PERFORMANCE COMPARISON OF ARA PROTOCOL WITH DSR AND AODV PROTOCOL

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Abstract- Most traditional mobile ad hoc network routing protocols were designed focusing on the efficiency and performance of the network [1]. Ad hoc network are wireless network with no fixed infrastructure in which nodes depend on each other to keep the networked connected. Ant algorithms are a class of swarm intelligence and try to map the solution capability of ant colonies to mathematical and engineering problems. The **A**nt- Colony-Based **R**outing **A**lgorithm (ARA) is based on ant algorithms. The main properties of the algorithm are high adaptive, efficiency. In this paper, we compared the performance of ARA routing protocol with different ad hoc on demand routing protocol using performance metrics such as packet delivery ratio, throughput etc.
Keywords- MANET, Routing, DSR, AODV, DSDV, ARA

Introduction

A mobile ad hoc network (MANET) is an infrastructure less networks consisting of mobile nodes, with constantly changing topologies that communicate via a wireless medium. Ad hoc networks have many applications, such as in disaster relief or in search and rescue, where there is no central administration or the environment is chaotic. The transmission range in MANETs is usually limited, so nodes within a network need to relay data packets over several intermediate nodes to communicate. Thus, nodes in MANETs act as both hosts and routers. Since the nodes are mobile, designing an effective routing technique is a significant challenge. A routing technique that is appropriate for MANETs needs to be flexible enough to adapt to arbitrarily changing network topologies, and to support efficient bandwidth and energy management, since low-powered batteries operate the nodes. Several protocols have been proposed for the routing problem in MANETs. These protocols are usually categorized according to their design approaches as proactive, reactive or hybrid. A proactive (table-driven) protocol is one in which the routing information is maintained for all the paths from source to destination, whether in use or not. Protocols such as Destination Sequenced Distance Vector routing DSDV. In a reactive (on-demand) protocol only routes currently in use are maintained and they are created only when needed. Ad hoc On-Demand Distance Vector (AODV). Hybrid protocols, attempt to, fuse proactive and reactive routing to achieve better performance. Zone routing Protocols (ZPR), Virtual Backbone routing (VBR) are categorized as hybrid protocols.

Routing

Routing is the act of moving information from a source to a destination in an internetwork. At least one intermediate node within the internetwork is encountered during the transfer of information. Basically two activities are involved in this concept: determining optimal routing paths and transferring the packets through an internetwork. The transferring of packets through an internetwork is called as packet switching which is straight forward, and the path determination could be very complex. Routing protocols use several metrics as a standard measurement to calculate the best path for routing the packets to its destination that could be number of hops, which are used by the routing algorithm to determine the

optimal path for the packet to its destination. The process of path determination is that, routing algorithms find out and maintain routing tables, which contain the total route information for the packet. The information of route varies from one routing algorithm to another. The routing tables are filled with entries in the routing table are ip-address prefix and the next hop. Destination/next hop associations of routing table tell the router that a particular destination can be reached optimally by sending the packet to a router representing the —next hop‖ on its way to the final destination and ip-address prefix specifies a set of destinations for which the routing entry is valid.

Routing in Mobile Ad hoc Networks

Mobile Ad-hoc networks are self-organizing and self-configuring multihop wireless networks, where the structure of the network changes dynamically. This is mainly due to the mobility of the nodes [1]. Nodes in these networks utilize the same random access wireless channel, cooperating in an intimate manner to engaging themselves in multihop forwarding. The node in the network not only acts as hosts but also as routers that route data to/ from other nodes in network [2]. In mobile ad-hoc networks there is no infrastructure support as is the case with wireless networks, and since a destination node might be out of range of a source node transferring packets; so there is need of a routing procedure. This is always ready to find a path so as to forward the packets appropriately between the source and the destination. Within a cell, a base station can reach all mobile nodes without routing via broadcast in common wireless networks. In the case of ad-hoc networks, each node must be able to forward data for other nodes. This creates additional problems along with the problems of dynamic topology which is unpredictable connectivity changes [3].

Protocols in Mobile Ad Hoc Network

A. Dynamic Source Routing (DSR)

DSR [4] is a reactive protocol that uses source routing rather than hop-by-hop routing, with each packet to be routed carrying in its header the complete, ordered list of nodes through which the packet must pass. The key advantage of source routing is that intermediate nodes do not need to maintain up-to-date routing information in order to route the packets they forward, since the packets themselves already contain all the routing decisions. This fact, coupled with the on-demand nature of the protocol, eliminates the need for the periodic route advertisement and neighbor detection packets present in other protocols. However, routing overhead is bigger. The DSR protocol consists of two mechanisms: Route Discovery and Route Maintenance. Route Discovery is the mechanism by which a node ns wanting to send a packet to a destination nd obtains a path. To perform a Route Discovery, the source node ns broadcasts a Route Request packet that is flooded through the network in a controlled manner and is answered by a Route Reply packet from either the destination node or another node that knows a route to the destination. To reduce the cost of Route Discovery, each node mantains and actively uses a cache of source routes it has learned or overheard. That way, the frequency and propagation of Route Requests is limited. Route Maintenance is the mechanism by which a packet's sender ns detects if the network topology has changed such that it can no

longer use its route to the destination nd because two nodes listed in the route have moved out of range of each other. When Route Maintenance indicates a source route is broken, ns is notified with a Route Error packet. The sender ns can attempt to use any other route to nd already in its cache or can invoke Route Discovery again to find a new path. A DSR node is able to learn routes by overhearing packets not addressed to it (the promiscuous mode). However, this feature requires an active receiver in the nodes, which may be rather power consuming and apparently does not improve performance [5].

The Route Request is flooded until it reaches a node that knows a route to the destination. Each node that forwards the Route Request creates a reverse route for itself back to node ns. When the Route Request reaches a node with a route to nd, that node generates a Route Reply that contains the number of hops necessary to reach nd and the sequence number for nd most recently seen by the node generating the Reply. Each node that participates in forwarding this Reply back toward the originator of the Route Request (node ns), creates a forward route to nd. The state created in each node along the path from ns to nd is hop-by-hop state; that is, each node remembers only the next hop and not the entire route, as would be done in source routing. In order to maintain routes, AODV normally requires that each node periodically transmit a HELLO message, with a default rate of once per second. Failure to receive three consecutive HELLO messages from a neighbor is taken as an indication that the link to the neighbor is down. Alternatively, the AODV specification briefly suggests that a node may use physical layer or link layer methods to detect link breakages to nodes that it considers neighbors [6]. When a link goes down, any upstream node that has recently forwarded packets to a destination using that link is notified via an Unsolicited Route Reply containing an infinite metric for that destination. Upon receipt of such a Route Reply, a node must acquire a new route to the destination using Route Discovery as described above

B. Ad hoc On-Demand Distance Vector (AODV)

AODV is essentially a combination of both DSR and DSDV. It borrows the basic on demand mechanism of Route Discovery and Route Maintenance from DSR, plus the use of hop-by-hop routing, sequence numbers, and periodic beacons from DSDV. When a node ns needs a route to some destination nd, it broadcasts a Route Request message to its neighbors, including the last known sequence number for that destination

C. Ant-Colony Based Routing Algorithm (ARA)

The protocol is based on swarm intelligence and especially on the ant colony based meta heuristic. The routing algorithm consists of three phases. In the first one, Route Discovery Phase, new paths are discovered. The creation of new routes requires the use of a forward ant (FANT), which establishes the pheromone track to the source node, and a backward ant (BANT), which establishes the track to the destination node. FANTs are broadcasted by the sender to all its neighbors. Each FANT has a unique sequence number to avoid duplicates. A node receiving a FANT for the first time, creates a record (destination address, next hop, pheromone value) in its routing table. The node interprets the source address of the FANT as destination address, the address of the previous

node as next hop, and computes the pheromone value depending on the number of hops the FANT needed to reach the node. Then the node relays the FANT to its neighbors. When the FANT reaches destination, it is processed in a special way. The destination node extracts the information and then destroys the FANT. A BANT is created and sent towards the source node. In that way, the path is established and data packets can be sent. In the second phase, called Route Maintenance, routes are improved during communication. Data packets are used to maintain the path, so no overhead is introduced. Pheromone values are changing. When a node vi relays a data packet toward destination vD to a neighbor node vj, it increases the pheromone value of the entry (vD, vj,) by _. The same happens in the opposite direction. The evaporation process is simulated by regular decreasing of the pheromone values. The third one handles routing failures, due especially to node mobility, a common issue in MANETs. ARA recognizes a route failure through a missing acknowledgement.

The links are deactivated by setting to 0 the pheromone value. Then the node searches for an alternative link. If a second path exists, it is used. Otherwise, neighbors are informed of the new situation. ARA fulfills the requirements of distributed operation, loop-freeness, on demand operation and sleep period operation (that is, nodes are able to sleep when their amount of pheromone reaches a threshold). Moreover, routing entries and statistic information are local to each node; several paths are maintained to reach a certain destination and, in a node with sleep mode on, only packets destined to it are processed.

Simulation Environment

Set-up
To evaluate the effectiveness of the proposed scheme, we simulated the scheme in NS-2. The simulation parameters are listed in Table 1.

Table 1- simulation Parameters

Simulator	Ns-2(version 2.32)
Simulation Time	200 (s)
Number of Nodes	10, 20, 30, 40, 50
Topology	750 * 750 (m)
Routing Protocol	AODV, ARA, DSR
Traffic	Constant Bit Rate (CBR)
Pause Time	50 (m/s)
Max Speed	10 (m/s)

We implement the random waypoint movement model for the simulation, in which a node starts at a random position, waits for the pause time, and then moves to another random position. To evaluate performance of ARA with that of AODV & DSR protocol, we compare them using four metrics:
I. Packet Delivery Rate: the ratio of packets reaching the destination node to the total packets generated at the source node.
II. Throughput: This represents the number of packets received within a given Time Interval.

Simulation Result
Figure 1 shows the packet delivery ratio of the three routing protocols. The graph confirms the results shown in figure.
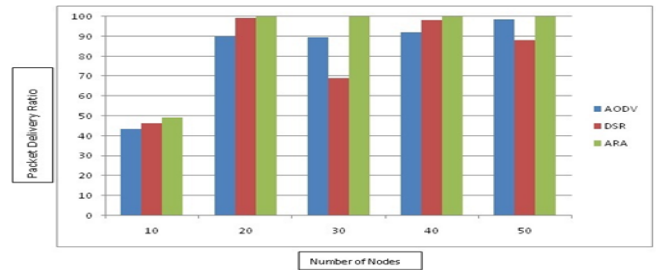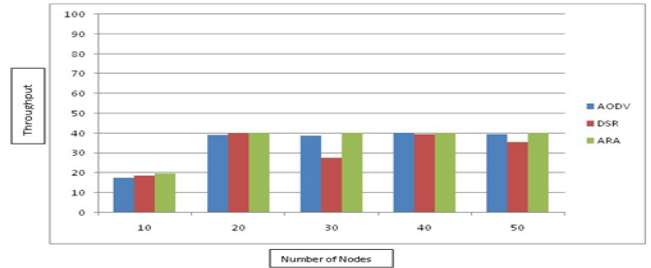

Fig. 1- Packet Delivery Ratio

Fig. 2- Throughput Vs Number of Nodes

Conclusion
Mobile multi-hop ad-hoc networks are flexible networks, which do not require pre-installed infrastructure. With upcoming wireless transmission technologies and highly sophisticated devices their application will increase. However main challenge in mobile multi-hop ad-hoc networks is still the routing problem. In this paper, we compared the performance of ARA routing protocol with different ad hoc on demand routing protocol. ARA protocols work better as compared to other routing protocols.

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