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## DYNAMIC SOURCE ROUTING-AN ONDEMAND ROUTING PROTOCOL IN MOBILE ADHOC NETWORKS

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**Abstract:** A mobile ad-hoc network is a group of wireless devices that communicate with each other without utilising any central management infrastructure. An ad-hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any pre-existing network infrastructure or centralized administration. An ad-hoc network uses different protocols for routing. Dynamic source routing is an on-demand routing protocol in MANETs. This paper discusses the advantages and disadvantages of DSR and generalizes the lessons learned from DSR so that they can be applied to the many other new routing protocols and techniques that have adopted the basic DSR framework.

**Keywords:** Dynamic Source Routing, DSR, On-demand routing, Reactive Routing Protocol.

### INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring network of mobile routers (and associated hosts) connected by wireless links, the union of which forms an arbitrary topology. This ad hoc networking technology provides "anytime" and "anywhere" services to the users, in a potentially large infrastructure-less wireless network, based on the collaboration among individual network nodes.

In recent years mobile ad hoc networks (MANETs) have become a very popular research topic. By providing communications in the absence of a fixed infrastructure MANETs are an attractive technology for many applications such as res-cue operations, tactical operations, environmental monitoring, conferences, and the like.

Routing protocols design for MANETs is a very active research area and many proactive and reactive protocols have been proposed. Design and analysis of routing protocols are the key issues in MANET. The primary goal of a MANET routing protocol is to establish a correct and efficient route between a pair of two hosts for delivering message in a timely manner. Many different routing protocols [4, 5] have been proposed for MANETs. They can be classified into two categories: proactive and reactive.

The Proactive routing approaches designed for ad hoc networks are derived from the traditional routing protocols. These protocols are sometimes referred to as table-driven protocols since the routing information is maintained in tables. Proactive approaches have the advantage that routes are available the moment they are needed. However, the primary disadvantage of these protocols is that the control overhead can be significant in large networks or in networks with rapidly moving nodes. Proactive routing protocol includes Destination-Sequenced Distance-Vector (DSDV) protocol, Wireless Routing Protocol (WRP), Optimized Link State Routing Protocol (OLSR) etc.

Reactive routing approaches take a departure from traditional Internet routing approaches by not continuously maintaining a route between all pairs of network nodes. Instead, routes are only discovered when they are actually needed. When a source node needs to send data packets to some destination, it checks its route table to determine whether it has a route. If no route exists, it performs a route discovery procedure to find a path to the destination. Hence, route discovery becomes on-demand. The drawback to reactive approaches is the introduction of route acquisition latency. That is, when a route is needed by a source node, there is some finite latency while the route is discovered.

In contrast, with a proactive approach, routes are typically available the moment they are needed. Hence, there is no delay to begin the data session. Reactive routing protocol includes Dynamic Source Routing (DSR) protocol, Ad hoc On-demand Distance Vector (AODV) protocol, Ad hoc On-demand Multiple Distance Vector (AOMDV) protocol etc.

### OVERVIEW OF DYNAMIC SOURCE ROUTING

The Dynamic Source Routing protocol (DSR) [1,2] is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. Using DSR, the network is completely self-organizing and self-configuring, requiring no existing network infrastructure or administration.

Network nodes cooperate to forward packets for each other to allow communication over multiple "hops" between nodes not directly within wireless transmission range of one another. As nodes in the network move about or join or leave the network, and as wireless transmission conditions such as sources of interference change, all routing is automatically determined and maintained by the DSR routing protocol.

Since the number or sequence of intermediate hops needed to reach any destination may change at any time, the

resulting network topology may be quite rich and rapidly changing.

DSR [3] is composed of the two main mechanisms: “Route Discovery” and “Route Maintenance” which are explained below:

#### **Route Discovery:**

Route Discovery aims at finding routes from a source node to destination. Figure-1 illustrates the procedure of Route Discovery. When a source node S wants to send a data packet to some destination node D, it first searches its route cache to find whether there is a route to D. If there is no route to D, then S will initiate a Route Discovery and send out Route Request message which is propagated to all the nodes within its transmission range.

At the mean time, it saves the data packet in its send buffer. The Route Request message contains the addresses of source node and destination node, a unique route request identifier and a route record which records all the intermediate nodes that this route request packet has travelled through. S appends itself to the beginning of the route record when it initiates the message.

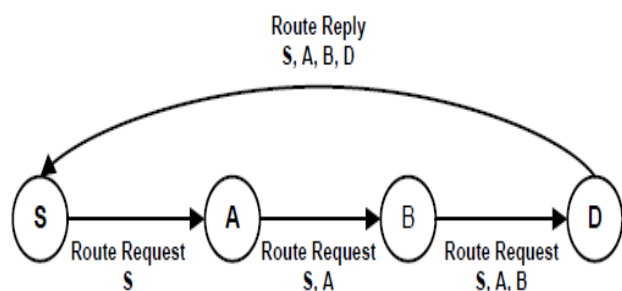


Figure 1: Route Discovery

When a node receives the Route Request message, it compares the destination address in the message with its own address to judge whether itself is the destination node. If it is not, it will append its own address in the route record and propagate the message to other nodes.

If the node is the destination node, it will send a Route Reply message to the source node and the message contains the source route record which is accumulated when the Route Request message is forwarded along its way to the destination. When the destination sends the Route Reply, if it uses MAC protocols such as IEEE 802.11 that require a bidirectional link, it just reverse the source route record and use it as route to send Route Reply to the source node. Otherwise it should find the route by searching its route cache or sending out a Route Request which piggybacks the Route Reply for the source node.

When the source node receives the Route Reply message, it puts the returned route into its route cache. From then on all the packets destined to the same destination will use this route until it is broken [1].

#### **Route maintenance:**

Since the ad hoc network is dynamic and the topology of the network changes frequently, the existing routes maintained by nodes in their route cache are often broken. After

forwarding a packet, a node must attempt to confirm the reachability of the next-hop node. If the node does not receive any confirmation from the next hop during a certain period of time, it will retransmit the packet. If after a maximum number of retransmission still does not receive any confirmation, it will think the link to the next hop is broken and will send a Route Error message to the source node.

DSR [6] proposes three acknowledge mechanisms to confirm that data can flow over the link from that node to the next hop:

- Link-layer acknowledgement which is provided by MAC layer protocol such as IEEE 802.11.
- Passive acknowledgement in which a node hears the next-hop node forwarding the packet and thus confirms the reachability of the link.
- Network-layer acknowledgement in which a node sends an explicit acknowledgement request to its next-hop node.

#### **Passive Acknowledgement:**

Passive Acknowledgement (PACK) is important because it is used to detect whether the next hop forwards the packet or drops it. Passive acknowledgement is used with the assumption that:

- Network links operates bi-directionally.
- The network interface is in the “promiscuous mode”.

When a node taps a new packet in “promiscuous mode” after it originates or forwards a packet, it consider it as an acknowledgement of the first packet if both of following check success [1]:

- The Source Address, Destination Address, Protocol, Identification, and Fragment Offset fields in the IP header of the two packets MUST match.
- If either packet contains a DSR Source Route header, both packets MUST contain one, and the value in the Segments Left field in the DSR Source Route header of the new packet MUST be less than that in the first packet.

If no matched packet is found during PACK timeout, the node will consider the link between the next hop and itself is broken and will send Route Error message to the source node [1,2].

#### **ADVANTAGES OF DSR**

- Routes are maintained only between nodes that need to communicate. This reduces the overhead of route maintenance.
- Route caching can further reduce route discovery overhead
- A single route discovery may yield many routes to the destination, due to intermediate nodes replying from local caches

#### **DISADVANTAGES OF DSR**

- Packet header size grows with route length due to source routing.
- Flood of route requests may potentially reach all nodes in the network.

- c. Potential collisions between route requests propagated by neighboring nodes
- d. Insertion of random delays before forwarding RREQ
- e. Increased contention if too many route replies come back due to nodes replying using their local cache.
- f. Route Reply Storm problem.
- g. Stale caches will lead to increased overhead

## OPTIMIZATIONS

Several optimizations to this basic protocol have been proposed and have been evaluated to be very effective by the authors of the protocol. Some of them are [7]:

- a. **Data Salvaging**– If an intermediate node encounters a broken link and has an alternate route to the destination in its cache, it can try to salvage the packet by sending it via the route from its cache. To avoid the packet to be salvaged endlessly, a counter is maintained in the packet to count the number of times that it has been salvaged.
- b. **Gratuitous Replies**– When a node overhears a packet not addressed to itself, it checks to see if the packet could be routed via itself to gain a shorter route. If so, the node sends a gratuitous reply to the source of the route with this new, better route. As shown in Figure 2, source node S sends a packet to destination node D along the source route  $S \rightarrow A \rightarrow B \rightarrow C \rightarrow D$ . If C snoops the packet forwarded by A and finds itself on the source route but it has not explicitly received the packet, C can confirm that node B is not necessary to participate in the forward and can be deleted from the source route. Then C sends a gratuitous route reply to notify source node S that there is a shortened route  $S \rightarrow A \rightarrow C \rightarrow D$ .

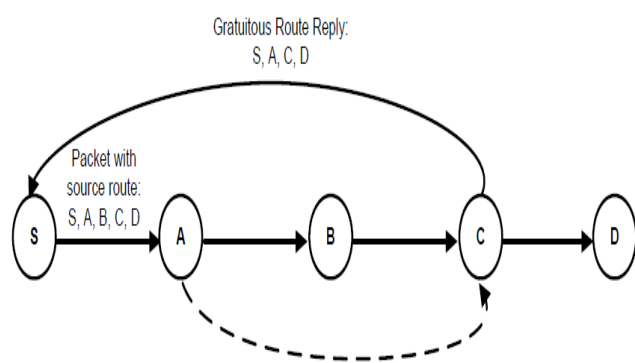


Figure 2: Gratuitous route reply

- c. **Route Snooping** – A node that overhears a data packet and does not have the route indicated in the packet's header in its own cache, adds the route to its cache for future use [7].

## CONCLUSION

Dynamic source routing protocol is an on-demand routing protocol in MANETs. It is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. Its main advantage is that routes are maintained only between nodes that need to

communicate. This reduces the overhead of route maintenance and drawback is that packet header size increases with route length due to source routing.

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