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Enhanced Performance of AODV with Power Boosted Alternate Path

C.Nishanthini[1], G.Rajkumar[2], G.N.Jayabhavani[3]
Electronics and Communication Department.
School of EEE, SASTRA University, Thanjavur, Tamil Nadu, India.
[1] cnisha2209@gmail.com [2] graj_grk2k7@yahoo.co.in

Abstract-- **Nodes in Mobile Adhoc Network (MANET) are highly mobile. As a result, network topology and neighbouring nodes of each node vary abruptly which affects the communication. Communication also fails when a node intrude from one network to another. Communication goes well until every node is within its range, else transmission fails. Therefore it is necessary to build an efficient routing to solve this problem. Here we introduce a new protocol named Enhanced Adhoc On demand Distance Vector (EAODV) to solve this link failure. In this paper we first calculate the average power of a node and the number of hops in the actual path. Secondly, when there is a link failure or path failure we mathematically calculate the number of hops the data has travelled and the remaining number of hops that the data has to travel in that route to reach the destination. At last the paper is concluded by defining the working of this protocol. In this paper we have increased the packet delivery ratio with reduced delay and increased life span of each node.**

Keywords— MANET, AODV, EAODV, FTMR, Adhoc.

I. INTRODUCTION

A. Routing in Mobile Ad-Hoc Network

MANET is a self-configuring network forming an arbitrary topology with mobile nodes in wireless environment. The network's wireless topology is random. They operate in a standalone fashion and may be linked to the huge network. Sensor networks helps in the formation of Adhoc networks comprising of processes like data processing, communication components and sensing. Each node acts as a router to forward the data packets to other nodes, due to the deficient infrastructure support[1]. Their application area includes Emergency Services, Tactical Networks, Commercial Environments Educational Applications and Entertainment.

The following limitations are observed for routing traffic in mobile ad hoc networks. Nodes in traditional wired networks do not route packets, where as in MANET every node is a router. Due to mobile nodes, MANET has dynamic topology and is static to traditional network. Indication of interference and connectivity is done by link layer informational traditional router in which each network has an interface to which it connects, while a MANET "router" has a single interface. Routed packet is forwarded to the next node and also to the previous transmitted node.

B. Short distance routing with booster and fault tolerant techniques

The performance of ad hoc routing protocols will significantly degrade because of faulty nodes in the network. Node mobility is the major cause of route failures. Wireless channel contention is also another factor for route failures. A route includes a sequence of links. The route stops the progressing even if one of the links fails. That is, link instability is the effect of route instability. Consequent route maintenance is affected and efficiency of the network degrades, when there is a route failure [3]. Node failure due to power shortage is a significant cause of route failure [4]. In MANET, users communicate by relaying on multihop. Due to the movement of neighbouring nodes, hidden terminal collisions and burst error in the wireless channel the multi hop route breaks. Unnecessary route maintenances like error diffusion and upper layer multihop retransmission occurs due to route failure. Routing overhead and prolonged end-to-end delay is significantly increased by these processes [5]. The fault tolerant routing protocol addresses the link failure problem by assigning alternate path which increases the delay due to increasing distance [13]. Techniques have been put forward for the use of energy boosters at the nodes to overcome node failure which in turn reduces the life of node resulting in entire collapse of the node.

In this proposed EAODV protocol we make use of both boosters and alternate path routing (one enabled at a time) to overcome this link failure problem and also to extend the life time of the node. This method works with the help of number of hops or nodes it has travelled and the remaining number of nodes or hops it needs to proceed to reach the destination. This is achieved by hop counters and an energy boosters (inactive untill triggered) which are adopted by all the nodes in the network. By this method we achieve reduced delay and extended node life.

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II. RELATED WORK

Oliviero Riganelli et al[6] said in his paper about power optimization in fault tolerant MANET and the importance of improving fault tolerance in MANET by scalable topology. Byung-seok Kang et al[7] helped by putting forward an routing protocol in MANET for huge and faster mobility environment. To put forth a new protocol based on greedy packet forwarding and GPS location information, from main route nodes, they made one hop beaconing applying directional forwarding from main route nodes. This introduced protocol had an improved data packet delivery. Michael Pan et al [8] put forth a local repair approach, enhancing the performance of on-demand ad hoc routing protocols. The proposed approach has two routing protocols. The two protocols were for breath and depth due to the different route pair request constrains. They are AOCV-LRQ and AODV-LRT. Maher Ben Jemaa [9] proposed a hybrid content location failure tolerant protocol for wireless ad hoc networks. Protocols in dynamic environments are studied. The comparison of the protocols aimed to deduce the ideal mechanism for the discovery of data. The protocol is intended to HCLFTP for location services in a central region rather than in one node in mobile environment and is based on Dynamic hash table. This work is based on exploring descriptions of data sources in the various recent proposals and protocol evaluation in real platform. Ahamd Anzar, Husain Shanawaz, Dr S.C Gupta have introduced the energy boosters to overcome link failures and route failures based on the average energy in the transmitting node.[13]

III. PROPOSED SOLUTION

In this paper, it is proposed to design a protocol - EAODV which efficiently overcomes the link failure using alternate path and energy boosters with increased packet delivery ratio and extended node life. The AOMDV [11] protocol forms the base of multipath routing. Here it uses alternate path FTMR [12] and energy booster mechanism [13] to retransmit the data whenever an intermediate node is unable to continue the process due to node failure or link failure. In this process when a RREQ is received by the node initially, it checks itself for the destination node and also the route to the destination if available in it. Else the entire process will proceed as conventional AOMDV protocol. If the destination node is itself, the first received RREQ is kept in the buffer and simultaneously starts the timer. Other copies of RREQ are also received by the node at the same time. All the copies of RREQ is tested for a new path or node-disjoint. If the RREQ has a new destination or link-disjoint path then the RREQ is kept in the buffer else discarded. Once the RREQ is stored the timer is triggered and when it expires the request is dropped. The node replies with more number of RREPs if it finds low battery power in it. When an upstream node sends the RREP, the number of nodes or hops that the data has travelled is found with the help of the downstream node with the same data. Also the remaining number of nodes or hops to be travelled is calculated mathematically.

Similarly if the downstream node encounters a failure, the same process is repeated considering the upstream node with the same data. Enabling either energy booster mechanism or alternate path depends upon the number of hops it needs to travel. If the number of hops travelled is more than the number of remaining hops then energy booster mechanism is enabled else alternate path is enabled.

A. Working Mechanism

Whenever a link failure or node failure is sensed by a downstream node it checks to the hop counter in the upstream node with the same data and vice versa

Hop Counter

It has the entries sorted as total number of hops in that path, number of hops travelled and remaining number of hops to reach the destination.

Once the failure (average battery power) has experienced by a node, it looks the hop counter at the preceding node. It checks to the entries left in the counter. If the number of hops it has come across is greater than the remaining hops then the energy booster is enabled else alternate path is set. By this means we can transfer the data with reduced delay and extended node life. This hop counter is present at each node.

The proposed protocol is summarized in simple steps. Let S and D be the source and destination nodes respectively.

Terms used in the algorithm are:

AV- Average Power
EN- Node Energy
LF- Link Failure
TH- Total Hops
HT- Hops Travelled
RH- Remaining Hops
AP- Alternate Path
EB- Energy Booster

When a node has experienced a route failure while transmitting a data, it is followed by the given steps.

Step 1

Calculates the number of hops (TH) required reaching its destination.

Step 2

The HT (hops travelled) counter get incremented at each hop of the data or HT is incremented when the data travels from one node to another.

HT=0 (initially)

HT=HT+1 (at each hop)

Step 3

If the node energy is nearing the average value RREP is sent to the preceding node with the same data. It calculates the RH (remaining hops)

RH=TH-HT

Step 4

It then checks whether HT is greater than RH. If so EB (energy booster) is enabled else AP (alternate path) is set.

```
if (EN<AV)
{
        if (HT>RH)
        {
                enable "energy booster";
        }
        else
        {
                enable "alternate path";
        }
}
```

B. Overall Algorithm of EAODV

Considerations made for this Algorithm. Source node as “S”, Destination node as “D” and intermediate node as “K”, “Pr” is power received, “Pt” is power transmitted,” Gt &Gr” gain of transmitter and receiver.

1. Calculates the battery power of node by the formula

$$\mathbf{Pr=Pt*Gt*Gr/(4r\Delta\square\Omega)^2}$$

2. Average energy of node is found by

$$\mathbf{E_{av}=\frac{\sum_{i=1}^{n} Er}{n}}$$

3. Energy level of the node is found by

$$\mathbf{E_l=\frac{Residual\ power}{Average\ energy}}$$

4. Packet is transferred from source to destination.
5. Checks for a valid route from routing table.
   - 5.1. If found
     - 5.1.1. Calculates the total number of hops (TH).
     - 5.1.2. Packet is transferred.
   - 5.2. Else
     - 5.2.1. Proceeds the process in conventional AODV
6. If node receives other copies RREQ then checks Whether RREQ is duplicate (same).
   - 6.1. If no
     - 6.1.1. Stores the RREQ in the buffer and timer are started.
   - 6.2. Else
     - 6.2.1. Dropped.
7. If timer expires
   - 7.1. All RREQ are dropped
8. If a node “K” is about to fail (insufficient energy)

   (Calculates the TH, Remaining hops(RH) and hops travelled(HT)).
   - 8.1. If (RH>>HT)
     - 8.1.1 Then an alternate path from “K-1”th node is established in AOMDV method considering the “K-1”th node as source and “D” as destination.
   - 8.2. Else
     - 8.2.1. Energy booster at node “K” is activated.
     - 8.2.2. Energy level E_l of the node “K” is boosted using this energy booster to proceed in the same path to the destination.
9. If a node “K” fails(due to other destructions)
   - 9.1. The node “K-1” establishes an alternate path through conventional AODV mechanism to the desired destination “D”.

IV. SIMULATION RESULTS

We have put forth the results of our proposed simulation using the NS2 simulator. The capacity of the channel is kept as the default one: 2 Mbps. For MAC layer protocol we have used the Distributed coordination function (DCF) of IEEE 802.11 for wireless Network.

For simulation we have considered 20 mobile nodes in a mobility area of 1500 x 300 meters. The simulation time for the area is 100 seconds. The nodes speed is 10m/s.

The simulation results show that the packet delivery ratio is much higher than AODV. It clearly states that the proposed protocol serves its purpose and is advantageous for the Mobile Adhoc Networks. Additionally along with the verification of packet delivery ratio we have also analyzed the delay that it requires while this as being processed. Surprisingly the time required to perform the data/packet transmission was far less than AODV.

The graphical representation of the simulation is shown below

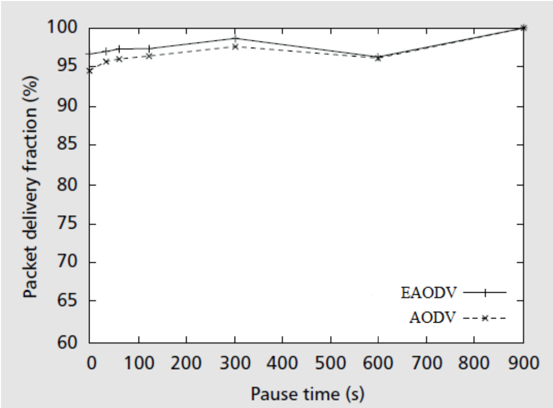

Fig 1 Packet delivery ratio

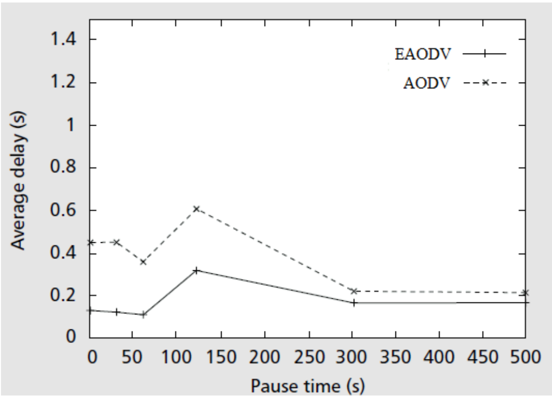

Fig 2 Average delay

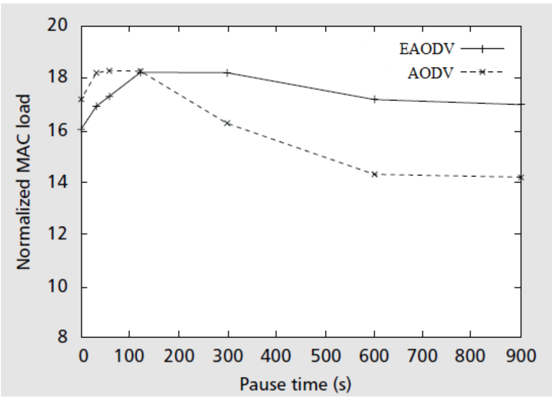

Fig 3 Normalized MAC load

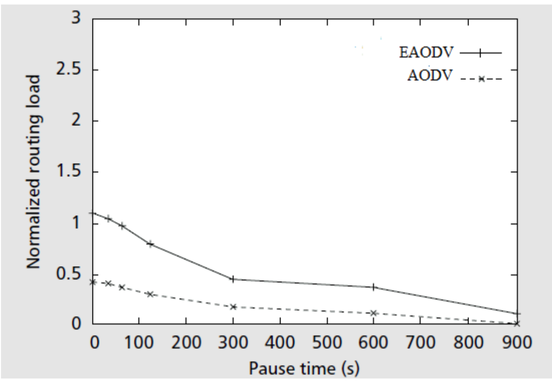

Fig 4 Normalized Routing load

V. CONCLUSION

Mobile Adhoc Network is the future technology; this energy booster and alternate multipath is a show case piece in many ways. Packet delivery during link failure, tackling route failure situation, during low battery power, during path loss are some of the aspects where this design plays an effective role. By this proposed protocol we can efficiently overcome the link failures by suggesting alternate path or energy booster according to the situation that the data has encountered. Also since the booster is triggered when necessary life of each node is enhanced to a great extent. Thus we can achieve high packet delivery ratio with reduced delay and extended node life. Provided the simulation results prove these arguments.

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