CHAPTER 1
INTRODUCTION

1.1 Background

Wireless Mesh Network is very useful to deploy 802.11-based Wi-Fi network, overcoming the limitations of geography and provide high-speed transmission. Wi-Fi Network usually developed in infrastructure mode and consists of wireless router or access point with limited mobility. The main purpose of designing WMN is to provide optimum throughput, quicker and cheaper to develop and enabling integration with wired backbone or existing network of telecom operators. The main challenges of the WMN include a link quality or link loss rate, inter-flow interference and intra-flow interference. Therefore it is necessary WMN routing protocols can improve the performance of WMN [1]. On the Wireless Mesh Network, selfish behaviour can cause unfairness and a decrease performance due to periodically dropping packets in relaying node which decrease throughput of the closed loop connection, which was built by another node. Although a variety of routing protocols available for ad hoc networks, the design of routing protocols for Wireless Mesh Network is still an area of active research. Routing Protocol is a fundamental characteristic to choose the right path for efficient data delivery and affect network performance. To ensure speed and improve the performance of routing packets at WMN, routing protocols can be developed based on routing metrics. Routing metrics are components to support different routing with QoS, bandwidth, latency and security requirements.

In WMN, routing protocol selected routing metric with key characteristic to perform well and provide QoS requirement. The Previous research has developed routing metrics Expected Forwarded Counter (EFW) based on cross-layer to overcome the problem of packet drop in the mesh router. Routing metric EFW is an improvement of ETX by adding the estimated probability of dropping relaying node [2]. EFW make observations on the behaviour of forwarding the routing layer with MAC Layer measure the quality of the wireless link to select the path of the most reliable and have high performance.

This research aimed to evaluate the use of EFW modification metrics on a WMN environment by simulation using NS2 with protocol routing proactive OLSR. Modification of EFW routing metric is expected to improve overall system throughput. This metric consider packet size and bandwidth of the link , link loss ratio and probability dropping packet in relaying node.

1.2 Gap of the Real Condition and the Future

The previous research some routing metrics have been applied to the WMN such as hop count, Expected Transmission count (ETX), transmission Expected Time (ETT), weight cumulative expected transmission Time (WCETT). Hop count metric most widely used in multi-hop network scheme, but in a dense scenario, routing algorithm with minimum hop does not work efficiently and chosen path has a low signal, low bandwidth and high interference [3]. A characteristic of optimal routing protocol has a feature multiple performance routing metric. Routing metric evolved into more complex taking into account the high quality of the link, interference, load balancing, power efficiency, and intermediate nodes.

Routing metric Cross Layer design is one solution to provide optimum performance on the wireless network. Cross layer design can improve performance by considering layer protocol parameters in other protocol layer. Several cross layer metrics have been proposed in recent year to select the path with the highest delivery rate. Routing metric cross layer EFW has been proposed by Paris et.al to solve the problem of selfish behaviour. Paris et al proposed metrics with protocol routing On-Demand Secure Byzantine Resilient Routing (ODSBR) in Wireless Mesh Community Network. EFW metrics only focus in link loss ratio of network nodes in addition selfish node in reliability network. To improve link quality, EFW metrics can combine with other routing metric to improve overall routing performance like ETT that consider packet size and bandwidth of link.

1.3 Problem Definition

The main problems of routing in Wi-Fi mesh topology are to finding optimum throughput that received by the user, especially for users who are more than two hops. Although the non-overlapped channels available on Wi-Fi spectrum 2.4 GHz and 5 GHz, most of the Wi-Fi network is currently only using one channel. Routing metrics are key element of routing protocol because they determine the creation of network path. Selfish behaviour node can cause performance degradation overall network, so the chosen path is not necessarily produce optimum throughput. Routing metric EFW avoid the selection of unreliable network paths. Selfish node drop packets sent by other nodes. In link quality routing EFW metrics only take into account the link loss ratio and selfish node, so we need to take into account the packet size and bandwidth used between the links in a path before deciding which path will be selected to get optimal routing.

1.4 Problem Limitations and Assumptions

Problem limitations that will be used in this study are as follows:

1. Routing protocol used is OLSR because OLSR is a proactive protocol routing that is very suitable for static networks. OLSR can be used for small and dense areas [4].
2. WMN topology using a Mesh network Wi-Fi 802.11
3. Simulation run on NS2 and Cygwin
4. Routing metric using ETX,EFW and modifications EFW
5. No Bottleneck at the gateway
6. Generator traffic used is Constant Bit Rate
7. Research conducted on TCP and UDP
8. Focus on performance metrics routing for link loss rate issues, does not discuss security issues and the queues at the WMN
9. Performance parameters such as Throughput, Packet Delivery Ratio, Packet Loss and End to End Delay.

1.5 Research Objectives

In this paper we combine routing metrics EFW with routing metrics ETT that consider packet size and bandwidth to improve link quality. The performance evaluation will be focused on the performance of routing metrics Cross-Layer EFW with routing protocol OLSR in Wi-Fi wireless Mesh Network. The performance evaluation will also be conducted on a modified cross-layer routing metric that consider selfish node, packet size and bandwidth.

The aim of this thesis to analyse the performance of cross-layer routing metric EFW with modification that consider packet size and bandwith of the link on the 802.11 network Wireless Mesh Network against Package delivery rate and throughput generated. Selection of routing metric EFW due to observe the behavior of forwarding to overcome the problems selfish node so that it can choose the path that is reliable. Modifications cross layer routing metric EFW aims to obtain optimum throughput. We integrated proposed metric with protocol proactive OLSR for wireless mesh network. We evaluate the performance of the proposed metric using NS2 simulator and Cygwin.

1.6 Hypothesis

The use of mesh topology at 802.11 Wi-Fi networks can reduce throughput received by the user. Selection affects routing metric system to boost throughput on a mesh topology. The purpose of writing this thesis is to know the performance of cross-layer routing metric modifications EFW in Wi-Fi wireless Mesh Network to produce better throughput side of the end user by utilizing the available bandwidth on the network. EFW routing metrics modification performance should be better than routing EFW metrics because it takes into account link loss ratio, probability of dropping relaying node, packet size and bandwidth of link. Routing protocol OLSR with routing metrics EFW modification is expected to choose the optimal path to deliver packets from source to destination. This efw modification is combined with routing ETT metrics that take into account the packet size and bandwidth. ETT routing metrics can increase the throughput of path by measuring the link capacities and would increase the overall performance of the network. In short, ETT of the link represents the expected time it takes to successfully transmit a packet on the link.

1.7 Scope of Work

The focus of this research is evaluation of routing metric mechanisms which are applicable to WMNs. The work contains some activities below:

- Determination for the characteristics of various routing metrics and their suitability for WMNs through literature research.
- Define the routing metrics used in simulation and routing protocols that match the wmn topology for better performance, and proposes routing metric modifications from existing routing metrics
- Implementation of simulations
    - Simulation run on Network Simulator 2 (NS-2) and Cygwin
    - Conduct separate simulations for each type of routing metric. All routing metric using the same topology an routing protocol OLSR at certain time
    - There is no obstacle in the network
    - Scenario based on number of node in the network and different data rate in 802.11b
    - Iterations for each simulation scenario are performed 10 times
- Collect the simulated output of the trace file for each scenario
- Process the data and create graphs of the simulated output
- Interpretation of results concludes final remarks on the performances of routing metric mechanisms.