Volume 2, Issue 8, August 2012 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

# A Survey of Ant based Routing Algorithms for Mobile Ad- hoc Network

**Nagaraj M. Lutimath**
*Rajiv Gandhi Institute of Technology*
*Bangalore, India*

**D. G. Anand**
*Rajiv Gandhi Institute of Technology*
*Bangalore, India*

**Suresh L**
*Cambridge Institute of Technology*
*Bangalore, India*

*Abstract*— **Routing is an important issue in a mobile ad hoc network because it is infrastructureless. In a mobile ad hoc network a node acts both as host and router. Agents play an important role in routing the packets in the mobile ad hoc network. They improve the latency of the network, reduce network traffic and find optimized routes to deliver the packets from source to destination. In this paper a survey of the ant based routing algorithms is made.**

***Keywords***— **Mobile ad hoc network, mobile agent, latency, packet delivery ratio , overhead**

## I. INTRODUCTION

A Mobile Ad hoc Network (MANET) is a self organized infrastructureless network. Routing is an important issue in a MANET because of the dynamic nature of the network. A node acts both as host and a router. There are three types of routing mechanisms in MANETs. They are the proactive, reactive and hybrid. A proactive routing algorithm finds the route based on the information of routing table at each node. A reactive routing algorithm finds the routes by initiating the route discovery at the source and maintaining the discovered routes for further discovery of route process in the cache. A hybrid algorithm is a combination of both the proactive and reactive algorithm. Based on the structure MANETs are classified as flat structured and clustered networks. In flat structured network communication is unicast. In clustered networks the communication is multicast. Some of the types of clustered networks are tree structured, others are mesh structured. Bandwidth is efficient for multicast communication [1] than unicast communication. Hence clustered networks are bandwidth efficient. However as mobility increases, link failures trigger the reconfigure the entire tree structured network. For further communication redundant packets need to be stored in each node of a mesh structured network. Thus unicast is advantages in such cases.

Agents play an important role in improving the packet delivery and overhead is decreased in a MANET [2]. Latency is improved with decrease in over head of the packets in the network. .

### *A. Ants as Agents*

The biological insects like ants in the ant colony form a collective behaviour. Their collective behaviour is studied and applied to solve the complex problems. Ants live in colony and they possess the following characteristics [2] which are described below,

1. Scalability: The ants can change their group size by local and distributed agent interactions. This is an important characteristic by which the group is scaled to the desired level.
2. Fault tolerance: Each ant follows simple rule. They do not rely on a centralized control mechanism, graceful, scalable degradation.
3. Adaptation: Ants always search for new path by roaming around their nest. Once they find the food their nest members follow the shortest path. While nest members follow shortest path, some of the members of the colony always search for other shortest path. To accomplish this they change, die or reproduce for the colony
4. Modularity: Ants follow simple rule of following the path which has higher level of pheromone concentration. They do not interact directly and act independently to accomplish the task.
5. Speed: In order to make other ants to know the food source, they move faster to their nest. Other ants find more pheromone on the path and follow the path to the food source. Thus changes are propagated very fast to communicate to other nest mates in order to follow the food source.
6. Modularity: Ants follow simple rule of following the path which has higher level of pheromone concentration. They do not interact directly and act independently to accomplish the task.
7. Autonomy: No centralized control and hence so no supervisor is needed. They work for the colony and always strive to search food source around their colony.
8. Parallelism: Ants work independently and the task of searching food source is carried out by each ant in parallelism. It is parallelism due to which they change their path, if a new food source is found near their colony. These characteristics of biological insects such as ants resemble the characteristics of MANETs.

 

*B. Software Agents*

Agents are the autonomous programs activated on an agent platform of a host. Agents use their own knowledge base to achieve the specified goals without disturbing the activities of the host. They have two special properties: mandatory and orthogonal, which make them different from the standard programs Mandatory properties are: autonomy, reactive, proactive and temporally continuous. The orthogonal properties are communicative, mobile, learning and believable [2, 3].

Mobile agent is an itinerant agent which contains program, data, execution state information, migrates from one host to another in a heterogeneous network, and executes at a remote host until it completes a given task. By nature, mobile agents are flexible modular entities that can be created and deleted in a real time. The mobile code should be platform independent, so that it can execute at any remote host in a heterogeneous network environment. Inter-agent communication can be achieved by message passing, remote procedure call (RPC) or common knowledge base (blackboard) [4].

A mobile agent platform comprises agents, agent server, and interpreter and transport mechanisms. The agent server is responsible for receiving mobile agents and sending it for execution by the local interpreter. Agents can be written in Java, Tcl and XML languages, Agent interpreter depends on the type of the agent script/ language used. An agent platform supports following services: agent creation, agent execution, agent migration, transport for mobile agents security and persistence. Some of the Java-based are: Aglets, Grasshopper, Concordia, Voyager and Odyssey [5].

Agents-based schemes comprising static or mobile agents offer several advantages as compared to traditional approaches: overcome latency; reduce network traffic; encapsulate protocols; flexibility, adaptability; software reusability and maintainability; and facilitate the creation of customized dynamic software architecture.

## II. REVIEW OF ANT BASED ROUTING ALGORITHMS IN MANETS

Generally ant routing algorithms can be classified in different ways, according to the pheromone updating, calculation of route probabilities, how often and how many ants are sent per request and so on. However, we can use any of the characteristics of the biological insect ants in an application to find the shortest route in the network. Ant Based Control (ABC) [6] is a proactive algorithm was designed for load balancing in a circuit switched network and is used for call controlling. This algorithm maintains only one routing table whose rows show destination, columns show neighbours. Routing table is maintained at each node containing probabilities of reaching next node. Forward Ant (FANT) updates routing table on each node. Pheromone value depends on age of agent. The next hop is chosen according to pheromone value. Antnet [7] is a simple and direct extension of simple ant colony optimization algorithm. It is a proactive approach that is; route is explored even if there is no data to send in hop to meet immediate need. It is used for wired datagram network. The algorithm uses two artificial homogenous ant agents. Forward ant agent is to find out minimum cost path joining its source and destination node. The next hop is chosen on the basis of Greedy-Stochastic policy. It depends on pheromone value, ant memory and local probabilistic information. AntHocNet [8, 9, 10] is a hybrid algorithm, which combines reactive path setup with proactive path probing, maintenance and improvement.

Co-operative Asymmetric Forward [11] is for wired as well as wireless networks and is a reactive algorithm so finds path only on demand. Link cost in CAF is assumed asymmetrical. Here forward ants are released from source to destination. These forward ants collect information regarding various nodes in network as according to the routing table maintained at each node and also records the launch-time. The next hop is chosen on the basis of pheromone concentration when backward ant retraces the path of forward ant in opposite direction and deposit equal amount of pheromone on nodes. Ant Colony Based Routing Algorithm (ARA) [11] is reactive algorithm and reduces the overhead for routing. It is a highly efficient, adaptive and scalable routing protocol. It is a multi path routing scheme. It uses two ant agents, Forward ANT (FANT) and Backward ANT (BANT). The Swarm Intelligence based routing algorithms Ant-AODV [12,13] is designed for MANET which use mobile agents like ants to carry on big scope to scan the networks, make use of ant agents to collect the information about routing. The Ant-AODV combines ACO proactive characteristics with AODV reactive characteristics, to improve the performance of routing search delay and to adapt the constantly change of network's topology. Probabilistic Emergent Routing Algorithm (PERA) [14] is proactive algorithm that assumes that all nodes in network fully co-operate in process of data transfer and there are bidirectional links in network. There are uniform forward ant and regular forward ants that are unicasted to reinforce available paths in network. Termite [15] is a distributed routing algorithm that provides scalability, adaptability and control overhead. Ant Routing Algorithm for MANETs (ARAMA) [16] is a proactive algorithm. The algorithm is efficient and scalable because it reduces route discovery time and overhead maintenance cost and delay. Mobile Ant Based Routing (MABR) algorithm is responsible for updating the routing tables of logical routers and determining logical paths for routing packets. Adaptive Swarm Based Distance Routing (ASDR) [17] routing algorithm features are high utilization, high scalability, destination of routing coops and oscillations. Ant based Distributed Routing Algorithm (ADRA) [18] is a reactive Algorithm that finds a single path between source and destination. Like other algorithm, it also uses two types of ant agents FANT and BANT. FANT moves from node to node. Ant Colony Based Multipath QoS aware Routing (AMQR) [19] is a reactive algorithm to find out multipath between source and destination. Ad hoc Networking with Swarm Intelligence (ANSI) [20] is a reactive algorithm which finds out path only when demanded that is, when node has data to send to other nodes it finds out the path. The Multicast for Ad hoc Network with Swarm Intelligence (MANSI) [21] algorithm provides multicast support for ad hoc networks. Within a multicast group, each member launches a forward ant in order to find an existing forwarding node where it can be used to establish connectivity to the group with lower cost. The Multicast for

 

Ad hoc Network with hybrid Swarm Intelligence (MANHSI) [22] utilizes small control packets equivalent to ants in the physical world. These packets, travelling like biological ants, deposit control information at nodes they visit similar to the way ants laying pheromone trails on the path.

Hybrid Ant Colony Optimization Routing Algorithm for MANET (HOPNET) [23] is a hybrid multipath routing algorithm and it combines concept of ZRP and DSR. Ant Colony Optimization –Ants Hybrid Routing (ACO-AHR) [24] Hybrid routing algorithm. It introduces the service agents to reduce expense of network. It uses two artificial ant agents that is, forward ant agent and backward ant. There are other types of agent that is called service agent (sagent). Improved Ant Colony Optimization algorithm for mobile ad hoc network (PACONET) [25] is a reactive algorithm. It is a very dynamic algorithm which takes into account the mobility, route maintenance, Link Failure-Handling. Position based on Ant colony routing algorithm for MANETS (POSANT) [26] is reactive that is, route is established only when there are some data to send. It is position based routing means each node has information about its own position, position of its neighbours, position of destination node. Probabilistic Ant Routing (PAR) [27] is proposed for routing in MANET. Each node maintains a list of neighbours according to HELLO MESSAGE received. (FANT) are probabilistic and explore the network to collect network traffic information. If route to destination is available as present node, the FANT is unicast otherwise it is broadcasted. Also, ant Pheromone for Quality of Service (QoS) provisioning in MANET is described in [28, 29, 30]

## III. COMPARISON OF ANT BASED ROUTING ALGORITHMS

A number of routing algorithms for routing MANETS are proposed. All ant based routing algorithm are enlisted in the Table 1 for comparison.

TABLE 1: COMPARISON OF ANT BASED ROUTING ALGORITHMS

| Algorithm | Year | Type | Path | Result of Overhead and Latency |
|---|---|---|---|---|
| Ant based Colony | 1997 | Proactive | Single | More Overhead and Latency |
| Ant net | 1997 | Proactive | Single | More Overhead and Latency |
| CAF | 1998 | Position based | Single | More Overhead and Latency |
| RBA | 1998 | Proactive | Single | More Overhead and Latency |
| ASGA | 1998 | Hybrid | Single | More Overhead and Latency |
| AARA | 2001 | Proactive | Multipath | More Overhead and Latency |
| ASDR | 2002 | Zonal | Single | More Overhead and Latency |
| ANT-AODV | 2002 | Hybrid | Single | More Overhead and Latency |
| ARH | 2002 | Reactive | Single | Overhead and Latency reduced |
| ARA | 2002 | Reactive | Multipath | Overhead and Latency reduced |
| MABR | 2003 | Proactive | Single | More Overhead and Latency |
| PERA | 2003 | Proactive | Single | More Overhead and Latency |
| EARA | 2003 | Reactive | Multipath | Overhead and Latency reduced |
| TERMITE | 2003 | Proactive | Multipath | More Overhead and Latency |
| ADRA | 2004 | Reactive | Single | Overhead and Latency reduced |
| ANTHOC NET | 2004 | Hybrid | Single | Overhead and Latency reduced |
| ANSI | 2005 | Reactive | Single | Overhead and Latency reduced |
| AMQR | 2005 | Reactive | Multipath | Overhead and Latency reduced |
| MANSI | 2005 | Reactive | Multipath | Overhead and Latency reduced |
| GPSAL | 2006 | Proactive | Single | More Overhead and Latency |
| MANHSI | 2007 | Hybrid | Multicast Connectivity | Overhead and Latency reduced |
| POSANT | 2008 | Reactive | Multipath | Overhead and Latency reduced |
| HOPNET | 2008 | Hybrid | Multipath | Overhead and Latency reduced |
| ACO-AHR | 2008 | Hybrid | Multipath | Overhead and Latency reduced |
| PACONET | 2008 | Reactive | Single | Overhead and Latency reduced |
| PSO-ODMRP | 2008 | Reactive | Single | Overhead and Latency reduced |
| PAR | 2009 | Hybrid | Multipath | Overhead and Latency reduced |
| AntOR | 2010 | Hybrid | Single | Overhead and Latency reduced with Packet delivery ratio increased |

## IV. ALGORITHMS USED FOR PATH COMPUTATION IN ANT BASED ROUTING ALGORITHMS

Generally Bellman–Ford algorithm and Dijkstra's algorithm are used to compute the single source multipath in a network. The complexity of Bellman –Ford algorithm is O ($N^3$) while that of Dijkstra's is O ($N^2$), where N is the number of nodes in the network. Hence in most of the cases Dijkstra's algorithm is used.

 

## V. CONCLUSION

In this paper we have considered biological ants for our study. The basic principle is to use ants like packets and let ant routing operate to gather routing information. We find that a number of ant based routing algorithms are proposed for routing in MANETs. Some of them are proactive that is, they keep on searching the best path from the source and destination even if no data packet is available for sending from source to destination. Some of the algorithms are reactive and nodes come into action only when a packet is received for transmission from source to destination. These proactive and reactive algorithms are having their own limitations and are not found suitable for routing in MANET mainly when real time applications QoS is to be ensured. Hybrid routing algorithms are proposed which contain advantages of proactive and reactive algorithms. These algorithms are simulated using different simulation environment that is, NS-2, QualNet. In these simulations some of the real scenario or environment constraints are not considered. There is need to consider environmental factors affecting real time applications. It can be concluded that ant based approach offers to be a powerful means to solve routing problems in MANETs. Further, it is required to consider real scenario conditions and need to tune and simulate to get an efficient and effective routing algorithm for MANETs.

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**Prof. Nagaraj M. Lutimath** , serving as Asst. Prof. in the Department of Computer Science and Engineering at Rajiv Gandhi Institute of Technology, Bangalore. He is graduated from Basaveshwar Engineering College, Bagalkot and Post graduated from the same Institute. His areas of interests are Mobile Computing, Data Mining and Wireless Technology.

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**Prof. D. G. Anand**, serving as Prof. and HOD in the Department Electronics and Communication Engineering at Rajiv Gandhi Institute of Technology, Bangalore. He is graduated from AIT, Chikmagalur and Post graduated from UVCE, Bangalore. He is the research scholar of JNTU, Anantpur, Andrapradesh. His areas of interests are MANET, Wireless Sensor Network and Wireless Technology.

**Dr. Suresh L.** serving as Vice Principal and HOD in the Department of Computer Science and Engineering at Cambridge Institute of Technology, Bangalore. His areas of interests are Mobile Computing, Data Mining and Wireless Technology.

 