

DEVELOPING MESH NETWORK TO EXTEND WIFI COVERAGE AREA

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This project and research work is dedicated to my beloved parents for their enthusiastic caring throughout my life, my loving brothers also my friends for their continuous encouragement and support.

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ABSTRACT

Nowadays, city-wide wireless mesh networks are a promising technology for offering ubiquitous Internet connectivity. These multi-hop wireless access networks consist of fixed and mobile nodes, which help each other relaying packets toward Internet gateways and back. The objectives of this project are to develop the best wireless mesh network that has a bigger coverage area using the Linksys router WRT310N. Next, the project needs to be setup with 3 flashed 2.4 GHz wireless Linksys WRT310N routers with different locations. The location of Router A at FKEKK building, Router B at Outdoor shed and Router C at Café 1 between FKEKK and FKE faculty. Every router needs to be measured using 1 wired LAN server connected to wireless router and 1 wireless client has 10 points in range about 1 to 20 meters of distance from router. The performance must consider the location of the wireless routers. Location of every wireless router must be stable and less interferences before the measurement can be run. Furthermore, locations chosen in this project were the best of stability connection of routers and less interference. Finally, when completing this project, the finding of the extending coverage area of the Wireless Mesh Network using Linksys Router WRT310N can be varied depends on the interferences in the outdoor test bed area.

ABSTRAK

Pada masa kini , rangkaian mesh tanpa wayar di seluruh bandar adalah satu teknologi yang menjanjikan untuk menawarkan sambungan internet yang sentiasa ada. Rangkaian capaian tanpa wayar “multi –hop” terdiri daripada nod tetap dan mudah alih, yang membantu antara satu sama lain ke arah menyampaikan paket gerbang Internet dua hala. Objektif projek ini adalah t membangunkan rangkaian mesh tanpa wayar terbaik yang mempunyai kawasan liputan yang lebih besar menggunakan router Linksys WRT310N . Seterusnya , projek ini perlu persediaan dengan 3 router yang telah “flashed” iaitu 2.4 GHz router LinksysWRT310N wayarles dengan lokasi yang berbeza. Lokasi Router A di bangunan FKEKK , Router B di luar susut dan Router C di Café 1 antara bangunan FKEKK dan FKE. Setiap router perlu menggunakan 1 server LAN berwayar disambungkan ke router tanpa wayar dan 1 pelanggan tanpa wayar yang mempunyai 10 mata dalam julat 1 hingga 20 meter jarak dari router. Pengkaji perlu mengambil kira lokasi router tanpa wayar. Lokasi strategik setiap router tanpa wayar mestilah stabil dan kurang gangguan sebelum pengukuran boleh dijalankan . Tambahan pula, lokasi yang dipilih dalam projek ini adalah yang terbaik sambungan dari segi kestabilan router dan kurang gangguan. Akhir sekali, apabila melengkapkan projek ini, dapatan kawasan liputan yang keluar daripada Mesh Rangkaian Tanpa Wayar menggunakan Linksys Router WRT310N boleh berubah bergantung kepada tahap gangguan di kawasan ujian luar.

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LIST OF ABBREVIATIONS

| | | |
|-------|---|--|
| AODV | - | Ad hoc On-demand Distance Vector |
| ARP | - | Address Resolution Protocol |
| BSSID | - | Basic Service Set Identification |
| DHCP | - | Dynamic Host Configuration Protocol |
| DNS | - | Domain Name System |
| DSSS | - | Direct-Sequence Spread Spectrum |
| ESSID | - | Extended Service Set ID |
| FTP | - | File Transfer Protocol |
| HTTP | - | Hypertext Transfer Protocol |
| IP | - | Internet Protocol |
| LAN | - | Local Area Network |
| LELA | - | Linksys EasyLink Advisor |
| MAC | - | Media Access Control |
| MAN | - | Metropolitan Area Network |
| MANET | - | Mobile Ad Hoc Networks |
| MPR | - | Multipoint Relaying |
| OFDM | - | Orthogonal Frequency-Division Multiplexing |
| OLSR | - | Optimize Link State Routing |
| PC | - | Personal Computer |
| QoS | - | Quality of Service |
| SNR | - | Signal toNoise Ratio |
| SSID | - | Service Set Identifier |

| | | |
|-------|---|---|
| TBRPF | - | Topology Dissemination Based on Reverse-Path Forwarding |
| TC | - | Topology control |
| TCP | - | Transmission Control Protocol |
| TFTP | - | Trivial File Transfer Protocol |

CHAPTER 1

INTRODUCTION

Chapter 1 describes about the introduction of the Final Year Project of Degree. It contains brief explanations of subchapters such as problem statements, objectives, scope of project, and methodology used while completing the project.

1.1 Project Introduction

Over the last years, several universities and research centers around the world have been developing and deploying intra-campus wireless networks for ubiquitous communication. Recently, wireless technology has been used for providing access to campus networks for users living nearby, using the concept of mesh networks.[3] In this type of networks, wireless routers communicate with each other in ad-hoc mode using multiple hops in order to forward messages to their destinations. Mesh networks [2, 11, 12] are community networks based on cooperative routing algorithms, such as the ones found in wireless ad-hoc networks [15]. End users can connect to an access point of the mesh network using wired Ethernet or wireless 802.11. Mesh networks have several advantages over other last mile access technologies including low cost, easy and incremental deployment and fault tolerance.

Figure 1.1 shows the ReMesh network with 6 routers surrounding the Praia Vermelha campus.[3] In UFF, it is proven that wireless mesh network is desirable low-cost alternative for the UFF students which majority of their students can't afford a traditional broadband Internet such as cable or ADSL.

1.2 Problem Statement

Nowadays, the usage of internet is widely being used by Malaysian people for any kind of purpose such as social networking, business, project proposal and etc. Therefore, they seek to have a better internet connection that covers all area they goes to, inside and outside of the city. There are some companies that have launched their products such as broadband, but with a certain monthly internet quota, limited internet speed and coverage area. Thus, this project would be an added value to the communities outside UTeM's campus so that they can easily access free internet WI-FI at anywhere and at any time where the WI-FI signal range can be extend and furthermore, maintain or boost up the internet connection at most time. Next, this project also would be able to solve the limited Wi-Fi coverage area issues in our campus.

1.3 Objective

The objectives of this project are as the following:

1. To create Wi-Fi Hotspot via existing Wi-Fi Signal.
2. To study and develop the best wireless mesh network that has a bigger coverage area.
3. To create a modeling design that is suitable for certain area or communities to enjoyed the internet connection.

1.4 Scope Of Project

The scope of this research is to create mesh network in order to extend WI-FI coverage area. Thus, software development is the top priority for this project to success. The open source that would be used is Virtual Router Plus to wirelessly share any internet connection with any Wi-Fi device in its range, which then will be combined with the OpenWRT mesh-firmware. OpenWRT has package management system and it's a framework to build an application without having to build a complete firmware. Next, the OpenWRT software will then be installed on the router to extend Wi-Fi coverage area. For wider coverage, the addition of Wi-Fi repeater is being used.

1.5 Report Structure

This report is covered by five chapters. The first chapter starts with project introduction, problem statement, objective, and scope of project. The literature review is discussed in Chapter 2 and project methodology in Chapter 3. The Chapter 4 covers hardware and software implementation and the conclusions and suggestions are respectively covers in Chapter 5. For the project to be successfully implemented, there are several areas to look into. The following are the main chapters :

Chapter 1 : Study the objectives and scope of work on the project.

The aim of this project is to develop mesh network to extend Wi-Fi coverage area by using Linksys WRT310N router with customized mesh firmware.

Chapter 2 : Literature review about developing mesh network to extend Wi-Fi coverage area

Research and read up relevant topics from sources such as reference book, internet and journal will enable to gain more understanding and information for the project. Research on similar system in the market and knowing what are the features and

capabilities of current products will also provide more information and understanding on the project.

Chapter 3 : Project methodology includes the planning, the development of the design and the management of the project.

This chapter will explain more about the project methodology used in the project. This part will explain more about the project should be explained step by step.

Chapter 4 : Hardware and Software implementation.

The fourth chapter should focus on hardware and simulation of the router mesh network. This chapter also shows about testing the firmware on the customized mesh router. Testing will be performed on each customized mesh router in order to create a full mesh network.

Chapter 5 : Conclusions and suggestions on the project.

The last chapter will review on the project, whether the implemented solution meet the objective of the project. Discussions on problems encountered, conclusions and suggestions will be included for the future improvements on this project.

Dividing the project into various chapter is to ensure the project implemented in a systematic and structural ways such that the project able to be undertaken smoothly.

CHAPTER 2

LITERATURE REVIEW

Chapter 2 describes on the analysis and review about component and its importance in this project. This chapter discuss about the contents of the mesh network, internet devices both in software and hardware.

2.1 Wi-Fi

Wi-Fi is basically a technology that has been developed to connect the internet wirelessly using radio waves or the simple way to say it, to exchange data in an electronic devices used nowadays such as smartphone, tablet, laptop, and etc. Moreover, Wi-Fi stands for “wireless fidelity”. The name “Wi-Fi” is actually a trademark phrase which give a meaning of IEEE 802.11x.

2.1.1 How the Wi-Fi works?

In order for the Wi-Fi to works, it uses the radio frequency (RF) technology which doesn't need to have any physical wired connection between the sender and receiver. The RF technology here is a type of frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created and would be able to propagate through space.

The important part of any wireless network is an access point (AP). Access point function is to broadcast a wireless signal such as computer, to detect and “tune” the signal for other devices. Next, in order to connect to an access point and join a wireless network, it is compulsory for the computers and devices are equipped with wireless network adapters.

2.1.2 Wi-Fi Supported Devices

Wi-Fi is supported by many kind of applications and devices such as smartphones, mobile phones, video game consoles, home networks, PDA's, major operating system, and other types of consumer electronics. In order for the Wi-Fi to be cooperated with each other, the products that are already tested and then being approved as “Wi-Fi Certified” by the Wi-Fi Alliance eventhough the product are from different manufacturers. For example, a user with a Wi-Fi Certified product can use any brand of access point with any other brand of client hardware that also is also "Wi-Fi Certified". Products that pass this certification are required to carry an identifying seal on their packaging that states "Wi-Fi Certified" and indicates the radio frequency band used (2.5GHz for 802.11b, 802.11g, or 802.11n, and 5GHz for 802.11a).[22]

2.2 Mesh Network

A mesh network is a network topology in which each node (called a mesh node) relays data for the network. Then, the data in the network will be distributed by the cooperation of all nodes in the area.[17]

A mesh network can be build using a different technique such as flooding or routing technique. In routing technique, through propagating path, the node will be hopping to other nodes repeatedly for the message to reach its destination. To check whether the paths' is available or not, self –healing algorithm is being applied. The algorithm function enables a routing network to make a continuous connections between the mesh nodes and auto-configured the error by discovering more than one