Research Inventy: International Journal Of Engineering And Science
Vol.3, Issue 9 (September 2013), PP 33-36
Issn(e): 2278-4721, Issn(p):2319-6483, Www.Researchinventy.Com

Optimized Ant Routing For Improving Qos In Manets

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ABSTRACT: MANET is a Self-configuring infra-structure less network. It is connected by wireless. One of the major issues in MANET is routing. Routing is the act of moving information across an internet from source to destination. Various characteristics like dynamic topology, limited resource & energy, time varying QoS requirements etc will limit the Performance and Quality. The primary challenge in building MANET is to find the path between communication end points for satisfying user's QoS requirements. In this paper an Optimized Ant Routing (OAR) for improving QoS has been proposed. It introduces a new concept named virtual sub-colony, which is used to search for an sub-optimal for a given QoS requirements in real time. The proposed algorithm will be highly adaptive, efficient & scalable, autonomously resolve network congestion & resist network failures. It can promptly adapt to a changing network status.

Index Terms: MANETS, QoS routing, Ant Colony Optimization

1. INTRODUCTION:

MANET is a collection of mobile systems. It communicates temporarily by means of wireless links. Since the nodes are mobile, the network topology may change rapidly. It is difficult to maintain the routing functionality into mobile nodes. Because any nodes may enter or leave from topology & any node can communicate to other nodes which are within its transmission range. It can change its structure constantly will make the network resources limited. The Fig: 1 is a kind of Self-Organizing network promising for cost & flexibility rather than infrastructure network. But they are limited in energy & bandwidth. Hence it leads to a critical problem such as Routing and Flow-Control. The node mobility and link failures produce constant changes in the network topology.

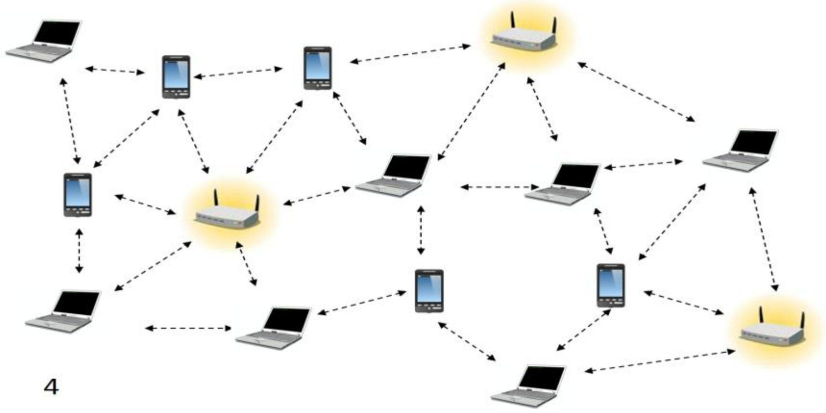

Fig:1 Framework of MANET

In recent years, a large number of routing algorithms have been proposed for MANETS. The role of QoS routing is to compute the paths that are suitable for different type of traffics generated by various applications while maximizing the utilization of new resources. But the problem of finding out the multi-constrained paths has high computational complexity. Hence it is a need to use algorithms to address and solve all these technical issues. The role of QoS routing is to find an optimal path from source to destination, optimize the utilization of network resource and to degrade the computing and performance when congestion & path breaks appear in the network. The path computation algorithm is at the core of QoS routing strategies. Instead of using shortest path algorithm the proposed algorithm is used to select several alternative paths (Multi-path) that are able to solve end-to-end delay bounds and bandwidth requirements. This proposed OAR provides promising capabilities for Self-Organizing QoS network (see Fig: 2) and Self-organizing controls.

PREVIOUS WORKS: The works related to ACO are found in the literature. In [1] the authors used a hybrid routing algorithm for MANETS based on ACO & Zone routing framework of broadcasting. Along with QoS routing protocol the authors [2] combined flow control mechanism, they described Ant system in-order to find the route with higher transmission rate, less latency and better stability. But the QoS issues end-to-end delay, available bandwidth, cost and error rate is not considered. In [3] the authors used a new Ant Colony based routing that uses the information about the location of nodes.

In [4] the authors used a OLSR routing protocol in-order to provide accuracy and stability with optimal path. But [4] authors used only symmetric links for route setup process.

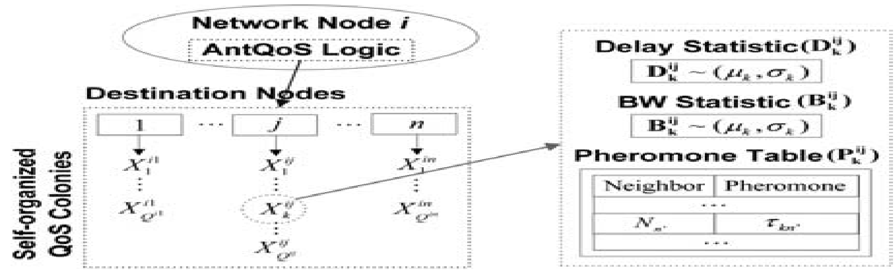

Fig. 2. Self-organizing QoS Framework

PROPOSED ANT FRAMEWORK

An OAR employs an artificial Ant colony on the network. It uses the Ant's behavior to find an optimal path successfully in real time. At regular intervals a number of Ants launch toward randomly chosen destination nodes to discover Self-Organizes virtual Sub-colonies to those nodes and to investigate the network status along the paths. The virtual Sub-colony contains three data structures: i) end-to-end delay statistic, ii) remaining bandwidth status, ii) pheromone table.When multiple paths are available from nest to food, ants do random walk initially. During their trip to food as well as their return trip to nest, ants lay a chemical substance called pheromone, which serves as a route mark even to new ants. The pheromone is a volatile substance. The new ants will prefer a path which has higher pheromone concentration and also reinforce the path they have taken. Because of this autocatalytic effect the solution emerges rapidly.

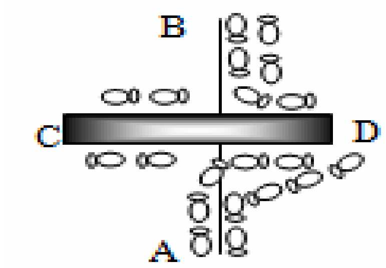

Fig:3 Behavior of Ant's during food search

Let us consider, A is the nest and B is the food source (see fig:3). C and D are obstacles on the way from A to B in which C has longer distance from A than D to A. The ants will thus have to decide which direction they will take either C or D. The first ones will choose a random direction and will deposit pheromone along their way. Those taking the way ADB (BDA) will arrive at the end of the obstacle (depositing more pheromone on their way) before those that take the way ACB (BCA). The following ant's choice is then influenced by the pheromone intensity which stimulates them to choose the path ADB rather than ACB. The ant's will then find the shortest route between their nest and the food source.

MECHANISM OF OA FOR ROUTING: In MANETS the network routing is a critical problem since the network characteristics such as traffic load and network topology may vary rapidly and in a time varying nature. The given network can be represented as a construction graph where the vertices correspond to set of routers and links corresponds to the connectivity among routers in that network. Then an ant algorithm is used to find out a set of minimum cost path between nodes present in the corresponding graph representation.

When an incoming flow arrives at a node, the node chooses the proper colony to guarantee QoS of the flow & forwards packets by referring to the pheromone trails in the colony. Suppose the node N_s transmits a forward ant toward node N_d. The forward ant explores a path and measures the status of all nodes along the explored path.

PROPOSED OA ALGORITHM:

The proposed approach has two phases i) path identification phase , ii) maintenance phase.

A. PATH IDENTIFICATION PHASE

1. Let the source node i has to send a data to destination j with QoS requirements such as less delay D, more bandwidth B, Hop-count H, and higher transmission rate. The list of nodes that are visited by ant is called visited nodes list, now the route R forms the link from i to j.
2. The node i send a Hello-ant message and it is broadcasted in the network. The neighbor node will react by replying a Hello-ack-ant. Immediately the initial pheromone is entered into a neighbor node table and it is deposited on the link.
3. The node i initiates a request-ant to node j through all its neighbors which contains source address, destination address, hop-count and available bandwidth.
4. While travelling to node j the request-ant will collects the transmission delay of each link, processing delay at each node, available capacity of each link and number of hops visited.
5. When the request-ant reaches to node j, it will be converted as reply-ant and forwarded towards to original source.
6. After the quantity of pheromone of all the I-Hop distance nodes will be calculated. The pheromone on each link
   (Vi, Vj) is initialized to constant C.
7. Then calculate the pheromone for all the 2-Hop distance nodes.
8. At last the path preference probability value of each path from node I with
   every node can be calculated.
9. If calculated path preference probability value is better than the
   requirements, the path is accepted and stored in memory.
10. The path with higher path preference probability will be considered as the best optimal path and data transmission can be started along that path.

B. MAINTENANCE PHASE

When the data transmission is going on the load on the selected path may increase which cause more delay and less available bandwidth. Nodes might have moved will cause link failures also. So the path preference probability will automatically decrease. Hence alternate routes can be used which are found during path identification phase. The alternate routes must be checked periodically for their validity even they are not currently used.

MANAGEMENT OF OPTIMAL PATH:

Let us assume the measured information to be {(Ik, dk, bk), k=0,1,2…,n} where I_k is the k-th intermediate node(I_0=Ni,I_n=Nj) along the explored path, dk is the arrival time at Ik and bk is the remaining bandwidth of Ik . The delay time is dij = dj – di , bandwidth bij=min{bl, l= i,…,j}.The optimal path can be taken by comparing all the possible bandwidth of nodes along the path from Ii to Ij. The information in the forward ant moves backward ant to an ant at In, in turn moves backward to I_0. The path which gives minimum bandwidth is to be selected as an optimal path. If Ii successfully selects N_*^{ij} then Ii updates D_*^{ij}, B_*^{ij} in N_*^{ij} using the exponential models and also updates the pheromone trails x_{*n}’ (Nn’ is a neighbor of Ii explored by the forward ant and Nn’=Ii+1). At regular interval all pheromone trails globally experience the pheromone evaporation process. It gives the criteria for deletion of unused QoS colonies.

From a node I to an arbitrary node j the metrics delay and bandwidth can be calculated as :

Delay (path (i,j)) = $\sum_{e \in p(i,j)} delay(e) + \sum_{n \in p(i,j)} delay(n)$ -------- (1)

Bandwidth (path (i,j))= min{bandwidth(e)} ------- (2)

Hop-count (path (i,j)=Number of nodes in the path ------- (3)

Where **e** denotes the set of bi-directional links , delay(n) denotes the processing delay at the node n. The hop-count is considered as an important metric because multiple hops are involved to transmit data from one place to another place in MANET. So it is desirable to find paths with minimum hops. An initial pheromone amount is 0.1 to be deposited on that link as soon as it establishes the connection between two nodes i and j. The amount of pheromone on the path (i,j) is represented as

$$X_{ij} = X_{ij} + \Delta X_{ij} \qquad \text{------- (4)}$$

Where ΔX_{ij} is the quantity of pheromone.

If there is no data toward a neighbor node its corresponding pheromone value decays by a factor q as follows:

$$X_{ij} = \begin{cases} (1-q) \cdot Xij & \text{, if } (1-q)\ Xij > 0.1 \\ 1 & \text{, if } (1-q)\ Xij \geq 0.1 \\ 1.5 & \text{Otherwise} \end{cases} \qquad \text{-------- (5)}$$

When node I lose its connectivity to its neighbors j then the pheromone on the link i to j will be set to 0. The path preference probability is calculated in both intermediate nodes as well as source nodes upon receipt of ant. The relative metrics are calculated using (1), (2) and (3) as follows ,when the next hop on the path from i to d is j:

$$D_{ijd} = \frac{1}{delay\ (path\ (i,d))} \qquad \text{--------- (6)}$$

$$H_{ijd} = \frac{1}{hopcount\ (path\ (i,d))} \qquad \text{--------- (7)}$$

$$B_{ijd} = \text{bandwidth (path (i, d))} \qquad \text{-------- (8)}$$

After finding the path preference through various neighbors, the source as well as intermediate nodes have multiple paths to destination. The path which has higher preference probability will be selected for data transmission.

$$p_{ij} = \frac{(X_{i,j})^{\alpha} \cdot (V_{i,j})^{B}}{\sum_{(i,k) \varepsilon C} (X_{i,k})^{\alpha} \cdot (V_{i,k})^{B}} \qquad \text{--------- (9)}$$

Where,

X_{ij} :- pheromone intensity on path(i,j)

V_{ij} :- ant's visibility field on path(i,j)

C :- represents the set of possible paths starting from point i

α,β :- parameters which control the relative importance of the pheromone intensity compared to ant's visibility field

CONCLUSIONS: This proposal is based on ant's-like mobile agents to establish multiple stable paths between source to destination nodes. The proposed OAR can effectively fine the globally best and optimal solution in terms of routing for given MANET. It is efficient, scalable, autonomously resolve network congestion and resist network failures. It is highly adaptive and achieves higher bandwidth, shorter delay, and shortest optimal route in terms of hop-count and pheromone.

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