ISSN No. 0976-5697

Volume 2, No. 5, Sept-Oct 2011

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Implementation of Ad-hoc On Demand Distance Vector Routing (AODV) in Mobile Ad-hoc networks

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Abstract: A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using any centralized access point, infrastructure, or centralized administration. To establish a data transmission between two nodes, typically multiple hops are required due to the limited transmission range. Mobility of the different nodes makes the situation even more complicated. Multiple routing protocols especially for these conditions have been developed during the last years, to find optimized routes from a source to some destination. Ad Hoc On-Demand Vector Routing (AODV) which is one of the protocols used in MANET . AODV has been designed for use in ad hoc mobile networks. It allows users to find and maintain routes to other users in the network whenever such routes are needed. Creating a working implementation of an ad hoc routing protocol is non-trivial and more difficult than developing a simulation . This paper explains the implementation of Ad Hoc On-Demand Vector Routing(AODV) in variable network sizes up to few nodes.

Keywords: MANET, AODV, RREQ, RREP, RRER

I. INTRODUCTION

A collection of mobile hosts with wireless network interfaces may form a temporary network without the aid of any established infrastructure or centralized administration. This type of wireless network is called ad hoc network. Ad hoc networks are a new wireless networking paradigm for mobile hosts, unlike traditional mobile wireless networks, ad hoc networks do not rely on any fixed infrastructure. Instead, hosts rely on each other to keep the network connected. They can be set up anywhere without any need for external infrastructure.

A mobile ad hoc network (MANET) is a self-configuring infra-structure less network of mobile devices connected by wireless links. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic.

Network or MANET is a type of ad hoc network that can change locations and configure itself on the fly. Because MANETS are mobile, they use wireless connections to connect to various networks. This can be a standard Wi-Fi connection, or another medium, such as cellular or satellite transmission .The mobile nodes that are in range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. A MANET provides network connectivity between mobile nodes over potentially multi-hop wireless channels mainly through link-layer protocols that ensure one-hop connectivity, and network-layer protocols that extend the connectivity to multiple hops. These distributed protocols typically assume that all nodes are cooperative in the coordination process.

An infra-structured network (Figure 1(a)) consists of wireless mobile nodes and one or more bridges, which connect the wireless network to the wired network. These bridges are called *base stations*. A mobile node within the network searches for the nearest base station (e.g. the one with the best signal strength), connect to it and communicates with it. The important fact is that all communication is taking place between the wireless node and the base station but not between different wireless nodes. While the mobile node is travelling around and all of a sudden gets out of range of the current base station, a handover to a new base station will let the mobile node communicate seamlessly with the new base station. In contrary to infra-structured networks, an ad-hoc network lacks any infrastructure. There are no base stations, no fixed routers and no centralized administration. All nodes may move randomly and are connecting dynamically to each other. Therefore all nodes are operating as routers and need to be capable to discover and maintain routes to every other node in the network and to propagate packets accordingly. Mobile ad-hoc networks may be used in areas with little or no communication infrastructure: think of emergency searches, rescue operations, or places where people wish to quickly share information, like meetings etc[1].

Figure.1(a):A mobile ad-hoc network

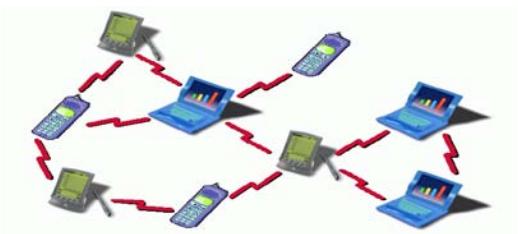

Figure. 1(b) : Mobile Network

Figure 1.Mobile networks

II. CHARACTERSTICS OF MANET

A. Dynamic Topologies:

Adhoc networking topologies are dynamic in nature because nodes can move unpredictably. Links between nodes can be broken at any time because of arbitrary movements of nodes. This feature makes it difficult to implement routing protocol for mobile adhoc networks.

B. Limited Bandwidth:

In ad-hoc network, nodes have to rely on wireless links for communicating with each other. Usually wireless link have less bandwidth than that of traditional wired link.

C. Energy Conservation:

Most ad hoc nodes have limited power supply and no capability to generate their own power. Some or all of the nodes in a MANET may rely on batteries or other exhaustible means for their energy.

D. Physical security:

Mobile wireless networks are generally more prone to physical security threats than are fixed-cable nets. The increased possibility of eavesdropping, spoofing and denial-of-service attacks should be carefully considered. As a benefit, the decentralized nature of network control in MANETs provides additional robustness against the single points of failure of more centralized approaches.

III. MESSAGE ROUTING

The foundation of any protocol is the method used to route its messages, and the primary concern of any routing method should be efficient and guaranteed delivery of information to its intended recipients. Current protocols handle message routing through centralized servers that maintain end-to-end connections with each client. When a user sends a message, the client sends it to the server through their end to-end connection and the server relays it on to the target via another connection. A peer-to-peer instant messaging protocol will not have a central server so it must have a method of routing messages in a distributed manner. When routing instant messages, there is an additional concern of keeping the messages private from eavesdroppers.

IV. AD-HOC ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL

There is a growing need for communication protocols which allow users of these devices to communicate over wireless links. To allow such on-the-fly formation of networks, the Ad hoc On-Demand Distance Vector (AODV) routing protocol has been developed. AODV has been designed for use in ad hoc mobile networks. It allows users to find and maintain routes to other users in the network whenever such routes are needed. Creating a working implementation of an ad hoc routing protocol is non-trivial and more difficult than developing a simulation. In simulation, the developer controls the whole system, which is in effect only a single component. An implementation, on the other hand, needs to interoperate with a large, complex system. Some components of this system are the operating system, sockets, and network interfaces. Additional implementation problems surface because current operating systems are not built to support ad hoc routing protocols. A number of required events are unsupported; support for these events must be added. Because these events encompass many system components, the components and their interactions must also be explored. For these reasons it takes significantly more effort to create an ad hoc routing protocol implementation than a simulation.

AODV routing protocol has 3 controlling information

a. Routing request(RREQ)
b. Routing response(RREP)
c. Routing error(RRER)

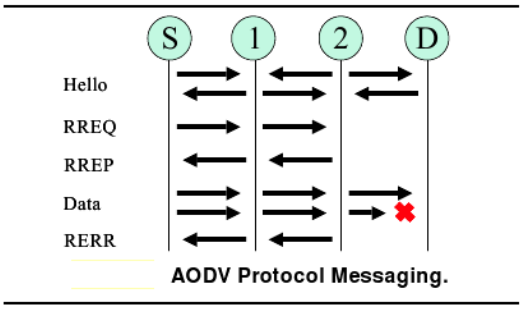

Figure 2.AODV Protocol Messaging

The AODV routing protocol is a reactive routing protocol; therefore, routes are determined only when needed. The Figure shows the message exchanges of the AODV protocol.

Hello messages may be used to detect and monitor links to neighbors. If Hello messages are used, each active node periodically broadcasts a Hello message that all its neighbors receive. Because nodes periodically send Hello messages, if a node fails to receive several Hello messages from a neighbor, a link break is detected. When a source has data to transmit to an unknown destination, it broadcasts a Route Request (RREQ) for that destination. At each intermediate node, when a RREQ is received a route to the source is created. If the receiving node has not received this RREQ before, is not the destination and does not have a current route to the destination, it rebroadcasts the RREQ. If the receiving node is the destination or has a current route to the destination, it generates a Route Reply (RREP). The RREP is unicast in a hop-by-hop fashion to the source. As the RREP propagates, each intermediate node creates a route to the destination. When the source receives the RREP, it records the route to the destination and can begin sending data. If multiple RREPs are received by the source, the route with the shortest hop count is chosen.

As dataflows from the source to the destination, each node along the route updates the timers associated with the routes to the source and destination, maintaining the routes in the routing table. If a route is not used for some period of time, a node cannot be sure whether the route is still valid; consequently, the node removes the route from its routing table.

If data isflowing and a link break is detected, a Route Error (RERR) is sent to the source of the data in a hop-by-hop fashion. As the RERR propagates towards the source, each intermediate node invalidates routes to any unreachable destinations. When the source of the data receives the RERR, it invalidates the route and reinitiates route discovery if necessary.[3]

Much of the complexity of the protocol is to lower the number of messages to conserve the capacity of the network. For example, each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a “time to live” number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request.

The RREQ has the following fields:
<source_addr,source_sequence-#,broadcast_id,dest_addr,dest_sequence_#,hop_cnt>

Table-1 shows RREQ packet format

Type	Reserved	Hop count
Broadcast ID		
Destination IP Address		
Source IP Address		
Source sequence Number		
Request Time		

Table 1. RREQ Packet Format

The route reply packet contains the following fields:
<source_addr, dest_addr, dest_sequence#, hop_cnt, lifetime>

Algorithms:

Steps performed upon receiving the broadcast packet

a. Listen to broadcast packet(such as RREQ,RREP)
b. if the packet is duplicate then
c. discard it
d. else
e. Search an item to the destination in hops table
f. If there is an item in the hops table then
g. Stop the hop counts as XL
h. calculate and update N,M and D.
i. else
j. Create an item to this target in hops table
k. store the hop counts as XL
l. calculate and update N,M and D
m. end if
n. end if

Steps performed upon sending a data packet

a. Search route table
b. If a valid route is found then
c. Send data
d. Else
e. search hops table
f. If there is an item to the destination then
g. calculate H
h. Set initial TTL equal to H
i. Else if no item is found then
j. Flooding
k. end if
l. end if

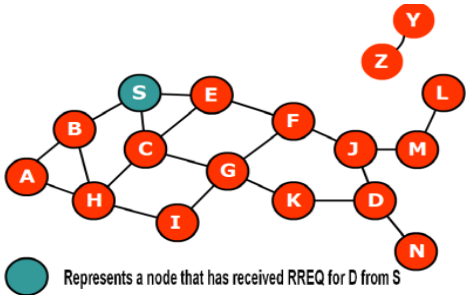

Figure 3. AODV Routing

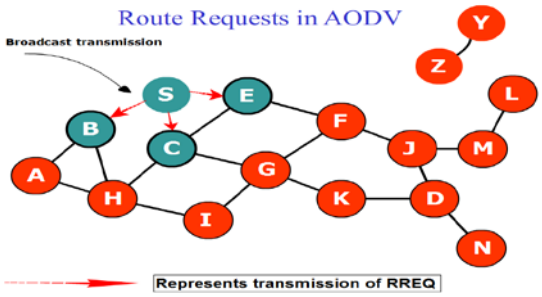

Figure 4. Route Requests in AODV

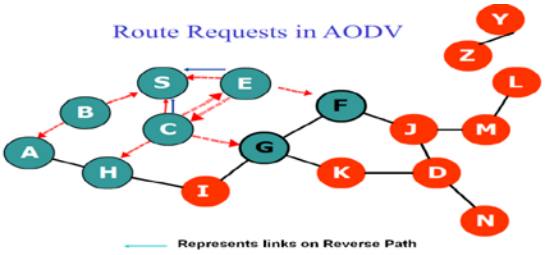

Figure 5. Route Requests in AODV

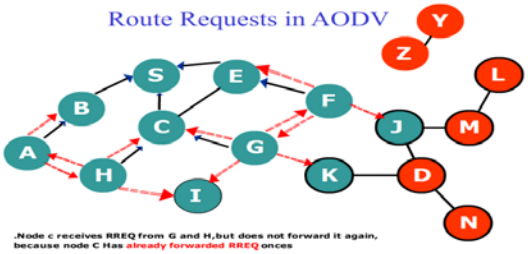

Figure 6. Route Requests in AODV

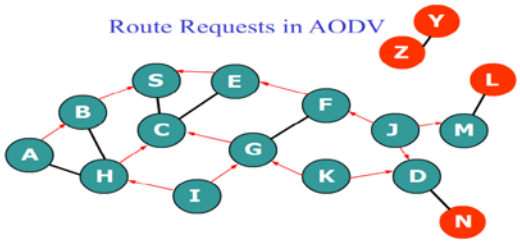

Figure 7. Route Requests in AODV

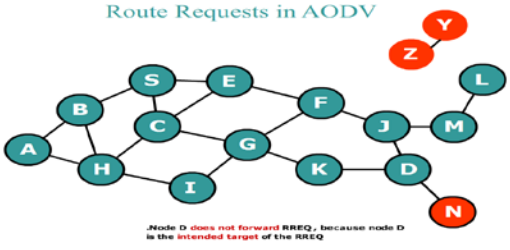

Figure 8. Route Requests in AODV

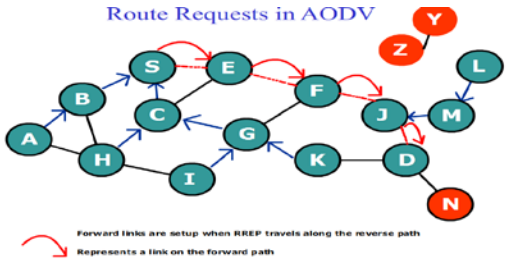

Figure 9.Route Request in AODV

V. CONCLUSION

In mobile ad-hoc networks, with the unique characteristic of being totally independent from any authority and infrastructure, there is a great potential for the users. Ad hoc networks is one of the evolving research and application area in wireless communication The network finds its need in various fields such as battle fields, natural disaster etc. where no communication system provided to be better. However, this network is constrained by its own limitation and results in lower performance in real time scenario. This paper tried to explain the implementation of Ad hoc On Demand Distance Vector Routing Protocol for message routing, which will display the route in which the message is being transmitted from source to destination a node among a set of systems connected through ad hoc network.

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