Bee-Inspired Routing Protocols for Mobile Ad HOC Network (MANET)

Deepika Chaudhary
Chitkara Institute of Engg & Technology Jhansla
Teh. Rajpura,Distt Patiala-140401,Punjab
deepika.chaudhary@chitkara.edu.in

Abstract – **Mobile AdHoc networks(MANETs) are receiving a significant amount of attention from researchers. This paper provides a high light on a new and very energy efficient algorithm for routing in Manets BeeAdHoc. This algorithm is a reactive source routing algorithm and consumes less energy as compared to other existing state of art routing algorithms because a fewer control packets for routing are sent as compared to other networks.**

I. Introduction

Mobile Ad HOC networks (MANET'S) are networks in which all nodes are mobile and communicate with each other via wireless connections. Nodes can join or leave the network at any time. There is no fixed infrastructure. All nodes are equal and there is no centralized control or overview. There no designated routers all nodes can serve as routers for each other and data packets are forwarded from node to node in multihop fashion.

Since a few years researcher's interest in MANETS have been growing and especially the design of MANET routing protocols has received a lot of attention. One of the reasons is that routing in MANETS is particularly challenging task due to the fact that the topology of the network changes constantly and paths, which were initially efficient, can quickly become inefficient or even infeasible. Moreover control information flow in the network is very restricted. This is because the bandwidth of the wireless medium is very limited and the medium is shared: nodes can only send or receive data if no other node is sending in their radio neighborhood. It is therefore important to design algorithm that are adaptive robust & self-healing. Nature self-organizing systems like insect societies show precisely these desirable properties. Making use of a number of relatively simple biological agents like ants, a variety of different organized behavior are generated at the system level from the local interaction among the agents and with the environment. The robustness and effectiveness of such collective behaviors with respect to variations of environment conditions are key aspects of their biological success. This kind of systems are often referred to with the term swarm intelligence. Swarm systems have recently become a source of inspiration for design of distributed & adaptive algorithms.

II. Design Issues of Routing Algorithms

The most important challenge in designing algorithms for MANETs are mobility and limited battery capacity of nodes. Mobility of nodes results in continuously evolving new topologies and consequently the routing algorithms have to discover or update the routes in real time but with small control overhead . The limited battery capacity requires that the packets if possible be distributed on multiple paths , which would result in the depletion of batteries of different nodes at an equal rate and hence as a result the life time of networks would increase[1]. Therefore an important challenge in Manets is to design a routing algorithm that is not only energy effieicent but also delivers performance same or better than existing state of art routing protocols.

III. Classification of Routing Algorithms in Manets

The routing algorithms for Manets can be broadly classified as proactive algorithms or reactive algorithms. Proactive algorithms periodically launch control packets which collect the new network state and update the routing tables accordingly. On the other hand, reactive algorithms find routes on demand only. Reactive algorithms looks more promising from the prespective of energy consumption in Manets. Each category of above mentioned algorithms can further be classified into host intelligent or router intelligent algorithms . A few reactive algorithms are DSR (Dynamic Source Routing) which is host intelligent algorithm while AODV(AdHoc On Demand Distance Vector Routing) which is a router –intelligent algorithm.However these algorithms are not designed for energy efficient routing. Here in this study an deep insight is provided on BeeAdHoc which delivers performance same as better than that of DSR,AODV but consumes less energy as compared to them. The algorithm achieves these objectives by transmitting fewer control packets and by distributing data packets on multiple paths.

IV. Existing Work on Nature –Inspired Manet Routing Protocols

The first algorithm which presents a detailed scheme for MANET routing based on ant colony principles is ARA [3]. The algorithm has its roots in ABC AND AntNet Routing algorithms for fixed networks and are inpired by the pheromone laying behavior of ant colonies . AntHocNet, which is hybrid algorithm having both reactive and proactive components have also been proposed.This algorithm tries to keep most of features of the original AntNet and shows promising results in simulation comared to AODV Termite is another MANET routing algorithm inspired by termite behaviour .Here no special agents are needed for updating the routing tables rather data packets are delegated this task.

V. Overview of BeeAdHoc Architecture

BeeAdHoc is an on-demand multi path routing algorithm for mobile adhoc networks inspired from the foraging principles of honey bees[4]. BeeAdHoc works with types of agents: packers, scouts foragers and swarms. The packers locate a forager and hand over the data packet to the discovered forager. Scouts discover new routes from the launching node to the destination

doi:10.4304/jetwi.2.2.86-88

node through broadcasting principle and an expanding time to live (TTL) timer. Foragers, the main workers.

The architecture of the hive is shown in Fig 1 where the entrance floor is an interface to the lower MAC layer, while the packing floor is an interface to the upper transport layer. The dance floor contains the foragers and the routing information to route locally generated packets. The functional characteristics of each floor composing the hive are explained in the following.

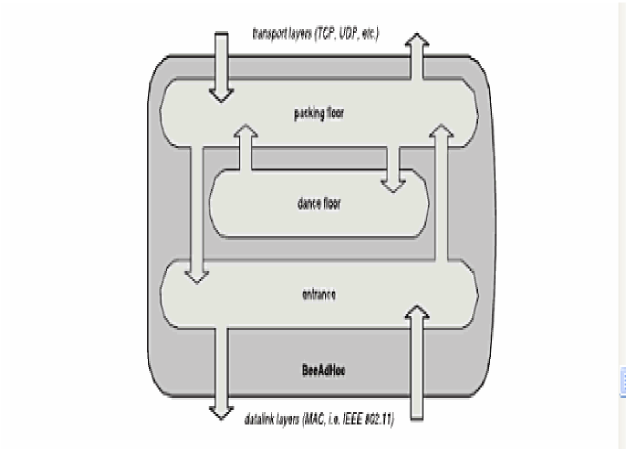


Fig 1. Overview of BeeAdHoc Architecture

VI. PACKING FLOOR

The packing floor is an interface to the upper transport layer (e.g, TCP or UDP) . Once a data packet arrives from transport layer, a matching forager for it is looked up on the danced floor . If a forager is found then the data packet is encapsulated in its payload . Otherwise, the data packet is temporary buffered waiting for a returning forager. If no forager comes back within a certain predefined time, a scout is launched which is responsible for discovering new routes to the packet destination . Figure 2 explains the series of action performed at packing floor.

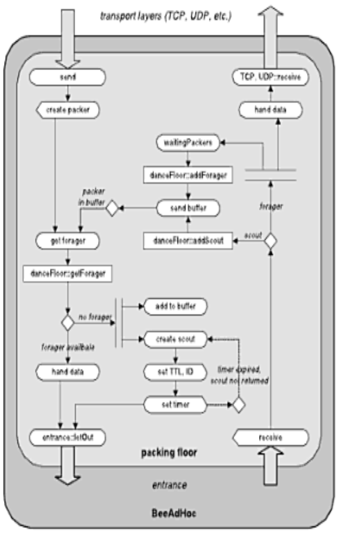


Fig 2 : The Packing Floor

VII. ENTRANCE

The function performed in the entrance are shown in figure .3. The entrance is an interface to the lower level MAC layer. The entrance handles all incoming and out going packet. Action on the dance floor depends on the type of packet entered the floor from the MAC layer. If the packet is the forager and th e current node is its destination, then the forager is forwarded to the packing floor.; otherwise, it is directly routed to the MAC interface of the next hop node. If the packet is a scout, it is broadcast to the neighbor nodes if its TTL timer has not expired yet or if the current node is not its destination. The information about the ID of the scout and its source node is stored in a local list. If a replica of previously received scout arrives at the entrance floor , it is removed from the system. If a forager with the same destination as the scout already exists on the dance floor, then the forager’s route to the destination is given to the scout by appending it to the route held so far by the scout.

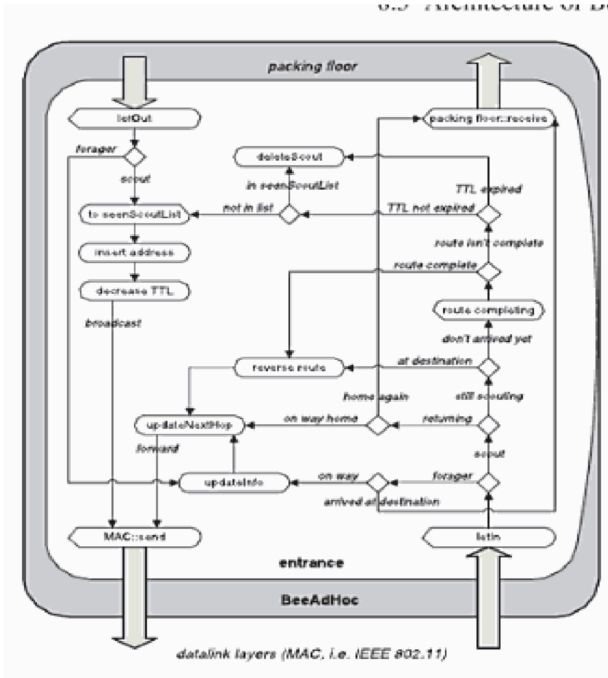
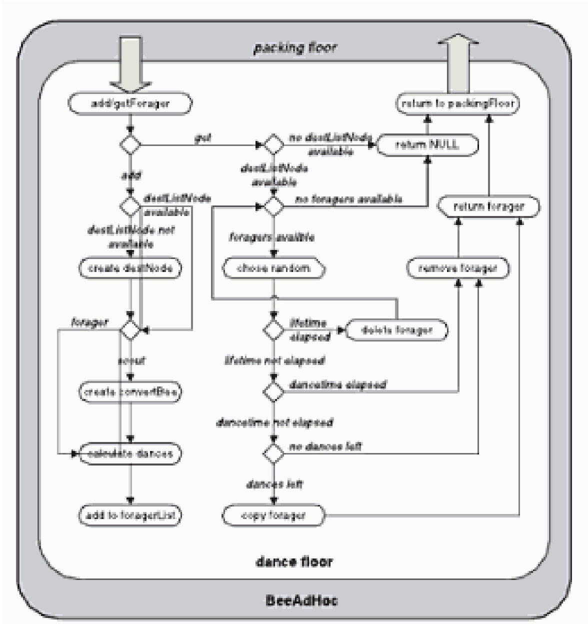


Fig 3: The Entrance

VIII. DANCE FLOOR

The dance floor is the heart of the hive because it maintains the routing information in the form of foragers. The dance floor is populated with routing information by means of mechanism reminiscent of the waggle dance recruitment in natural bee hives once a forager returns after its journey, it recruits new forager by “dancing” according to the quality of the path it traversed.

A lifetime forager evaluates the quality of its route based on the average remaining battery capacity of the nodes along its route. The central activity of the dance floor module consists of sending a matching forager to the packing floor in response to a request from a packer. The foragers whose lifetime has expired are not considered for matching. If multiple path be identified for matching, then a forager is selected in a random way. This helps in distributing the packets over multiple paths, which in turn serves two purpose : avoiding congestion under high loads and depleting batteries of different nodes at comparable rate. A clone of the selected forager is sent to the packing floor and the number of permitted clones. If the dance number is 0 then the original forager is sent to the packing floor removing it in this way from the dance floor. This strategy aims at favoring young over old foragers.If the last forager for a destination leaves a hive then the hive does not have any more route to the destination. Nevertheless if a route to the desination still exists then soon a forager will be returning to the hive if no forager comes back within reasonable amount of time, then the node has probably lost its connection to the destination node. In this way fewer control packets are transmitted resulting in less energy expenditure.



IX. CONCLUSION

The simplicity of BeeAdHoc which results from its simpler architecture and its using a smaller number of control packets pay off once we look at the energy consumption in transpoting the packets from their source to their destination. BeeAdHoc network employs a simple bee behavior to monitor the validity of the routes.When compared to other algorithms the battery level of BeeAdHoc is better because it tries to spread the data packets over different routes rather then always sending them on the best routes.

X. FUTURE ASPECTS

Design and development of routing protocols for Mobile Ad Hoc Networks (MANETs) is an active area of research. The standard practice among researchers working in this emerging domain is to evaluate the performance of their routing protocols in a network simulator. In future a mathematical models of two key performance metrics, routing overhead and route optimality, of *BeeAdHoc* MANET routing protocol using a simulator can be studied . One of the key components of our *BeeAdHoc* model is the collision model at Medium Access Control (MAC) layer. To design the mathematical expressions of the performance metrics can also provide insight about the behavior of *BeeAdHoc* in particular, and a typical ad hoc routing protocol in general.

REFERENCES

[1] Formal Modeling of *BeeAdHoc* : A Bio-inspired Mobile Ad Hoc Network Routing Protocol, Muhammad Saleem[1], Syed Ali Khayam[2] and Muddassar Farooq[3.]

[2] The wisdom of the hive applied to mobile ad-hoc networks Wedde, H.R.; Farooq, M.

[3] BeeAdHoc: an Efficient, Secure and Scalable Routing Framework for Mobile AdHoc Networks , Prof. Dr. Horst F. Wedde (wedde@ls3.cs.uni-dortmund.de) ME Muddassar Farooq (muddassar.farooq@ls3.cs.uni-dortmund.de)

[4] M. Farooq, “From the Wisdom of the Hive to Intelligent Routing in Telecommunication Networks” PhD Thesis, Dortmund University, 2006.

[5] H. F. Wedde and M. Farooq. “The wisdom of the hive applied to mobile ad-hoc networks.” In Proceedings of the IEEE Swarm Intelligence Symposium, pages 341–348, 2005.

[6] P. K. Visscher, “Dance Language”, Encyclopedia of Insects, Academic Press, 2003