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ANALYZE THE PERFORMANCE OF ROUTING METRICS USING OLSR PROTOCOL

[1*]Subba Rao P, [2]Dr Jaideep Gera

[1]Pursuing M.Tech in Department of Computer Science and Engineering at
St.Mary's Group of Institutions Guntur, AP,India.
E-Mail: subbaraoperam224@gmail.com

[2]Associate Professor in Department of Computer Science and Engineering at
St.Mary's Group of Institutions Guntur, AP,India.
E-Mail: gera.jaideep@gmail.com

Abstract : For WMNs, many routing matrices have been proposed, allowing routing algorithms to choose the most energy-efficient method that balances throughput, delay, and power consumption. In WMNs, the presence of static nodes and shared wireless medium invalidates existing techniques and imposes new constraints when constructing routing metrics (WMNs). In this paper, we conducted a small experiment to locate this specification based on variety of metrics. Additionally, we also provide some analysis following that, where we investigate the impact of a mesh networking configuration of 16 nodes on a 4x4 WMN. This research study examined how the total network performance impacted upon OLSR-based routing protocol throughput, loss ratio, and delay.

I. INTRODUCTION

1.1 Introduction to Wireless MeshNetworks (WMN)

In mesh topology, radio nodes communicate with each other via WMN (WMNs).
Gateways, mesh clients, and routers are commonly used in it. Cell phones, laptops, and other wireless devices are commonly used with WMN clients, and the mesh routers distributes the traffic to the gateways and also sends it to the clients. A network that has the ability to self-heal, self-configure, and handle faults. Similar to the cooperative multi-hop technique, property Wi-Fi nodes use makes routing among a single node, multi-hop node to base station, and multi-hop node to destination possible. It's this wireless technology's ability to provide fast internet connections in both urban and wild environments while being cheaper to deploy upfront than conventional wiring and optical links. Mesh networks (MN) have numerous properties of WAD, static WSN, and wired networks, as shown in the image labelled "WMNs (WMN) have different attributes of WAD, static wireless networks, and wired networks." WMN are superior to conventional stand-alone networks when it comes to resources because of their unique characteristics.Routing metrics determine the cost of computed routes.Routing metrics offer information that is helpful when determining route costs or efficiency.As far as WMNs go, mobility features and power needs are considerably different as compared to ad hoc networks.WMNs mesh clients are mobile, but WMNs mesh routers are not; instead, they are designed to accommodate no mobility with fixed power.In order to get these benefits, ad hoc networks are required, and this applies to WMNs as well.

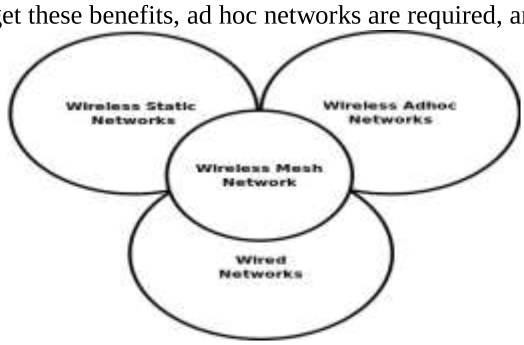


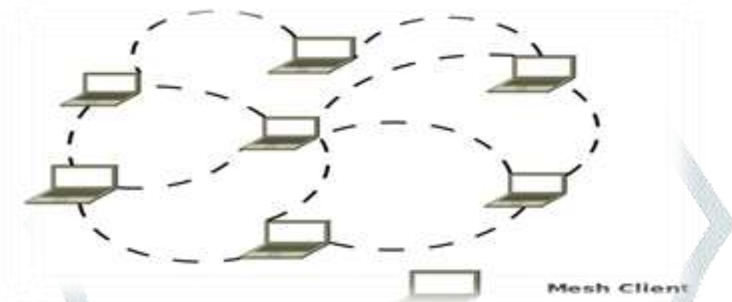
Figure 1.1: Hybrid nature of WMN

1.2 Our Contribution on this paper

Specifically, in this research, we investigate which routing measure for routing etiquettes in WMN produces the best results when compared to the other options.Because a routing etiquette in WMN. The routing protocol calculates a set of routes in order to satisfy maximum data rate, minimum delay, and the like.Quality of a network link aids in discovering the most appropriate path to take. Specifically, in this article, we focus on a relative study comparing in terms of throughput, loss-ratio, and delay, ETX and ETT perform better when used in conjunction with OLSR.

2. Work on routing in WMN that is unrelated to the presented work.

To provide service in places such as offices, transportation, security, and residential areas, the network uses WMNs.Being able to connect to a broad variety of network topologies, such as wireless and wired, is also addressed. The various network components are mentioned as follows in a WMN. When it comes to WMNs, the mesh clients, mesh routers, and mesh gateway routers can be identified as its many components. The Mesh client functions as a user on a mesh network, while the Mesh routers build the backbone of the network. Increasing network capacity by adding MCMR or MCSS radios to mesh routers is another way to achieve this. Mesh clients are extremely mobile devices, such as laptops, IP phones, and PDAs, with constrained attributes such as power.It depends on the architecture of the network mesh whether clients have routing capabilities. Everything shown in Figure 2.1 is present in all components.



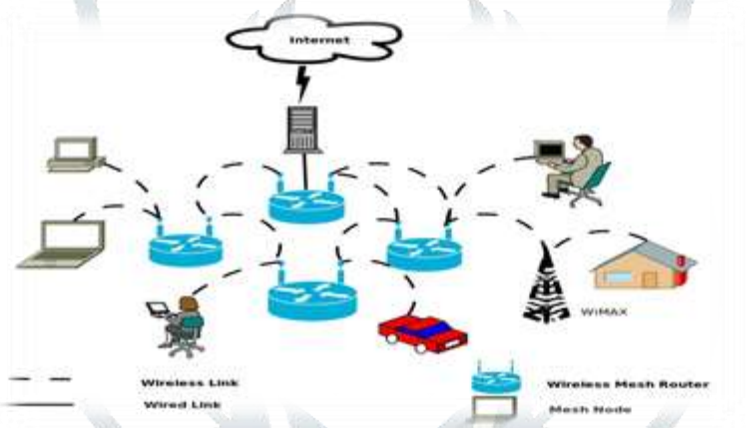


Figure 2.1: Components and architecture of mesh network

Figure 2.2: Client WMN

There are three types of WMN architecture: client WMN, hierarchical WMN, and hybrid WMN[5].

A complete list of the network's characteristics is shown below. A WMN Client WMN is a network where all of the mesh clients are interconnected with no infrastructure or backbone in between. While mesh routers are not typically deployed, mesh clients serve as a layer of intermediary routers for multi-hop communication. The client WMN uses peer-to-peer wireless technology. There is only one component in a mesh network, a mesh router. Mesh routers are the mesh network's infrastructure, called the mesh network backbone. Connectivity can be achieved via several networks, including wireless, sensor, the internet, and WiMax. Once you have connected a mesh router to the Internet, you will be able to access the network immediately. Other network users need to know how to connect to the access point or base station before they can communicate with the rest of the network. This backbone is accessible to clients who use either the conventional or mesh network. A network interface card (NIC) or an Ethernet link is required to connect to mesh routers. Since conventional clients connect to the mesh router via the same radio technology as the mesh router, conventional clients are directly connected to the mesh router. In mesh routers, there are two sorts of radios: radios that are for communicating with users, and radios that are for communicating with the network backbone. This network is constructed using mesh routers and mesh clients working together.

2.1. Applications and Characteristics of WMNs

The increased speed and dependability alongside the other networks make it popular in real-time applications such peer-to-peer networks like MANETs, Wi-Fi, and multi-hop feature WMNs. Some aspects of WMN include: WMNs do not have any dead zones, hence there is no need for a cabling structure. Avoiding dead zones in mesh networks is as simple as changing the router in the mesh network. WMNs proliferate and expand quickly due to the same issues as wireless access points (802.11).When you use a standard one-hop network, such as a dial-up connection, you are using a single path. When you use a WMN, however, you are using different paths from the source and the destination, which provides more reliability .As a result, there are no points where the system can fail due to one of the available pathways, such as hardware failure or a power outage. Network communication is significantly more steady and robust because of the abundance of links between the nodes. Multi-channel and multi-radio configurations assist with WMN throughput. Multiple-channel radios are used at the source and destination to improve communication.

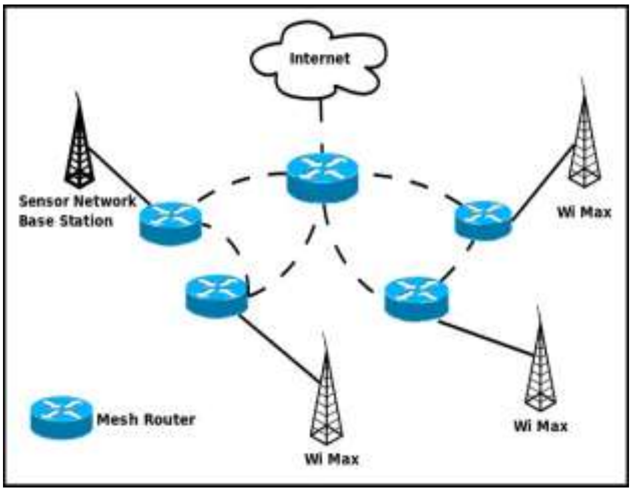


Figure 2.3: Infrastructure/Backbone WMN

3. The Proposed ETT And ETX Metrics Value Calculation

3.1. Design of 4x4 Wireless Mesh

The topology explored for this simulation is depicted in Figure 3.1The horizontal and vertical distances of two nodes in this 4x4 mesh are 150 metres, and the transmission range of a node is 250 metres. We calculated the ETX and ETT values for each link using probing packet sizes of 128 bytes, 256 bytes, and 512 bytes in order to determine the optimal route from source to destination node.

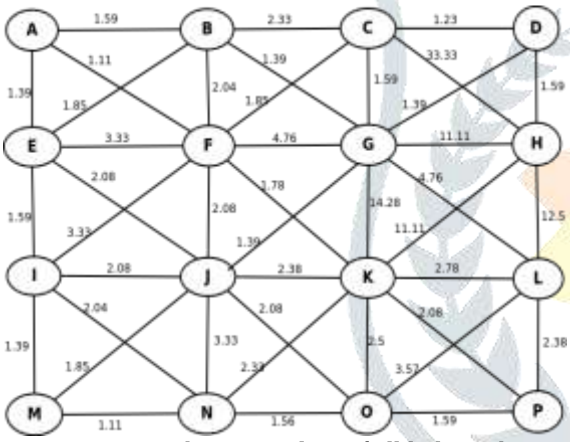


Figure 3.4: The ETX values of all links with 256 byte probe packets

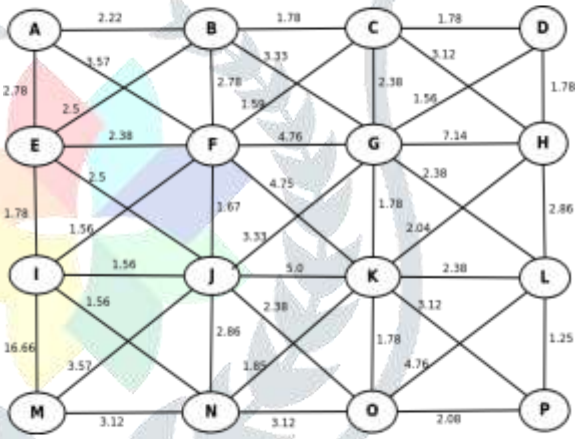


Figure 3.5: The ETX values of all links with 512 byte probe packets

Calculation of ETXValue:

Discussing the method of calculating the ETX based on the network illustrated in Figure 3.2 can be helpful. Node A sends a total of 10 probe packets, with each one being 128 bytes in size, and these packets are being sent out at a rate of one per second for 10 seconds [14]. Assume that node B is the sole node to have received eight probe packets delivered by node A. At this point, node B is also sending 10 probe packets, each one being 128 bytes in size for 10 seconds. Now the forward delivery ratio is

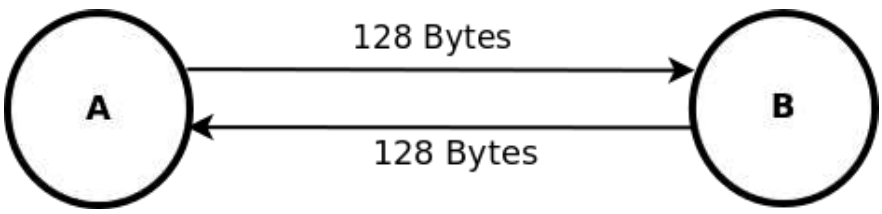


Figure 3.2: Node A sends 128 byte probe packets to Node B. In return Node A sends 128-byte probe packets to Node B.

$$D_{fwd} = \frac{8}{10} = 0.8 \quad (3.1)$$

and reverse delivery ratio is

$$D_{rve} = \frac{7}{10} = 0.7 \quad (3.2)$$

So the ETX value of the link between node A and B is

$$ETX = \frac{1}{08x0.7} = 1.79 \quad (3.3)$$

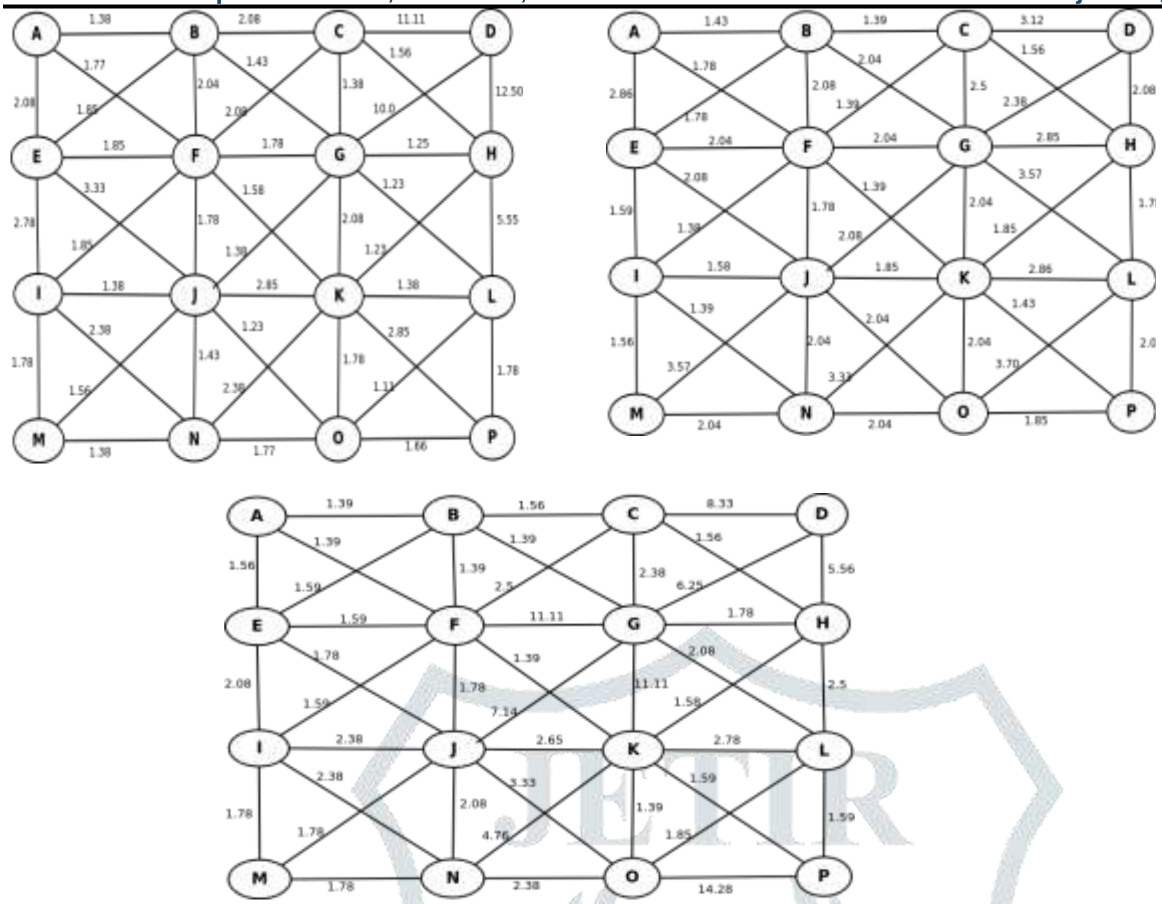


Figure 3.6-3.8: The ETT values of all links with 512 byte probe packets

Path Selection

When you look at Figure 3.9, keep in mind that there are three sub-pathways between the source and the destination, and that the paths have three hops.To learn more about the link metrics, see the image below. Now we have three pathways, each with three hops.The ETX connection metrics for the sub routes and their summing are provided in Table 3.1.

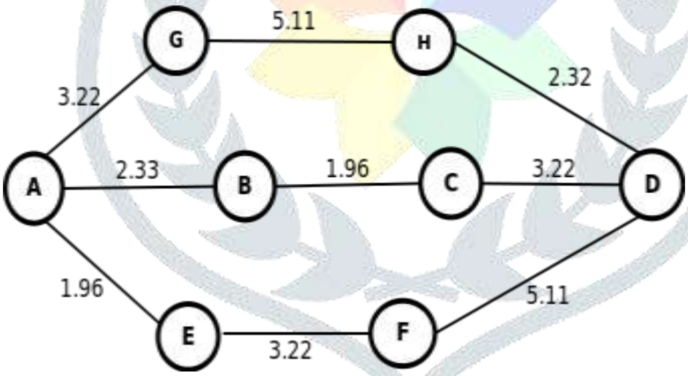


Figure 3.9: A Network Toplology with ETX values of all the links

In the table 3.1 The pathways in Figure 3.9 that have 3 hops and the ETX link metrics are shown in this figure. The lowest ETX

Sub paths having 3 hops each	ETX value for the sub path
A-B-C-D	7.51
A-E-F-D	10.29
A-G-H-D	10.65

metric for the A-B-C-D sub path is 7.51, which indicates that this sub path will be the path metric for the topology. Using ETX metrics, we can find the path metric for the route.

4. Simulation and Results

Simulation setup

Simulation is done with the Network Simulator 2.34(NS2). The network architecture, which uses the four-by-four topology, is represented by a grid of sixteen static odes spread over a 1000 m x 1000 m space, as shown in Figure 3.1 Using the assumption that horizontal and vertical distances between two nodes are 150 meters, and that a node's transmission range is 250 meters, the horizontal and vertical horizontal and vertical distances between two nodes are 150 meters, and we also estimate that a node's transmission range is 250 meters. Two metrics were simulated in Network Simulator 2.34 to examine how they functioned on a 16-node network. We used two measures for comparison: the ETX metric offered (where the ETX value of a particular route is derived as the total of the ETX values of each connection on that route) is a) ETX metric, which is a 512-byte probe packet size and 512-byte path size combination ETT metric provided (the ETT value of a particular path is equal to the total of the ETT values of each link on that path), where ETT is calculated by dividing the total of the ETT values of each link on that path by the number of probes needed to obtain the total. This table provides the simulation parameters, as seen in table 4.1contains the values for the simulation parameters. The OLSR protocol's parameters and metrics are listed in Table 4.2.From the first second, HELLO messages were sent every two seconds.TC messages have a start and interval time of 1 and 5 seconds, respectively. The ETX value is determined by taking ten consecutive samples. The remaining parameters are listed in the table below.

Simulation Parameter	Value
Tool Used	NS2
Simulation Area	1000m*1000m
Number of Nodes	16
Simulation Time	50s
Data Rate	11mbps

Table 4.1: Simulation Parameter

OLSR and Metrics Parameter	Value
Hello Message Interval	2s
Hello Hold Time	6s
TC Hold Time	15s
TC Message Interval	5s
ETX Window Size	10
ETT Window Size	5

Table 4.2: OLSR and Metric Parameter.

Analysis of Simulation Result

To determine the average amount of throughput, we measure the average duration of the path's performance and determine that this amount is constant bit rate throughput. The Path Length and Throughput Evaluation in Figure 4.1 depicts how throughput improves as path length increases. If you design your network to use fewer links, your network's throughput will be greater because you eliminate the inefficiency and loss that occurs on a network with a greater number of links. Avoiding low-throughput channels enables higher-throughput metrics like the expected Transmission Count (ETX) and Expected Transmission Time (ETT) to deliver greater benefits. Figures 4.2 and 4.3 illustrate the performance of the three measures as flow rates increase. When flow rates are increased, it is clear that Expected Transmission Time (ETT) produces the best results in terms of packet loss ratio and end-end delay. Due to the fact that Expected Transmission Time (ETT) takes into account both connection capacity and link loss ratio. The following figures 4.2 and 4.3 illustrate the output of three metrics as flow rates are increased. The above figure 4.4 illustrates a summary of the simulation results for a 4x4 wireless mesh. Note that the ETX and ETT metrics do not constrain the path based on the number of hops because when ETX and ETT are equal, the path with the fewest hops is chosen.

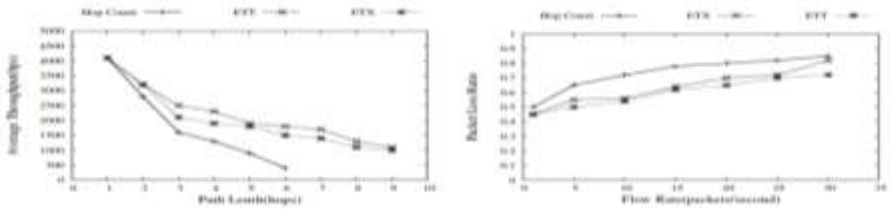


Figure 4.1-4.2: Average throughput with path length increases

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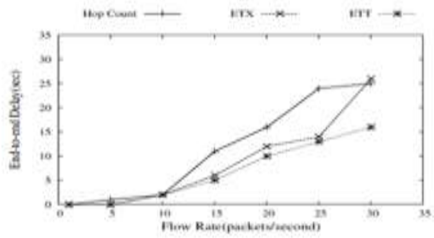

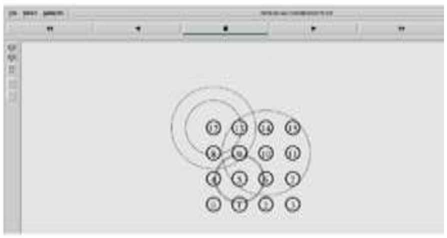

Figure 4.3: Average end-to-end delay with various flow rates

Figure 4.4: Node Position in 4x4 Mesh at Network Animator

5. **Conclusions and Future Work**

WMNs have the potential to be a groundbreaking technology for future networking. It makes using the Internet effortless for end users, giving them the ability to access the web from any location at any time.To enhance knowledge of the research contests, we offer an overview of WMNs, explaining its architecture, components, typical routing metrics, and protocols, as well as their limitations and obstacles. Additionally, we also showed how ETX, ETT, and Hop count each performed using the OLSR protocol when it came to throughput, latency, and loss-ratio. Additionally, we perform constant auditing of WMNs (WMNs) to search for various routing methodologies and hop-count as the main routing statistic is discovered. WMNs use several hops for routing, but at the same time are riddled with the challenges of interference from concurrent transmissions and self-interference. The network simulator NS-2 will be used in the future to assess all routing metrics across several routing protocols, such as BGP, EIGRP, OSPF, and RIP.In other words, we must do a comparison research of various routing metrics, with respect to delay, throughput, and loss-ratio, to evaluate the performance of different routing protocols.

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