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Energy Aware Multipath AODV Routing Protocol for Mobile Ad hoc Network

Nagaraj M. Lutimath[1],Suresh L[2],Chandrakant Naikodi [3]
[1]Department of CSE, Sri Venkateshwara College of Engineering, Bangalore, India
[2,3]Department of CSE, Cambridge Institute of Technology, Bangalore, India,
[1]nagarajlutimath@gmail.com,[2]suriakls@gmail.com, [3]nadhachandra@gmail.com

Abstract— Energy is an important characteristic of Mobile Ad hoc Network (MANET). We proposeanEnergy Aware Multipath AODV protocol (EAMAODV) based on AODV. EAMAODV obtains nodes energy by upgrading the route discovery and route maintenance process of AODV. It calculates drop rate derived by routes total hops. Drop threshold is used in deciding the route. Simulation is done using NS-2.35. The results show that EAMAODV has higher packet delivery ratio and throughput than classical AODV protocol.

Keywords—**AODV, nodes energy, Multi-path routing, residual Energy**

I. Introduction

MANET is a self-creation, self-organized, self-managed,infrastructureless wireless network [1]. it is widely used in defence and civil fields because of its characteristics of mobile communication. It has a dynamic topology and limited energy, which makes its routing protocol more complex than the traditional network [2-3]. Therefore, MANET network routing strategy focuses on how to balance the energy consumption of nodes, increase the network lifetime, establish a backup routing and shorten the network delay.

A high energy nodes driven strategy for routing discovery has been proposed, through high energy node to transmit data to balance the network energy consumption [4]. A routing protocol to avoid low energy nodes, to increase nodes lifetime by setting the node energy threshold, reducing the low energy nodes over involved in data forwarding [5]. A forward a fast link algorithm for fault routing link on the thoughts of fast repairing was introduced [6].

The above documents made corresponding improvement and optimization on the energy and route repair of the route discovery process, because of without considering the multi-routing, the route discovery process still need to be carry on to repair the broken link, it will prolong the delay. Based on document [5], this paper improved a multi-path routing improved protocol in AODV based on nodes energy, establish multiple paths from the source node to the destination node by setting node energy threshold, When communication breaks, using alternate routing in a timely manner, so as to shorten the network delay. If there is breakage somewhere, the backup routing will be used timely to reduce the network delay [7]-[10].The rest of the paper is organized as follows. We begin with Section II of discussing related work. In Section III design and implementation is described. Section IV describes simulationand result Section V conclusion.

II. Related Work

The proposed work is aimed at developing an energy efficient AODV routing protocol therefore this section studies some of the many energy efficient schemes using AODV algorithm developed by researchers in the field. In [6], Jin-Man Kim and Jong-Wook Jang proposes an enhanced AODV (Ad-hoc On-demand Distance Vector) routing protocol which is modified to improve the networks lifetime in MANET (Mobile Ad-hoc Network). One improvement for the AODV protocol is to maximize the networks lifetime by applying an Energy Mean Value algorithm which considerate node energy-aware. Increase in the number of applications which use Ad hoc network has led to an increase in the development of algorithms which consider energy efficiency as the cost metric. In [11], Yumei Liu, LiliGuo, Huizhu Ma and Tao Jiang propose a multipath routing protocol for mobile ad hoc networks is proposed, called MMRE-AOMDV, which extends the Ad Hoc On-demand Multipath Distance Vector (AOMDV) routing protocol. The key idea of the protocol is to find the minimal nodal residual energy of each route in the process of selecting path and sort multi-route by descending nodal residual energy. Once a new route with greater nodal residual energy is emerging, it is reselected to forward rest data packets. It can balance individual node's battery power utilization and hence prolong the entire network's lifetime. In [12], Zhang Zhaoxiao, Pei Tingrui and ZengWenli propose a new mechanism of energy-aware named EAODV for Ad Hoc is proposed in this paper, which is based on the classical AODV (the routing protocol on demand). And backup routing mechanism is adopted. In EAODV, the route which spends less energy and owns larger capacity is selected by synthetic analysis.Therefore from the research work done many proposals for optimizing AODV to make it energy efficient were seen. In the next section we propose the method to optimize AODV by combining three energy cost metrics.

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III. Design and Implementation

The algorithm which we propose integrates three energy metrics into AODV in an efficient way so that the Ad hocnetwork has a greater life time and energy consumptionacross the nodes is reduced. The three energy metrics which we combine are:

1) Energy of intermediate node
2) Drop Rate
3) Threshold Drop Rate

Energy of Intermediate Node

This cost metric makes the fairness of energy consumption the main focus. It is the energy of the node when the packets are received. It is calculated using the energy model.

Drop Rate

It calculated by taking the inverse ratio of the number of hops from the request node to the destination node.

Threshold Drop Rate

This is an important cost metric in deciding the route. It is calculated using the data rate, distance between the source node and the intermediate node and the weighing factor, which depends on the number of nodes in the network. It is given by,

T= D / (d*k), where D is the data rate,

d is the distance between the source code and the intermediatenode. k is the weighing factor that depends on the number of nodes in the network.

Working:

To incorporate these two metrics AODV algorithm is altered such that the RouteRequest and RouteReply packets sent during route discovery and route table contain fields that provide a measure of the node energy capacity.

Route Table Entries are as follows:

• Destination IP Address
• Destination Sequence Number
• Valid Destination Sequence Number flag
• Other state and routing flags (e.g., valid, invalid)
• Network Interface
• Hop Count
• Next Hop
• List of Precursors
• Lifetime (expiration or deletion time of the route)
• Maximum Remaining Energy Capacity

The formulae specified above are used for calculation ofenergies in the steps of the algorithm.

During route discovery from the source to the destination the energy values along the route are accumulated in the RREQ packets. At the destination or intermediate node (which has a fresh enough route to the destination) these values are copied into the RREP packet which is transmitted back to the source.

The following are the steps for routing process.

Steps of Algorithm

During the route discovery process

1. Find the Energy of the intermediate node when the request packets are received.
2. Compare the energy of the intermediate node with the residual energy.
3. Calculate the Drop Rate using the hop count of the intermediate node and source node.
4. Calculate the Threshold Drop Rate.
5. If the energy of the intermediate node is greater than the residual energy and the Drop Rate is greater than the Threshold Drop Rate forward the request packets for route discovery otherwise drop the packets call the route error process for discovering new route.

The algorithm once designed is to be evaluated using theperformance metrics,throughput and packetdelivery ratio

IV. Simulation and Results

The system is implemented using NS-2.34 to simulate our proposed algorithm. In oursimulation, the bandwidth of mobile hosts is set to 11 Mbps. The testing isdone in a simulation environment which is 600m x 6000m in area and the simulation time is 60seconds.

The simulation settings and parameters are summarized in Table 1.

Table 1. Simulation parameters

Parameter Type	**Parameter Value**
Routing Protocol	AODV
Simulation Time	60 sec
Simulation Area	600 m* 600 m
Number of Nodes	30, 40
Transmission Range	250m
Bandwidth	11Mbps
Mobility Model	Random way point
Data Packet Size	512 bytes
Traffic Source	CBR
Initial Energy	10 (Joules)
Packet Size	512byte
Transport Protocol	UDP

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Performance Metrics

The performance of the proposed EAMAODV protocol is compared with that of traditional AODVprotocol according to the following metrics.

Packet Delivery Ratio

The packet delivery ratio is the ratio of number of data packets received at the destination to the number of data packets sent from given source.

Throughput

The throughput is the ratio of number of data packets received at the destination from different sources per unit time.

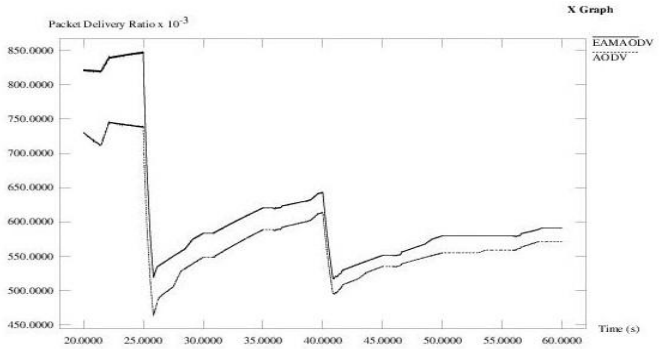

Fig 1: Packet Delivery vs. Time for 30 Nodes

Fig 1 shows the packet delivery results for 30 nodes.

In the Fig 1 the Packet Delivery Ratio for AODV is $475*10^{-3}$ at 28 second . EAMAODV it is $525*10^{-3}$ which is 10.5 percent higher than AODV..Similarly packet delivery ratio for EAMAODV is $630*10^{-3}$at 40 second and it is $600*10^{-3}$ which is 5 percent higher than AODV. This is because more efficient energy route is taken for routing the packet.

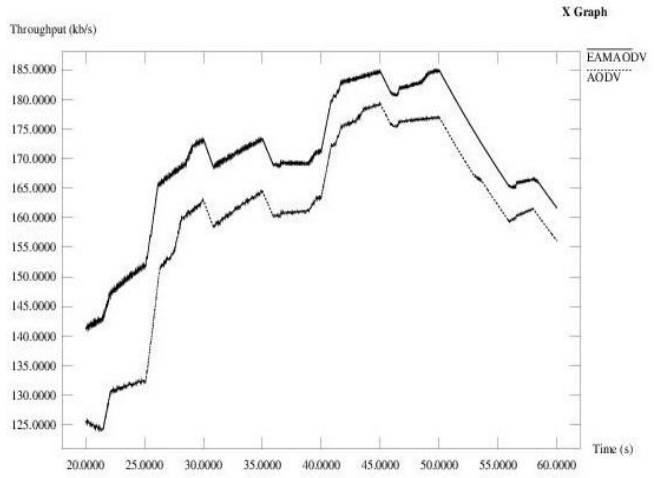

Fig 2: Throughput vs. Time for 30 Nodes

Fig 2 show the throughput results for 30 nodes.

In the Fig 2 , we find at each interval of time EAMAODV throughput is higher than AODV.

Hence the throughput of EAMAODV is better than AODV.

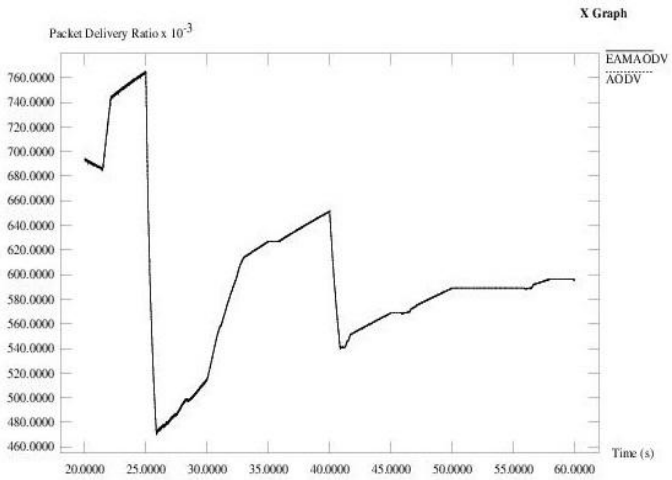

Fig 3: Packet Delivery vs. Time for 40 Nodes

Fig 3 shows the packet delivery results for 40 nodes.

In the Fig 3 , we find at each interval of time packet delivery of EAMAODV and AODV are equal. Hence the EAMAODV behaves like a AODV depending on the mobility of the nodes.

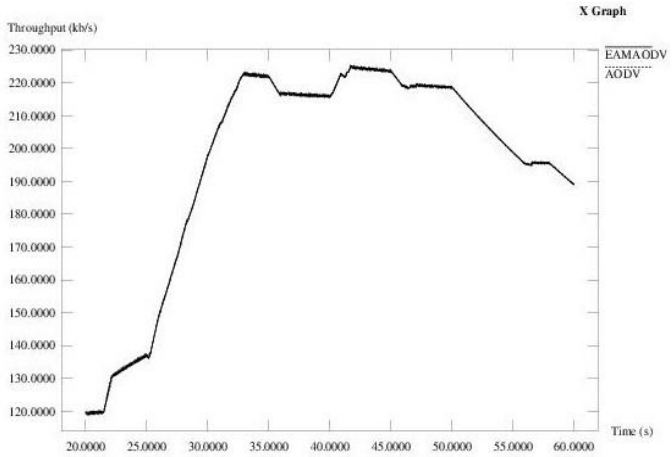

Fig 4: Packet Delivery vs. Time for 40 Nodes

In the Fig 4 , we find at each interval of time throughput of EAMAODV and AODV are equal. Hence the EAMAODV behaves like a AODV depending on the mobility of the nodes

V.Conclusion

In this paper, we proposed an energy efficient multipath routing protocol (EAMAODV) for choosing energyefficient route. The proposedalgorithm considers residual energy and

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node energy of intermediate nodes together with the drop rate to extend network lifetime. In future we improve the performance of the protocol by developing a better drop rate and drop rate threshold based on the network characteristics to improve the efficiency of the protocol.

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