ARA Using Association feature in MANETs

Ravi Regulagadda[1], G Nagappa[2], B.Sunil[3], A.Santhoshi[4]
[1,2,3]*Asst. Prof, Department of CSE, MRIET, Secunderabad, India*
[4]*Assoc.Prof., Department of IT, SMEC, Secunderabad, India*

Abstract **-** Newly a novel method is developed to feel the difficulty of routing in ad hoc network and conquer the limitation of the traditional methods; these methods are support on group brainpower encouraged from natural crowd, such as ants in order to solve some composite problems such as discovery food or optimizing route to food in real insect crowd. The most known directing calculations for MANETs, as communicated Ant based Routing Algorithm (ARA) encounter from a few impediments inside the pheromone figuring since it has not being used the essential reflection to the attributes of MANETs, for example, portability and the medium imperative. Here we propose improvement to ARA called Link quality based ARA (LARA), it can be built-in the link excellence in route collection and chance computing which have significantly enhanced the network concert and the system life span.

Keywords **-** MANETs, LARA, Cross-layer, Routing, Link excellence, crowd Intelligence

I. INTRODUCTION

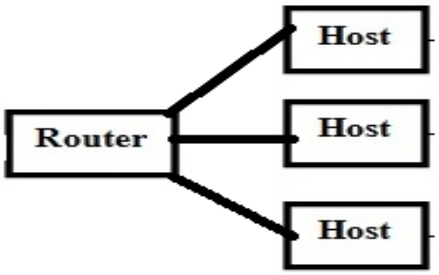

Figure 1: Diagram for mobile node acting both as hosts and as router

An ad hoc system typically refers to some set of networks where all strategy have equal position on a network and are without charge to connect with some other ad hoc network devices in link range. As an alternative, each node play a part in routing by reassign data for other nodes, and so the idea of which nodes move data is made enthusiastically based on the network connectivity. Nodes are free to move around randomly. An ad hoc network employs no centralized administration. Hubs are allowed to move around arbitrarily. An impromptu system utilizes no unified organization. Hubs in the impromptu system are frequently portable, however can likewise comprise of stationary hubs, for example, get to focuses to the web. Therefore every node acts both as a router and as a host.

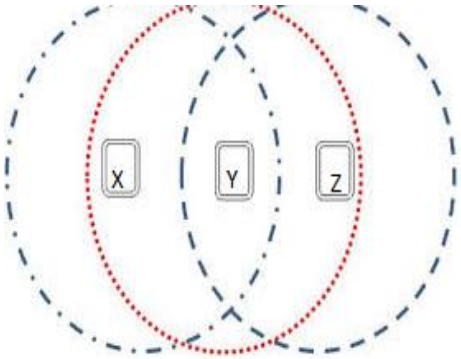

Figure 2: A sample ad-hoc network with three nodes participation

A hub can be seen as an interface conceptual entity consisting of a router and a set of allied mobile host's figure 2. A switch is a substance, which among extra assets runs a steering convention. A portable host is just an IP-addressable host/element in the ordinary sense. Specially appointed systems don't depend on a pre-built up correspondences; thus, they can be compose in places with no settled interchanges remote portable impromptu systems are most appropriate for gathering gatherings, instructor, swarm control, hunt and protect, fiasco recuperation, on-the-fly conferencing applications, organizing canny gadgets and robotized combat zones.

The used spectrum for wireless transmissions is the spectrum situated around the 2.4 GHz ISM and around 5.0 ghz U NII (Unlicensed-National Information Infrastructure). The transmission range and the emission power are regulated by laws in each country depending on the location where the network is deployed (indoor or outdoor), ranging from 10 m for personal area networks (PAN) to 100-200 m for Local Area Networks [1]. Typically MANETs are costless, too simple for utilize and sending, which gives them part of fields of utilization consistently running from military applications for interfacing warrior in combat zones to non-military personnel or business applications, for example, Public and Personal Area Networks and also sensor systems for observing or reconnaissance [12].

II. ROUTING PROTOCOLS IN MANETS

An expressly appointed system comprises of various took care of gadgets which impart to each other over remote channel with no brought together control, or foundation. Accordingly, the system topology might change quickly and unusually, along these lines no devoted hub can be characterized to perform directing in MANETs. Subsequently, portable hubs must team up between

themselves to perform directing and powerfully build up courses. any portable hub in a specially appointed system assumes two parts, the first as a normal hub and the second one as a switch keeping in mind the end goal to take an interest in the steering procedure by executing directing calculations. Accordingly, the regular steering conventions can't be utilized for MANETs [4]. Because of every one of these requirements, part of directing conventions were characterized for specially appointed systems, as indicated by the procedure and the technique for steering we can separate four classes: Proactive (Table-driven) conventions(e.g: OLSR (Optimized Link State Routing) [11], WRP (Wireless Routing Protocol) and DSDV (Destination Sequenced Distance Vector directing convention).

III. ANT COLONY OPTIMIZATION

Swarm Intelligence (SI) idea is utilized in chip away at counterfeit consciousness procedure in view of the investigation of aggregate conduct of extraordinary populaces. SI based frameworks are created of a populace of straightforward specialists cooperating locally with each different and in addition with their condition. Cases of such frameworks can be found in nature, including subterranean insect provinces, flying creature rushing, honey bee swarming, creature grouping, microscopic organism's embellishment and fish tutoring [6].

This is finished by removing pheromone on the trail taken by every subterranean insect, a substance identified with hormones created by ants amid development, which different ants can detect. Ants are pulled in by pheromone and in this way take after the correct trail to the home or nourishment. Ants take after trails with higher pheromone focus which frequently upgrades their course to nourishment and prompts take after the most limited trail and causes a self-quickened response with none brought together intercession

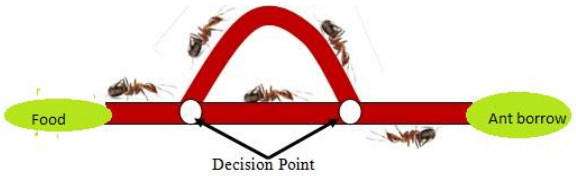

Figure 3: Ant colony shortening path

Figure 3 shows scenario ants are start from their shell and walk in the track of the food. At the point when an insect achieves a gathering point, it needs to choose which branch to take straightaway. The primary subterranean insect arbitrarily tails one of the two branches. When returning ants take another route to the home and select one of the two branches, however inevitably the convergence of pheromone will be more in the most limited branch and along these lines ants take after the briefest way by mean of pheromone focus [18]. conduct of ants keeping in mind the end goal to locate the most limited way from the home to nourishment can be utilized for steering advancement in MANETs, since a subterranean insect state can be seen as a specially appointed system made out of little gadgets and went up against to a similar issue which is finding the briefest course in a decentralized manner [9]. The explanation for picking ACO for directing in MANETs is its dispersed nature and the arbitrariness of subterranean insect development and in addition the idea of the earth which is constantly compelled and unusual for ants.

The calculation utilized for streamlining is a simply conveyed executed by the joint effort of little operator with constrained limits and keen. This has part of suggestions for MANETs, since in a MANETs hubs are obliged by power, stockpiling and preparing power, an absolutely conveyed calculation like ACO lessen calculation load and message trade which may diminish the system overhead and enhance the directing administration over impromptu system.

A. ACO meta-heuristic for routing in MANETs:

In this area we will introduce a basic case of utilizing subterranean insect settlement advancement meta-heuristic for steering keeping in mind the end goal to locate the briefest way between two hubs in MANETs, the determinations given in this segment are the premise of any insect province based directing calculation for MANETs [8]. The following assumptions and notation are used:

Here consider a connected graph G = (V,E), where |V| = n , n is the number of nodes in the network.

Each two neighbours i and j are connected by an edge e(i,j) ? E if they are in the transmission range of each other. We denote Ni the set of one hop neighbours of i. ?i,j, is the artificial pheromone deposed by ants corresponding to the edge e(i,j) connecting i and j. Every insect when going by a middle of the road hub looking for the most limited way stores a steady measure of the simulated pheromone?i,j.

$\phi_{i,j} = \phi_{i,j} + \Delta\phi_{i,j}$

The artificial pheromone $\phi_{i,j}$ is used by the ant on node i to compute the probability of using j as next hop for routing using the following equation,

$$P_{i,j} = \begin{cases} \dfrac{\phi_{i,j}}{\sum_{j \in N_i} \phi_{i,j}} & j \in N_i \\ 0 & j \in N_i \end{cases} \quad \text{------- (1)}$$

$$\sum_{j \in N_i} P_{i,j} = 1$$

Periodically decrementing the Artificial pheromone with a following equation

$$\phi_{i,j}(t+\theta) = (1-q)\phi_{i,j}(t), q \in (0,1) \quad \text{------ (2)}$$

Consider that a node s wants to find a path to a destination d using this algorithm described above:

The source hub s dispatches the task of discovering course to d by sending manufactured ants over the entire system. Each ant travels over the network and deposit artificial pheromone on each used edge until it arrives to the destination node. Routes are selected according to the

probability computed using the existed pheromone on each link using equation (1), by choosing the route having the best probability.

IV. ANT BASED ROUTING ALGORITHM

Subterranean insect based Routing Algorithm (ARA) utilizes particular technique and components created for specially appointed system keeping in mind the end goal to deal with way foundation and upkeep [8]. Typically, ARA routing management process is composed of:

- Route discovery in which the route is established using forward and backward ants
- Route maintenance phase in which the pheromone is updated according to equations (1) and (2)
- Finally an error handling phase in order to treat link failures

A. Route discovery phase:

The objective of this phase is finding a route between a source node s and a destination node d (Figure 4). Two classes of ants exist for this purpose; the first one is called Forward ANT (FANT) which is defusing over the whole network in order to find all possible routes to d. Thus FANT travel between full network and update pheromone on every visited node using equation (1) until it arrives to destination node d, at each time the FANT is received by an intermediate node, this last create a record in its pheromone table if it does not exist or increase the existed pheromone with $\Delta\phi_{i,j}$. In the other hand the Backward ANT (BANT) establish the final route to the source node s, like the pheromone is increased by FANT and BANT and according the time will be decreased.

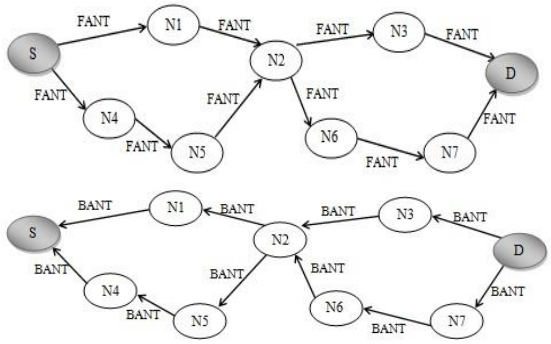

Figure 4: FANT and BANT in ARA

Pheromone table structure: The pheromone table is similar to the routing table in classical routing, except that for the pheromone table is stored information corresponding to only one hop neighbors'. This table is updated using forward and backward ants. Whenever the forward ant visits an intermediate node for the first time an entry is created containing:

- The identifier of the source node which has initiated the route discovery.
- The identifier of the next hop used to reach the destination node.
- The initial value of the pheromone, which is the same for all new created entries.

The pheromone table is updated using two ways:

The first way using forward and backward ants, since at each visit of these ants the pheromone is increased with a fixed amount such as in real systems.

Periodically, the value of pheromone is decreased according to time in order to emulate the biological pheromone which loses concentration due to time.

B. Route maintenance and Error Handling:

Route maintenance operation is responsible of maintaining routes during communication, by updating the pheromone tables as delineated above and managing link errors if they exist.

V. LINK QUALITY BASED ARA (LARA)

As devoted above ARA suffers from some design limitations, since it do not gives the necessary consideration to the ad hoc networks uniqueness in the method of pheromone update and route selection. Hence, in this section we are going to improve the ARA by defining a new mechanism of pheromone computing which includes some of the most important characteristics of ad hoc network which are the link quality and the devices' constraints. Link quality is the most promise parameters, since it define the ability of a given link and devices to support the density of the traffic for the period of connection. The link state between two neighbours can be affected by lot of parameters such as distance, battery power and mobility. Thus, in the next sections we are going to define a method for link state evaluation using cross-layer design between the physical layer and the network layer, used for pheromone update. The second parameter utilized as a part of course choice will be the quantity of associations over a similar way, keeping in mind the end goal to pick ways with less associations (activity) as course so as to spare assets of middle hubs over this way by disseminating the system movement over different hubs of the system which builds the framework lifetime and in addition end to end delay.

A. Link Quality Evaluation:

We define link quality between two neighbours as the ability of this link to be as long as possible stable, have less bit errors and reach its destination with the maximum signal strength. In literature link quality is usually evaluated according to the received signal strength, because the transmission power of the wireless medium is proportional to the link quality, since a signal with high strength is more stable and has less bit errors. Equation (3) gives the reception power Pr for a signal transmitted with power Pt at a distance d:

$$P_r = P_t X G_r X G_t X \frac{\lambda^2}{(4 X \pi X d)^2} \text{ --------- (3)}$$

Where, Pr - received power, Pt - transmitted power, Gt - antenna gain of the transmitter, Gr -antenna gain of the receiver, λ – wavelength, d – distance. From the equation(3) evaluating the link quality according to the received signal strength can be descriptive for other network reasons such as:

- The battery power of nodes, this factor is very important since a node with less energy in its battery have small transmission range which affects the quality of links with its neighborhood; in the other hand it cannot forward data for long time. From equation (3) whenever the battery level is low the transmission power is also low and therefore the reception power is low, thus this link has not high quality.

Route discovery - Similar to ARA, the route discovery mechanism is intended to find routes over the network, as well as updating pheromone table such as in swarm intelligence based routing. To accomplish the discovery and establishment of routes over the network, two classes of ants are defined which are forward and backward ants.

Forward ANT (FANT) - Forward ants are intended to discover routes; it is launched by the source nodes and broadcasted over the entire network until it arrive s to the destination node. During its trip over the network, the FANT causes pheromone update because the reception of FANT is the event which launches all kinds of pheromone update. The structure of the forward ant can be described as follow (Table 1), where:

- Packet Type: This field is one byte size; its value describes the purpose of the packet, data, FANT or BANT, in this case it is fixed to FANT.
- Source IP Address: This field is four bytes and describes the IP address of the source node.
- Destination IP Address: This field is four bytes and describes the IP address of the destination node.
- IP list: This field is an array of four bytes and contains the list of IP addresses followed by the FANT during its broadcasting over the network.
- Pheromone list: This field is an array of four bytes and contains the amount of pheromone carried by each link traversed by the FANT.
- Sequence number: this field is four bytes and contains a unique sequence number used to avoid route loops, similar to DSR
- Time-To-Live (TTL): This field is one byte and describes the remaining allowed hop count for the FANT. It is fixed to 255 and decremented at each visited node.

Table 1 Forward ANT (FANT) packet structure

Packet Type	Sequence Number	TTL
Source IP		
Destination IP		
IP List		
Pheromone List		

- Packet Type: is fixed to BANT.
- Source IP Address contains the address of the destination node.
- Destination IP Address contains the address of the destination node.
- Reversed IP list: This field is an array of four bytes and contains the reversed list of the list retrieved from the FANT.
- Time-To-Live (TTL) is fixed to the length of the reversed list.

Table 2 Backward ANT (BANT) packet structure

Packet Type	Sequence Number	TTL
Source IP		
Destination IP		
IP List		

B. Route Maintenance and Error handling:

The route maintenance is similar to the original ARA and no modifications are done. Hence, whenever a link between two neighbours fails included in the routing process, a route error packet is sent to the source node which launches a new route discovery as described above intended to establish a new path between the corresponding nodes. The route error packet structure is similar to ARA:

- Error Source Address: The address of the node originating the Route Error (node has discovered the link failure).
- Error Destination Address: The delivery of the hub to which the Route Error must be conveyed.
- Error Type field: in our proposed is always set to NODE_UNREACHABLE.

VI. CONCLUSION

In this document we have examined crowd cleverness based direction-finding, this class of routing which is more talented in the earlier future by up-and-coming new device and ideas. As loyal above, crowd aptitude is very appropriate for ad hoc networks, concerning its spread manner to treat and decide complex problems using similarity to natural crowd of insects. We have also provided ant routing algorithm, the most known routing algorithm for MANETs, as explained ARA suffers from some confines in the pheromone computing since it has not taken the necessary reflection to the uniqueness of MANETs such as mobility and the medium limitation. Consequently, in our future enhancement to ARA called LARA we have built-in the link quality in route selection and likelihood computing which have noticeably better the network presentation and the system lifetime. In the respite of this hypothesis we are going to treat the feature of security in ad hoc and sensor networks by proposing a lightweight execution of public key infrastructure in order to secure message over these networks.

VII. REFERENCES

[1]. Al Agha K., Pujolle G., Vivier , Reseaux de Mobiles et reseaux sans fil, Eyrolles, 2005.

[2]. S Basagni, I Chlamtac , Syrotiuk , A distance routing effect algorithm- for mobility (DREAM), ACM/IEEE , pg: 76-84, Oct 1998.
[3]. T.Camp, Boleng, Wilcox ,Performance -Comparison of Two location based routing protocols for ad hoc networks, INFOCOM 2002, Twenty-First Annual joint conference of the IEEE Computer and Communications Societies, IEEE, Volume. 3, 2002, pg:. 1678 –168.
[4]. Clausen T., Jacquet P., Viennot L.,Comparative Study of Routing Protocols for Mobile Ad hoc Networks, Med-Hoc-Net'02, Sardegna, Italy, September 2002.
[5]. D Camara, Alfredo,Loureiro, A Novel Routing -Algorithm for Hoc Networks, Journal of Telecommunications Systems, 18:1-3, Kluwer Academic Publishers, 2001, pp. 85-100.
[6]. M.L Gerharz, De Waal C., artini , Link Stability in Mobile Wireless Ad Hoc Networks, IEEE Conference on Local Computer Networks (LCN), Florida, Nov 2002.
[7]. M Gunes, Bouazisi I., "ARA - the Ant Colony Based routing Algorithm for MANETs", ICPP Workshop on Ad hoc Networks, Vancouver, Canada, 2002, pp. 7985.
[8]. Heusse , Snyers , Guérin , Kuntz , :Adaptive agent-driven routing and load balancing -communication network, Proceedings ANTS'98,First International Workshop on Ant Colony Optimization, Brussels, Belgium, October 15-16, 1998.
[9]. Jinyang Li, John Janotti, Douglas S. J. De Coutu, D R. Karger, Robert Morris-A Scalable Location Service for Geographic Ad Hoc Routing, M.I.T.
[10]. D Johnson , Maltz D, Jetcheva, "The dynamic source routing protocol for mobile ad hoc networks", April 2003.
[11]. Ko Y.-B., V. N. H. "Location-Aided Routing in mobile Ad hoc networks", In Proceeding ACM/IEEE Mobicom, October 1998, pp. 66-75.
[12]. Mesut Gunes et, "ARA : the ant-colony Based Routing Algorithm for MANETs", In Stephan Olariu, ICPP Workshop on Ad Hoc Networks (IWAHN 2002), IEEE, August 2002, pp. 79-85.
[13]. Nikaein, Ch Bonnet, N Nikaein,Hybrid ad hoc routing protocol – HARP, IST 2001: International Symposium on Telecommunications.
[14]. Park V., Corson S., TORA (Temporally-Ordered Routing Algorithm routing protocol, Internet Draft, draft-IETF-MANET-TORA-spec- 03.txt, June 2001.
[15]. C Perkins , E Royer , Das S., Ad hoc On-demand Distance Vector (AODV) Routing, Internet Draft, draft-ietf-manet-aodv-11.txt, Aug 2002.
[16]. Perkins C. E., Bhagwat P., "Highly dynamic destination sequenced distance vector for mobile computers", SIGCOMM 1994 Conference on Communications Architectures, 1994 August , pp 234-244.
[17]. Siva Ram Nurthy C., Manoj B.S., "Ad hoc wireless networks Architectures and Protocols", le Prentice Hall, 2004.
[18]. Tsu-Wei Chen, Mario Gerla, Global State Routing- A New Routing Scheme for Ad hoc Wireless Networks, Proceedings IEEE ICC'98.