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Mobility in Routing Protocol in MANETS using ACO

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Abstract: This paper presents an algorithm for mobility in routing protocol along with an Ant Colony Optimization (ACO) to solve path finding problem and reduce packet losses in mobile ad hoc networks (MANETs). The algorithm can be applied to any Reactive protocols Such as DSR and AODV. Here ant communication behaviour is the inspiration for solving computational problems which can be reduced to find a good path, and the mobility assisted routing applied over reactive protocol to estimate the number of packet which can traverse before the link failure, by calculating its link life time which in-turn gives route life time. This algorithm reduces the path finding problem, increases packet delivery ratio and throughput.

Keywords: ACO, Link life time, packet loss, route life time, mobility, link failure, MANET.

I. INTRODUCTION

A MANET is an autonomous collection of mobile users that communicate over relatively bandwidth constrained wireless links. MANETs sport highly dynamic topology, Fragile, low-capacity links, no dedicated infrastructure components and with presence of dynamic and adaptive routing protocols enables MANETs to be formed quickly. As result it is more focused on issues like Availability, wireless channel access and multihop routing, ignoring the most important issues includes packet loss, throughput, path discovery in protocols.

Since the topology of MANET is dynamic, connectivity among nodes may vary with the movements of nodes and the with time node departures. MANETs have several advantages compared to any other network, but pose many challenges includes mobility of node, route discovery, link failure, packet loss and many other, as per our paper we concentrate only on the packet loss, throughput, route discovery using ACO, and measuring the link life time which determines the route life time.

In this paper we consider the impact of mobility on the link and route lifetimes in ad hoc network, till now there no real-life measurements were used to study the effect of node mobility on the link and route lifetime. We develop a statistical framework about the routing protocol and route discovery in the mobility assisted routing as it clearly explained in fig 2 and fig 3, which is carried with ACO algorithm and Mobility algorithm includes few steps to calculate link lifetime and determination of route lifetime, algorithm for controlling packet loss, Finally[4] Evaluation of algorithm, which come with the increase in throughput and packet delivery ratio.

II. DESCRIPTION OF ACO

Ant Colony Optimization algorithm inspired by one aspect of ant behavior, the ability to find the shortest path, the most successful algorithm technique based on ant behavior. ACO algorithms as the potentiality of using artificial pheromone and artificial ants to drive the search of always better solutions for complex optimization problems. In ACO once all ants have computed their tour, ACO
updates the pheromone trail using all the solutions produced by the ant colony. The pheromone trails allow the ants to find their way to the food source. The same pheromone trails can be used by other ants to find the location of the food sources discovered by their mates. At the end of this phase the
Pheromone of the entire system evaporates and the process of construction and update is iterated.
ACO mechanism is more effective since it avoids long convergence time by directly concentrate the search in a neighbourhood of the best tour found up to the current iteration of the algorithm.

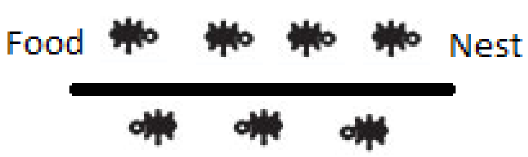

Fig 1 Ants in pheromone trail between nest and food

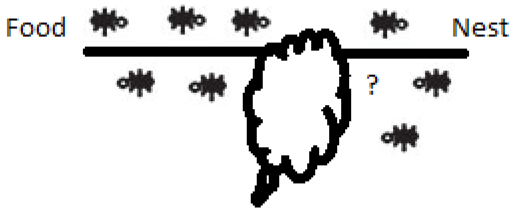

Fig 2 An obstacle interrupts the trail

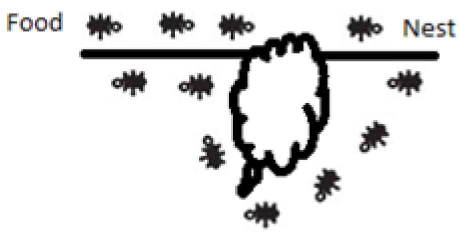

Fig 3 Ants finds two path to go around the obstacles

Fig 4 A new pheromone trail is formed along the shorter path

Fig 1 shows the ants moving in pheromone trail between nest and food leaving pheromone of its own at each node in path, which is done vice verse on reverse process. In Fig 2 an obstacle interrupts the trail which led ant in searching new path towards food. Fig 3 ants find two paths to go around the obstacle leaving pheromone in which one is shortest, Finally Fig 4 shows a new pheromone trail is formed along the shorter path and all transmission is done through that path thereafter. Each node updates its routing tables and used to select next hops according to the weighted probability.

III. INTEGRATION OF ACO WITH MOBILITY SCHEME

Mobility of nodes is the factor effecting the connectivity between the two node which is unlimited if it static ad hoc network and changes with increase in mobility. Hence link failure is inevitable if increase in mobility and its difficult to find the route to destination. In order to control this link failure and path finding issue we need to integrate ACO along with Mobility in routing protocol which should be independent of effective solution .We can apply this on any Reactive protocols (ex: DSR or AODV) . Here the duration of link between two nodes is considered as the link life time(LLT) and is used to find the route life time(RLT) of the link between source to destination. Upton determining the RLT we apply ACO technique to the route which are active and valid for transmission, which in turn gives the shortest and best path to reach the destination.

A. *Calculation of Link Life Time—*

Link exists between two nodes if they are within communication range of each other. In this paper, we calculate LLT and presented briefly for clarity. Figure 5 shows the two mobile nodes A and B with radio range of *r*. The present location of nodes A and B are A(Xa1,Ya1) and B(Xb1, Yb1), respectively. And these nodes are moving with velocities Va and Vb, and angles Ɵa and Ɵb respectively. As nodes are mobile the future locations are A(Xa2,Ya2) and B(Xb2, Yb2) after some duration, *t*.

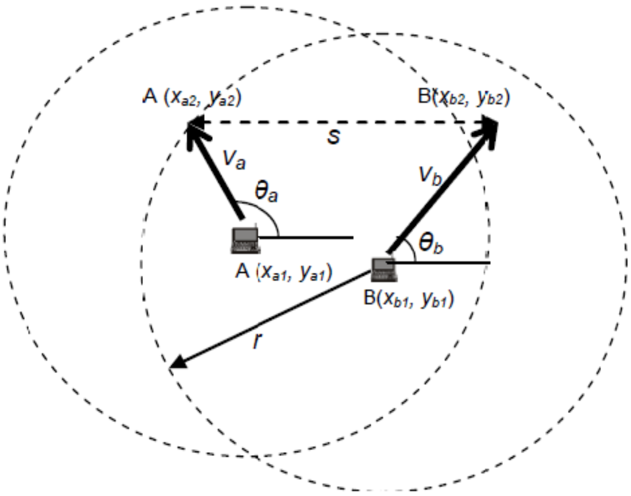

Figure 5. A scenario for calculating LLT.

The future location is calculated using all the information related to their current location, by following two functions.

$$A(xa2,ya2) = f\,(t, va, \theta a, xa1,ya1). \quad (1)$$
$$B(xb2,yb2) = f\,(t, vb, \theta b, xb1,yb1). \quad (2)$$

If the distance between A and B after time t is s then

$$s2 = (xa2 - xb2)2 + (ya2 - yb2)2. \quad (3)$$

A and B will be able to communicate with each other as long as they will remain within their transmission range, r. So, t = LLT if $s \le r$. After solving (3) with $s \le r$ and considering t = LLT, we get

$$\mathrm{LLT} = \frac{-(ab+cd)+\sqrt{(a^2+c^2)r^2-(ad-bc)^2}}{a^2+c^2}, \quad (4)$$

where, $a = v_a \cos\theta_a - v_b \cos\theta_b$, $b = x_{a1} - x_{b1}$, $c = v_a \sin\theta_a - v_b \sin\theta_b$, and $d = y_{a1} - y_{b1}$.

B. Mobility Model—

This model has been implemented to treat the mobility related issues in the ad hoc network. In MANETs the movement of node is unpredictable and the time they are in link holds key for packet transmission. Hence calculation of link life time is carried with respect to the mobility of nodes, as increase in mobility, LLT between the nodes decreases. This breaks the routes, and packet loss due to link failure. Which significantly affect the packet delivery ratio, throughput and delay caused by link failure. Hence this model has be proposed along with other routing protocol to increase its efficiency. After calculating the LLT and RLT, ACO algorithm comes in picture in finding the shortest among all the available routes calculated using RLT. These algorithms solve the path finding and mobility related problem and explained in four steps.

Step 1: Estimation of minimum LLT initiated by source:

Here the estimation of LLT is carried on any reactive protocol (ex: DSR or AODV) in which minimum threshold link life time (TLLT) used by the source to find more stable link and route to the destination. Upon estimating the TLLT based on the nature of mobility, which is random mobility in some area and stable in places where mobility is least. As per two aspects of mobility, the TLLT has to be set accordingly. In random mobility the TLLT can be set higher for low speeds compare to high speed and in stable aspect the TLLT can be set higher.

Step 2: Route discovery using TLLT along ACO:

In a reactive protocol, whenever there is a packet to be transmitted, the source itself will search for the route in the route cache. If there is no route present in the cache then with the help of ACO algorithm the path finding process is initiated from source to desired destination, upon finding the route the threshold link life time is calculated over that path by source, each node along the path towards destination calculate own LLT with the previous nodes, and compares the calculation with TLLT in the packet. If the calculated LLT is greater than the TLLT of the packet, then this node become part of the route. Similarly same will be carried over all routes found by ACO and among all which has higher and same TLLT are included other nodes are discarded from route.

Step 3: Determination of route life time:

The liveliness of the route is called the route life time (RLT), that is all the nodes in the networks have their own link life time, and the node with lowest LLT has high probability of breaking the route. So, the link with lowest LLT in any route is considered as RLT. Here if any node is a part of the route, it compares its own LLT with the RLT in the route discovery packet sent by the source. If the LLT is less than the RLT, it replaces the RLT in the discovery packet with its own LLT. Or if LLT is more or equal, it forwards the route discovery packet without changing RLT field. The source receives the route reply packet, calculate the net RLT, RLTnet, which is difference between RLT of the packet and the time it took the route reply packet to arrive to the source, troute. Then, RLTnet is given by

RLTnet = RLT– troute. (5)

RLTnet and troute are stored in route cache by source. troute is average latency between source and destination.

Step 4: Algorithm for reducing packet loss:

Whenever there is a packet to send, the source search a route from route cache, and estimate the number of packet that route is able to deliver without loss. Latency between source and destination, troute, is important. Let as consider Nest be estimated number of packets to be sent through that route, and given by

Nest = RLTnet/troute. (6)

The selected route will be alive during RLTnet, and within RLTnet, the source will be able to send the Nest number of packets. If more than Nest number of packet sent they have high probability of getting lost due to broken route. If there are more packets to be sent then the source find alternative route from route cache, if there no route is present again the route discovery process is carried by source using ACO technique and mobility algorithm.

D. System Model and Implementation

We present the proposed algorithm using 5, 10 and 15 nodes, where nodes communication pattern is omni-directional with a transmission radius r. Nodes moves at constant velocity in communication range or sometimes out of range. Each node is equipped with GPS and antenna with height above 1 meter to provide location, current velocity and direction of movement. Packet loss occurs due to link failure and collisions. As per implementation the nodes share same channel for packet transmission. UDP is used as transport layer protocol. Destination is used as Loss monitor which gives detail about packet loss n failure in transmission. Here DSR is the reactive protocol used as routing protocol combined with the algorithm. On this DSR routing protocol we apply four modifications made in above steps. First, whenever there is a route discovery request at node, it calculates the shortest path to the destination by ACO technique, upon which it calculates LLT with previous nodes. Second, each packet route discovery packet contains TLLT value assigned at source, nodes that receives this packet compares it LLT with TLLT in the packet, and passes to next node if its same or high or drops the packet if the LLT is less than TLLT. Third, RLT of the discovered route is estimated with minimum of LLT values of the nodes. Forth, the latency of the route is calculated by destination and sends to source through route reply packet. Thus, the source estimates the number of packets to be sent using the RLT and latency of the corresponding route. This implementation reduces the path finding complexity and packet loss due to failure.

IV. EVALUATION

We consider three metrics packet delivery ratio, packet loss and average packet delay in measuring performance of the proposed algorithm with existing solutions. Packet delivery ratio is the number of received packets by the destination and the total number of packets sent by the source. Packet loss is the total number of lost packet during transmission. Average packet delay is the time required by a packet to reach from source to destination. As our evaluation is in wireless network so we consider the speed of the mobile nodes for

measuring the performance of the protocols. We compare our implementation "DSR with LLT" with original DSR and DSR with Direction Tracking. Simulation is carried with these protocols and the output is plotted on the graph as shown in figures 6, 7 and 8 which provides the results of 5 nodes. The original DSR has a solution to broken routes called maintenance procedure, which deletes the route with broken links from cache. DSR with Direction Tracking search for the shortest path based on number of hop-count from cache and second, it searches for path with better LLT with Minimum hop-count from cache.
The packet delivery ratio is obtained with "DSR with LLT" is compared with other two DSR protocols and the result in figure shows the significant improvement in the packet delivery ratio which is above 40 percent.

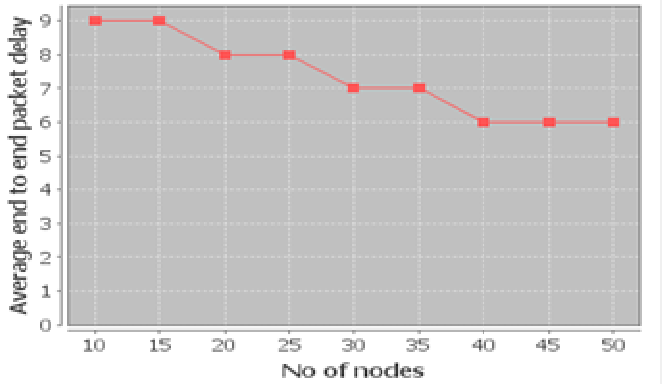

Fig 6 Average end to end packet delay

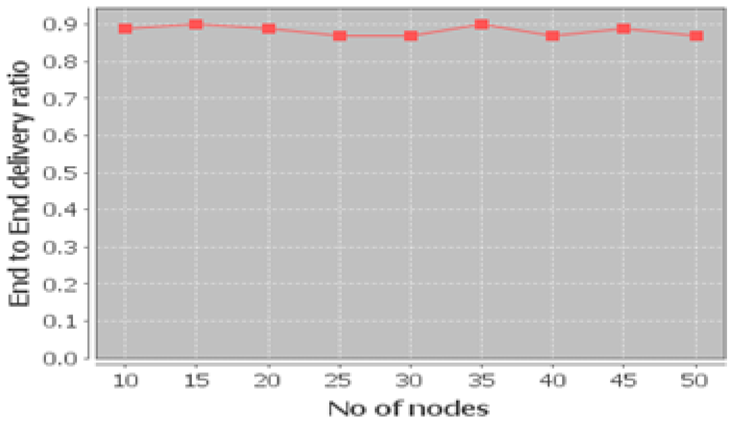

Fig.7 End to End delivery ratio

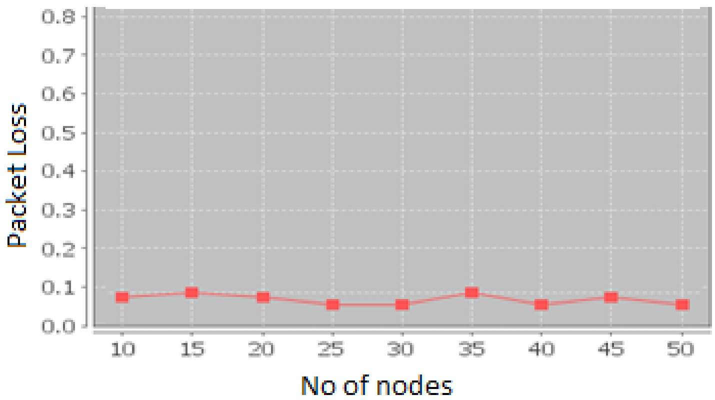

Fig 8 Packet Loss ratio

V. CONCLUSION

In this paper, a new algorithm is applied to earlier routing protocol along with ACO technique to path finding complexes and reduce packet loss due to inevitable link failures in MANET is presented. The proposed changes to the routing algorithm are implemented in DSR and can be applied to any reactive or on-demand routing protocols. ACO used for path finding along with RLT is estimated using the route discovery mechanism. Using RLT and latency, the number of packets that can traverse a route is estimated by source by route reply packet, and only this number of packets is sent through that route. Thus the evaluation of this in above section shows that packet loss decreases and packet delivery ratio increases significantly.

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