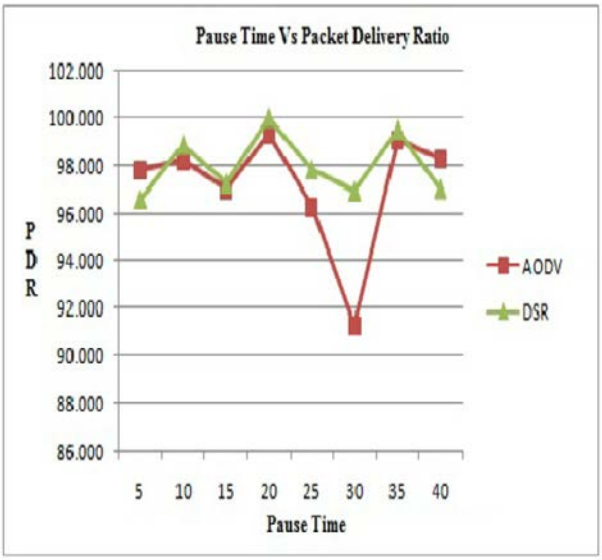
Ant colony system

The first major improvement over the original ant system to be proposed was ant colony system (ACS), introduced by Dorigo and Gambardella (1997). The first important difference between ACS and AS is the form of the decision rule used by the ants during the construction process. Ants in ACS use the so-called pseudorandom proportional rule: the probability for an ant to move from city i to city j depends on a random variable q uniformly distributed over [0,1] , and a parameter q0 ; if q≤q0 , then, among the feasible components, the component that maximizes the product τilηβil is chosen; otherwise, the same equation as in AS is used.

This rather greedy rule, which favors exploitation of the pheromone information, is counterbalanced by the introduction of a diversifying component: the local pheromone update. The local pheromone update is performed by all ants after each construction step. Each ant applies it only to the last edge traversed:

$$\tau_{ij} \leftarrow (1-\rho) \cdot \tau_{ij} + \rho \cdot \Delta\tau_{ij}^{best}$$

where Δτbestij=1/Lbest if the best ant used edge (i,j) in its tour, Δτbestij=0 otherwise (Lbest can be set to either the length of the best tour found in the current iteration -- iteration-best, Lib -- or the best solution found since the start of the algorithm -- best-so-far, Lbs).



PROPOSED ALGORITHM

JOHNSON Alg :

The problem is to find shortest paths between every pair of vertices in a given weighted directed Graph and weights may be negative. We have discussed Floyd Warshall Algorithm for this problem. Time complexity of Floyd Warshall Algorithm is Θ(V3). Using Johnson's algorithm, we can find all pair shortest paths in O(V2log V + VE) time. Johnson's algorithm uses both Dijkstra and Bellman-Ford as subroutines.

If we apply Dijkstra's Single Source shortest path algorithm for every vertex, considering every vertex as source, we can find all pair shortest paths in O(V*VLogV) time. So using Dijkstra's single source shortest path seems to be a better option than Floyd Warshell, but the problem with Dijkstra's algorithm is, it doesn't work for negative weight edge.

The idea of Johnson's algorithm is to re-weight all edges and make them all positive, then apply Dijkstra's algorithm for every vertex.

How to transform a given graph to a graph with all non-negative weight edges?

One may think of a simple approach of finding the minimum weight edge and adding this weight to all edges. Unfortunately, this doesn't work as there may be different number of edges in different paths (See this for an example). If there are multiple paths from a vertex u to v, then all paths must be increased by same amount, so that the shortest path remains the shortest in the transformed graph.

The idea of Johnson's algorithm is to assign a weight to every vertex. Let the weight assigned to vertex u be h[u]. We reweight edges using vertex weights. For example, for an edge (u, v) of weight w(u, v), the new weight becomes w(u, v) + h[u] – h[v]. The great thing about this reweighting is, all set of paths between any two vertices are increased by same amount and all negative weights become non-negative. Consider any path between two vertices s and t, weight of every path is increased by h[s] – h[t], all h[] values of vertices on path from s to t cancel each other.

How do we calculate h[] values? Bellman-Ford algorithm is used for this purpose. Following is the complete algorithm. A new vertex is added to the graph and connected to all existing vertices. The shortest distance values from new vertex to all existing vertices are h[] values.

Algorithm:

1) Let the given graph be G. Add a new vertex s to the graph, add edges from new vertex to all vertices of G. Let the modified graph be G'.

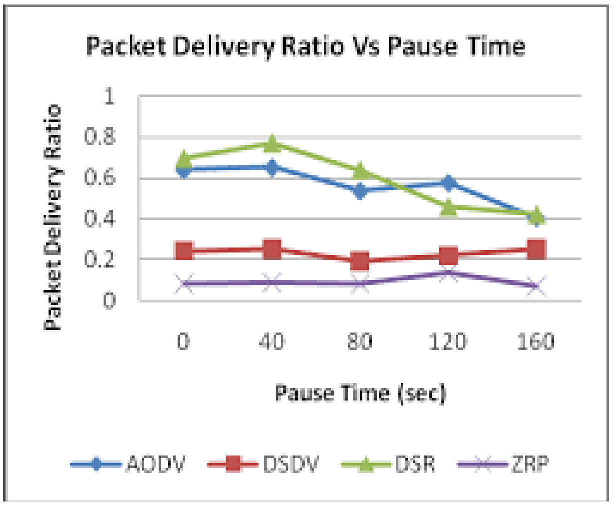
2) Run Bellman-Ford algorithm on G' with s as source. Let the distances calculated by Bellman-Ford be h[0], h[1], .. h[V-1]. If we find a negative weight cycle, then return. Note that the negative weight cycle cannot be created by new vertex s as there is no edge to s. All edges are from s.

3) Reweight the edges of original graph. For each edge (u, v), assign the new weight as "original weight + h[u] – h[v]".

4) Remove the added vertex s and run Dijkstra's algorithm for every vertex.

```
Johnson(G)
   1.
   create G` where G`.V = G.V + {s},
      G`.E = G.E + ((s, u) for u in G.V), and
weight(s, u) = 0 for u in G.V
   2.
   if Bellman-Ford(s) == False
      return "The input graph has a negative
weight cycle"
   else:
      for vertex v in G`.V:
         h(v) = distance(s, v) computed by
Bellman-Ford
      for edge (u, v) in G`.E:
         weight`(u, v) = weight(u, v) + h(u) - h(v)
   3.
      D = new matrix of distances initialized to
infinity
      for vertex u in G.V:
```

run Dijkstra(G, weight`, u) to compute distance`(u, v) for all v in G.V
for each vertex v in G.V:
D_(u, v) = distance`(u, v) + h(v) - h(u)
return D



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