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A Novel Approach for Internet Connectivity in Mobile Ad Hoc Network Using Enhanced Multipath MPR AODV Routing Protocol

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Abstract

Mobile node is a collection of mobile nodes which forms a temporary network. Some of the nodes in an ad hoc network may want access to an external network, such as internet. Different mechanisms have been proposed to integrate MANETs and the Internet. These mechanisms are differing based on gateway discovery mechanism, and Adhoc routing protocol. When MANET is connected to the Internet, it is important for the mobile nodes to detect an available gateway providing an access to the Internet. The objective of this paper is based on Mobile Ad-hoc Network (MANET) routing protocols used in gateways. AODV is one of the most popular routing protocols for ad-hoc networks; it uses the flooding technique for locating the destinations, and gateway, possibly cause an overhead in the network. To overcome this problem we have introduced the MPR (Multi Point Relay) algorithm in the AODV protocol to obtain EMMDV protocol. The EMMDV protocol reduces the number of messages broadcasted during the flooding phase and also it uses the hybrid approach to find out the gateway.

Keywords :- MANET, Adhoc Network,Multipoint Relay,AODV,EMMDV,Gateway, Internet

I. Introduction

A mobile Ad hoc network consists of mobile nodes forming a dynamic autonomous system without using any physical infrastructure. Mobile nodes communicate with each other through wireless channel without base station support. Most important characters of MANET is Mobility. That means the nodes in a MANET can dynamically join or leave the network frequently, thus the network topology changes quickly. Therefore, in order to update connection states between them, the nodes in a MANET have to generate and distribute

control messages in regular time, interval which leads to rise in the internet traffic [4].

A MANET is a point –to-point network, which allows direct communication between any two nodes, when both nodes are within their radio range. But unfortunately, all the nodes of network are not in the radio range means, multi-hop scheme is used. The message sent by source node to destination node via intermediate nodes. Routing is an essential part of the ad hoc domain. Since topologies change frequently in MANETs, efficient routing protocols are required to unstable the networks and guarantee the packet delivery [16].

Generally broadcast mechanism has been used for transmitting large amount of data. It requires a broadcast routing to find an efficient route before the actual transmission of data. Proactive routing is used for data transmission. In contrast, usually the flooding technique is used for distribution of control packet[1]. It does not need Pre-routing. In recent research, flooding scheme has been concentrated vitally because of unnecessary redundancy of messages, resource contention, and signal collision.

The Traditional flooding schemes can be classified into three categories such as, no need of neighbor information, 1-hop neighbor information, 2-hop or more neighbor information. First scheme, do not require any neighbors. In second scheme, each node keeps information of 1-hop neighbor by exchanging HELLO message. In third scheme, each node knows network topology of 2-hop neighbor obtained by attaching a list of its own neighbor information with HELLO message [1].

Ad hoc On-Demand Distance Vector (AODV) [6] Routing is a routing protocol for mobile ad hoc network and other wireless ad-hoc network. Generally there are four routing methods such as Unicast, Multicast, Broadcast and Geocast are used. AODV uses both unicast and multicast routing. The simplest way of broadcasting a packet to all nodes in the network is basic flooding or blind flooding. In this method each node retransmits a packet to its neighbors only if it has not received the packet before[5]..

Multipoint Relays are nodes in wireless Ad-Hoc networks. It relay messages between nodes. The main role of Multipoint Relay is routing and selecting the proper route from any source to any desired destination node[1].

Ii.Providing Internet Connectivity To The Nodes In Adhoc Network

When connecting MANETs with the Internet, the Routing Interoperability becomes a crucial challenge. Ad hoc routing protocols are originally designed for stand-alone MANETs where no intervention of any centralized router exists [4]. In contrast to the Internet Protocol (IP), under a pure ad hoc routing protocol, every node must perform as a router and participate in route discovery and maintenance for other nodes.

The ad hoc nodes cannot obtain the routing information beyond the scope of the MANET. When ad hoc routing is considered within the realms of IP-based networking, an ad hoc routing protocol is not capable of handling the communications across the boundary between MANET and the Internet[8]. Therefore, the interoperability (or interfacing) between IP routing and ad hoc routing requires attention. Other challenges also emerge related to IP mobility issues in the Internet-integrated MANET. If any node within the MANET wants to access internet applications then it should be integrated with the internet[9]. To establish the connection between the nodes within the MANET and INTERNET, a

gateway is required to be discovered to route the information between the MANET nodes and Internet.

There are different approaches for internet gateway discovery, such as proactive, reactive and hybrid. Proactive approaches are table driven, reactive approaches are source driven and hybrid approach is the combination of both of these approaches [8].

Internet gateway may be a mobile node within the MANET or it may be any external fixed node outside the MANET. The Following fig(1) illustrate to provide Internet connectivity to the nodes in an ad hoc network, routers or one or more nodes in the ad hoc network can serve as gateways to an external network , where the external network can be an infrastructure network such as LAN, Internet or a cellular network, or even an infrastructure-less network such as another ad hoc network. An integration of Mobile IP and ad hoc networks is implemented, through Mobile IP. It enables nodes to move between different gateways [10].

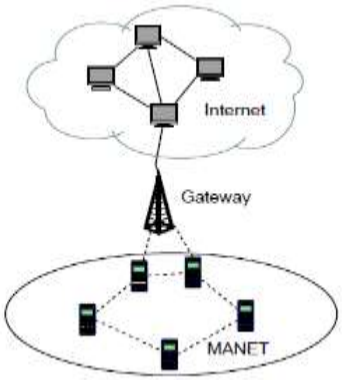

Fig.1. Internet Connectivity in Ad Hoc Networks

In this paper we implement and optimize an alternative flooding control mechanism, called Multipoint Relay (MPR), In order to use this optimized mechanism, the nodes must perform a proactive control in order to know their two-hop neighborhood[7]. This can be done via the reception of hello messages generating by the nodes and containing their neighbors list. The EMMDV Protocol provide Internet connectivity with MANET using Hybrid approach. We propose, as an extension of the AODV protocol, the introduction of MPR (Multi Point Relay) mechanism. MPR is a flooding mechanism used to reduce the number of broadcasted message for the control; in order to limit the flow on the network by selecting a small number of nodes.

III. Integration of MANET With Internet

In order to be able to communicate with Internet hosts, each mobile node must find a gateway, called Gateway Discovery, and obtain an address with the prefix of that gateway. With this new globally routable address, packets can be received from and sent to the Internet. When a mobile node moves and selects a different gateway, it configures a new address with the new prefix.

A mobile node obtains its globally routable address in following steps.

Basically, it

(1) has an initial IP address (home address) which is routable in the ad hoc network,

(2) Discovers reachable gateways in its surrounding

(3) Selects one gateway out of the set of reachable gateways

(4) Forms a globally routable IP address with the prefix of the selected gateway

In a similar way used to find foreign agents, gateway discovery is achieved either in a proactive or reactive way. In proactive approach, also called passive discovery, periodical gateway advertisements are sent to all nodes in the ad hoc network from the Internet Gateways[14].In the reactive approach, also called active discovery,

Request and advertisement messaging between a mobile node and the Internet Gateway takes place. Once a mobile node discovers an Internet Gateway, it can connect to the Internet through the gateway. As a mobile node receives gateway discovery advertisements, useful extension can be achieved if it can forward the advertisements to neighbor nodes that are located beyond the range of the gateway[15].

In the Hybrid approach both the proactive and reactive gateway discovery approaches, and a combination of the proactive and reactive approaches, are used. This kind of integration uses flood-periodic agent advertisement messages to announce the presence of the gateway nodes, and uses agent solicitation messages or the agent discovery procedure by mobile nodes to discover the gateway nodes[16]. The EMMDV Protocol provide Internet connectivity with MANET using Hybrid approach.

IV.EMMDV Gateway Discovery Process

Once the EMMDV protocol calculates the MPR node it finds out the gateway node using hybrid approach method. In this approach Internet Gateway (IGW) is used for the connection of a MANET node to the global Internet. When an ad hoc network is connected to the Internet the use of single gateway has the drawback of single point of failure. In order to solve these problems, multiple gateways can be used for a particular MANET domain. In multiple gateways, the availability of multiple gateways provides the network with higher robustness and more flexibility for global Internet connectivity [16]. The following fig.2 shows MANET and Internet connectivity.

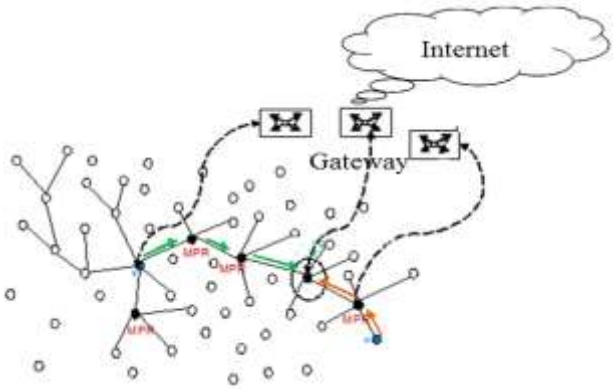

Fig.2.MANET and Internet Connectivity

With multiple IGWs, if any one of the IGWs fails, another IGW can take over the failed one, to increase the overall throughput of the MANET to the global Internet. An Internet gateway periodically broadcasts a GWADV (Gateway Advertisement) message[11]. Once Mobile nodes that receive GWADV message, it create or update reverse route entries for the Internet gateway and maintain such routes as default entries in their routing tables. Mobile nodes that cannot receive GWADV it issue Route Request packets (RREQ) to discover gateway proactively. Each Mobile node maintains a Neighbor Node List (NNL) to record its set of neighbors (i.e., all nodes from which can hear hello message) and it then appends this set in its coming HELLOs[17]. All Mobile nodes broadcast ordinary hello messages periodically and record its neighbor‟s information in its NNL through exchanging hello messages. The neighbor‟s information is appended in local route broadcasting packets (RREQ and GWADV) rather than in HELLOs. It means that the neighbor‟s information is broadcast only when we need to search for a route. When RREQ is forwarded by intermediate node, it appends its address [15].

V.EMMDV Gateway Discovery Process

In this gateway discovery process, the Source node observes the neighborhood changes to

detect its mobility. Initially, the node waits a time corresponding to one-transmission and two receptions of Fast-Hello messages, or two transmissions and one reception of Fast-hello messages, to record the number of new neighbors[7]. After find out the MPR node the EMMDV protocol initiate the gateway discovery process to find out the gateway. If a node discovers multiple gateways then it has to decide which one is to use. Majority of current gateway selection schemes use hop count to select the best gateway, and they always select the nearest gateway with the hop count metric. If all the mobile nodes always select their nearest gateway then the nearest gateway may become bottleneck under heavy traffic load, also there might be congested nodes along the route to the gateway. That is, hop count based selection schemes choose a gateway that might have less capacity and difficult to reach.

VI.EMMDV Gateway Discovery Process Algorithm

The EMMDV protocol uses the following algorithm to find out the gateway and established the connection between the node and Internet.

Step 1: Detect the high mobility
If Changes > Threshold value then
Node detect high mobility
Else
Node detect low mobility

Step 2: Find MPR Node
For each node, after receiving *HELLO* messages from its neighbors,
(1) Construct set of *N1*(*x*) and *N2*(*x*) nodes
(2) Create an empty MPR set *MPR*(*x*)
(3) Select one-hop neighbor nodes in *N1*(*x*) as MPRs which are the only neighbor of some node in *N2*(*x*), and add these one-hop neighbor nodes to the MPR set *MPR*(*x*)
(4) Set *M*=1, where *M* is the number of *MPR*(*x*) sets
(5) Set *m*=1, where *m* is a counter for the number of *MPR*(*x*) sets
1. Input: x ,N(x) =N,N2(x) =N2.
2. MPR={∅}
3. MPR←{n∈N:∃m∈N2, m is only covered by n}
4. while (∃ uncovered m ∈ N2)
MPR←n∈N: covers max.# of uncovered m ∈N2
5.Output:MPR(x, N, N2)

Step 3: Forward the Packet to Core Router
If (Node = Source Node) then
Create Source To Destination Process (STD)
STD ← MPR Node
MPR Node ← GW

Step 4: Gateway send the message to Internet
If (Node =Destination Node) then
Create Destination To Source Process (DTS)
If (Current Node = RREQ) then
Establish the Connection

VII. Performance Analysis of AODV & EMMDV Protocol

The comparison of the AODV and EMMDV Routing Protocols is done by using the NS-allinone-2.34 Simulator. The number of nodes is considered by changing their number as 10, 20, 30, 40,50,60,70 and 80 with same propagation model. The routing protocol AODV and EMMDV are used which routes the packet towards its destination on its call. The mobility model used is static with movement maximum speed is 1.5 m/s and minimum speed is 0.5 m/s. The network type is wireless with 50 packets in interface queue. The constant bit rate is transferring the constant rate of bits for a particular time. The performance of AODV and EMMDV protocols are compared according to the following metrics.

1) Packet delivery Ratio
2) Through put
3) Packet Delay

4) Energy

The following fig(3) shows the Screenshot of EMMDV protocol.

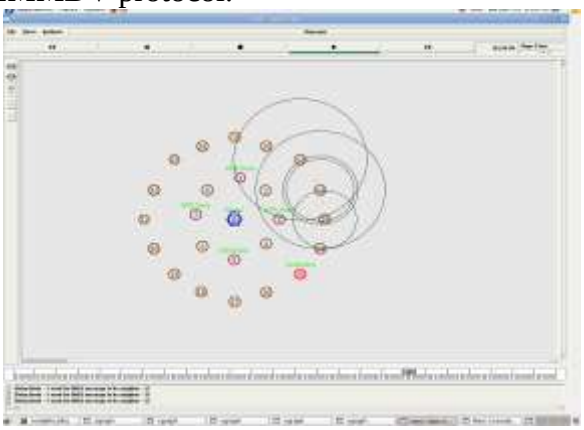

Fig.3.Screenshot for EMMDV protocol

1. Packet delivery ratio (PDF)

PDF is the ratio between the number of packets originated by the application layer sources and the number of packets received by the sinks at the final destination. In terms of packet delivery ratio, EMMDV performs well. However its performance declines with increased number of nodes due to more traffic in the network. The performance of AODV is better at the beginning and decreases slightly with increase in number of nodes. The performance of EMMDV protocol is better when compared to AODV protocol.

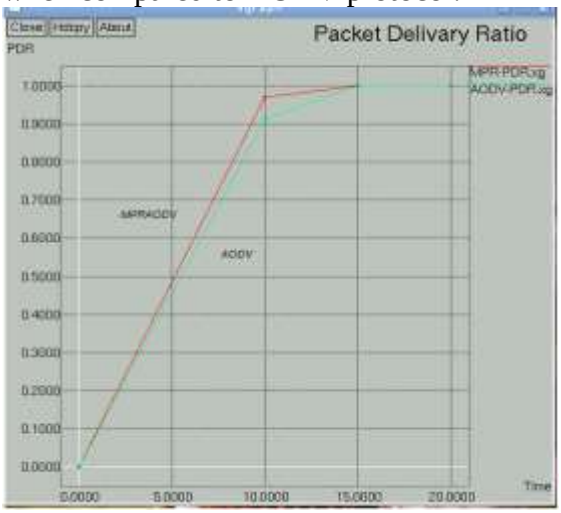

Fig.4. PDR between AODV and EMMDV

2.Throughput

Another important quality of communication networks is the throughput. It is defined as the total useful data received per unit of time. Fig.**5** illustrate the comparison of throughput for EMMDV and AODV, 25 nodes in specific are spaces. In this metric, the throughput of the protocol in terms of number of messages delivered per one second (Mbps) is analyzed. In figure 9 the EMMDV provides highest throughput than AODV. More routing packets are generated and delivered by EMMDV than AODV.

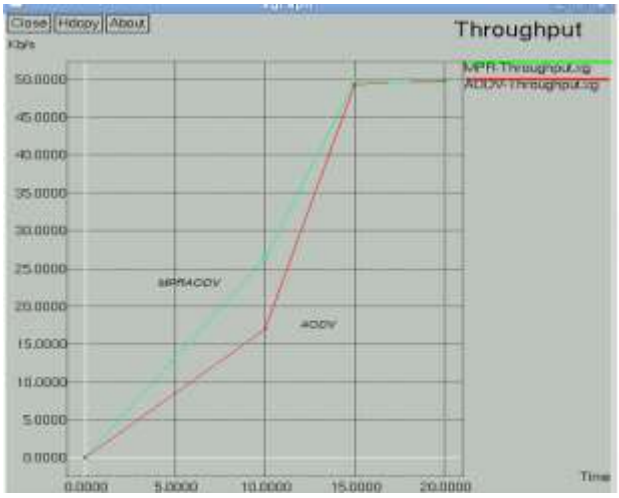

Fig.5 Throughput between AODV and EMMDV

3. Packet Loss

It is the number of data packets that are not successfully sent to the destination. In terms of dropped packets, AODV's performance is the worst. The performance degrades with the increase in the number of nodes. As the number of nodes increases the number of packets dropped increases which means that number of packets not successfully reaching the destination has also increased. EMMDV performs consistently well with increase in the number of nodes. The number of packets dropped is negligible which means that almost all packets reach the destination successfully. The packets dropped are much less compared to performance of AODV.

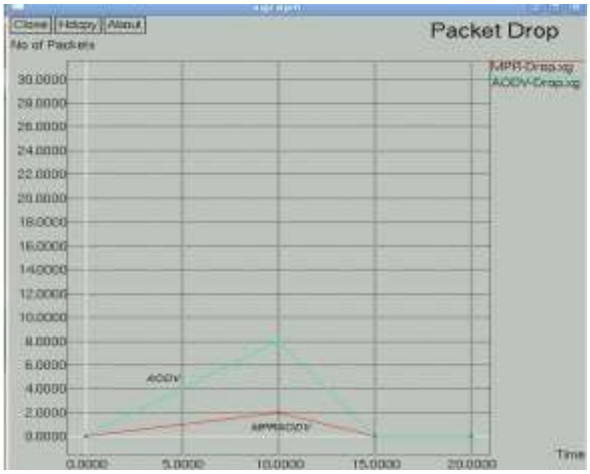

Fig.6 Packet Loss between AODV and EMMDV

4. Energy

Energy Consumption is defined as the ratio between the sums of energy increased by each node to the total number of data packets delivered. The fib.7 shows the total transmission and receiving energy. The energy consumed mainly due to receiving process. When number of nodes is low, the transmitting energy is more. When number of nodes is high, all traffic type consumed similar amount of energy. In this proposal the energy is calculated based on searching time. In EMMDV, source node first finds the gateway whether it present in the current network or not.For the purpose it uses MPR algorithm. If available it sends the message to gateway. So it helps to reduce the discovery time. So EMMDV consumes less energy when compare to AODV.

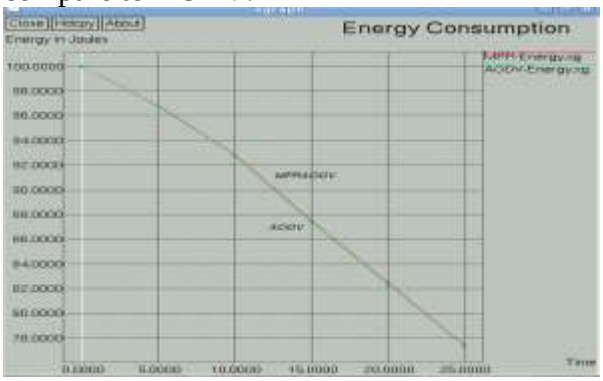

Fig.7. Energy Level between AODV and EMMDV

5. Conclusion

The new Enhanced Multipath and MPR based AODV (EMMDV) protocol providing multipath and MPR based flooding. This protocol consists of both proactive and reactive components. In a proactive phase, nodes compute their MPR lists and compute paths to their two hop neighbors. In a reactive phase, nodes compute two paths for each destination. EMMDV protocol finds the path between the source and destination based on gateway discovery process.

This gateway process finds the path between the source and destination. In the use of EMMDV protocol the route discovery is made very fast and the flooding overhead will be reduced which leads to decrease in delivery time and increase in delivery ratio.

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