Chapter 3

Ad hoc On-Demand Distance Vector Routing

3.1 Introduction

An *ad hoc network* is often defined as an "infrastructureless" network, meaning a network without the usual routing infrastructure like fixed routers and routing backbones. Typically, the ad hoc nodes are mobile and the underlying communication medium is wireless. Each ad hoc node may be capable of acting as a router (see figure 3.1). Such ad hoc networks may arise in personal area networking, meeting rooms and conferences, disaster relief and rescue operations, battlefield operations, etc.

3.2 AODV

Ad Hoc On-Demand Vector Routing (AODV) protocol [36] is a reactive routing protocol for ad hoc and mobile networks that maintains routes only between nodes which need to communicate. The routing messages do not contain information about the whole route path, but only about the source and the destination. Therefore, routing messages do not have an increasing size. It uses destination sequence numbers to specify how fresh a route is (in relation to another), which is used to grant loop freedom.

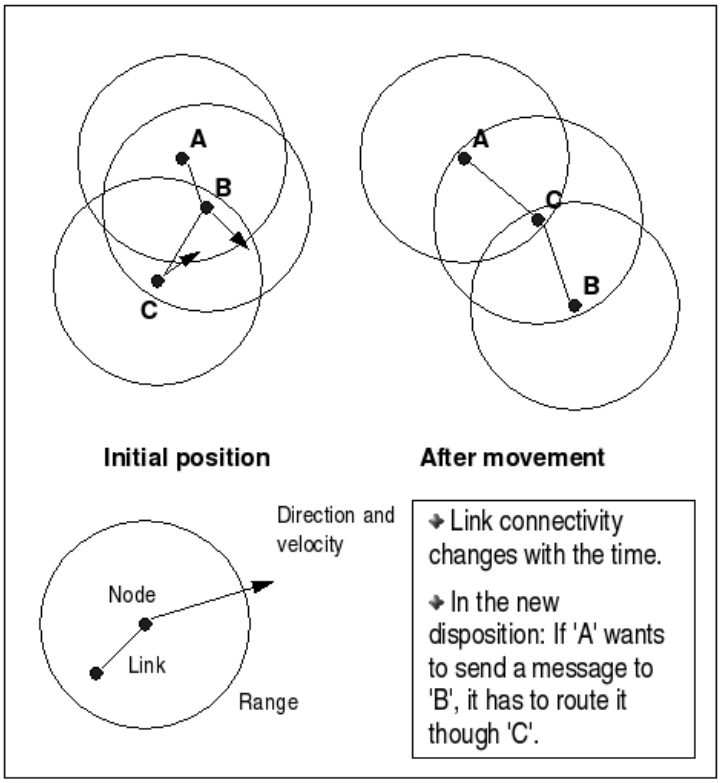

Figure 3.1: Mobility in Routing

Whenever a node needs to send a packet to a destination for which it has no 'fresh enough' route (i.e., a valid route entry for the destination whose associated sequence number is at least as great as the ones contained in any RREQ that the node has received for that destination) it broadcasts a route request (RREQ) message to its neighbors. Each node that receives the broadcast sets up a reverse route towards the originator of the RREQ, unless it has a 'fresher' one (figure 3.2).

When the intended destination (or an intermediate node that has a 'fresh enough' route to the destination) receives the RREQ, it replies by sending a Route Reply (RREP). It is important to note that the only mutable information in a RREQ and in a RREP is the hop count (which is being monotonically increased at each hop). The RREP is uncast back to the originator of the RREQ (figure 3.3). At each intermediate node, a route to

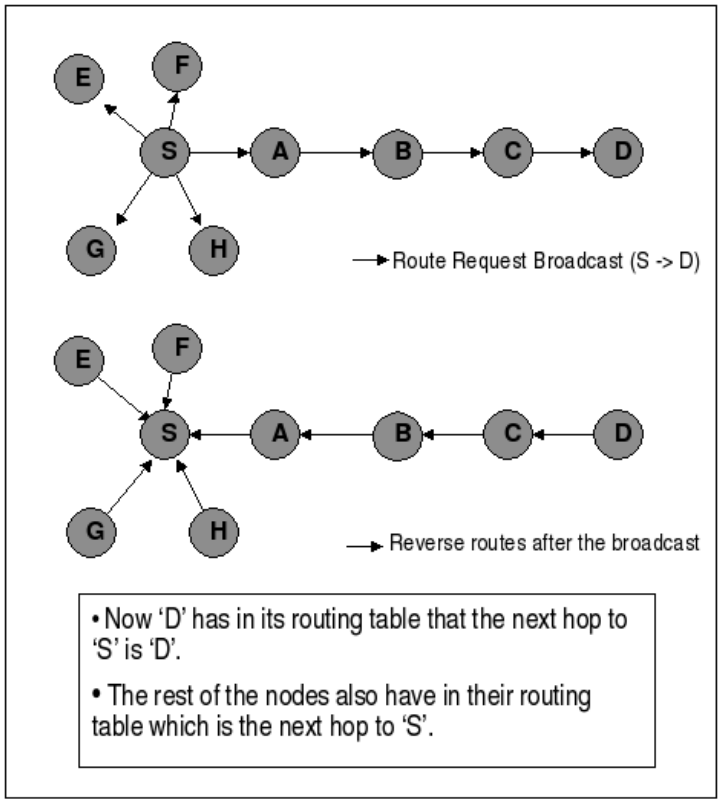

Figure 3.2: Route Request

the destination is set (again, unless the node has a 'fresher' route than the one specified in the RREP). In the case that the RREQ is replied to by an intermediate node (and if the RREQ had set this option), the intermediate node also sends a RREP to the destination. In this way, it can be granted that the route path is being set up bidirectionally. In the case that a node receives a new route (by a RREQ or by a RREP) and the node already has a route 'as fresh' as the received one, the shortest one will be updated.

If there is a subnet (a collection of nodes that are identified by a common network prefix) that does not use AODV as its routing protocol and wants to be able to exchange information with an AODV network, one of the nodes of the subnet can be selected as their 'network leader'. The network leader is the only node of the subnet that sends, forwards and processes AODV

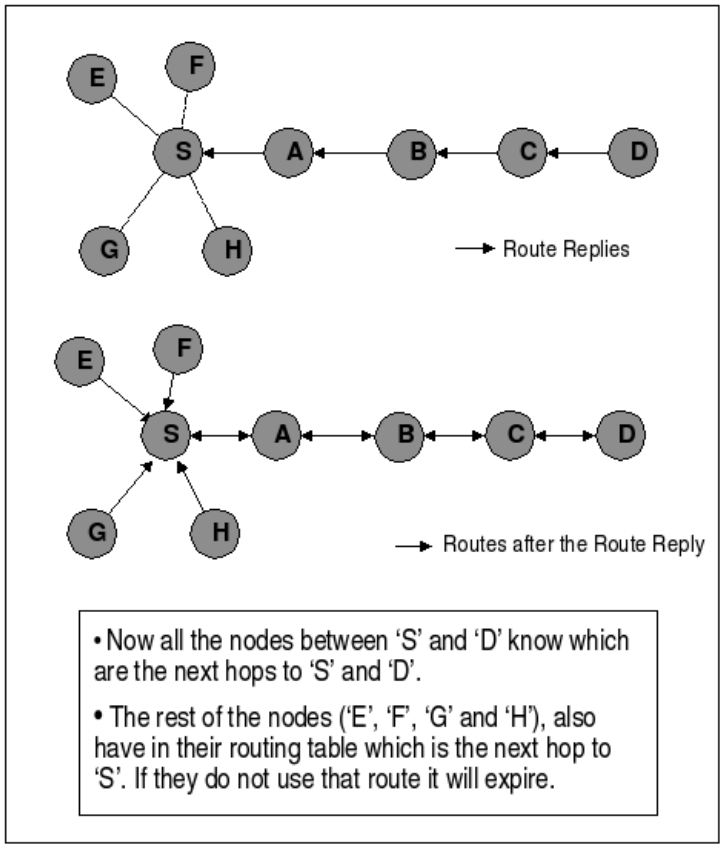

Figure 3.3: Route Reply

routing messages. In every RREP that the leader issues, it sets the prefix size of the subnet.

Optionally, a Route Reply Acknowledgment (RREP-ACK) message may be sent by the originator of the RREQ to acknowledge the receipt of the RREP. RREP-ACK message has no mutable information.

In addition to these routing messages, Route Error (RERR) message are used to notify the other nodes that certain nodes are not anymore reachable due to a link breakage (figure 3.4). When a node rebroadcasts a RERR, it only adds the unreachable destinations to which the node might forward messages. Therefore, the mutable information in a RERR are the list of unreachable destinations and the counter of unreachable destinations included

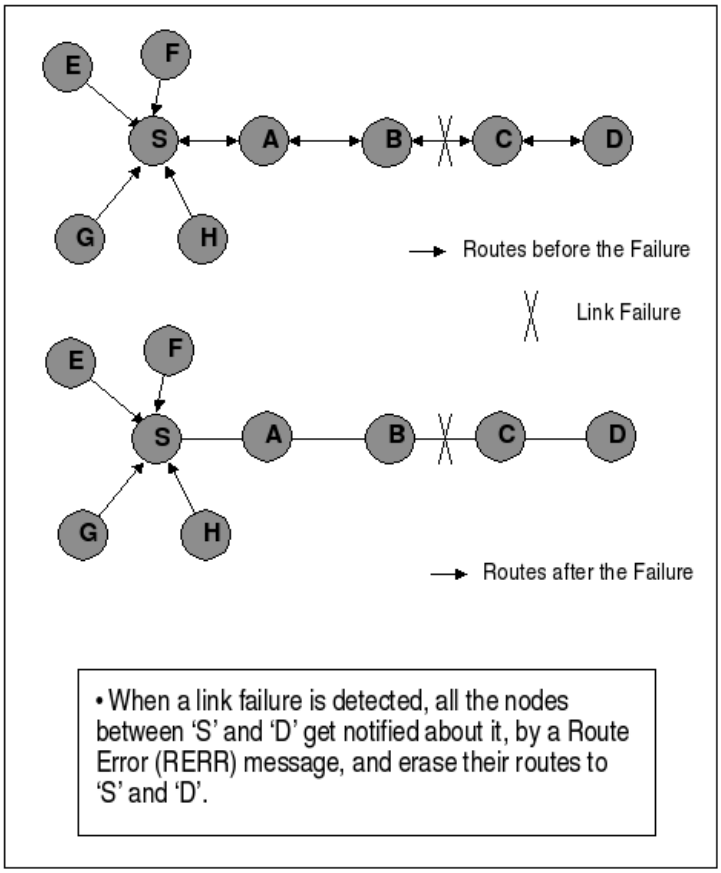

Figure 3.4: Route Error

in the message. Anyway, it is predictable that, at each hop, the unreachable destination list may not change or become a subset of the original one.

3.3 AODV Message Formats

The figures show the structure of the AODV messages and indicate what are the mutable fields of the messages.

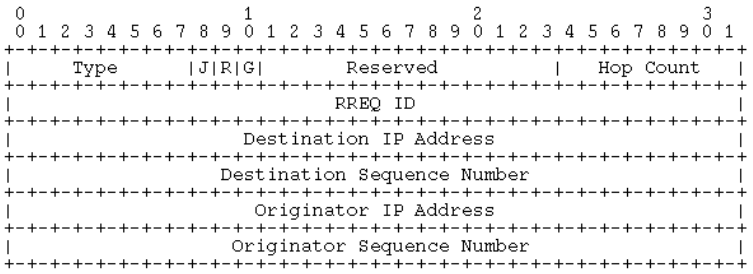

Figure 3.5: Route Request (RREQ) Message Format
Mutable fields: Hop Count

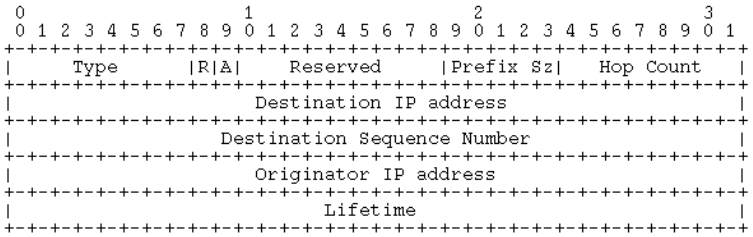

Figure 3.6: Route Reply (RREP) Message Format
Mutable fields: Hop Count

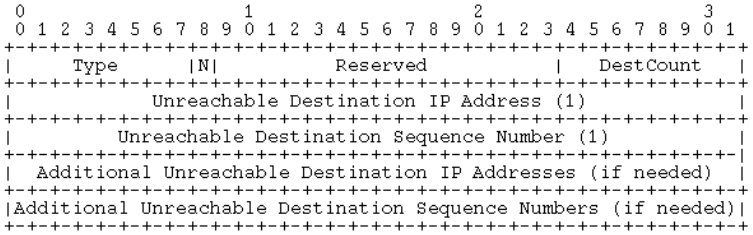

Figure 3.7: Route Error (RERR) Message Format
Mutable fields: None

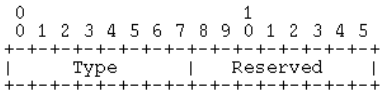

Figure 3.8: Route Reply Acknowledgment (RREP-ACK) Message Format
Mutable fields: None