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Comparative Study of ANT Based Routing Algorithms in MANETs

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Abstract: The concerns of the MANET environment and the nature of the cellular nodes create additional problems which outcome within the need to advance exact routing algorithms to satisfy these challenges. Swarm intelligence, a bio-prompted method, which has established to be very adaptable in other difficulty domains, has been applied to the MANET routing challenge as it types a excellent fit to the crisis. On this paper, we've got studied Ant Colony established routing algorithms i.e. Two widespread Ant founded algorithms, AntHocNet and the Ant Routing Algorithm(ARA). An intensive evaluation of ARA is implemented established onthe effect of its character routing mechanisms on its routing efficacy. The customary ARA algorithm, even though finds the shortest path between source and destination, is observed to no longer be aggressive in opposition to different MANET algorithms reminiscent of AODV in efficiency criteria.

Keywords-Ant Colony Optimization, Ant Colony, Routing, ARA.

I. INTRODUCTION

A mobile adhoc network (MANET) is a set of mobile nodes which communicate over radio and do not need any infrastructure. This kind of networks are very flexible and suitable for several situations and applications, thus they allow the establishing of temporary communication without pre installed infrastructure. Due to the limited transmission range of wireless interfaces, the communication traffic has to be relayed over several intermediate nodes to enable the communication between two nodes. Therefore, these kinds of networks are also called mobile multi-hop ad-hoc networks. Nodes not only have to fulfill the functionality of hosts, but each node has also to serve as a router, forwarding packets for other nodes. One of the interesting applications for mobile ad-hoc networks is the deployment of mobile ad-hoc networks for multimedia applications. However, the performance of such networks has to be improved before this can be realized.

The main problem in mobile ad-hoc networks so far is in the finding of a route between the communication end-points, which is aggravated through the node mobility. In today's fast growing internet traffic conditions, changes and failures occur at some parts of the network from time to time, in an unpredictable manner. Therefore, there is a need of an algorithm to manage traffic flows and deliver packets from the source to the destination in a realistic time. An ideal routing algorithm should be node and link independent, and be able to deliver packets to their destination with the minimum amount of delay, regardless of the network size and the traffic load. The routing algorithms currently in use lack intelligence, and need human assistance and interpretation in order to adapt themselves to failures and changes.

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. RELATED WORKS

Because so many routing protocols have been proposed for MANETs, it is impossible to cover all of them in this review. Therefore, this paper presents typical protocols selected from the class of similar approaches that can reflect the state-of-the-art of research work on MANET routing. Table.1 lists advantages and disadvantages of the protocols reviewed in this paper

Routing in MANET using ANT:

Routing protocols are classified into reactive [5, 6, 7],
proactive [8, 9] and hybrid [10, 19] algorithms. Reactive protocol is also known as on-demand routing protocols,reactive routing protocols have been proposed with an aim to reduce the overhead caused by flooding of control packets This is achieved by maintaining routing information only for
the active routes, rather than maintaining all the routes periodically. Therefore, route discovery is initiated 'ondemand' when required. This protocol consists of two phases:(i) route discovery and (ii) route maintenance. In proactiverouting protocols, each node attempts to maintain a consistent view of the network, which is done by periodically broadcasting its routing information to every other node within its neighborhood. They are classified into two, which are (i) link state routing and (ii) distance vector routing. In proactive algorithms each node broadcasts control information(called HELLO packets) about route information, that it has,to other nodes periodically, and the nodes which receive that
information update their routing tables. Hybrid routing protocols were introduced with an aim to combine the advantages of proactive and reactive routing protocols. In hybrid protocols, the network is partitioned into zones.

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Ad hoc routing protocols	Advantages	Disadvantages
Destination sequence, Distance vector routing protocol (DSDV)	Loop free, simple, computationally efficient	Excessive communication overhead, low convergence, tendency to create routing loops in large networks
Wireless routing protocol (WRP)	Loop free, lower WTC than DSDV	Does not allow nodes to enter sleep mode
Fisheye state routing (FSR)	Reduces the size of update messages generated in GSR in large networks	Nodes may not have the best route to a distant destination
Ad hoc on demand distance vector routing protocol (AODV)	Adaptable to highly dynamic topologies, multicast routing capabilities	Requires HELLO messages, does not support multiple routes, intermediate nodes need to store routing information, may not scale well with network size
Dynamic source routing (DSR)	Intermediate nodes do not store route information, can provide multiple path	Stale caches and relay storm problems may arise in large and highly mobile MANETs, additional communication overhead due to source routing
Temporally ordered routing algorithm (TORA)	Localized route maintenance	Can falsely detect partitions, requires reliable and in-order delivery of route control packets, temporary routing loops

III. PROPOSED WORK

The Ant Algorithm:

In ACO, artificial ants build a solution to a combinatorial optimization problem by traversing a fully connected construction graph, defined as follows. First, each instantiated decision variable Xi
= vji is called a solution component and denoted by cij. The solution is constructed by incrementally

choosing the components from the Graph G(V, E). As mentioned before, the components can be associated with either the vertices or the edges of the graph. Each component has a pheromone value associated with itτij. The ants move through the graph and at each node probabilistically choosing the next component to add to thesolution determined by the pheromone value of the components. The ant also deposits an amount of pheromoneon the component depending on the quality of solution found.The ACO algorithm as described by [2-4] is shown in Algorithm 1.

Algorithm 1 ACO Meta heuristic
Require: parameters
1: while Iterations not complete do
2: Construct Solutions;
3: Update Pheromones;
4: Daemon Actions; {optional}
5: end while

Construct Solutions, chooses a subset of the set of components C. The solution begins with an empty partial solution sp = ϑ and then at each construction step a feasible component is added to sp. Daemon Actions are usually used to perform centralized actions that cannot be performed by asingle ant and that may be problem specific. Update Pheromones serves two tasks: To increase the pheromonevalues of the components which are good, and to decrease the pheromone values of the components which are bad. The pheromone decrease is achieved through evaporation. Many different algorithms have been proposed with different pheromone update equations.

In this paper, we have described one of the popular Ant Colony algorithm i.e. Ant Routing Algorithm (ARA).

The ARA Algorithm

ARA is a purely reactive MANET routing algorithm. It does not use any HELLO packets [15] to explicitly find its neighbors.

Routing Mechanisms: When a packet arrives at a node, the node checks to see ifrouting information is available for destination d in its routing table. In ARA the route discovery is done either by the FANT
(forward ant) flood technique [2] or FANT forward technique[12]. In the FANT flooding scheme, when a FANT arrives toany intermediate node, the FANT is flooded to all its neighbors. If found, it forwards the packet over that node, if not, it broadcasts a forward ant (FANT) to find a path to the destination. By introducing a maximum hop count on the FANT, flooding can be reduced. In the FANT forwarding scheme, when a FANT reaches an intermediate node, the node checks its routing table to see whether it has a route to the destination over any of its neighbors. If such a neighbor is found, the FANT is forwarded to only that neighbor; else, it is flooded to all its neighbors as in the flood scheme. In ARA, aroute is indicated by a positive pheromone value in the node's pheromone table over any of its neighbors to the FANT destination. When the ant reaches the destination it is sent

back along the path it came, as a backward ant. All the ants that reach the destination are sent back along their path. Nodes modify their routing table information when a backward ant is seen according to number of hops the ant has taken. When aroute is found the packet is forwarded over the next hopstochastically according to equation 2.3. The results for the route discovery mechanism reveal an interesting trend. The FANT forwarding technique does better in situation of high mobility, that is, in situations having a lower pause time.

However in cases of lower mobility, the FANT flood
technique does better in the metrics of packet delivery ratio,throughput, delay and jitter. One more thing is being observed that in lower mobility situations, the FANT flood technique causes a lot of overhead, and increases the time required to find a route to the destination.

Route Maintenance: In ARA the route is maintained through the adjustment of pheromone values of the links present in the node routing tables. Whenever a particular link is selected as the next hop, the pheromone value of that link for the destination of that packet is incremented by a constant value in the routing table. Pheromone values also made to constantly decrease. The authors of[12] studied and classified the various pheromone update functions used in ant algorithms.

Route Error Correction: In order to ensure delivery of the packet, the algorithm may need to correct the link if it fails due to mobility of nodes. In general, two mechanisms are widely used for route error correction: local route repair [12], and route error back propagation [11]. In local route repair, if a link at a particular node fails, the algorithm buffers the packet and sends out anew FANT to discover a route to the destination. Once a route is found, the packet is forwarded over that route. In the route error back-propagation mechanism, if a link error occurs at anode and another route to the destination does not exist at that node, a ROUTE-ERROR packet is sent to the previous node inthe forwarding chain. This is repeated until the ROUTE ERROR packet reaches the source and then a route discovery process is initiated. The route correction mechanism used in this case is the error back-propagation algorithm and for route maintenance the discrete pheromone decay equation is used.

Proposed modifications to ARA:

ARA and AODV are compared by the author in [18] and ARAis found better than AODV. Since ARA is a reactive protocol,that is why it is used in such situations where mobility of nodes are higher. In this section, we have proposed the modifications to the algorithm by which the potential of ARA will increase in high mobility scenarios. Pheromone updates play a critical role in the performance of the ant algorithm. In ARA algorithm, initial pheromone value is computed by number hops during the route discovery. This method may notbe suitable when nodes are mobile. Pheromone equations are classified in different categories. Two of them are the Classic pheromone filter, where route quality is not taken into consideration, for example the original ARA pheromone equation, and the Gamma pheromone filter, which takes time and route quality into consideration

IV. CONCLUSION

Early research revealed their ability to detect shortest paths in static environments, whereas recent research discovered fundamental mechanisms in the foraging systems for the dynamic systems as well.The main objective of this paper was to develop an algorithm which works well under certain constrained conditions. The proposed routing algorithm design in this paper is a step forward towards that goal. Through the simulations routing mechanism is being analyzed and it has been found that the proposed technique is working well in high mobility scenarios. The ARA algorithm is modified and it is observed, through various simulation based experiments, that modified ARA performed better in comparison to the original ARA in terms of varying mobility.

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