Analysis and Comparison Routing Protocols based on ACO and Without ACO in MANET

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Abstract. Mobile Ad-hoc Networks (MANETs) are a set of mobile nodes which communicate without any fixed infrastructure and centralized controller. Routing in such networks is a big challenge because of the dynamic nature of this networks that each node keeps moving continuously, power energy and bandwidth are limited. Finding routes which moreover optimization, reduce the overhead of the networks. Different protocols are proposed for routing in MANETs, but nowadays researchers incorporation routing protocol with swarm intelligence (SI) techniques. One of the important techniques is, use of ant colony optimization (ACO) with routing protocols. Nature has proven that the ants finding optimal path between the nest and food and adaptive nature of this agent, make help to propose a suitable routing protocol for MANETs. In this paper, we review some routing protocol that mingle ACO with existing routing protocol and introduce the advantages and disadvantages of them. Finally, we compare these protocols to each other.

Keywords: Mobile ad-hoc networks (MANETs), Ant colony optimization (ACO), Routing

1. Introduction

Mobile Ad Hoc Networks, are dynamically configurable wireless networks without fixed infrastructure or central administrative management [1]. Each node has limited power and communicates with other node that exists within the transmission range directly otherwise communication is done through intermediate nodes [2] hence these networks are also called as multi-hop networks [3]. Any node can be a sender, a receiver as well as a router where it takes part forwarding other node's packets [4].Due to the random movement of nodes, the network topology may change continuously and unpredictably over time. Then we have to use the protocol that deals with the dynamic aspects of MANETs in their own way and own metrics[5].Mobile nodes and multi-hop nature of MANETs also poses other problems as the nodes can move freely and the network topology may change very often. To support this new communication paradigm, robust, reliable and efficient routing algorithms are needed to allow the network to offer a good, or at least an acceptable, level of service. New approaches are needed to overcome the difficulties and proposed a suitable routing protocol is still a challenge.

Basically, Routing is the process of choosing paths in a network along, so that the source can send data packets towards the destination. Routing is an important phase of network communication because the characteristics like throughput, reliability, packet delivery, congestion and so on depends upon the routing information [6].

Swarm Intelligence based Routing with Opportunistic Routing represent sets of algorithms based on biological models, inspired by highly dynamic environments, which are particularly adequate for MANETs [7].

Ant Colony Optimization (ACO) is a subset of Swarm Intelligence. It is introduced by Marco (1992) [6]. The main idea of the ant colony optimization is taken from the food searching foraging behavior of real ant colonies[8, 9]. When ants are on the way to search for food, they start from their nest and walk toward the food. When an ant reaches an intersection, it has to decide which branch to go. While going, ants deposit a chemical substance named pheromone, which ants are able to sense, which marks the route taken and they are attracted to the marked paths. The concentration of pheromone on a certain path is an indication of its usage. The more pheromone that is deposited on a path, the more attractive that path becomes. With time, the concentration of pheromone decreases due to volatile effects. Evaporation clears the pheromone on longer paths as well as on less interesting paths. Shortest paths are refreshed more quickly with ants, thus having the

chance of being more frequently explored. Intuitively, ants will converge towards the most efficient path due to the fact that it gets the strongest concentration of pheromone[10, 11].

Nowadays, there are many routing protocols for MANETs such as AODV [12], TORA [13], ZRP [14] and so on. But researchers try to optimize thess protocols and in this way, many protocol that combine ACO with routing protocols are proposed. Samples of this combined protocols are HOPNET [15], DAR [16] and HRAZHLS [17].

   The rest of the paper is organized as follows: section 2 proposes classification of Ad Hoc Routing protocols. Section 3 reviews routing protocol without Ant Colony Optimization in MANET. Section 4 describes *Ant Colony based routing* in MANET. In section 5, we investigate analysis and comparison between routing protocol that proposed with ACO and without ACO in MANET with respect to various metrics. The conclusion is given in section 6.

2. CLASSIFICATION OF AD HOC ROUTING PROTOCOLS

   Multiple routing protocols have been developed for Mobile Ad hoc Networks. MANET routing protocols depend on the mechanism and functionalities can be classified into three categories [4]:

- Proactive (Table-driven)
- Reactive (On-demand)
- Hybrid

2.1.Proactive protocols

   In this category, each node in the network holds one or more routing table which stores information of next hops/subnet. All nodes keep on updating these tables periodically. The drawback of this routing causes more overhead, not used for large topology network, consumption of more Bandwidth, If the network topology changes too frequently, might be very high cost of maintaining the network, information about actual topology might even not be used if network activity is low [2]. The differences among the protocols lies in their routing table structure, number of tables, updating frequency, use of control messages and the presence of a central node [3]. These protocols forward the packets irrespective of when and how routes are desired as there is always the availability of the routes in the continuously updated routed tables [18]. The main disadvantages of table-driven routing protocols are QoS, bandwidth consumption in transmitting, routing tables and also saving the table of the routes that are not used in the future[19].

2.2.Reactive protocols

   Reactive protocols are elected when we want to set up routes on demand. This route will be established by the routing protocol in the situation when any node wants to initiate the communication with another node to which it has no route. This type of protocol is generally based on flooding the network with Route Request (RREQ) and Route Reply (RREP) messages [18]. Advantage of reactive protocols is less control overhead as compared to proactive protocols for Mobile Ad Hoc Networks. Thus, reactive routing protocols have better scalability than proactive routing protocols in mobile ad hoc networks [3]. The main disadvantages of the on-demand protocols are dilation when the source node trying to find a route and also excessive flooding can be led to the network clogging[20].

2.3.Hybrid protocols

   Hybrid routing protocols combine the advantages of proactive and reactive routing protocols. Proactive tactic is used to discover and maintain routes to nearer nodes, while routes for far away nodes are discovered reactively. In an ad-hoc network, a hybrid routing algorithm can be implemented in a hierarchical network architecture. The performance of the network depends on the distribution of the proactive/reactive approaches for each level of the network hierarchy [3]. The hybrid routing protocols disadvantage is that the nodes have to maintain high level topological information which leads to more memory and power consumption [21].

3. SOME ROUTING PROTOCOL WITHOUT ACO IN MANET