# ANALYSIS OF ROUTING PROTOCOLS IN WIRELESS MESH NETWORK

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**Abstract:** As a developed technology, in recent years wireless mesh networks has a great achievement in wireless networks. In Wireless mesh networks Routing is very difficult because of undeterminable variations in wireless environment. There are two methods to improve the performance of routing protocols in wireless mesh networks. One way is to improve the methods used for select the path. Second way is to improve the algorithms to add up the new characteristics of wireless mesh networks. We also propose a new protocol that is used for Multi Interfaces and Multiple Channels (MIMC) named as Hybrid Wireless Mesh Protocol. This protocol selects the high throughput path to reduce the overhead of control messages. This protocol is used to overcome the disadvantages of IEEE 802.11. We implement these protocols using Ns2 simulator tool.

**Keywords**: Wireless mesh network, Routing protocols, throughput, MIMC

## I.    INTRODUCTION

Wireless mesh networks (WMN) have gained acceptance from both academic and industry because of cost effective feature to support high speed connections and large access of broadband because of advance characteristics such as robustness, high flexibility, self organization, self configuration. Wireless mesh network has two types of nodes-mesh router and mesh clients. Mesh router have some great features to support mesh networking. Mesh routers are the backbone for mesh clients. Mesh network has multiple interfaces which can be used either in same or different network. Mesh clients also work as a node operator not as a host also as a router.

There are many types of mesh networks with advance characteristics available in the market today, these products are not compatible with each other because each employ has its own routing protocols and their solutions. To solve the problem of compatibility in mesh network we describe the IEEE 802.11s and this is standardized in the final stage.

Other protocol that is used to select the path is Hybrid Wireless Mesh Protocol (HWMP). This protocol combines an on- demand mode with a proactive tree building mode. The airtime link is the time to transmit the frame from source to destination. HWMP calculates the overall cost of the path selected. The main drawback in IEEE 802.11 is that it does not consider the channel diversity. Due to this, it is suitable for Multi-interface and Multi- channels. The main challenge for the IEEE 802.11 is to reduce the overhead between frames. Many control messages such as Path request (PREQ), these messages transmit again and again by every interface. If the interface increases then the amount of transmission increases.
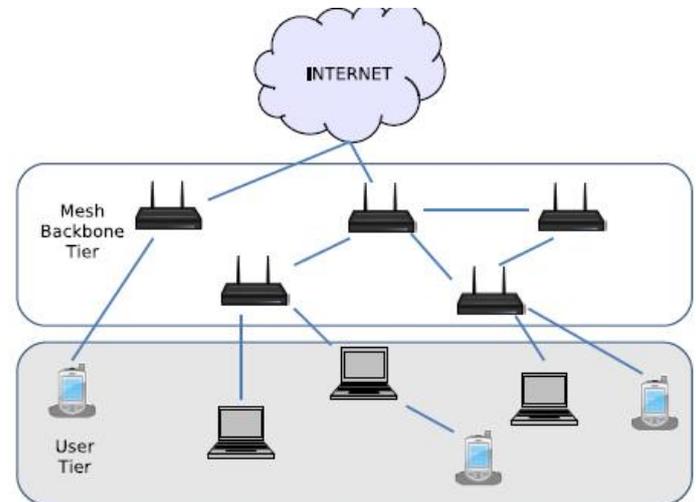


Fig. 1: WMN architecture: Router backbone and user devices

**Path selection metrics in WMN**

1. Minimal hop count metric often not optimal
- Wireless links often vary in quality

2. Link metric: assign weights to links
- Weights derived from low rate, available bandwidth

3. Path metric: combine all link metrics on path
- prefer short paths

4. Metrics:
- hop count
- ETT (Expected Transmission Time)
- ETX (Expected Transmission Count)
- WCETT (Weighted Cumulative ETT)

## II.   REVIEW OF WMN ROUTING PROTOCOL

Wireless mesh networks have unique features that differentiate them from other networks like wired and other wireless networks technologies. Therefore, existing routing protocol need to visit again and again in any order to check their flexibility to WMNs. Routing protocols can be mentioned into proactive routing, reactive routing and hybrid routing.

In proactive routing protocol, each node creates a one or more routing tables exits all information about other nodes within the network. Reactive routing creates only routes between source and destination if needed. Hybrid routing is the combination of the proactive routing and reactive routing to transmit the data from source to destination. Hybrid routing take the advantages of both proactive and reactive routing. To increase the performance of routing protocols, we have to adapt the new methods and modify the algorithms of routing

protocols by adding the new features in the wireless mesh network. The more appropriate method is to enhance the existing routing protocols with new routing protocols by using its methods.

The recently used routing protocols are briefed. Dynamic source routing (DSR). Before sending the data source will check that there is a route or not, if any route exists then source sends the data to the destination and if no route exits then the source sends route request packet. The advantage of this protocol is that it does not use more energy as compare to the other protocols. This protocol is used for low power devices. The main shortcoming of this protocol is that it is unable to control the congestion between the nodes in a high traffic. The DSR protocol using the transmission time rather than the number of hops. The advantage of this protocol is that it founds high throughput route. The disadvantage of this protocol is that it is not flexible. Other protocol named as Link Quality Source Routing (LQSR), it is an extension of the DSR routing protocol. The metrics can be Hop Count, Round- Trip Time Latency, Packet Pair Latency, expected Transmission time. The advantage of this protocol is that if expected transmission time is considered then the throughput will increased. The disadvantage of this protocol is same as the DSR protocol. Multi radio-Link Quality source routing (MLQSR), If a node has multiple radios then they are distributed to different non-interference channels. This protocol checks all the nodes in the wireless mesh network and assigns the weights to all the nodes. Each link has the information about the channel assignment and bandwidth. The advantages of this protocol are same as the Multiple-radios: traffic balancing and it has the good quality channels. The disadvantage of this protocol is that it is not scalable. Ad hoc on Demand Distance Vector (AODV). This protocol uses the on demand route technique and only active routes are maintained. It uses the request-reply mechanism for discover the routes that are used to send the frames from source to destination. The advantage of this protocol is that if the topology changes it react quickly. The disadvantage of this protocol is that only active routes are set up not on demand routes are set up.

### III. PERFORMANCE EVALUATION

We calculate the performance in wireless mesh network using ns2 simulator, which is used to support multiple interfaces and multiple channels. The purpose of this simulation is to analyze the performance of different routing protocols in wireless mesh network. The performance of the routing protocols in wireless mesh network can be evaluated using different metrics. The two main metrics are throughput and average end to end delay. Throughput is measured in terms of bits and throughput is the total time that takes to receive the data from the sender. Average end to end delay is measured in terms of bytes and average end to end delay is the average total time for all the packets to be delivered from source to destination. Network size or number of nodes is also a metric to evaluate the performance. The number of nodes should be between 10 to 100 nodes. If the number of nodes increases in the protocol then the throughput will be reduced. The Performance of the protocol degrades due to the increasing the size of the protocol and packet losses in the network. If the number of nodes increases then the

network sizes are getting larger. Due to this, average end to end delay increases as the network size increases. Due to poor end to end delay by increasing the size of the network, the routing protocols will not able to carry out the load efficiency. Other metrics used for performance evaluation are number of sources and more. But the metrics mentioned above are more important to evaluate the performance.

### IV. MESH SECURITY

The security in wireless mesh network is to protect the message passing from the malicious attacks. It is required to authenticate the data packet exchanges by designing the highly reliable and authentication networks to protect the data from the attackers. In a mesh network, the authentication is an important step where the node wants to access the network. The node needs to link establishment and authentication to access the network. We already studied the two protocols that is SAE and EMSA for security in mesh network.

ESMA use the mesh key hierarchy in a mesh network for providing a reliable link establishment security between two nodes. In mesh network only master gateway is responsible for distributing a mesh key hierarchy to its neighbored gateways. Master gateway stores the all authentication information. At the initial stage of ESMA, MP takes its first security association with an MA and established a key hierarchy for securing a future links. ESMA follows a 4-way handshake. After a successful authentication, the master gateway will started with 4-way handshake and as a result it derives PTK (Pairwise Transmit Key) for unicast communication and GTK (Group Transmit Key) for multicast communication.

In SAE, a single password is used for all MP's to secure each other in the absence of knowledge proof. No authentication server is used in SAE which is involved in ESMA. In this paper, the parties involved are MP-A and MP-B and can be identified by their MAC addresses. After successful the SAE authentication, both parties generate a PMK, which is used to produce a PTK (Pairwise Transmit key) and GTK (Group Transmit Key). In SAE , the key material will be updated after the regular time intervals. This can be done by initiating the SAE authorization and 4-way handshaking for driving a new set of keys before the expiration of existing keys. The lifetime of the keys should be noted in the ESMA protocol. In ESMA the lifetime of the keys should not be more than the MSK. In order to maintain the operation of the network for lifetime we have to refresh the keys periodically. In this approach, we have to implement our testbeds for both SAE and ESMA and refresh them periodically. The refreshment of the keys should be done before the expiration of the MSK keys.

### V. CONCLUSION

Wireless mesh network achieved a great technology for the next generation wireless networks. In this paper, the analysis of the routing protocols, performance evaluation metrics and security in mesh networks have been presented and mentioned their features and challenges.
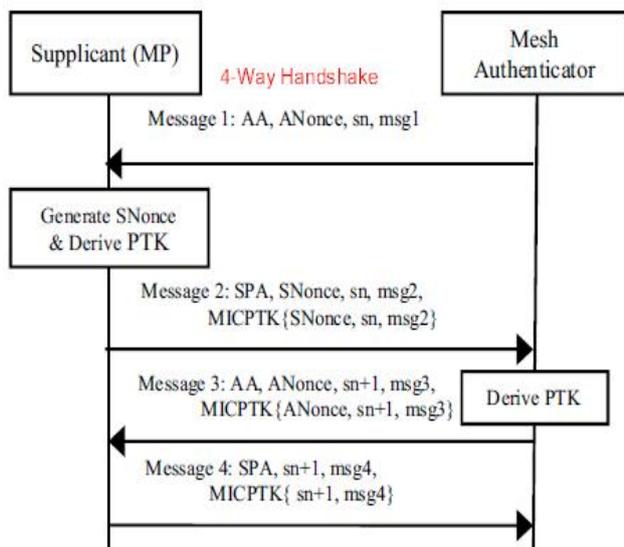
Fig. 2: 4-way handshaking procedure

In this paper, we mentioned a many routing protocols that have been implemented in wireless mesh network and we also described the performance metrics that are throughput, average end to end delay and network size. Now, in this research we study in detailed to improve these protocols using the ns2 simulator.

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