AN OVERVIEW OF ROUTING PROTOCOL IN MANET

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ABSTRACT

The emergence of the Mobile Ad Hoc Networking (MANET) technology advocates self-organized wireless interconnection of communication devices that would either extend or operate in concert with the wired networking infrastructure or, possibly, evolve to autonomous networks. The Efficient routing protocols can provide significant benefits to mobile ad hoc networks, in terms of both performance and reliability. Many routing protocols for such networks have been proposed so far. Amongst the most popular ones are Ad hoc On-demand Distance Vector (AODV) and Dynamic Source Routing Protocol (DSR). Despite the popularity of those protocols, research efforts have not focused much in evaluating their performance. In this paper we present our observations regarding the performance comparison of the above protocols in mobile ad hoc networks (MANETs).
Keywords : MANET, AODV, DSR, ZRP

I. INTRODUCTION

A mobile ad hoc wireless network is a collection of mobile/semi-mobile nodes with no pre established infrastructure, forming a temporary network. Each of the nodes has a wireless interface and communicates with each other over either radio or infrared. Laptop computers and personal digital assistants that communicate directly with each other are some examples of nodes in an ad-hoc network. Nodes in the ad-hoc network are often mobile, but can also consist of stationary nodes, such as access points to the Internet. Semi mobile nodes can be used to deploy relay points in areas where relay points might be needed temporarily. Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Figure1 shows a simple ad-hoc network with three nodes. The outermost nodes are not within transmitter range of each other. However the middle node can be used to forward packets between the outermost nodes. The middle node is acting as a router and the three nodes have formed an ad-hoc network.

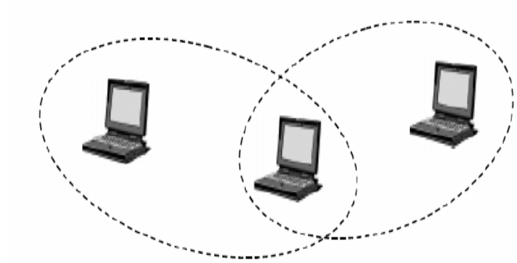


Figure 1 Example of a simple ad-hoc network with three participating nodes.

An ad-hoc network uses no centralized administration. This is to be sure that the network won't collapse just because one of the mobile nodes moves out of transmitter range of the others. Nodes should be able to enter/leave the network as they wish. Because of the limited transmitter range of the nodes, multiple hops may be needed to reach other nodes. Every node wishing to participate in an ad-hoc network must be willing to forward packets for other nodes. Thus every node acts both as a host and as a router. A node can be viewed as an abstract entity consisting of a router and a set of affiliated mobile hosts. A router is an entity, which, among other things runs a routing protocol. A mobile host is simply an IP-addressable host/entity in the traditional sense.

II. REACTIVE ROUTING PROTOCOLS

Reactive routing protocols can dramatically reduce routing overhead because they do not need to search for and maintain the routes on which there is no data traffic. This property is very appealing in the resource-limited environment.

2.2.1 Dynamic Source Routing (DSR)

The Dynamic Source Routing (DSR) protocol uses the source routing approach (every data packet carries the whole path information in its header) to forward packets. Before a source node sends data packets, it must know the total path to the destination. Otherwise, it will initiate a route discovery phase by flooding a Route REQuest (RREQ) message.

The RREQ message carries the sequence of hops it passed through in the message header. Any nodes that have received the same RREQ message will not broadcast it again. Once an RREQ message reaches the destination node, the destination node will reply with a Route REPly (RREP) packet to the source. The RREP packet will carry the path information obtained from the RREQ packet. When the RREP packet traverses backward to the source, the source and all traversed nodes will know the route to the destination. Each node uses a route cache to record the complete route to desired destinations.

Route failure is detected by the failure of message transmissions. Such a failure will initiate a route error message to the source when the source and the intermediate nodes receive the error message, they will erase all the paths that use the broken link from their route cache the path calculated in DSR is loop-free since loops can be detected easily and erased by the source routing. A few optimizations are proposed for DSR. For example, a flooded route query can be quenched early by having any non-destination node reply to the query if that node already knows a route to the desired destination; the routes can be refreshed and improved by having nodes promiscuously listen to the conversations between other neighboring nodes. DSR is simple and loop-free. However, it may waste bandwidth if every data packet carries the entire path information. The response time may be large since the source node must wait for a successful RREP if no routing information to the intended destination is available. In addition, if the destination is unreachable from the source node due to a network partition, the source node will continue to send RREQ messages, possibly congesting the network.

2.2.2 Ad hoc On-Demand Distance Vector (AODV) Routing

Since DSR includes the entire route information in the data packet header, it may waste bandwidth and degrade performance, especially when the data contents in a packet are small. Ad hoc On-Demand Distance Vector (AODV) Routing tries to improve performance by keeping the routing information in each node. The main difference between AODV and DSR is that DSR uses source routing while AODV uses forwarding tables at each node. In AODV, the route is calculated hop by hop. Therefore, the data packet need not include the total path.

The route discovery mechanism in AODV is very similar to that in DSR. In AODV, any node will establish a reverse path pointing toward the source when it receives an RREQ packet. When the desired destination or an intermediate node has a fresh route (based on the destination sequence number) to the destination, the destination/intermediate node responds by sending a route reply (RREP) packet back to the source node using the reverse path established when the RREQ was forwarded. When a node receives the RREP, it establishes a forward path pointing to the destination. The path from the source to the destination is established when the source receives the RREP.

III. RELATED WORK

Acc. to Trung et.al. Compare the performance of different protocols for ad-hoc networks – Ad-Hoc On-Demand Distance Vector Routing (AODV), Location-Aided Routing (LAR), Ad-Hoc On-Demand Multipath Distant Vector (AOMDV) routing and Location-Aided Multipath Routing (LAMR). A location multipath routing-based method by extension of LAR [1]. acc. to Josh et.al. The area of ad hoc networking has been receiving increasing attention among researchers in recent years, as the available wireless Networking and mobile computing hardware bases are now capable of supporting the promise of this technology. These protocols, DSDV, TORA, DSR, and AODV, cover a range of design choices, including periodic advertisements vs. on demand route discovery, use of feedback from the MAC layer to indicate a failure to forward a packet to the next hop, and hop by hop routing vs. source routing [2]. The protocol for routing packets between wireless mobile hosts, in an ad hoc network. Acc. David unlike routing protocols using distance vector or link state algorithms, our protocol uses dynamic source routing which adapts quickly to routing changes when host movement is frequent, yet requires little or no overhead during periods in which hosts move less frequently [3]. Acc. Trung The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (called packets) through an internetwork. The later concept is called as packet switching which is straight forward, and the path determination could be very complex [7].

IV. INTRODUCTION TO DSR & AODV PROTOCOL

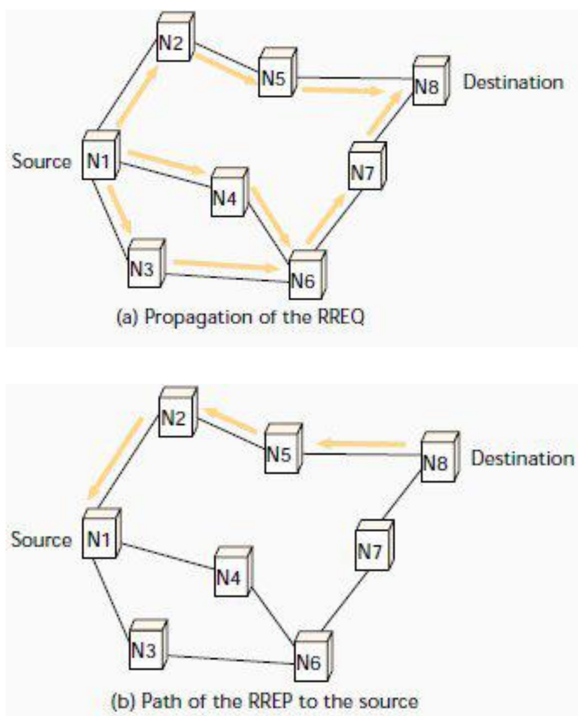
4.1 Ad hoc On-demand Distance Vector (AODV)

Ad hoc On-demand distance vector (AODV) is another variant of classic distance vector routing algorithm, based on DSDV and DSR. It shares DSR on-demand characteristics, discovers routes on an as needed basis via a similar route discovery process. However, AODV adopts traditional routing tables; one entry per destination which is in contrast to DSR that preserves multiple route cache entries for each destination. The early design of AODV is undertaken after the experience with DSDV routing algorithm. Like DSDV, AODV provides loop free routes in case of link breakage but unlike DSDV, it doesn't need global periodic routing advertisement. AODV uses a broadcast route discovery algorithm and then the unicast route reply massage. The following sections explain these mechanisms in more details.

Route Discovery:

When a node wants to send a packet to some destination and does not have a valid route in its routing table for that destination, initiates a route discovery. Source node broadcasts a route request (RREQ) packet to its neighbors, which then forwards the request to their neighbors and so on shown in figure 2.

To control network-wide broadcasts of RREQ packets, the source node use an expanding ring search technique. In this technique, source node starts searching the destination using some initial time to live (TTL) value. If no reply is received within the discovery period, TTL value incremented by an increment value. This process will continue until the threshold value is reached. When an intermediate node forwards the RREQ, it records the address of the neighbor from which first packet of the broadcast is received, thereby establishing a reverse path.



(a) Propagation of the RREQ

(b) Path of the RREP to the source

Figure 2: AODV Path Discovery Process

When the RREQ reaches a node that is either the destination node or an intermediate node with a fresh enough route to the destination, replies by unicasting the route reply (RREP) towards the source node. As the RREP is routed back along the reverse path shown figure 2, intermediate nodes along this path set up forward path entries to the destination in its route table and when the RREP reaches the source node, a route from source to the destination establish.

Route Maintenance:

A route established between source and destination pair is maintained as long as needed by the source. If the source node moves during an active session, it can reinitiate route discovery to find out a new route to destination. However, if the destination or some intermediate node moves, the node upstream of the break remove the routing entry and send route error
(RERR) message to the affected active upstream neighbors.

These nodes in turn propagate the RERR to their precursor nodes, and so on until the source node is reached. The affected source node may then choose to either stop sending data or reinitiate route discovery for that destination by sending out a new RREQ message.

4.2 Dynamic Source Routing (DSR)

The Dynamic Source Routing (DSR) is one of the purest examples of an on-demand routing protocol that is based on the idea of source routing. It is designed especially for use in multihop ad hoc networks for mobile nodes. It allows the network to be completely self-organizing and self-configuring
and does not need any existing network infrastructure or administration. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. Instead DSR needs support from the MAC layer to identify link failure. DSR is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the network show in figure 4. The following sections explain
these mechanisms in more details.

Route Discovery:

When a mobile node has a packet to send to some destination shown figure 3, it first checks its route cache to decide whether it already has a route to the destination. If it has an unexpired route, it will use this route to send the packet to the destination. On the other hand, if the cache does not have such a route, it initiates route discovery by broadcasting a route request packet shown in figure 3. Each node receiving the route request packet searches throughout its route cache for a route to the intended destination. If no route is found in the cache, it adds its own address to the route record of the packet and then forwards the packet to its neighbors.

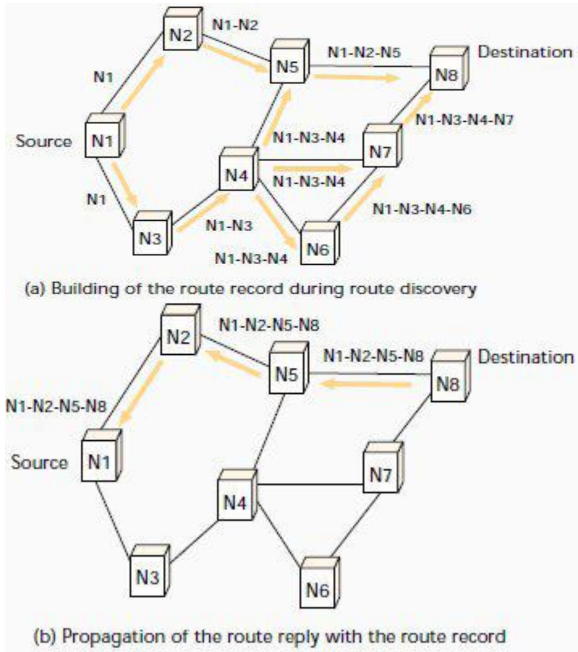


Figure 3: DSR Route Discovery Process

This request propagates through the network until either the destination or an intermediate node with a route to destination is reached. Whenever route request reaches either to the destination itself or to an intermediate node which has a route to the destination, a route reply is unicasted back to its originator.

Route Maintenance:

In DSR, route is maintained by using route error packets and acknowledgments. When a packet with source route is originated or forwarded, each node sending the packet is responsible for confirming that the packet has been received by the next hop. The packet is retransmitted until the conformation of receipt is received. If the packet is transmitted by a node the maximum number of times and yet no receipt information is received, this node returns a route error message to the source of the packet. When this route error packet is received, the hop in error is removed from the host's route cache and all routes containing the hop are truncated at that point.

4.3. **COMPARISON BETWEEN DSR & AODV**

The DSR and the AODV protocol are two dynamic routing protocols that initiate routing activities for ad hoc networks on an on demand basis . These protocols were designed for reducing the routing loading in networks. The routing mechanism in DSR uses source routing, while AODV uses a table driven routing framework and destination sequence numbers.

AODV relies on certain timer-based activities while DSR does not rely on such options. In DSR the sender knows the hop-by-hop route to the destination because of the use of source routing in the protocol. In DSR, the routes are stored in route cache. The packet header contains the source route. Route Discovery is used to dynamically determine a route when the route is not known. Route Request packets are send to flood the network and Route Error packets are send when any link in the source route is broken. DSR makes use of source routing and route caching. DSR uses Route Maintenance mechanism to repair routes that get broken when sending packets from the sender to the destination. Packet Salvaging, Automatic Route Shortening, Increased Spreading of Route Error Messages are some of the mechanisms, which are used under Route Maintenance.

AODV discovers routes on an on-demand basis using a similar route discovery process as in DSR. AODV uses traditional routing tables, one entry per destination for maintaining routing information. DSR on the other hand maintains multiple route cache entries for each destination. To propagate route reply back to the source and to route data packets to the destination, AODV relies on routing table entries. Sequence numbers at each destination determines freshness of routing information and prevents routing loops. Routing packets carry the sequence numbers.

The maintenance of timer-based states in each node for utilization of individual route entries is an important feature of AODV protocol. Sets of predecessor nodes are maintained for each routing table entry, which indicates the set of neighboring nodes. Route Error packets are used to notify these nodes when the next-hop link breaks. All the routes using the broken link are erased when the route error packets are sending to its own set of predecessors. Route Error packets in AODV are intended to inform all sources using a link when a failure occurs. In AODV, Route Error propagation is visualized as a tree structure where the root is the node at the point of failure and all sources using the failed link as leaves. An optimizing technique in AODV to control Route Request flood in the route discovery process is to use an expanding ring search to discover routes to unknown destination. DSR with the influence of source routing and promiscuous listening of data packet transmissions has access to a significantly greater amount of routing information than AODV. AODV can gather only limited amount of routing information. DSR uses route caching aggressively by replying to all requests reaching a destination from a single request cycle. In AODV, the destination replies only once to the request arrive first.

The rest of the requests are ignored. Since DSR does not have any mechanism for the expiration of stale routes stored in the cache, some of these stale routes may start polluting other caches. AODV when faced with the choice of stale routes would choose the fresher one. The entry in the routing table if not used recently gets expired .

In all, DSR allow cache more paths from a source to a destination, while AODV just use the path first discovered. Thus, DSR have significant greater amount of routing information than AODV. Meanwhile, DSR has access to many alternate routes which saves route discovery floods, the performance then will be better if they are actually in use. DSR doesn’t contain any explicit mechanism to expire stale routes in the cache.
Choosing stale routes under stressful situation is normal thing in DSR. So, AODV is more conservative while DSR is more aggressive in using the past information. Which is better is hard to say.

Parameter	AODV	DSR
No. of nodes	22	22
Packet transmit	34000	34000
Throu- ghput	1600	1400
Packet loss in frame	60	100
delay	1.6 b/ms	3.5 b/ms

table 4.3 comparison table of AODV and DSR the above table 4.3 is design based on simulation result in ns2

V. CONCLUSION

This paper review and compare the two protocols. The conclusion that if the MANET has to be setup for a small amount of time then AODV should be prefer due to low initial packet loss and DSR should not be prefer to setup a MANET for a small amount of time because initially there is packet loss is very high. If we have to use the MANET for a longer duration then both the protocols can be used, because after sometimes both the protocols have same ratio of packet delivering. But AODV have very good packet receiving ratio in comparison to DSR. AODV and DSR are very similar, but AODV mechanisms are easier to implement and to integrate with other mechanisms using other different routing protocols. Moreover, AODV has better scalability and its header size on data packet is relative constant. However, AODV maintains only one route per destination. This is one of the major problems in AODV, since every time a route is broken; a route discovery has to be initiated. This leads to more overhead, higher delays and high packet lost. On the other hand, DSR seems to be more stable and has less overhead than AODV. DSR can make use of multiple paths and does not send a periodic packet as AODV. Moreover, it stores all usable routing information extracted from overhearing packets. However, these Overheard route information could lead to inconsistencies. The two protocols Ad hoc On-Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) should be compared using simulation, it would be interesting to note the Behavior of these protocols on a real life test bed.

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