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REVIEW ARTICLE

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A Review Paper on Ant Based Routing Protocol in MANET

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Abstract: Mobile ad hoc network (MANET) is a group of mobile nodes which communicates with each other without any supporting infrastructure. Routing in MANET is extremely challenging because of MANETs dynamic features, its limited bandwidth and power energy. MANET nodes operating on battery try to pursue the energy efficiency heuristically by reducing the energy they consumed. This paper reviews some on-demand routing algorithm for mobile, multi-hop ad-hoc networks. The algorithms are based on swarm intelligence and especially on the ant colony based meta heuristic. Two major ACO based algorithms, ARA and ABIRP are compared on packet delivery ratio.

Keywords: Mobile ad hoc network (MANET), Global System for Mobile Communication, Ant Colony Optimization (ACO).

I. INTRODUCTION

Mobile Ad hoc NETwork (MANET) is a growing field of research with development of various wireless communication protocols like Bluetooth and Wi-Fi. MANET is a mobile network which is capable of performing autonomous operation. Base station infrastructure is not required for operation of MANET unlike traditional mobile networks like GSM. Nodes in a MANET cooperate with each other to provide network connectivity and various services. The whole system operates without a central system administrator. Thus the limitation of controlling everything from a single point is removed and computational ability of network is enhanced.

To implement MANET on a particular location a routing protocol is required so that the nodes can communicate with each other efficiently. Several routing protocols have been implemented that best suit the distributed system in an unreliable environment and the dynamic topology of the network. Some of the MANET routing protocols are: Ad-hoc On-demand Distance Vector (AODV) Routing, Optimized Link State Routing (OLSR), Dynamic Source Routing (DSR), and Topology Broadcast based on Reverse Path Forwarding (TBRPF).

Swarm intelligence, particularly studied in ants have inspired a number of methods and techniques among which the most studied and the most successful is the general purpose optimization technique known as ant colony optimization. Ant colony optimization (ACO) takes inspiration from the foraging behavior of some ant species. These ants deposit pheromone on the ground in order to mark some favorable path that should be followed by other members of the colony. Ant colony optimization exploits a similar mechanism for solving optimization problems.

The simple ant algorithm could perform well in mobile multi-hop ad-hoc networks. The properties of ant based algorithm which make them suitable for MANET routing are:

a. Dynamic topology
b. Local work
c. Link quality
d. Support for multi-path

II. LITERATURE REVIEW

There are several routing algorithms for MANET that is based on ACO. Some major ones are studied and reviewed here.

Ant-Based Control (ABC) is an algorithm proposed by Schoonderwoerd et al. [1] for load balancing in circuit switched networks. In ABC, the calls are routed using probabilistic routing tables that consist of next hop probabilities for each destination. The link costs are assumed to be symmetric and hence, only one-directional mobile agents are used for updating and maintaining the routing tables. The mobile agents use heuristics based on the routing tables to move across the network between arbitrary pairs of nodes. At each node along the path, the mobile agents update the routing tables based on their distance from the source node and the current state of the routing table.

Ad hoc Networking with Swarm Intelligence (ANSI) is a reactive routing protocol proposed by Rajagopalan and Shen [2] for mobile ad hoc networks. ANSI protocol uses two sets of mobile agents called forward reactive ants and backward reactive ants. The routing tables in ANSI contain an entry for each reachable node and next best hop while the ant decision tables store the pheromone values. In ANSI, the forward reactive ants are generated only when a node needs to transmit data to another node. The forward reactive ants are broadcast while the backward reactive ants retrace the path of forward reactive ants and update the pheromone values at the nodes. The data packets choose the next hop deterministically i.e., the hop which contains the largest pheromone value is chosen as the next hop.

Ant-AODV technique proposed by Shivanajay Marwaha, et al [3] forms a hybrid of both ant-based routing and AODV routing protocols to overcome some of their inherent drawbacks. The hybrid technique enhances the node connectivity and decreases the end-to-end delay and route discovery latency. Ant-AODV ant agents work independently and provide routes to the nodes. The nodes also have the capability of launching on-demand route discovery to find routes to destinations for which they do not have a fresh enough route entry. The use of ants with AODV increases the node connectivity (the number of destinations for which a node has unexpired routes), which in turn reduces the amount of route discoveries even if a node launches a RREQ (for a destination it does not have a fresh enough route), the probability of its receiving replies quickly (as compared to AODV) from nearby nodes is high due to the increased connectivity of all the nodes resulting in reduced route discovery latency. As ant agents update the routes continuously, a source node can switch from a longer (and stale) route to a newer and shorter route provided by the ants. This leads to a considerable decrease in the average end-to-end delay as compared to both AODV and ants-based routing. Ant-AODV uses route error messages (RERR) to inform upstream nodes of a local link failure similar to AODV.

Ant routing algorithm for mobile ad hoc networks (ARAMA), [4] is a proactive routing algorithm proposed by O. Hossein and T. Saadawi. The main task of the forward ant as in other ACO algorithms for MANETs is to collect path information. However, in ARAMA, the forward ant takes into account not only the hop count factor, as most protocols do, but also the links local heuristic along the route such as the node's battery power and queue delay. ARAMA defines a value called grade. This value is calculated by each backward ant, which is a function of the path information stored in the forward ant. At each node, the backward ant updates the pheromone amount of the node's routing table, using the grade value. The protocol uses the same grade to update pheromone value of all links. The authors claim that the route discovery and maintenance overheads are reduced by controlling the forward ant's generation rate. However, they do not clarify how to control the generation rate in a dynamic environment.

Ant-Colony-Based Routing Algorithm (ARA) is a reactive routing protocol proposed by Gu··nes_ and Spaniol [5] for mobile ad hoc networks. The routing table entries in ARA contain pheromone values for choosing a neighbor as the next hop for each destination. The pheromone values in the routing tables decay with time and the nodes enter a sleep mode if the pheromone in the routing table has reached a lower threshold. Route discovery in ARA is performed by a set of two mobile agents- forward ants and backward ants. During route discovery, the forward and backward ant packets having unique sequence numbers, to prevent duplicate packets, are flooded through the network by the source and destination nodes, respectively. The forward and backward ants update the pheromone tables at the nodes along the path for the source and destination nodes respectively. Once the route discovery for a particular destination has been performed, the source node does not generate new mobile agents for the destination instead the route maintenance is performed by the data packets.

Ant Based Intelligent Routing Protocol (ABIRP) [6] is based on ACO and is proposed by D. Karthikeyan and M. Dharmalingam. SPAN elect a Coordinator node, and let it coordinate the communication on behalf of its neighboring as non-coordinator nodes. Now, non coordinator nodes can safely sleep most of time saving battery energy. Each non-coordinator node periodically wakes up and communicates with the coordinator node to find out if it has data to receive. In a multi-hop MANET, more than one coordinator node would be required because a single Coordinator cannot cover the entire MANET, So multiple coordinators are elected. The packets used in the network can be divided into two classes like data packets and control packets. Data packets represent the information that the end-users exchange with each other. In ant-routing, data packets use the information stored at routing tables for travelling from the source to the destination node. Control packets like forward ant (FANT) and a backward ant (BANT) are used to update the routing tables and distribute information about the traffic load in the network. The ABIRP algorithm improves the Energy efficiency, robustness and reliability. The efficiency of ABIRP is shown to better than other demand routing protocols AODV .The ABIRP routing protocol uses a optimal path routing and fast route discovery. The established paths provide reliable, shorter and faster communication.

III. COMPARISON AND DISCUSSION

ARA and ABIRP protocols are compared with respect to packet delivery ratio and the results are discussed below.

$$PDR = \frac{\sum \text{number of packets received}}{\sum \text{number of packets send by source}} \text{ x } 100$$

This performance evaluation parameter measures effectiveness, reliability and efficiency of a protocol. PDR of both the routing protocols are compared with AODV.

The graph below shows the PDR with respect to arrival time delay for ARA simulation.

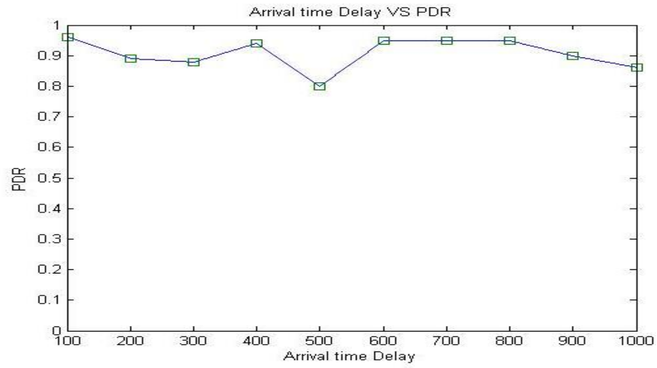

Figure: 1 The graph remains more or less constant with very less variation.

The graph below shows the PDR with respect to arrival time delay for ABIRP simulation.

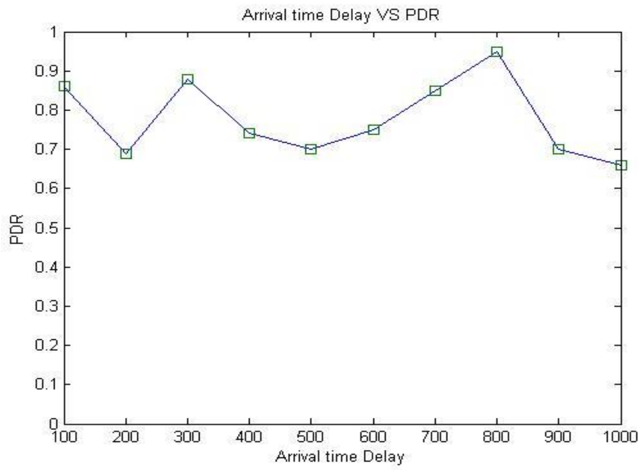

Figure: 2 The variation in PDR with respect to arrival time delay is significant.

The following figure compares the PDR variation with respect to arrival time delay for ARA and ABIRP algorithms.

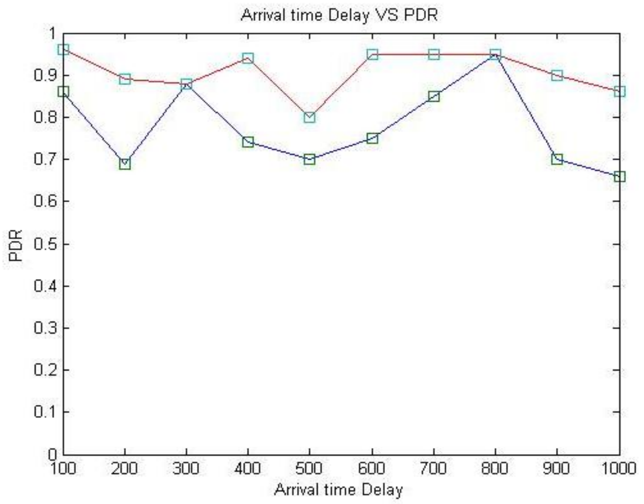

Figure: 3

The line shown is red represents ARA algorithm while the line shown in blue represents ABIRP algorithm. It can be noticed that the variation in PDR with respect to arrival time delay is less for ARA than ABIRP. Further for specific delay values PDR for ARA is always higher than that for ABIRP. Thus it can be concluded that ARA is more efficient than ABIRP in terms of packet delivery.

IV. CONCLUSION AND FUTURE WORK

ARA and ABIRP are both proactive ACO based routing algorithms for MANET. ARA is based on pheromone value which when falls below threshold causes the node to sleep thus conserving energy. In ABIRP a coordinator node is chosen from among neighbor nodes which remain awake while the neighbors sleep. Each node awakes on-demand thus conserving energy. ARA is seen to be more efficient than ABIRP in terms of packet delivery.

In both the algorithms however there is a variation in PDR (variation is more in ABIRP than ARA). Variation in PDA need to be reduced which remains area of future work. The efficiency of these algorithms needs to be tested in high load network conditions.

V. REFERENCES

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