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Ant Colony Optimization in Dynamic Source Routing Protocol

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Abstract:
An ad hoc network is a set of wireless mobile hosts making a temporary network without need of any available infrastructure. In this type of environment, to send a packet from host to destination node needs a mobile host. This paper shows a various techniques in ant colony optimization in DSR protocol for routing in Mobile ad–hoc networks. Dynamic Source Routing which is a reactive routing protocol follows frequently to routing changes when host movement is quick, yet needs little or no overhead during periods in which hosts move less quickly. The DSR is a simple and effective routing protocol intended particularly for utilization in multi-hop wireless ad hoc networks of mobile nodes. DSR permits the network without requirement for any available network administration or infrastructure. The protocol is consisted of the two techniques of Route Discovery and Route Maintenance, which work together to permit nodes to find and manage source routes to arbitrary destinations in the ad hoc network. Source routing permits packet routing to be trivially loop-free, neglects the requirement for up-to-date routing information in the intermediary nodes via which packets are sent, and permits nodes sending or overhearing packets to store the routing information in them for their own future usage. DSR is completely on-demand.
Keywords: MAC, DSR, MANET, AODV

I. INTRODUCTION

Mobile ad-hoc networks (MANETs) are particular type of networks in which the nodes mobility is quite high. No node can join or leave to the network any time as there is no centralized control and static infrastructure in MANETs. All nodes are considered to be equal in processing power. The network is needed to have self configuration by means of the cooperation among the mobile devices: all nodes works as routers and are able of finding and managing paths to forward packets to their destinations node. The mobile nodes movement needs the help of quite complicated routing algorithms, as routes are not stable and require to be updated in a continuous way. Because of the dynamic behavior of MANETs, route management is quite complex task. Generally, Routing is the phenomenon of selecting network paths along which the source can forward data packets to the destination. Routing is a significant part of network communication because the features i.e. reliability, throughput and congestion based upon the information of routing. An ideal routing algorithm is one which is capable to send the packet to its destination node with least network overhead and least amount of delay. The nodes maintain the routing tables by exchanging routing information between the other network nodes. In opposite with infrastructure networks, MANETs do not require centralized infrastructures i.e. base stations. MANETs should be self-configured, self-built and adaptive to dynamic modifications. In a traditional routing algorithm, which is unknown of energy budget, links between two nodes are set up among nodes by the shortest path routes. The battery power of mobile nodes is a restricted resource, and there is no way to permit a device to live always, thus mechanisms to increase life of battery are relevant. Since, it results in a frequent reduction of the battery energy of the nodes along the most usually utilized network routes. A power-awareness routing protocol is the one that maintains the traffic load inside the network so as to improve the nodes battery lifetime and thus the total useful life of the ad hoc network.

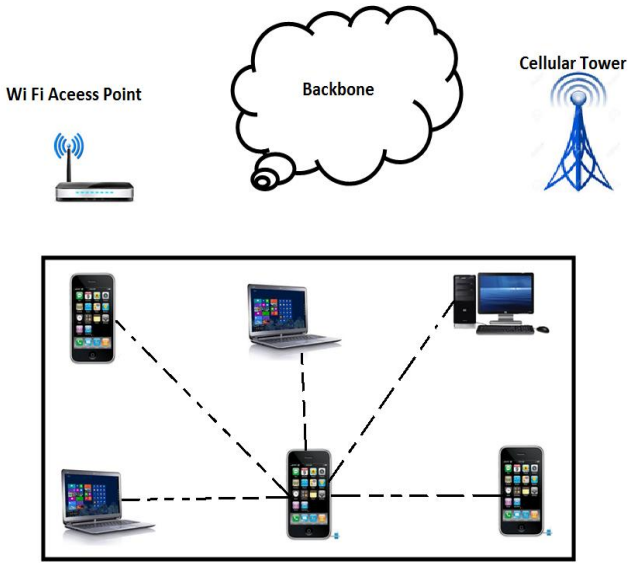

Figure 1. Mobile Ad Hoc Network

A mobile Ad - hoc Network is a network that makes from the co–operative engagement of a set of hosts without any centralized access point. MANETS routing protocols are not

performed by routers, but performed by general hosts. The network configuration will also change dynamically as the hosts "move" across the network and so the routing protocol must be reliable enough to assure that data gets propagated correctly and effectively. Most protocols show their minimum required behavior in a highly dynamic configuration. This has resulted in the requirement for novel routing protocols in MANETS. In some Ad–hoc Networks, those two hosts that wish to interact may not be with in the wireless transmission range of each other, but could interact if other hosts between them also playing role in the Ad – hoc Network are wishing to send packets for them.

II. CATEGORIES OF AD-HOC ROUTING PROTOCOLS

Recently, the wireless networks that permit communication among mobile devices can be categorized into the following two classes:

1. Networks having a static infrastructure: an example of this type of network is a cellular phone network.
2. Networks that do not have a static infrastructure: this is a developing but highly supporting and promising kind of network communication mechanism. There are various situations where this type of network would be essential; mostly, in unplanned events i.e. wars and natural disasters, but also in a planned event. This kind of network can be explained as a network of mobile devices that is generated or destroyed as required and thus it is known as mobile ad hoc network or MANET. In wireless networks, physical connections do not available and a single packet transmission will transfer a packet to several nodes within the communication range of a transmitting node simultaneously. We cal this inherent broadcast of MANETS „local broadcast" to differentiate it from global broadcast.

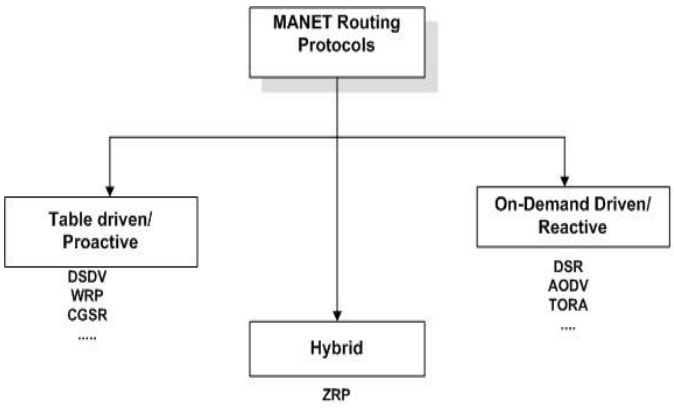

Fig 2: Categorization of ad hoc routing protocols

Some routing protocols have been introduced for MANET. These can be classified as proactive (also called table driven) protocols, reactive (called source initiated or demand-driven) protocols or the hybrid of the proactive and reactive protocols. A classification of the high ad hoc routing protocols is depicted in Figure 2 Routing protocols in traditional wired networks normally utilize either link state or distance vector routing algorithms, both of which need periodic routing advertisements to be forwarded by every router. In distance vector routing, every router forwards to each of its neighboring routers its view of the distance to all hosts, and every router evaluates the shortest route to every host depending on the information advertised by every neighbors. In link state routing, every router instead forwards to all other routers in the network its status view of each of its adjacent network connections, and every router then evaluates the shortest distance to every host depending on the whole picture of the network built from the most recent connection information from all routers. In addition to its usage in wired networks, the fundamental distance vector algorithm has also been followed for routing in wireless ad hoc networks, necessarily treating every mobile host as a router.

Assumptions

All ad hoc network hosts should send packets for other network hosts. Network diameter is assumed to be the no. of hops essential for a packet to arrive from host positioned at one extreme network edge to host positioned at the opposite extreme. The node mobility speed is taken to be moderate according to the packet. Specifically, DSR can support very speedy rates of arbitrary node mobility, but here consideration is that hosts do not move continuously so frequently as to make the broadcasting of each packet the only possible routing protocol.

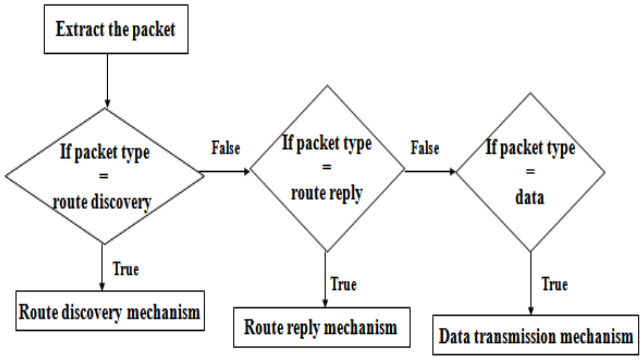

Fig 3: Basic operation- Flow chart of Dynamic Source routing protocol

Mobile subscribers will wish to interact in circumstances in which no static wired infrastructure is existed, either because it may not be economically practical or physically possible to offer the essential infrastructure. If only two hosts, positioned closely together, are included in the ad hoc network, no real routing protocol or routing decisions are essential. In some ad hoc networks, though, two hosts that wish to interact may not be inside the wireless transmission range of each other, but could interact if other hosts among them also playing role in the ad hoc network are wishing to send packets for them.

III. DYNAMIC SOURCE ROUTING (DSR) PROTOCOL

The Dynamic Source Routing (DSR) protocol is a robust and simple routing protocol intended particularly for utilize in multi-hop wireless ad-hoc networks of mobile nodes. The Dynamic Source Routing protocol (DSR) depends on source routing, which implies that the originator of every packet finds an ordered list of nodes through which the packet must pass while propagating to the destination node. The DSR

protocol contains two basic techniques: Route Discovery and Route Maintenance.

A. Route Discovery:

Route discovery is utilized only when a source node tries to forward a packet to a destination and does not already aware of a route to it. To start the Route Discovery, the source node sends a "Route Request" with a unique ID as a single local broadcast packet. When some intermediary node obtains this Route Request, at first it detects whether it has viewed the Route Request or not. If the node has already viewed the Route Request former, it will drop the packet; otherwise it will examine its Route Cache whether there is a path to the packet destination.

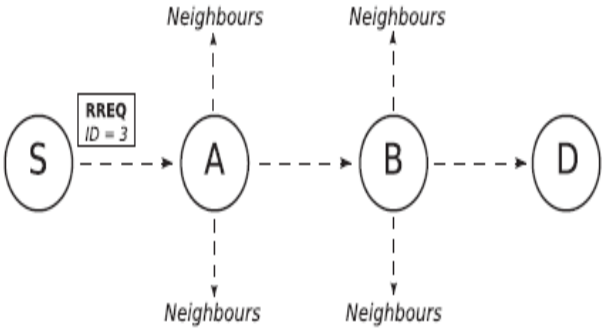

Fig. 4 Path discovery with RREQ

If it has the path to target in its routing cache, it sends a "Route Reply" to the initiator of the Route Discovery, providing a copy of the accommodated route record from the Route Request; otherwise it forwards the Route Request until the Route Request is obtained by the target .

B. Route Maintenance:

DSR protocol carries out the route maintenance technique while communicating the packets from source node to destination node. But when the communication connection between the source and the destination node is broken or else a change in network configuration is observed. It will cause to communication failure between source and destination node. In this scenario DSR protocols utilizes the route mechanism, to determine any other possible known route towards the destination node to transmit data. If the route maintenance fails to detect an alternative known route to set up the interaction then it will invoke the route discovery to discover the new route to destination node.

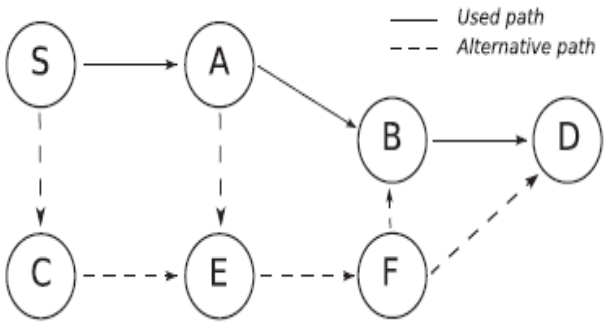

Fig. 5 Example path between source and destination

C. ROUTE CACHE

A host may utilize its route cache to neglect forwarding a route request packet obtained from another host.

Consider a host obtains a route request packet for which it is not the destination, and is not already stored in the packet route record, and for which the pair "initiator address, request id "is not discovered in its list of currently viewed requests. If the host has a route cache entry for the destination of the request, it may add this cache route to the accumulated route record in the packet, and may return this route in a route response packet to the initiator without forwarding the route request.

Before replying from its route cache a host performs the following actions.

1. Picks a delay period.

2. If packet is obtained by this host at the time of the delay period addressed to the destination of this route discovery, and If the route length on this packet is less (delay period), then cancel the delay and do not transmit the route response from this host, this host may infer that the route discovery initiator has already obtained a route response, providing an equal or better route.

As last optimization including full use of the route cache, we have appended the capability for the route request initiator to mention in the request packet, the maximum no of hops over which the packet may be forwarded. If another host close to the initiator has a cache entry for the destination of the route request, the propagation of some duplicate copies of the route request can be neglected if the initiator can explicitly restrict the request propagation when it is originally forwarded. Recently, we utilize this capability during route discovery as follows.

1. To perform a route discovery, initially forward the route request with a hop limit of one. We call this as a non propagating route request.

2. If no route response is obtained from this route request after a small time period, forward a new route request with the hop limit set to a predefined maximum value for which it is considered that all useful routes in the Ad hoc Network are less than this limit.

IV. ANT COLONY OPTIMIZATION

Ant colony optimization (ACO) obtains inspiration from the foraging nature of some ant species. These ants deposit pheromone on the ground for marking some favourable route that should be adopted by other colony members. Ant colony optimization exploits a same technique for solving optimization issues. Ant colony optimization (ACO) is a population-based meta- heuristic technique. As the name represents the mechanism was inspired by the nature of ‘‘real" ants. Ant colonies are capable to discover the shortest path between their nest and a food source by depositing and reacting to chase of pheromone which offer support to future ants towards optimum routes to food. Ants on arriving the destination; initiate a new path backward towards the source nest by adopting the similar path and biases the route by depositing more pheromone on the shorter path. As time progresses, the pheromone on non-optimum paths evaporate while the pheromone on near-optimum paths is built. The general principle of ACO algorithms can also be employed to some other combinatorial optimization issues.

V. RELATED WORK

Anuj K. Gupta et.al [1] introduces two new energy-aware routing algorithms for wireless ad hoc networks, known as Reliable Minimum Energy Routing (RMER) and Reliable Minimum Energy Cost Routing (RMECR). RMECR addresses three significant needs of ad hoc networks: reliability, energy-efficiency and increasing network lifetime. It takes the energy consumption and the left battery energy of nodes as well as quality of connections to discover energy-efficient and reliable routes that improve the network operational lifetime. RMER, on the other side, is an energy-effective routing algorithm which discovers routes reducing the total energy needed for end-to-end packet traversal. RMECR and RMER are introduced for networks in which either end-to-end or hop-by-hop retransmissions assure reliability. Simulation studies represent that RMECR is capable to detect reliable and energy-efficient routes same as RMER, while also increasing the network operational lifetime. This builds RMECR a graceful solution to increase reliability, energy-efficiency and wireless ad hoc networks lifetime. In the RMECR design, they consider minute details i.e. restricted no. of retransmissions permitted per packet, energy consumed by processing elements of transceivers, packet sizes and the effect of acknowledgment packets. This adds to the newness of this work in comparison of the available studies.

Parma Nand1 et.al. [2] proposes a power-aware route maintenance protocol for Mobile Ad Hoc Networks (MANETs). Termed Dynamic Path Switching (DPS), the novel protocol puts an overloaded node to sleep before a route connection breaks because that node runs out of energy, and takes other proper nodes into play. When the battery charge of a node arrive a stated level, the node can send a request to change to a sleep state for sometime. The request is honored unless survival of some path rests on the propagating activity of that very node. All nodes are considered to be collaborative. The DPS protocol is completely backward compatible, as it can be enforced within available routing protocols i.e. Dynamic Source Routing (DSR). The novel protocol has been widely modeled with the demonstrated network simulator NS2. The findings show a much enhanced power awareness of the managed routing protocol with respect to the unadorned one. Power saving is specifically efficient at the time of long-lived sessions.

Shariq Haseeb et.al [3] introduced that in mobile ad hoc networks, the on demand multi-path routing protocols addresses specific issues i.e. link failures, more message overheads and node's high mobility. More message overheads are caused because of increased broadcasting. Packets are discarded by intermediary nodes because of frequent connection failures. Furthermore, the total packet delivery ratio and throughput are decreased in high mobility scenarios. For overcoming the efficient multi-path routing protocol ABMRLBCC (Ant Based Multi-path Routing for Load Balancing and CongestionControl) issues depending on Ant Colony Optimization is introduced. The best path for every ant is chosen depending upon the travel time and no. of hops. Bibhash Roy et.al [4] proposes that the complexity increases because of several features i.e. time varying QoS needs, dynamic configuration, restricted resources and energy etc. QoS routing plays a significant role for offering QoS in wireless ad hoc networks. The major challenge in this type of networks is to discover a path between the communication end points fulfilling subscriber's QoS need. Nature-inspired algorithms (swarm intelligence) i.e. ant colony optimization (ACO) algorithms have indicated to be a good mechanism for developing routing algorithms for MANETs. In this paper, a novel QoS algorithm for mobile ad hoc network has been introduced.

N. Umapathi et.al [5] explains, AntHocNet an algorithm for routing in mobile ad-hoc networks. It is a hybrid algorithm which integrates reactive and proactive behaviour to measure end to end delay, packet delivery ratio and overhead by changing the mobile nodes speed. The algorithm depends on introduced nature inspired, self organized algorithm of ANT colony optimization (ACO). The bit error rate of ANT algorithm with respect to with other algorithms (DSDV, AODV, DSR) is computed involving time delay, power consumption and packet loss.

Young-Min Kim et.al [6] introduces an ant colony optimization (ACO) based energy saving routing, called as A-ESR, for energy effective networks. The introduced A-ESR algorithm firstly re-develops the energy-consumption minimized network (EMN) problem, which is NP-complete, into a simpler one by utilizing the traffic centrality concept. After that, it solves the re-development problem by 1) letting the flow to autonomously be combined on some particular heavy-loaded connections and 2) switching off the other light-loaded connections. Simulation results present that the A-ESR algorithm can achieve better performance as compared to prior works with respect to energy efficiency.

Javad Vazifehdan et.al [7] introduces some energy-aware routing algorithms for these ad hoc networks. The introduced algorithms characteristics directing the traffic load dynamically to mains-powered devices holding the hop count of chosen routes minimal. They combine these algorithms into a framework in which the path selection is developed as a bi-criteria decision making problem. Reducing the cost of energy for end-to-end packet transfer and reducing the hop count are the two criteria in this framework. Several algorithms that is introduced differ in the manner they define the energy cost for end-to-end packet traversal or the manner they solve the bi-criteria decision making issue. Some of them take the energy consumed to transmit and obtain packets, while others also assume the residual battery energy of battery enabled nodes. The introduced algorithms utilize either the weighted sum method or the lexicographic mechanism to solve the bi-criteria decision making issue. They measure the algorithms performance in fix andd mobile ad hoc networks, and in networks with and without transmission power control. Sarala.P et.al [8] utilizes the Multipath dynamic source routing protocol (MPDSR) to find multipath route under MANET nodes. The MPDSR protocol utilizes the local connection information for the route discovery mechanism. The MPDSR protocol is improved with ant colony optimization mechanism to offer multipath route information utilizing global connection information. EMPDSR offers QoS parameters i.e. end to end reliability. Bandwidth, Network traffic and battery power parameters make an effect over the route discovery method. Cost enabled

route discovery is one of the considerable routing mechanisms that enable the cost estimation with several metrics. The multipath routing protocols focus on the route discovery with end to end reliability elements. The EMPDSR protocol is combined with fuzzy cost estimations mechanisms. Network traffic, Distance, battery power metrics and bandwidth are utilized in the fuzzy cost enabled multipath dynamic source routing protocol.

VI. CONCLUSION

Dynamic source routing protocol, Mobile ad-hoc network and ant colony optimization mechanism has been studied. It has been observed that DSR protocol which is employed for discovering the existed route does not always provides the best route to forward the packets from source to destination node. So to discover the best path, a mechanism known as ACO can be utilized.ACO is employed to discover the multiple paths. By employing ACO, the network efficiency or network lifetime can be increased. As the energy of node is also assumed for path computation, the network lifetime get automatically enhanced. It is not essential that ACO always provides shortest path to forward packet, it can be greater than that of shortest path.

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