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On Demand Route Routing Protocol (ODRRP) for MANET

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Abstract— ***Mobile ad hoc networks (MANET) play an important role in connecting devices in pervasive environments. Each node in MANET can act as source and router. In this paper, we propose a On Demand Route Routing Protocol (ODRRP) with Broadcast Reply which combines the merits of both proactive and reactive approach. Like proactive approach, it maintains routing table at every node. However, it differs from proactive approach; that the routing table is not built prior to communication. Routing table is built in incremental steps during route discovery. Route discovery takes place like reactive approach only on demand. ODRRP takes advantage of broadcast nature in MANET for route discovery and store maximum information in the routing tables at each node. Broadcast natures avoid handshaking of RTS and CTS and effectively utilize trans-receiver antennas which reduce power consumption and effectively utilize bandwidth. The simulation of ODRRP carried out in network simulator (NS-2.32) which shows significant improvement in packet delivery ratio.***

Keywords— ODRRP, MANET, Proactive, Reactive,Topology.

I. INTRODUCTION

On Demand Route Routing Protocol proposed in the paper takes the advantage of both proactive and reactive routing protocol. Like proactive protocols, it maintains a routing table at each node. However, it differs from it in the way the routing table is constructed and maintained. Unlike proactive routing protocol, it does not exchange the routing table information among the nodes. The routing table at each node is built in incremental steps. Like reactive routing protocol, the source initiates route discovery only on-demand. It uses the route request (RREQ) and route reply (RREP) packet of reactive routing protocol. Routing table in our propose protocol is built during the route discovery phase and is not exchanged along the nodes.

To build routing table, it extracts necessary information from the RREQ and RREP packets. Propose protocol does not require exchange of hello message required in proactive routing protocol, needed to maintain up-to-date information. It uses the route error message of reactive routing protocol in case of link failure. A node having packet to transmit, first checks its routing table for an existence of path to destination. If an entry exists to the destination, then the packet is forwarded to the next node along the path to destination. For non existence of path, it initiates a route discovery to the destination. The structure of routing table is shown in Table 1. It consists of following three entries:

- Dest: Destination node of packet,
- Next hop: Next hop on the path to destination,
- Hop Count: Hop distance to destination from the current node,
- Bid: Broad Cast ID

Table 1: Structure of Routing Table

Dest	Next hop	Hop Count	Bid
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The format of RREQ packet is shown in Figure 1. Meaning of each Field of the RREQ/RREP packet is explained below:

- Src - Source of packet.
- Dest - Destination of the packet.
- Prev node - Previous node address.
- Hop count - Noumber of hops traversed by the packet.
- Bdid - Broadcast id.

Src	Dest	Prev node	Hop Count	Bdid

Figure 1: Format of RREQ/RREP Packet

The process of route discovery and routing table updates in HRP are explained below.

II. ROUTE DISCOVERY IN ON DEMAND ROUTE ROUTING PROTOCOL

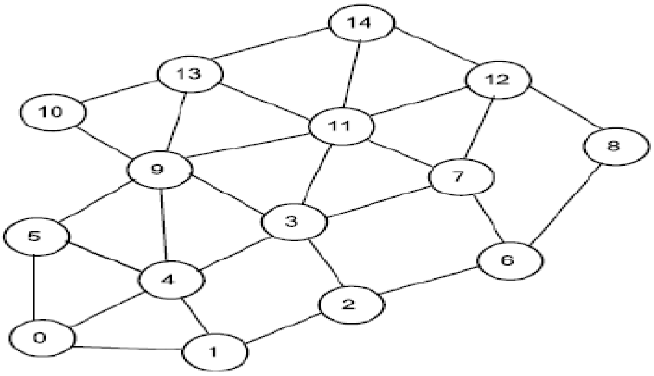

Figure 2: Network Topology

To explain the mechanism of route discovery and routing table updates we consider Network Topology shown in Figure 2. Assume that node *0* has some packet to transmit to node *14*. Initially, routing table maintained at each node is empty. A node on receiving RREQ/RREP packet extracts necessary information and enters into the routing table. Since node *0* has no path to node *14*, a route discovery process is initiated. Node *0* broadcast RREQ packet. As shown in Figure 4.

0	14	5	2	1

0	14	4	2	1

0	14	1	2	1

Figure 3: Rebroadcast of RREQ Packet from node 0 by
(a) Node 5, (b) Node 4 and (c) Node 1.

Nodes within the transmission range of node *0* i.e. node *5, 4* and *1* receives the packet shown in Figure 3 and start building their routing table. The routing table at node and *5, 4* after processing RREQ is as shown in Table 2 and 3.

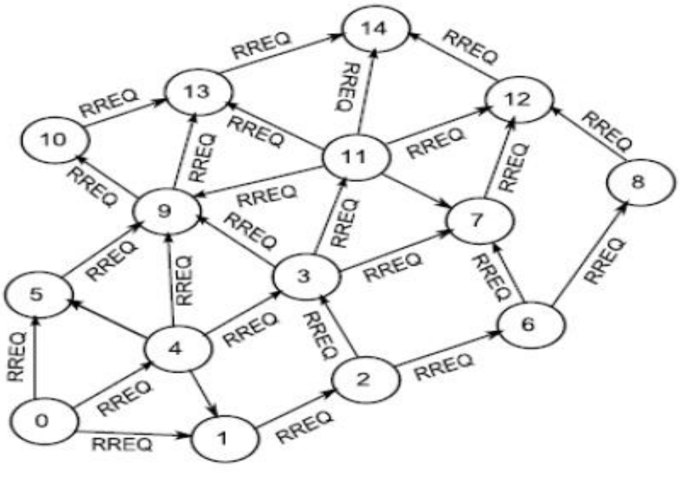

Figure 4: Process of Broadcasting RREQ packet

Table 2: Routing Table at Node 5

Dest	Next hop	Hop Count	Bid
0	0	1	1

Table 3: Routing Table at Node 4

Dest	Next hop	Hop Count	Bid
0	0	1	1

After processing the RREQ packet node 5 , 4 and 1 rebroadcast it updating the Prev node and Hop Count field of packet as shown in Figure 3. Intermediate nodes on receiving the RREQ packet make an entry in their routing table for the source and the neighboring nodes from which it has received the RREQ packet. The entry for the neighboring nodes has a hop count of one only. Table 4 and 5 shows the routing table at node 11 and 14 respectively after processing received RREQ packet which is flooded in the network due to broadcasting. Figure 4 shows the propagation of RREQ packet from Node 0 to Node 14.

Table 4: Routing Table at Node 11

Dest	Next Hop	Hop Count	Bid
0	3	3	1
3	3	1	1
9	9	1	1
7	7	1	1
13	13	1	1
12	12	1	1

Table 5: Routing Table at Node 14

Dest	Next Hop	Hop Count	Bid
0	11	4	1
11	11	1	1
13	13	1	1
12	12	1	1

Having a route (entry in its routing table) to the destination. There are two ways in which a destination can send the RREP packet. Destination node can either broadcast or unicast the RREP packet. In this paper we are concentrating on Broadcasting of Reply packet hence the name Hybrid Routing Protocol with Broadcast Reply.

III. ON DEMAND ROUTE ROUTING PROTOCOL WITH BROADCAST REPLY

In, On Demand Route Routing Protocol with Broadcast Reply, destination node broadcast the RREP packet to its neighboring nodes which are within its transmission range. These nodes, update their routing table by making an entry for the source and forwarding node of RREP packet. Node which is on the active path of the RREP packet rebroadcast it to its neighboring nodes where as other node simply drops the received reply packet(REEP) after making necessary entries in corresponding routing table. In our example, node 14 broadcast the RREP packet which is received by its neighboring node *11, 12* and *13*. Nodes 12 and 13 are not on the active path of the RREP packet. Therefore, the RREP packet is dropped at node 12 and 13 after updating the routing table as shown in table 7 & 6 respectively. Node 11 rebroadcast it which will be again processed by the neighboring nodes. During the propagation of RREP packet, the next hop field of RREP packet is updated to the next hop node on the path. This process of routing table updating and rebroadcast of RREP continues until it reaches the destination node 0. Routing table at node 0 after processing the RREP packet is shown in table 8. Thereafter, node 0 updates it routing table and start sending data packets to the next hop node 4 on the path to node 14.This next hope information is retrieved from routing table of node *0*. In the example, we have assumed that node *0* called source node has data packets to transmit to destination node 14. The process of RREP transmission is shown in Figure 5.

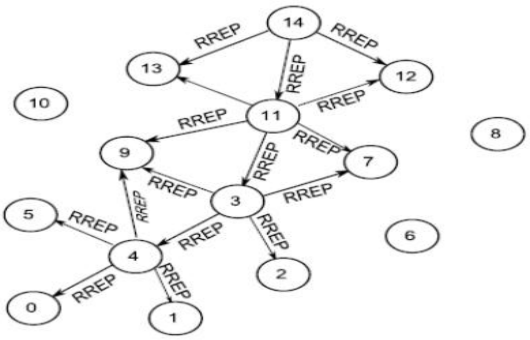

Figure 5: Process of RREP Transmission in the Network

Table 6: Routing Table at Node 13 after processing RREP Packet

Dest	Next Hop	Hop Count	Bid
0	9	3	1
10	10	1	1
9	9	1	1
11	11	1	1

14	14	1	1

Table 7: Routing Table at Node 12 after processing RREP Packet

Dest	Next Hop	Hop Count	Bid
0	11	4	1
7	7	1	1
8	8	1	1
11	11	1	1
14	14	1	1

Table 8: Routing Table at Node 0 after processing RREP Packet

Dest	Next Hop	Hop Count	Bid
5	5	1	1
4	4	1	1
1	1	1	1
14	4	4	1

IV. ROUTE MAINTENANCE IN ON DEMAND ROUTE ROUTING PROTOCOL

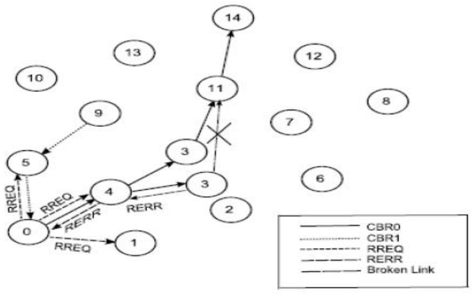

Figure 6: Route Maintenance in ODRRP

To explain route maintenance in ODRRP, consider network topology shown in Figure 6. Suppose node *3* has moved out of the communication range of node *4*, while data packets are transmitted from node *0* to node *14*. Node *4* on receiving data packet from node 0, send RTS packet to next hop node *3* on the path to destination node *14* and waits for a CTS packet.

Since node *3* has moved out of transmission range of node *4*, the RTS packet fails to reach node *3*; hence no CTS reply from node *3*. Non-receive of CTS reply from node *3* is detected as link failure by node *4*. So, a route error message(RERR), is sent from node *4* to node *0*.After receiving RERR message, node *0* invalidate the route entry for node *14* in its routing table and initiates a new route discovery for node *14* with a the next broadcast id. Intermediate nodes, that have an entry for node *0* in their routing table, update it accordingly when they receive the new RREQ packet. For example, node *11* receives the RREQ packet from node *0* with a higher broadcast id. Let this RREQ packet has followed the path 0 / 4/ 9 / 11. In the routing table for node *11*, there exists an entry with node *3* as the next hop node for destination node *0*; shown in Table 4. Since, the broadcast id is higher than that exist in the routing table, node *11* update the entry for node *0* as shown in Table 6. Here we assume that, when a node re-initiates a route discovery process, it increments the current broadcast id in its routing table by *one*, which becomes the new broadcast id for the RREQ packet. Intermediate nodes, update their routing table based on the value of broadcast id.

V. SIMULATION RESULTS

We have used NS 2.32 network simulator on Linux platform having operating system Fedora 8. For simulation, we consider *node* network as shown in Figure 2 and CBR traffics are considered as given below.

CBR 0: From Node 1 to Node *2*, start time is 10.*0,* when network load is 3
CBR 1: From Node 2 to Node 5, start time is *10.0,* when network load is 6
CBR 2: From Node *3* to Node *8*, start time is *10.0,* when network load is 9
CBR 3: From Node *4* to Node *11*, start time is *10.0,* when network load is 12
CBR 4: From Node *5* to Node *14*, start time is *10.0,* when network load is 15

Table 9: Simulation Parameters

Simulator	Ns-2(version 2.32)
Simulation Time	200 (s)
Number of Mobile Nodes	3,6,9,12,15

Topology	1000 * 1000 (m)
Routing Protocol	ODRRP,AODV, DSDV
Traffic	Constant Bit Rate (CBR)

The performance metrics consider for simulation are: (i) packet loss in the network, (ii) Packet delivery ratio.

A. Packet Delivery Ratio

The ratio between the number of packets originated by the "application layer" CBR sources and the number of packets received by the CBR sink at the final destination.

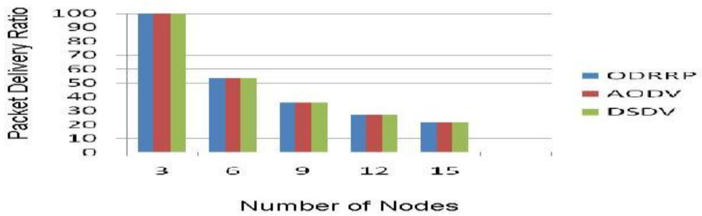

Figure 7 Packet Delivery Ratio

B. Average End-to-End Delay

This is the average delay between the sending of the data packet by the CBR source and its receipt at the corresponding CBR receiver. This includes all the delays caused during route acquisition, buffering and processing at intermediate nodes, retransmission delays at the MAC layer, etc. It is measured in milliseconds.

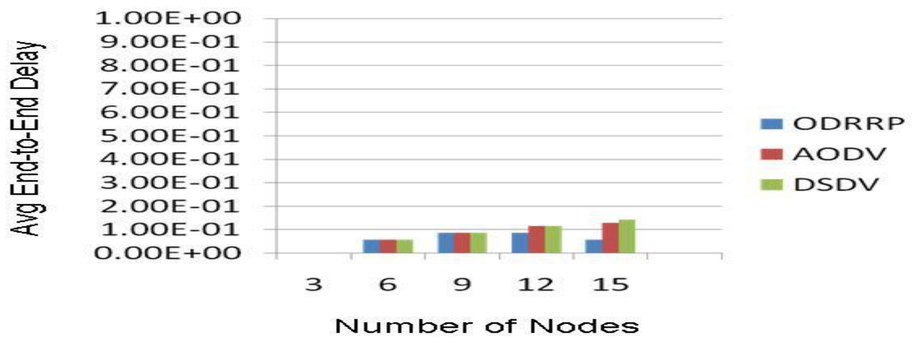

Figure 7 Average End-to-End Delay

VI. CONCLUSIONS

The In this paper, we proposed a new On Demand Route Routing Protocol with Broadcast Reply scheme. The existing proactive routing protocol approach will results in wastage of bandwidth by continuously exchanging routing information among nodes in the network. The reactive routing protocol approach unnecessary increases routing overhead. In ODRRP, the route request and route reply message are broadcasted. The advantage of broadcasting route reply message within the transmission range of the node is that the routing information is collected about source as well as destination at the nodes which are neighbours to intended node. Another advantage is that there is no RTS-CTS transmission for broadcast packets. This is because; we use IEEE 802.11 DCF-MAC protocol which does not require RTS/CTS/DATA/ACK pattern for broadcast packet.

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