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Efficient Routing Protocol for MANET

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***Abstract* - Current generation of applications including audio, video, and multimedia applications is dependent on the infra-structure based networks. But a large amount of research work is in process to utilize the benefits of adhoc networks over the infrastructure based wireless networks or adhoc networks. Due to the dynamic nature of adhoc networks, it becomes difficult task to provide assured quality to the end user. In this paper, we present a new routing protocol named as *"Efficient Routing Protocol for MANET(ERPM)"* which not only provide QoS (Quality of Service) but also deal with efficient loop free routing.**

***Key words*- Bandwidth, Energy efficient, MANET, QoS, Routing**

I. INTRODUCTION

This paper deals with a large number of nodes which are interconnected through wireless links. The difference between the wired network and adhoc network lies in the fact that adhoc network have infrastructure less networking i.e. each node in such wireless network can operate without any fixed infrastructure or any centralized access point.

"An Adhoc network generally termed as Mobile Adhoc Network (MANET) is the cooperative engagement of a collection of mobile hosts without the required intervention of any centralized access point".

The credit for growth of adhoc network goes to its self-organizing and self-configuring properties. Such kinds of networks are formed arbitrarily and dynamically. They can be deployed rapidly without much cost. Generally all nodes of an adhoc network functions as end nodes (source and destination) as well as routers. Communication between two hosts is done by multi-hop routing through the nodes of the network. This is required because the nodes which want to communicate may not be within direct radio range of each other (Fig. 1).

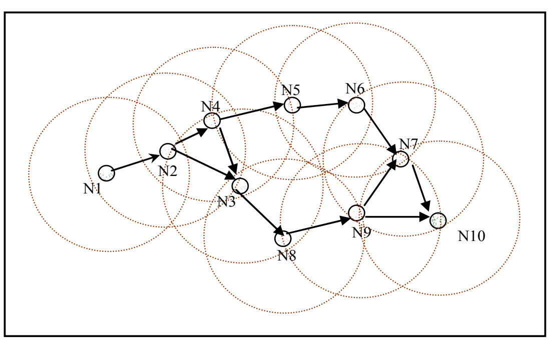

Fig. 1. Mobile Adhoc Network

The next generation of applications running on the wireless networks should carry diverse multimedia applications such as video, audio and data etc. Such applications require a routing algorithm that can provide efficient routing, assured quality (pertaining to bandwidth, delay, and throughput) and proper utilization of battery.

The work presented in this paper deals with all the above cited issues and provide a standard framework for routing in mobile adhoc networks.

II. RELATED WORK

Supporting Quality of Service (QoS) in multimedia networks is desirable to improve the performance of communications and satisfy the requirements of different network applications [1]. As nodes are mobile, there is no constant source of power in MANET. Nodes are completely dependent on battery. If routing algorithm does not consider battery as an important factor, this could lead into network partitioning. Thus, proper utilization of battery is also of great importance for adhoc network. Many protocols have been proposed in order to provide QoS by managing the bandwidth consumption [2,3,4,5,6,7,8]. Some protocols [9,10,11,12] have been proposed in order to provide power aware routing.

Here, in this paper we are proposing a new routing protocol which provide a loop free routing with assured quality in terms of bandwidth and tries to solve the problem of network partitioning.

III. PROPOSED WORK

The main aim of this proposed work is to create a standard outline for all type of traffic over adhoc network. Considering only bandwidth as a QoS requirement will not be beneficial. Packet delivery ratio, delay, Throughput, battery life etc. of intermediate nodes also plays a pivotal role in routing. For eg. If required bandwidth for traffic is available on a particular path but intermediate nodes do not have sufficient energy to forward the data packet. This will lead to increase in packet drop ratio and hence increase the delay in packet delivery. Here, in this paper a new protocol is proposed which checks for the availability of required bandwidth at the time of route discovery process. Nodes having available bandwidth equal or greater than the required bandwidth will take part in route discovery process. This concept will help in the provision of assured bandwidth.

On generation of request for data communication source node broadcast a RREQ Packet with sequence number, source address, destination address, and required bandwidth in packet

0	8 16	24
Seq_No	RBW	TTL
Src_Add		
Dest_Add		
Add 1		
:		
Add n		

header. Seq_no will help in identifying the stale RREQ Packets.

Fig. 2. Structure of RREQ Packet

Where,
Seq_No: Unique identifier for Packet
RBW: Required Bandwidth
TTL: Time To Live
Src_Add: Source Address
Dest_Add: Destination Address
Add1…..Add n: List of Visited Nodes

TTL (Time to Live) field contains the maximum number of nodes that a RREQ packet can visit.

Algorithm for broadcasting RREQ Packet at source node

```
{
        Generate RREQ Packet;
        Append Seq_No, TOP, TTL, Src_Add, Dest_Add;
        Append node_add to List of visited nodes;
        Broadcast RREQ Packet;

}
```

Every time a node broadcasts RREQ, it will decrease the counter in TTL. If TTL becomes 0, RREQ packet will be dropped by the intermediate node. Also, the node will append its own address to the RREQ Packet. This will help the destination node for sending back the RREP Packet. Structure of RREQ Packet header is shown in Fig. 2.

On receiving a RREQ Packet, the intermediate node first

0	8	9 16	32
Seq_No	Avail_ Path	Min_Power	Min_BW
Src_Add			
Dest_Add			
Add1			
:			
Add n			

check for the destination address. If packet is destined to the node, it will consume the RREQ packet and send back RREP Packet (Fig. 3) using List of Visited nodes.

Fig. 3. Structure of RREP Packet

Where,
Seq_No: is a unique number used to identify duplicate
Src_add: contains the IP address of the sender of packet.
Dest_ Add: contains the IP address of the destination node.
List_of_Visited_Nodes(Add1……Add n): contains list of addresses of previously visited nodes.
Min_Power: contains minimum power available at the route from destination to the node
Min_BW: contains minimum bandwidth available at the route from destination to the node

If the intermediate node is not the destination node, it will check for the TTL. If TTL becomes zero then the RREQ Packet is dropped. Each node maintains a table (List_of_available_paths) having information regarding the paths to the destinations along with the sequence number. This table get the information from the RREP packets passed through it. If the value of TTL is greater than zero, then it will check for the availability of path to the destination. If path to the destination with a sequence number higher than the Seq_no of RREQ Packet, then this path is appended to the List of visited nodes with a condition that after appending TTL should not be less than zero. Avail_Path in the RREP packet will now equal to 1.This path is send back to the source node in RREP Packet. If node does not have the path to the destination, it will append its own address to the RREQ packet, decrease the TTL, enters the available bandwidth in Min_BW field, available power in Min_Power and rebroadcast the packet. This process will continue till the RREQ reaches the destination or TTL becomes zero.

Algorithm for handling the RREQ Packet at intermediate node

```
{
  If (node_add = = Dest_Add)
  {
     Consume RREQ packet;
     Generate RREP Packet;
     Append Avail_BW to Min_BW, Avail_Power to
    Min_Power, 0 to Avail_Path;
    Send RREP Packet to source using
    List_of_visited_nodes;
  }
  Elseif(fnNot_Visited(node_add,List_of_visited_nodes)==
  1)
  {
     If (TTL= = 0 or Avail_BW< RBW)
     {
        Drop RREQ;
      }
     Else
     {
         If(fnpath_avail(Dest_Add)==1and
         Seq_No<Stored_Seq_No)
        {
           Count no_of_nodes in available_path;
         Min_BW=Min(Avail_BW,pathfound_Min_BW);
           If( (TTL – count )>0 and Min_BW>= RBW)
           {


              Append Min_BW, Min(Avail_Power,
              Pathfound_Min_Power) to Min_Power, 1 to
```

```
            Avail_Path, pathfound to
            List_of_visited_nodes ;

            Send RREP Packet to source using
            List_of_visited_ nodes;
          }
          Else
          {
             TTL=TTL-1;
             Append node_add to    List_of_visited_node;
             Rebroadcast RREQ Packet;
          }
        }
        Else
        {
          TTL=TTL-1
          Append node_add to List of visited node;
          Rebroadcast RREQ Packet;
        }
      }
    }
    Else
    {
      Drop RREQ;
    }
}
```

Algorithm for checking whether path is available With intermediate node or not.

```
fnpath_Avail(Dest_Add)
{
   If(Path_to_Dest_Exists in List_of_Avail_Paths)
      Return 1;
   Else
      Return 0;
}
```

Algorithm for checking whether a node is visited previously or not

fnNot_Visited(node_add, List_of _Visited_nodes)

```
for ( i = 0  to i < SIZE[List_of_Visited_Nodes] )
{
        if ( List_of_Visited_Nodes[i] == Node_add)
        {
                return 0;
        }
        else
        {
                return 1;
        }
}
```

When an intermediate node receives a RREP packet, it will compare its own bandwidth and power with the bandwidth and power in RREP packet. If the values are less than the Min_BW or Min_Power then node will overwrite the values in RREP packet and forward it to the next node. This will continue till RREP reaches the source node.

Node Id	Avail _BW	Avail_ power	List_of_Avail_paths	Min_ BW_ Path	Min_P ower_ Path	Stored_ Seq_ No
N1	50	32				
N2	65	45				
N3	62	54				
N4	54	78				
N5	60	20	N5-N6-N7-N10	30	20	25
N6	30	97				
N7	42	65				
N8	80	48				
N9	53	100				
N10	64	87				

On receiving the RREP packet, source node will first check for the value in avail_Path. If avail_path is equal to zero, the data packet will be forwarded to the destination node immediately. But, if avail_path is 1 then the node will wait for some predefined time. This is necessary because, the path was send back by intermediate node and it might be possible that there is some other path which is better than this path in terms of number of intermediate nodes or in terms of power. Within this stipulated time if source node receives another path better than the previous path, data packet will be forwarded through the new path otherwise the data packets will be forwarded through the previous path.

Algorithm for handling RREP Packet at Source Node

```
{
        If(Avail_Path = = 0)
        {
                Send Data Packet using
                List_of_visited_nodes;
        }
        Else
        {
                While (timer < pre-requisite time)
                {
                        If
                        (count(new_RREP_List_of_visited
                        _nodes)<count(Prev_RREP_List_o
                        f_visited_nodes) or
                        (new_RREP_Min_Power) –
                        (Prev_RREP_Min_Power) >20 )
                        {
                                Drop Prev_RREP;
                                Prev_RREP=New_RREP;
                        }
                        Else
                        {
                                Drop new_RREP
                        }
                }

        }
```

}

In case of link failure an error message RERR is generated to the source node. On receiving the RERR message, source node will reinitiate the route finding process with a new sequence number.

IV. ANALYSIS

TABLE 1. ROUTING INFORMATION OF NODES

In order to analyse the above proposed protocol let us take an example of adhoc network of 10 nodes. Nodes and their vicinity are shown in Fig. 4. Availble bandwidth and available power at each node is shown in Table 1.

Here, N1 is the source node and N10 is the destination node. Node 1 will broadcast the RREQ packet with required bandwidth (Req_BW) =50 and Seq_No=20. This packet will be received by node N2. As N2 is not the destination node. It will again rebroadcast the packet. Here, N5 is the node having path available to the destination. According to the proposed work this path will not be chosen as the Minimum bandwidth on the path is less than the required bandwidth. So, N5 will rebroadcast the RREQ packet.

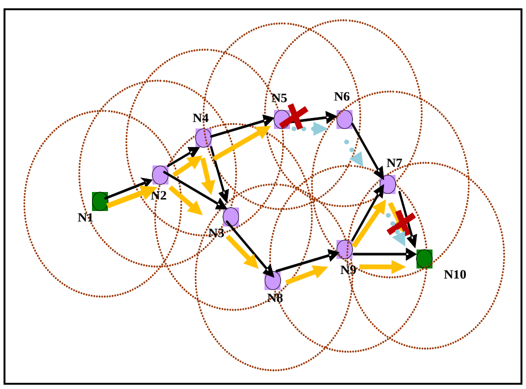

Fig. 4. Network Topology of nodes

V. CONCLUSION

Random topology, limited bandwidth and limited resources in terms of memory and battery power leads to the requirement of a routing protocol which not only deals with efficient routing but also cater with the above said limitations. ERPM is an on demand routing protocol which handles the various issues related to adhoc network along with the loop free environment. Here, in ERPM if source node receives a RREP from any intermediate node will wait for some predefined time to get some other better path in terms of power and bandwidth. This will help in reducing the number of packet drop due to discharge of battery. Also, nodes need not to maintain large tables, thus, the problem of limited storage space can be easily solved. Thus, ERPM is a routing protocol that can deal with the issues of MANET in an efficient manner along with the guaranteed services to the end user .

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