Faculty of Information and Communication Technology

ANALYZING WIRELESS NETWORK SIGNAL PERFORMANCE OF MELAKA PUTRA SPECIALIST HOSPITAL CASE STUDY

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A dissertation submitted
in fulfilment of the requirements for the award of the Master of Computer Science
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DECLARATION

I declare that this dissertation entitled “Analyzing Wireless Network Signal Performance of MELAKA PUTRA SPECIALIST HOSPITAL CASE STUDY” is the result of my own research except as cited as in the reference. The dissertation has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……..

Name : AMINAH BINTI ABOD

Date : ……..……

APPROVAL

I hereby declare that I have read this dissertation and in my opinion this dissertation is sufficient in term of scope and quality for the award of Master of Computer Science (Internetworking Technology).

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Date	:	……..……

DEDICATION

Specially dedicated to my beloved family for their

endless prayer, encouragement and blessings

ABSTRACT

Nowadays, Wireless Local Area Network (WLAN) has been growing rapidly in the world, especially in business and education institutions. There is much type of wireless technology on the market today such as Institute of Electrical and Electronics Engineer (IEEE) 802.11*a*, *b, g*, and *n* series. WLAN generally consist of a central point connection called an Access Point (AP). It is the same function as hubs or switches in a star topology-based, traditional wired networks in the local area network. The Access Point (AP) can transmit data between different node of the wireless local area network and it serves as the only connection between wireless LAN and wired LAN. The rapid development of WLAN campus, it is easier for the lecturers and students gain access to targeted information anytime and anywhere. WLAN is meant for the administration usage in Putra Specialist Hospital for fetching critically important information in a real-time environment. Besides that, WLAN provide great freedom and enables users from different department to communicate and facilitate with patience and each other to communicate without special sitting at the computer. WLAN has played a big part in Putra Specialist Hospital in form of administration and public relations. Naturally being a specialist hospital it is understood that most important documents or patience medical record must be able to be fetched in a timely manner. This dissertation wants to identify the issue arise from the use of WLAN from the perspective of users and particularly from the perspective of doctors and the administration staffs. There are many issues in the implementation of WLAN in Putra Specialist Hospital, which is the coverage of WLAN limited to access, slow connection, sometimes it can be shared sometimes not and the number of APs do not support the number of existing users. This dissertation also want to investigate about the coverage of WLAN, the channels used and band interferences in the Putra Specialist Hospital. In addition, this dissertation aims to enhance the signal performance of wireless networks in the Putra Specialist Hospital.

ABSTRAK

Pada masa kini, Wireless Local Area Network (WLAN) telah berkembang pesat di dunia, terutama di institusi perniagaan dan pendidikan. Terdapat pelbagai jenis teknologi tanpa wayar di pasaran hari ini seperti Institut Jurutera Elektrik dan Elektronik (IEEE) 802.11a, b, g, dan n siri. WLAN umumnya terdiri daripada sambungan titik pusat yang dipanggil Pusat Akses (AP). Ia adalah fungsi yang sama seperti hub atau suis yang berasaskan topologi STAR, rangkaian berwayar tradisional dalam rangkaian kawasan tempatan. Access Point (AP) boleh memindahkan data antara nod yang berbeza rangkaian kawasan setempat tanpa wayar dan ia berfungsi sebagai satu-satunya hubungan antara LAN wayarles dan LAN berwayar. Pembangunan pesat kampus WLAN memberi kemudahan kepada pensyarah dan pelajar mendapat akses kepada maklumat yang disasarkan pada bila-bila masa dan di mana sahaja. WLAN amat penting kepada pengurusan pentadbiran di Hospital Pakar Putra untuk mengambil maklumat semasa dalam persekitaran yang nyata. Selain itu, WLAN memberi keutamaan, kebebasan dan membolehkan pengguna dari bahagian yang berbeza untuk berkomunikasi dengan mudah antara satu sama lain tanpa persidangan khas di komputer. WLAN telah memainkan peranan yang penting dalam Hospital Pakar Putra dalam bentuk pentadbiran dan perhubungan awam. Lumrahnya sebagai hospital pakar, dokumen yang paling penting atau rekod perubatan pesakit mesti dapat diambil dengan cara yang tepat pada masanya. Disertasi ini mahu mengenal pasti isu yang timbul daripada penggunaan WLAN dari perspektif pengguna dan terutamanya dari perspektif doktor dan kakitangan pentadbiran. Terdapat banyak isu-isu dalam pelaksanaan WLAN di Hospital Pakar Putra, antaranya akses liputan WLAN yang terhad, sambungan perlahan, kadang-kadang ia boleh dikongsi kadang-kadang tidak dan jumlah AP yang tidak menyokong bilangan pengguna sedia ada. Disertasi ini juga bertujuan untuk menyiasat mengenai liputan WLAN, saluran yang digunakan dan gangguan band di Hospital Pakar Putra. Di samping itu, disertasi ini bertujuan untuk meningkatkan prestasi signal rangkaian tanpa wayar di Hospital Pakar Putra.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AP	Access Point
PC	Personal Computer
QoS	Quality of Service
SSID	Service Set Identifier
WLAN	Wireless Local Area Network
LAN	Local Area Network
HIS	Hospital Integration System
WIMAX	Worldwide Interoperability for Microwave Access
RF	Radio Frequency
PSH	Putra Specialist Hospital
WPAN	Wireless Personal Area Network
WMAN	Wireless Metropolitan-Area Network
WWAN	Wireless Wide Area Network

CHAPTER 1

INTRODUCTION

1.1 Background and Context

Nowadays, WLAN has been growing rapidly in the world, especially in business and education institutions. There is a lot of type of wireless technology on the market today such as Institute of Electrical and Electronics Engineer (IEEE) 802.11*a, b, g, n* and *ac* series. This wireless networking technology designed for simple data transfer around 100-300 square feet in each of their own respective radios waves.

For example, radio wave 802.11*a/b* were only able to provide a very small transmission bandwidth within 802.11*a/b* range and because of the small bandwidth transmission, 802.11*a/b* is no longer applicable to be used in any organization. Radio wave 802.11*g* is the common used standard which this radio wave uses 2.4GHz frequency to communicate and transfer data. At a time 802.11*g* can transfer at the rate of 54Mbps. Radio wave 802.11*n* is the latest among the other which theoretically can transfer data at speed of 300Mbps. Radio wave *n* are now supported by all latest tablets laptop, smartphones and PCs. Radio wave *n* is also able to use any of 2.4GHz or 5GHz frequency but is prone to signal intervention. The newest generation is the 802.11*ac* which utilize the dual band wireless technology. 802.11*ac* can transmit data up to a speed of 2300Mbps on 5GHz frequency and 450Mbps on 2.4GHz.

This wireless networking technology has replaced the wired network and has now been widely used in organizations and institutions as part of their daily working days. This wireless network provides the same capability and speeds compare able to wired 10 Base-T, without the problems associated with set up the wire, drill into walls to install wires or install Ethernet cables throughout an office building at a university and college.

WLAN generally consist of a central point connection called an AP. It is the same function as hubs or switches in a star topology-based, traditional wired networks in the LAN. The AP can transmit data between different node of the WLAN and it serves as the only connection between wireless LAN and wired LAN. Typically, the AP can handle some number of users within 100-300 feet. Wireless nodes also known as WLAN clients which usually consist of Desktop PC, Laptop, Tablet and Smartphones.

With the development of multimedia communication, people need wireless broadband access with higher speed, larger coverage and mobility. The emergence of WiMAX technology met the people's demand for wireless Internet to some extent. If wireless LAN technology solved the common problem of the "last one hundred meters", then WiMAX technology is the best access solution of the "last mile" IJCNC (2014). In term of costing, with WLAN methods organizations and institutions was able to cut and the set-up complexity are far below the traditional wired network. With the ability of being flexible from being able to connect by any devices that have wireless radio. In addition, WLAN has a wide range of application in networks to be supported at home, office and in growing number of cafes, hotels, hospitals and airports.

In a rapid development, WLAN have become a wide used solution because of it flexibility in deployment, cost effective and with a more production of devices. Telecommunication carriers have been installing public Wi-Fi hotspots in downtown or places where people gather while also distributing Wi-Fi APs in individual homes. These efforts are providing more opportunities for users to access Wi-Fi communications. To disseminate Wi-Fi access even more universally, it is required to achieve further improvements in usability such as by reducing power consumption, simplified setup of terminal devices and security countermeasures, etc.

W. yoshikazu et al (2014) claimed that to cope with these issues and to decrease the load on cellular networks, the employment of WLAN communications in support of smart devices is being applied widely. This trend is accelerating the dissemination of several WLAN APs in the public domain and in individual homes, and brought an increase in the number of WLAN users.

Currently WLAN has not been implemented in PSH to help doctors and administration staffs to perform their daily duties quickly and easily. This dissertation wants to identify the issue arise from the use of WLAN from the perspective of user and particularly from the perspective of doctors and administration staffs. There are many issues in the implementation of wired LAN in PSH, among the problem is the coverage of LAN and limited to the length of network cable, slow connection, limited resources and the number of switches do not support the number of existing users. This dissertation also want to investigate about the coverage of WLAN, the channels to be used and suitable band for

WLAN in PSH. In addition, this dissertation aims to improve the performance of wireless networks in the PSHs.

1.2 Research Background

These days, WLAN also provides to industry demand increased very rapidly in demand access wireless broadband recently. This wireless technology increases the number of mobile phone and laptop in the workplace. Since the use of the 802.11 standard WLAN, network performance becomes a very significant concern because of the use of performance WLAN AP. Wired network cannot increase the network capacity by simply moving the equipment so easily.

Kuruzovich (2008) a study was done to investigated the use and impact of wireless communication technology developed by Vocera Communications and implemented at St Agnes Hospital, Baltimore, MD. The specific focus was on the impact of a newly installed component of the Vocera system, the Vocera Messaging Interface, which enables connectivity between third-party systems, such as a nurse call system. The results of the investigation of the nurse call integration confirmed that the use of the integrated communications system reduced overall mean time for completing a patient request by 51% across all observations when controlling for observation type. Furthermore, analysis of clinicians' usage of the system for different types of patient requests revealed that it enables the clinician to have more control in prioritizing and responding to requests according to the seriousness of the event. The study also exposed several "creative" and "evolving" impacts of the system that are discussed along with practical implications of the findings.

Zhou et al. (2013) showed that coverage optimization become big challenge in deployment of WLAN. The researcher proposed a solution to self-optimization coverage performance with adjust the power of each beam AP and Received Signal Strength (RSS) and Signal to Interference Ratio (SIR) of the sensor. With this solution, the researchers able to improve the performance of coverage and saving cost.

Abbasi et al. (2011) showed that the importance of the issues channel assignment to minimum availability of orthogonal channel of WLAN. The authors find an efficient method to utilize channel overlap of 2.4 GHz band, was achieve high throughput to minimum interferences within backhaul and directional antennas. The researchers propose channel assignments that have the limited number of channels, the concept to assign the sets of channels to connect in the interference area of each node, where the nodes are works with directional antenna. Study by (Abbasi et al. 2011) found that can decrease the channel interference and increase the throughput.

It is known that the frequency assignment and the band association played an important role and it should be considered simultaneously to improve or to enhance the network performance. In this dissertation, the use of JPerf to analyze the bandwidth limitation of current network setup in PSH which is wired LAN and bandwidth limitation of WLAN setup in PSH. The collected data before and after implementation WLAN was analyzed and then their new WLAN deployment for PSH using the JPerf network simulation.

1.3 Problem Statement

PSH is one of the hospital that haven't developed WLAN environment. There are many issues with the current implementation of wired LAN in PSH, which is the limitation length of network cable, slow connection, sometimes the old network switches are not able to cater the usage from doctors and administration staffs. Sometime, the wired LAN connection becomes extremely slow when all the nurses or doctors want to access the patience medical records.

1.4 Research Questions

The main research questions for this study are given as follows:

1. How does the frequency band issues and signal overlapping affect the performance in WLAN?
2. What is the impact of channel assignment on the performance of WLAN?
3. Are there the channel assignments that achieve the good performance in WLAN?

1.5 Research Objectives

The objectives in this dissertation will focuses on the following objectives:

1. The first objective is to investigate the current wired LAN setup in PSH