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International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-1 Issue-2, July 2012

# A routing metric for wireless mesh networks with optimal cost and optimal power

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***Abstract: As while transmitting packets or data in the network, multiple number of traversal can occur because of the number of links in the data transfer route of source and destination and also the links in the relative position of the link are not accurate. But with some previous efforts it is able to calculate the optimal cost with required number of links in layer transmission but again there occurs the problem of power conjunction means it is more and more difficult to compute the optimal cost along with optimal power. To overcome this problem this paper synthesizes on existing methodology related to optimal path selection through which it exactly finds out the number of links layer which are essential for source to destination packet delivery and highlight towards how to compute the path with optimal cost along with optimal power.***

***Index Terms**: Wireless ad-hoc network, Routing metric, Throughput.*

## I. INTRODUCTION

Routing in wireless mesh networks has been a hot research area in recent years, with the objective to achieve as high throughput as possible over the network [2]. As we know while transmitting packets or data in the network, to minimize the number of link layer transmission including retransmission in a wireless mesh network is major issue and at the same to ensure high overall throughput. This can be achieved by selecting routes with reliable links. Many popular multimedia applications, e.g., voice over IP (Internet Telephony), IPTV (IPTV (Internet Protocol Television) is a system where a digital television service is delivered by using Internet Protocol over a network infrastructure), and on-line gaming, have strict delay requirement. This paper includes the, designing a routing metric to minimize the end-to-end delay, power at the time of node to node delivery of data. As the end to end delay is minimized, it ultimately results in reduced cost.

This has a two-different effect. First, the throughput of the flow using these paths is higher. Second, the throughput of the network as a whole increases, since the fewer transmissions lead to lower network-wide contention.[1]
To reduce the delay problem, this paper works on to select the efficient route for node transfer with effective route along with the minimum power (hops) i.e. optimal power. Means the work will be in such a way to get efficient path at the time of data transmission and retransmission along with the optimal hoping (minimum power).

Even under benign conditions, various factors, like fading (fading in a communication system is the fluctuations in the amplitude and phase of the signal at the receiver side.), interference, multi-path effects, and collisions, lead to heavy loss rates on wireless links. There are two well-known ways to achieve end-to-end reliability on multi-node routes. The first approach employs node-to-node transmission along with retransmissions. Each link layer node retransmits lost frames as and when necessary. The second approach assumes that link layers are unreliable and retransmissions are performed end-to-end. It is also possible to consider a mix of the above as a third approach, where link layers perform a few retransmissions if necessary, but perfect reliability is only guaranteed through end-to-end mechanisms. Traditional power aware routing schemes do not take link loss rates into account when computing energy efficient paths. By ignoring the impact of such losses, they implicitly assume that every link is totally reliable [5]

In a minimum cost path with minimum energy path will consider the end-to-end retransmission [where the individual links do not provide link-layer retransmissions] and hop by hop retransmission. [Where each individual link provides reliable forwarding to the next hop using localized packet retransmissions.]

To implement the concept of minimum power and minimum cost Expected number of transmission on path has been used. (Greedy optimization technique is its part), UDP has been used (CBR:-Constant Bit Rate generator) and to find the distance between source to destination Euclidean method is used. Again, AODV has been used to establish a route on demand only.

- Wireless ad hoc network: An ad hoc network is a type of temporary computer-to-computer connection. In ad hoc mode, you can set up a wireless connection directly to another computer without having to connect to a wireless access point or router.
- Routing Metric: Routing is the process of selecting paths in a network along which to send network traffic. Routing metric is concerned primarily with routing in electronic data networks using packet switching technology.
- Throughput: The system throughput or aggregate throughput is the sum of the data rates that are delivered to all terminals in a network..or throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

## II. LITERATURE SURVEY

In this section, we analyze some efforts performed earlier. Many measurement studies link experience losses in wireless network.

**Revised Manuscript Received on 30 July 2012**
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The end-to-end cost of the path is sum of the ETX values of the link on the path the routing layer simply computes routes with the minimum cost.[1] Energy efficient routing has always been a central research topic in wireless networks, both in the paradigm of multicast/broadcast and in the paradigm of uncast. In both paradigms, our objective is to design a routing scheme such that the total transmission power is minimized. [5]

By using Dijkstra's shortest path algorithm, PAMAS finds a minimum cost path where the link cost is set to the transmission power. If every link in the paths is error free, then a single transmission over each link can successfully deliver a packet from the source to its destination with minimum cost. [4]

Multi-hop wireless networks typically possess two important characteristics:

1) The battery power available on the lightweight mobile nodes (such as sensor nodes or smart-phones) is relatively limited.
2) Communication costs in terms of transmission energy required are often much higher than computing costs on individual devices. Energy-aware routing protocols for such networks typically select routes that minimize the total transmission power aggregated over all nodes in the selected path [3]. From the above literature survey, it is clear that reduction in the transmission cost and the transmission power are the main aspects to be considered.

The paper summarizes the issue served. From the previous literature survey it is clear that in a network at the time of end-to-end data transfer the link transfer mode maximizes the cost of path. Still there remains a problem of maximum power loss. So, with the survey of this paper we will further move towards to implement a technique or algorithm which efficiently finds out the path with optimal cost and optimal hops.

## III. RELATED EXAMPLE

[1]This problem will be illustrated with the example given in Fig. 1. There are two paths from the source S to the destination R; the number next to each link depicts the probability of a successful transmission (denoted as link success probability) across that link. At first glance, it may seem that it is better to use the path [S, X, Y, R] instead of [S, A, B, C, R]. However, the path [S, A, B, C, R] is better than [S, X, Y, R]. If the link layer will allow only one retransmission is it is easy to calculate the required total number of link layer transmissions per packet is approximately10 for the path [S, A, B, C, R], while it is approximately 16 for the path [S, A, B, C, R]. The higher cost is due to the bad link that is closer to the destination, in the path [S, X, Y, R].[1]

As it selects the path with optimal cost, it also checks for the route with optimal power. To travel from source S to the destination R, it will select the link with optimal path along with optimal power in Mwatt.Suppose for path [S, X, Y, R] it takes 100 mw power and for [S, A, B, C, R] it takes 80 Mwatt power means path [S, A, B, C, R] is more efficient as compared to path [S, X, Y, R].So, it will travel trough path of [S, A, B, C, R] to move from S to T because it minimize the cost and power both.

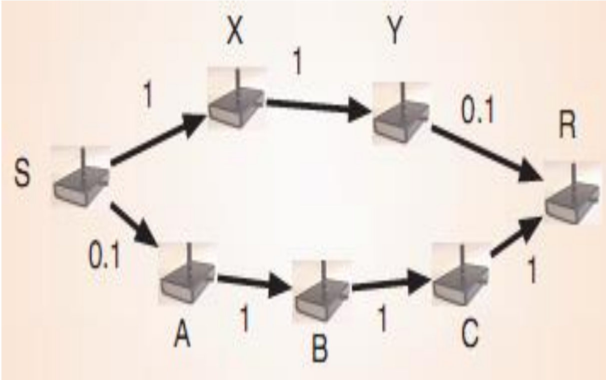


Fig: 1.The effect of Link Position on the performance of the path.

With this example it clear that how to calculate minimum path. With this paper the additional concept to calculate the minimum power will elaborate.

## IV. PRINCIPLE BEHIND IMPLEMENTATION

With the help of Expected number of transmission on path (it also consider the relative position of links) we compute the minimum cost .Expected number of transmission on path again called as ETOP in short.[2]Additionally we are calculating the minimum hops.

To implement ETOP we are making use of 50 nodes and 20 hops.(In this hops means node to node transmission, means to save the power while data transmission it will check either send data directly from source to destination or hop by hop.)Simply, in the path of data transmission we have include limit up to 20 hops if the hops will increase above 20 then it will send data directly from source to destination.

Explanation: If we want to send data from node 1 to 8 means it has to find out the hops through which get the minimum cost and minimum power path .Suppose to travel from node 1 to 8 it will travel through hops like 1-3,3-5,5-8..means, 3 hops will required. But suppose the hops will goes on increasing above 20 means node to node power will also increase (as it will passes from 20 nodes).So, in such case it will send data directly from source node to the destination and this is the main concept behind implementation to save power while sending data according to condition hop by hop or directly source to destination. [2]Again the throughput of Expected number of transmission on path is 50 percent good than ETX-based routing.[2] ETX-based routing means wired connected routing and ETOP is wireless routing.

## V. EUCLIDEAN METHOD

(To calculate distance between source and destination) Very often, especially when measuring the distance in the plane, we use the formula for the Euclidean distance. According to the Euclidean distance formula, the distance between two points in the plane calculated. The source of this formula is in the Pythagorean theorem.

As Euclidean distance formula calculates the distance between two points so, we are making use of Euclidean distance formula to calculate distance between source and destination and find out the cost between source and destination.



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The formula to calculate source to destination distance is given by,

$$Dist=\sqrt{(x1 - x2)^2 + (y1 - y2)^2}$$

Where,

Dist= Distance From source to destination

x1, x2, y1, y2= Nodes in the path of source to destination.

VI. AODV AND UDP

AODV stands for Ad hoc On-Demand Distance Vector. It is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. The advantage of AODV is that it creates no extra traffic for communication along existing links. The main advantage of this protocol is having routes established on demand and that destination sequence numbers are applied for find the latest route to the destination. The connection setup delay is lower. So, the conjunction will reduced and hop by hop data transfer will also reduce means it will save cost as well as power also. Hence, the concept of AODV has been used.

UDP applications use datagram sockets to establish host-to-host communications [6].Voice and video traffic is generally transmitted using UDP. Real-time video and audio streaming protocols are designed to handle occasional lost packets, so only slight degradation in quality occurs, rather than large delays if lost packets were retransmitted.[7]

With the use of Ad hoc On-Demand Distance Vector (AODV) and UDP it becomes easier to find the latest route to the destination, reduced delay hence, we are using AODV and UDP.

## VII. SIMULATION RESULT

By using Euclidean method, AODV and UDP we have simulated the result to calculate the minimum cost and minimum path while hop by hop data transfer. Total 20 hops taken into consideration if hops will increase above 20 then it will directly travel from source to destination instead of hop to hop packet delivery Means, by both ways it will give efficient path to compute optimal cost and optimal hops.(To calculate minimum power ).We have simulated the result with the help of three graphs. i.e.

1. Delay
2. Normal Cost.
3. ETOP Cost.
3. The ratio of cost and power delay calculated by cost*$10^3$ form. The unit of power is MW.

In first graph it shows while travelling from source to destination when it used ETX method(wired connection method) then what will be the cost and power.

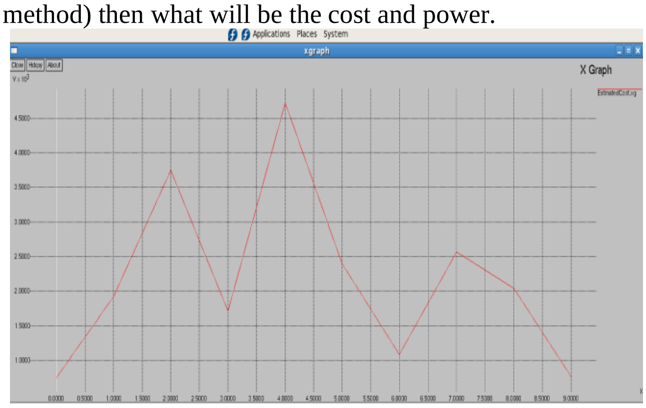


Fig: 2.The Normal cost

In second graph it shows `how the Expected number of transmission on path (ETOP)(wireless network) will increase the throughput of power and cost of path.

The third graph displays the difference between the normal cost and ETOP cost. With this graphical result it clear that ETOP efficiently saves the power and cost while transmission of link layer from source to destination.

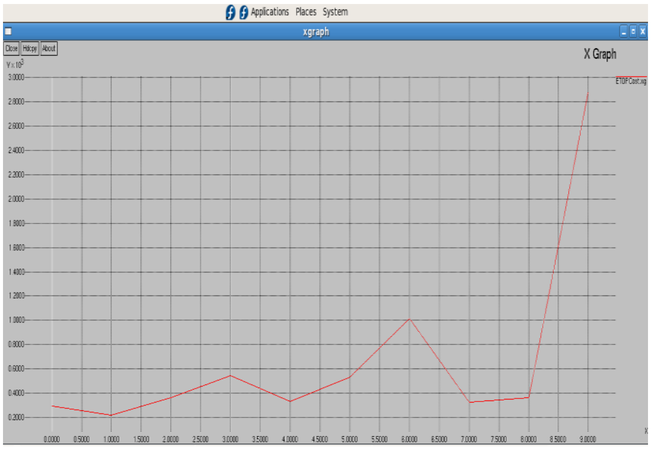


Fig: 3.The graph showing efficient ETOP COST.

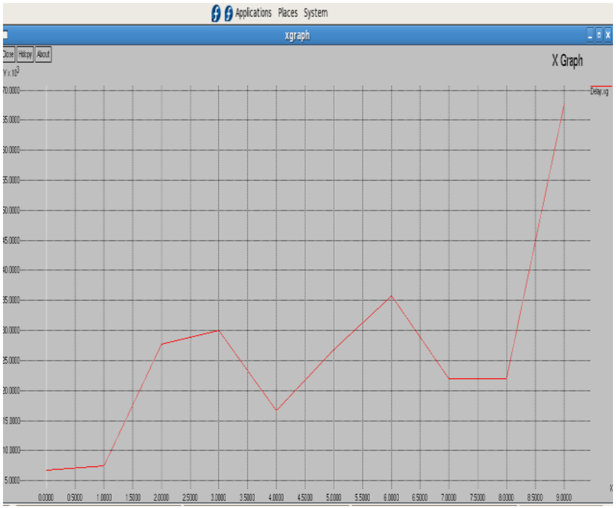


Fig: 3.The Delay between Normal cost and ETOP cost.

## VIII. CONCLUSION

Thus we revisit the problem of computing the path with the minimum cost and minimum power in multihop wireless networks. Here the minimum ETOP value is calculated using Euclidean method. As compared to ETX approach, ETOP outshines by 50% in terms of TCP good put.

The delivery of packet from source to destination and vice versa i.e. while transmission and retransmission we are computing the route with the concept of optimal cost in terms of multiple (many) links layer in path of wireless network. For this improvement to compute optimal cost new areas are emerging [1].Along with this we move towards to compute path with optimal power (For this we have taken 20 hops) Up to 20 hops it travel from hop by hop otherwise it directly move from source to destination. .


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That means, the goal of the paper is to select a high throughput path between source and destination with optimal cost and power(optimal cost and power) in a network while data transmission. This is again merit of this paper that it optimizes the cost and power.

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