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Quality of Service Enhancement of Network using AOMDV Protocol

Nidhi L Patel[1] Karishma Gandhi[2]

[1]*Student, Department of Information & Technology, SOCET, Ahmedabad, Gujarat, India.*
[2]*Assistant Professor, Department of Compute Engineering, SOCET, Ahmedabad, Gujarat, India.*

ABSTRACT

A Mobile Ad Hoc Network (MANET) is a dynamic wireless network that can be formed without the need for any pre-existing infrastructure in which each node can act as a router. Multipath routing protocols are more popular in mobile ad hoc network, as they overcome certain limitation of single path routing. compared to single path routing approaches they have many advantages in term of higher throughput, lower end to end delay, higher energy efficiency and network lifetime. Providing Quality of Service aware routing is a challenging task in MANET due to mobile nature of MANET nodes, multi hop communication, lack of central coordination, dynamic topology and limited resources. In Quality of Service, residual battery power is crucial requirement in many applications as nodes in MANET are battery operated. AOMDV with Quality of service is a multipath routing protocol which selects paths between source-destination pair based on a route cost function. The route cost function is computed by considering residual battery power of a node and its present traffic. In our work, the standard ad hoc on demand multipath distance vector protocol is extended as the base routing protocol. The main aim of proposed scheme is to enhance Quality of Service in Network. The performance is measure on the basis of commonly used performance parameters like Packet Delivery Ratio, Throughput and Residual Energy.

Index Terms: *- AOMDV, QoS, Residual Energy, Traffic load, wireless ad-hoc network, MANET.*

1. INTRODUCTION

A wireless network is any type of computer network that uses wireless data connections for connecting network nodes. It is a method by which homes, telecommunications networks & enterprise installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. [19] The wireless networks classified into two types: (1) Infra structured Wireless Network (2) Infrastructure less or Ad hoc Wireless Network.

In Infra structured network the mobile nodes are free to move while communicating with other nodes in the network. In this type of networks the base station governs the communication among mobile nodes which are located in its range. As the node moves out of the range of one base station, the communication services to mobile nodes are served by another base station. [8] A wireless ad hoc network is a decentralized type of wireless network. The network is ad hoc because it doesn't relay pre-existing infrastructure, such as a router in a wired networks or access points in infrastructure wireless networks. Instead each node participates in routing by forwarding data for other nodes, so the determination of which node forward data is made dynamically on the basis of network connectivity. In addition to the classic routing, ad hoc networks can use flooding for forwarding data. [19]

A mobile ad hoc network(MANET) is a continuously self-configuring, infrastructure less network of mobile devices connected wirelessly. In MANET, there are various routing protocols available to improve residual battery power with its present traffic load. This routing protocol are important part of MANET whose main task is to discover and maintain routes from this source node to destination node & to send data packets. Therefore, a good routing protocol directly affects the performance of the network. Based on different principles, this routing protocols can be classified in several ways: (1) According to routing strategy (2) According to the number of paths reserved. [10]

According to the routing strategy routing protocols are classified into three types:(i) Proactive (ii) Reactive (iii) Hybrid. Proactive routing protocols are also known as table driven routing protocols. Nodes using proactive routing protocols maintain

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routing table(s), which contain information about each and every node residing in that particular network. Examples of proactive routing protocols are DSDV, WRP, CGSR & OLSR. Reactive routing protocols are also known as on demand routing protocols. Reactive routing protocols doesn't need to continuously maintaining a route between all pairs of network nodes, but route from source to destination node is established when two nodes wants to communicate with each other. Examples of reactive routing protocols are DSR, AODV, CBR & ABR. Hybrid routing protocols combine features of both reactive and proactive routing protocols. [8] Examples of hybrid routing protocols are ZRP, ZHLS.

According to the number of the paths reserved there are two kinds of protocols for MANETs: (i) Single Path (ii) Multi Path. In a single path protocol, there is only one route path found & maintain from source node to destination node. Example of single path routing protocol is AODV. In a multi path protocol, there are multiple paths found & maintained because of which when the current path is disconnected, multipath routing protocol could restore the transmission of packet readily with backup multiple paths. [10] Example of multi path routing protocol is AOMDV. In MANET routing is the toughest task because nodes work as a router and host at the same time with changing environment, in fact for this many researcher have proposed works well and is improved over different scenario, strategy and conditions. But it is quite challenging that which protocol performs best under different scenario, strategy and condition. [14] Routing protocols for ad hoc networks must deal with limitations such as a high error rate, scalability, security, quality of service, energy efficiency, multi cast & node co-operation etc. Here quality of service is taken into account in our proposed work. [9]

Main objective of QOS is to find a path from source to destination satisfying user's requirement to optimize network resource usage and to degrade the network performance when unwanted things like congestion, path breaks appear in the networks. [9] QOS is the performance level of service which is offered by the network to user in case of QOS routing process. It has to provide end to end loop free path with ensure the necessary QOS parameters like bandwidth, delay, battery power, jitter, availability & resources has met. Depending upon the application QOS parameters varies. In MANET, routing protocol aim is to just considering delay and energy consumption during end to end packet travelling is not reliable routing but it also considers reliable links and residual energy of nodes which not only improve QOS but also improve network lifetime & reduced the congestion.

We focus on reactive ad hoc on demand multi path distance vector(AOMDV) routing with quality of service. In AOMDV it discovers multiple routes between source to destination. The AOMDV has a better routing protocol for efficient data delivery. We enhance quality of service parameter like residual battery power with present traffic load with using AOMDV protocol. To improve residual battery power with present traffic load we use route cost function to select paths between source to destinations.

2. RELATED WORK

In Wireless ad-hoc network, Quality of service have gained interest among researchers and lots of work had been done in this regard to provide better network with each node having advanced advantages.

Energy based Ad-hoc On-Demand Distance Vector Routing(E-AOMDV) [1]is an extension of AOMDV protocol. Main intension of this protocol is, a scheme which could consider energy conservation, shortest path and load balancing. They consider both the shortest path and the energy conservation in multipath way with proposed energy based multipath routing (E-AOMDV).

In [2] authors proposed Load balancing ad hoc on-demand multipath distance vector (LBAOMDV) routing protocol, which regulates the fair usage of both node energy and available bandwidth by exploiting the availability of multiple paths for data transfer. The uniform distribution of data across multiple paths enhances the quality of service of the given network by ensuring fair usage of both network bandwidth and node energy. The LBAOMDV protocol ensures reduced node breakdowns, thus enhancing the reliability of the given MANET.

This paper [3] presents Energy efficient and Load Balancing Multi-path (EALBM) routing protocol. EALBM is an on-demand routing protocol, it has three working phases: neighbor discovery, multipath discovery and data transmission. The source initiates multipath discovery process to determine all existing disjoint multipath from source to destination. Each disjoint path is assigned a weight based on the energy level of nodes along that path. The path with maximum energy has least weight i.e. most preferred.

In the proposal [4], they evaluate the performance of well-known and widely investigated in terms of energy efficiency and propose a new routing algorithm that modifies AOMDV. It also proposed routing protocol EAOMDV in order to sense of balance the traffic load among diverse nodes according to their capacity of nodal residual battery and make longer the individual node's lifetime and thus the entire system lifetime.

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In [5] authors proposed LBMMRE-AOMDV protocol that evaluates the generated paths based on the maximal nodal residual energy and the actual number of packets that could be transmitted over that path without depleting the nodes energy.
The LBMMRE-AOMDV protocol involves two phases. The first generates link disjoint paths and maintains them in case of one or more path failures. The second phase balances the data load among the generated link-disjoint paths. LBMMRE-AOMDV achieved better performance in four of the five evaluation metrics, but encountered higher End-to-End delay.

3. AD-HOC ON DEMAND MULTIPATH DISTANCE VECTOR ROUTING PROTOCOL

One of the most commonly used AOMDV is a multipath routing protocol provides loop-free extension to another multipath routing protocol AODV. [7] AOMDV with a route tables contain a list of paths for each destination, to support multipath routing. All the paths have the same destination sequence number to a destination. All the routes with the old sequence number are removed, once a rout advertisement with higher sequence number is received. [4]

Two additional fields, hop count and last hop, are stored in the route table entry to help address respectively the problems of loop freedom and path disjointness. The loop freedom guarantee from AODV is no longer required here, because the multipath routing protocol implement multipath discovery. [4] AOMDV having two table fields hop count field and last hop field, in which hop count field initialized once at the time of the first advertisement for that sequence number and contains length of the longest path for a specific destination sequence number. That's why hop count field remain unchanged till a path for a higher destination sequence number is received. To ensure disjointness of that path in the route table, a node discards a path advertisement that has either a common last hop or a common next hop as already stored in the route table. [4]

Destination IP address
Destination sequence number
Advertised hop-count
Path list {(nexthop1, hopcount1), (nexthop2, hopcount2) …}
Expiration Route

Table 1: AOMDV Routing Table

A. Advantages of AOMDV Protocol:

- It allows multiple path from source to destination.
- It selects Optimum path for communication to occur.
- It avoids link breakage by having multiple path in route discovery. [7]

B. Disadvantages of AOMDV Protocol:

- It uses multiple paths hence it needs to handle more control packets.
- The increment in routing overhead will degrade the performance of the network. [7]
- Unnecessary flooding decrease the energy of nodes.

4. PROBLEM STATEMENT

In AOMDV Protocol nodes consumes more energy due to battery operated mobile nodes. Also, a node in path when forward large amount of traffic its battery will deplete faster and node dies. This will affect the network operation and lifetime. So, we need to enhance the quality of service parameters like residual battery power and current traffic load in a network by using AOMDV protocol to save battery life time of node. There are various algorithms available for quality of service in MANET but looking at various issues in the different algorithm still some research is to be done to improve the performance and quality of service of the algorithms.

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5. PROPOSED WORK

5.1. Proposed Protocol

Quality of services is usually defined as a set of service requirements that needs to be met by the network while transporting a packet stream from a source to its destination. [9] QoS routing requires not only finding a route from source to a destination, but a route that satisfy the end to end QoS requirements, in terms of bandwidth or delay. The roll of a QoS routing is to compute paths that are suitable for different type of traffic generated by various applications while maximizing the utilization of network resources. Routing is critical to QoS support, while its performance is vulnerable to changes in network topology in mobile wireless network such a change is mainly caused by node mobility. [9] In our proposed scheme we provide quality of service by using two parameters namely Residual batter power and Current traffic load using ad hoc on demand distance vector routing protocol (AOMDV). Some of the approaches consider residual batter power as the only path metric to achieve energy efficiency so here we provide residual batter power as well as current traffic load to achieve better energy efficiency.

The proposed protocol quality of service with AOMDV is discussed in this section. The protocol selects path based upon a route cost function. The route cost function of (i) Residual battery power (ii) Present traffic load. Some of the approaches considered residual battery power as the only path metric to achieve energy efficiency. However, it may not give any guarantee to enhance network lifetime. A node in a path went forward large amount of traffic its battery will deplete faster and node dies. This will affect the network operation and lifetime. Therefore, we have included the traffic load at a node along with residual batter power to compute the route cost. The route cost functions help to select energy efficient path. Also, we have considered node disjoint approach to select multiple paths between source destination pair.

5.2. Protocol Description

The route discovery procedure of proposed protocol is very much similar to AOMDV. We made some necessary changes to the route discovery phase of AOMDV. A node when has some packet to send prepare the RREQ. The RREQ packet contains the cost function which is computed by that node. A node on receiving the RREQ first computes it cost function. If the value is less than the value in the RREQ packet, then node updates RREQ packet by putting its own computing cost. Otherwise, it forwards the RREQ packet without changing its value. In this way RREQ reaches at the destination through
intermediate nodes. Destination nodes on receiving the first RREQ packet run a timer. All the RREQ received during this time will be considered for path selection. Any RREQ received after the expiry of the timer will be discarded. Then the destination node selects the path. The route reply is sent to the source through selected paths.

5.3. Proposed Algorithm

```
Set node = n; // n number of mobile node
Set Sender = Send;
Set receiver= Rec;
Set protocol = AOMDV;
Set initial energy = E // For all node energy is different value
Broadcast Route

{
        While (next hop available && next hop is not destination node)

 {
    Calculate the route cost function for that node using following formula

    Route_Cost= (Energy_weight+ Present_load) *Random_delay

    Where Energy_weight will be calculated using below method.

    Energy=Power*Time;
    Time=8 * packetsize/bandwidth;

    transmission_energy = node_tansmission_power*Time;
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receiving_energy = node_receiving_power*Time;

Therefore,

total_ consumed_energy = transmission_energy + receiving_energy;
Energy_delay_weight = (1- (currrent_residual_energy / total _ consumed _energy))
Present_load = current_load / max_load;

If (Route_cost (new_node) < Route_cost (old_node))
{
Route_REQ = new_Route_RREQ
}
Else
{
Forward the packet without any changes
}
Destination node runs time on receiving first Route_REQ
If (Route_REQ_time > expiration_time)
{
Route_REQ = Route_REQ_Discard
}
}
}

6. SIMULATION ENVIRONMENT

The Proposed protocol was simulated, and its performance was evaluated against AOMDV protocol using the prominent NS2 network simulator. Table 2 shows the details of the simulation environment features.

Simulator Used	NS-2.34
Routing Protocol	AOMDV
Dimension of simulated area	1000m×500m
Radio Propogation Model	Two Ray Ground
Number of nodes	60,200,500
Simulation time	300 sec.
Traffic type	CBR
Node speed	10 m/sec
Maximum queue len	50 packets
Receiving Energy Consumption	1 joules
Transmission Energy Consumption	1.5 joules
Transmission range	250m

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Table 2: Simulation Parameters

6.1. Performance Metrics

In order to balance the requests of the resources it is important to recognize a few major parameters to improve residual battery power with current traffic load:

1) Packet Delivery Ratio: Usually it refers to the proportion of correctly received packets to all sent packets in a period of time. It is an evaluation indicator of the reliability of transmission in ad hoc network.

2) Throughput**:** Number of packets sends or receives in per unit of time in network.

3) Residual Energy: This metric measures the amount of a residual energy or battery life for each node at the end of simulation time.

7. SIMULATION RESULTS

This section evaluated the results in case of previous AOMDV case and imp_AOMDV case. The performances of proposed scheme are better than previous.

A. Packet Delivery Ratio (PDR) Analysis in case of AOMDV and Imp_AOMDV:

Packet Delivery Ratio (PDR) is the ratio of number of packets received and number of packets sends in network. This performance metrics important to analyze the packet percentage successfully received in network. Table shows PDR results for different values of X and Y Dimensions. Graph for the X=1000 and Y=500 shows the improvement in PDR.

Total No. of Nodes	AOMDV	Imp_AOMDV
60	0.78	0.91
200	0.76	0.89
500	0.83	0.92

Table 3: Packet Delivery Ratio Analysis

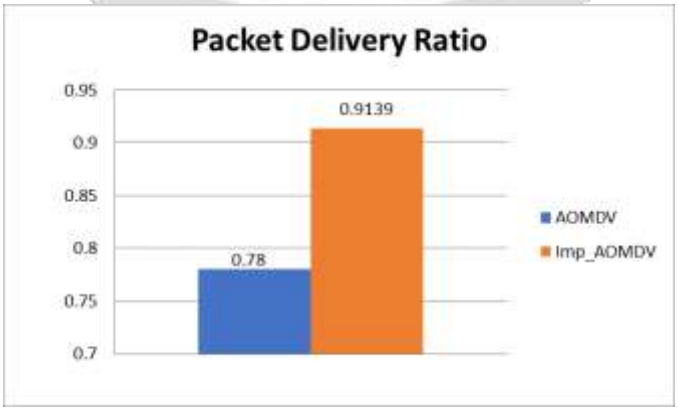

Figure. 1

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B. Throughput Analysis in case of AOMDV and Imp_AOMDV:

Throughput represents the number of packets send and received in per unit of time. In this graph, the throughput in case of normal AOMDV routing is less as compare to proposed Imp_AOMDV routing. Table shows throughput results for different values of X and Y Dimensions. Graph for the X=1000 and Y=500 shows the improvement in throughput.

Total No. of Nodes	**AOMDV(kbps)**	**Imp_AOMDV(kbps)**
60	17.64	23.03
200	15.18	17.57
500	16.50	18.09

Table 4: Throughput Analysis

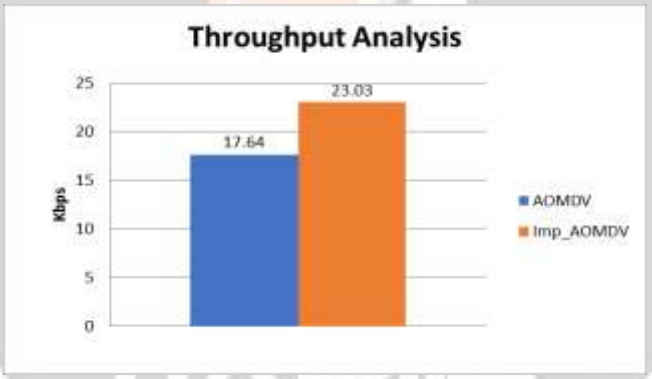

Figure. 2

C. Energy Efficiency in case of AOMDV and Imp_AOMDV:

Energy Efficiency represents Avg_Energy consumption in a given amount of time. Table shows Energy results for different values of X and Y Dimensions. Graph for the X=1000 and Y=500 shows the improvement in Residual Energy.

Total No. of Nodes	**AOMDV**	**Imp_AOMDV**
60	36J	39J
200	38J	42J
500	37J	40J

Table 5: Residual Energy Analysis

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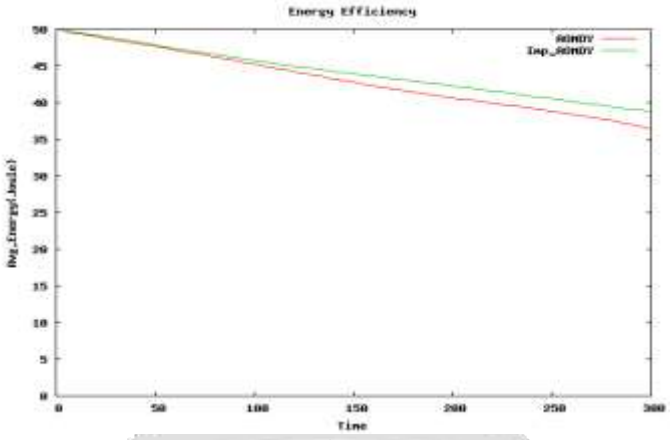

Figure. 3

8. CONCLUSION AND FUTURE WORK

We conclude that the proposed protocol provides quality of services. The proposed protocol uses a cost function which considers both residual battery power and present traffic load at a node. By using this cost function at the end, we improve energy efficiency & better network lifetime as well as it performs better in terms of packet delivery ratio & throughput. The results of quality of service with AOMDV protocol is very effective as compare to normal AOMDV routing protocol

In future, we will analyze the performance of proposed algorithm with different values of parameters using route cost function to improve quality of service.

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