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Routing Mechanics of on-Demand Route Discovery of Aodv

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ABSTRACT *Wireless mobile ad-hoc networks are characterized as networks without any physical connections. In these networks there is no fixed topology due to the mobility of nodes, interference, multipath propagation and path loss. Hence a dynamic routing protocol is needed for these networks to function properly. Many Routing protocols have been developed for accomplishing this task. The purpose of this thesis is to give the brief introduction of Routing Protocols and mainly study, understand, analyze, discuss and evaluate the performance of mobile ad-hoc routing protocol AODV. The AODV is a reactive protocol, which finds a route to a destination on demand, whenever communication is needed. Considering the bandwidth, throughput and packet loss, in AODV routing protocol, AODV is suited for general Ad-hoc networks.*

KEYWORDS :

I. Introduction:
Ad hoc network is a wireless network, which do not have a centralized and fixed infrastructure. MANET is referred to as a wireless ad hoc network in which nodes are free to move arbitrarily and mobile nodes can transmit and receive the traffic. Also mobile nodes can act like routers by forwarding the neighbors traffic to the destination node as the routers are multi hop devices. MANET does not need base stations of wired infrastructure. The mobile nodes in wireless network range can communicate with each other because it is a self organized network. The mobile nodes form a network automatically without a fixed infrastructure and central management. The mobile nodes have transmitters and receivers with smart antennas, which enable the mobile nodes to communicate with each others.

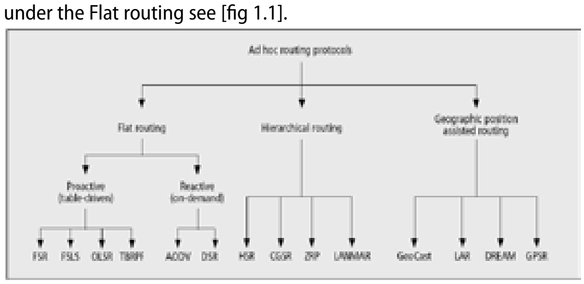
In the beginning MANET was designed for military use but now the MANET is used in many areas. Such as in disaster hit areas, data collection in some region, in rescue missions, virtual classes and conferences. Intrusion detection technique is investigated in MANET for security purpose Mobile nodes in the network waste much energy by joining in and out with connection to wireless network. This connection and reconnection create energy limitation in the wireless network. The main purpose of developing the ad hoc routing protocols is to cope with the dynamic nature of MANET. The routing protocols efficiency can be determined by the battery power consumption. Energy is consumed during participation of a node in a network and also in routing of traffic.

II. Ad hoc Networks Routing Protocols
Routing is the act of moving information from a source to a destination in an internetwork. During this process, at least one intermediate node within the internetwork is encountered. 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. Routing has two basic types, which are as under.1) Static routing: is done by the administrator manually to forward the data packets in the network and it is permanent. 2) Dynamic Routing is automatically done by the choice of router. It can route the traffic on any route depend on the routing table. Dynamic routing uses different paths to forward the data packets. Dynamic routing is better than static routing.

Classification of Dynamic Routing Protocols
Dynamic routing protocols are classified depending on what the routers tell each other and how they use the information to form their routing tables.

Distance Vector Protocols:
Using a distance vector protocol, the router simply forwards the packet to the neighbouring host (or destination) with the available shortest path in the routing table and assumes that the receiving router will know how to forward the packet beyond that point. The best example for this is the routing information protocol (RIP). Moreover to say the routers sends two pieces of information first, the router tells, how far it thinks the destination is and secondly, it tells in what direction (vector) to use to get to the destination. **Link State Protocols:** In link state protocols, a router doesn't provide the information about the destination instead it provides the information about the topology of the network. This usually consists of the network segments and links that are attached to that particular router along with the state of the link.

Classification of routing Protocols in MANET's
Classification of routing protocols in MANET's depending on routing strategy and network structure. According to the routing strategy the routing protocols can be categorized as Table-driven and source initiated, while depending on the network structure these are classified as flat routing, hierarchical routing and geographic position assisted routing. Both the Table-driven and source initiated protocols come under the Flat routing see [fig 1.1].



[Figure 1.1: Classification of Routing Protocols In Mobile Ad-hoc Networks]

Table-Driven Routing Protocols (Proactive):
These protocols are also called as proactive protocols since they maintain the routing information even before it is needed. Routes information is generally kept in the routing tables and is periodically updated as the network topology changes. Proactive protocols are not suitable for larger networks, as they need to maintain node entries for each and every node in the routing table of every node. This causes more overhead in the routing table leading to consumption of more bandwidth.

On Demand Routing Protocols (Reactive)
These protocols are also called reactive protocols since they don't maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery usually occurs by flooding the route request packets throughout the network.

III. Ad-hoc On-Demand Distance Vector (AODV) Protocol
The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multi hop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. One distinguishing feature of AODV is its use of a destination sequence

number for each route entry. The destination sequence number is created by the destination to be included along with any route information it sends to requesting nodes. Using destination sequence numbers ensures loop freedom and is simple to program. Given the choice between two routes to a destination, a requesting node is required to select the one with the greatest sequence number. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. These message types are received via UDP, and normal IP header processing applies.

AODV Terminology

This protocol specification uses conventional meanings for capitalized words such as MUST, SHOULD, etc., to indicate requirement levels for various protocol features. This section defines other terminology used with AODV that is not already defined in.Active route, broadcast, destination, forwarding node, forward route, invalid route, originating node, reverse route, sequence number.

Applicability Statement

The AODV routing protocol is designed for mobile ad hoc networks with populations of tens to thousands of mobile nodes. AODV can handle low, moderate, and relatively high mobility rates, as well as a variety of data traffic levels. AODV is designed for use in networks where the nodes can all trust each other, either by use of preconfigured keys, or because it is known that there are no malicious intruder nodes. AODV has been designed to reduce the dissemination of control traffic and eliminate overhead on data traffic, in order to improve scalability and performance.

1. Route Request (RREQ) Message Format

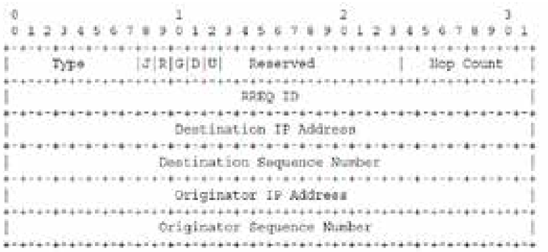


Figure 1.2: Route Request (RREQ) Message Format

Table 1.1 The format of the Route Request message Type 1

Type	1
J	Join flag; reserved for multicast
R	Repair flag; reserved for multicast.
G	Gratuitous RREP flag; indicates whether a gratuitous RREP should be unicast to the node specified in the Destination IP Address field.
D	Destination only flag; indicates only the destination may respond to this RREQ
U	Unknown sequence number; indicates the destination sequence number is unknown.
Reserved	Sent as 0; ignored on reception
Hop Count	The number of hops from the Originator IP Address to the node handling the request.
RREQ ID	A sequence number niquely identifying the particular RREQ when taken in conjunction with the originating node's IP address.
Destination Sequence Number	The latest sequence number received in the past by the originator for any route towards the destination.
Destination IP Address	The IP address of the destination for which a route is desired.
Originator IP Address	The IP address of the node which originated the Route Request.
Originator Sequence Number	The latest sequence number received in the past by the originator for any route towards the destination.

2. Route Reply Message Format

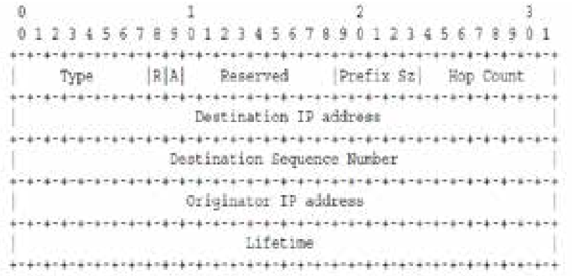


Figure 1.3: Route Reply Message Format

Table 1.2 The format of the Route Reply message Type 2

Type	2
R	Repair flag; used for multicast.
A	Acknowledgment required
Reserved	Sent as 0; ignored on reception.
Prefix Size	If nonzero, the 5-bit Prefix Size specifies that the indicated next hop may be used for any nodes with the same routing prefix (as defined by the Prefix Size) as the requested destination.
Hop Count	The number of hops from the Originator IP Address to the Destination IP Address. For multicast route requests this indicates the number of hops to the multicast tree member sending the RREP.
Destination IP Address	The IP address of the destination for which a route is supplied.
Destination Sequence Number	The destination sequence number associated to the route.
Originator IP Address	The IP address of the node which originated the RREQ for which the route is supplied. Lifetime The time in milliseconds for which nodes receiving the RREP consider the route to be valid.

0.0.1 Route Error (RERR) Message Format

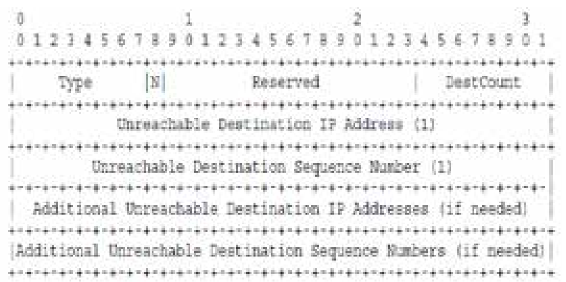


Figure 1.4: Route Error Message Format

Table 1.3 The format of the Route Error message Type 3

Type	3
N	No delete flag; set when a node has performed a local repair of a link, and upstream nodes should not delete the route.
Reserved	Sent as 0; ignored on reception.
DestCount	The number of unreachable destinations included in the message; MUST be at least 1.
Unreachable Destination IP Address	The IP address of the destination that has become unreachable due to a link break.
Unreachable	The sequence number in the route table entry for the destination listed in the previous Dest Seq No.

The RERR message is sent whenever a link break causes one or more destinations to become unreachable from some of the node's neighbors.

0.0.2 Route Reply Acknowledgment Message Format

The Route Reply Acknowledgment message MUST be sent in response to a RREP message with the 'A' bit set .This is typically done when there is danger of unidirectional links preventing the completion of a Route Discovery cycle.

```
 0                   1
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |   Reserved    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1.5: Route Reply Acknowledgment Message Format

Table 1.4 The format of the Route Error message Type 4

Type	4
Reserved	Sent as 0; ignored on reception.

AODV Operation

This section describes the scenarios under which nodes generate Route Request (RREQ), Route Reply (RREP) and Route Error (RERR) messages for unicast communication towards a destination, and how the message data are handled. In order to process the messages correctly, certain state information has to be maintained in the route table entries for the destinations of interest.

- Maintaining Sequence Numbers
- Route Table Entries and Precursor Lists
- Generating Route Requests
- Controlling Dissemination of Route Request Messages
- Processing and Forwarding Route Requests
- Generating Route Replies
- Receiving and Forwarding Route Replies
- Operation over Unidirectional Links
- Hello Messages
- Maintaining Local Connectivity
- Route Error (RERR) Messages, Route Expiry and Route Deletion
- Local Repair
- Actions After Reboot

Conclusion

AODV is better as it doesn't maintain any routing tables at nodes which results in less overhead and more bandwidth. From the above, chapters, it can be assumed that, AODV routing protocol is best suited for general mobile ad-hoc networks as it consumes less bandwidth and lower overhead.

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