PERFORMANCE ANALYSIS OF RANDOM MAC PROTOCOLS IN WIRELESS MESH NETWORKS

SAIYIDATUL ADILAH BINTI SULAIMAN

Universiti Teknikal Malaysia Melaka (UTeM)

ANALISIS PRESTASI BAGI PROTOKOL RAWAK MAC DALAM RANGKAIAN MESH TANPA WAYAR

SAIYIDATUL ADILAH BINTI SULAIMAN

Laporan ini dikemukakan untuk memenuhi sebahagian daripada syarat penganugerahan Ijazah Sarjana Muda Kejuruteraan Elektronik (Kejuruteraan Komputer) dengan Kepujian

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SAIYIDATUL ADILAH BINTI SULAIMAN

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PENGHARGAAN

Projek dan kajian terhadap hasil kerja ini saya dedikasikan buat seluruh keluarga saya terutama sekali kepada kedua ibu bapa saya atas pengorbanan dan sokongan yang tidak pernah putus sepanjang hidup saya, adik-adik saya dan juga rakan-rakan yang sentiasa memberi sokongan dan dorongan. Serta tidak dilupakan kepada tenaga pengajar yang banyak memberi tunjuk ajar kepada saya.

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ABSTRAK

Seperti yang dinyatakan dalam tajuk, iaitu “Analisis Prestasi bagi Protokol Rawak MAC dalam Rangkaian Mesh Tanpa Wayar”, tesis ini mengandungi maklumat-maklumat berkenaan dengan prestasi Rangkaian Mesh Tanpa Wayar yang menggunakan tiga jenis protokol MAC, dalam konteks daya pemprosesan dan purata masa tunda. Sudah menjadi satu kebiasaan pada masa sekarang bagi setiap bangunan dan juga rumah mempunyai sambungan kepada rangkaian tanpa wayar mereka sendiri. Kebanyakan pengguna selalu menghadapi masalah mendapatkan liputan internet tanpa wayar dalam kawasan yang luas, terutama sekali di dalam bangunan bertingkat. Para pengguna akan memerlukan kos yang tinggi dan melalui pemasangan “router” yang sukar bagi meluaskan lagi liputan rangkaian tanpa wayar mereka. Dengan menggunakan Rangkaian Tanpa Wayar Mesh, ia berpotensi untuk menyelesaikan masalah-masalah tersebut. Objektif utama kertas ini ditulis adalah untuk membuat penilaian secara individu, prestasi rangkaian tanpa wayar mesh bagi setiap penggunaan protokol MAC, iaitu “Pure ALOHA”, “Slotted ALOHA” dan np-CSMA. Kita akan lihat prestasi bagi kesemua protocol berdasarkan daya pemprosesan dan purata masa tunda. Dalam projek ini, kami telah menghasilkan dan membuat simulasi ke atas satu set kod program MATLAB yang digunakan untuk menganalisis prestasi rangkaian tanpa wayar mesh dalam protokol MAC. Ujian pada situasi sebenar tidak termasuk dalam projek ini.

ABSTRACT

As stated in the title which is “Performance Analysis of Random MAC Protocols in Wireless Mesh Networks”, this thesis provides some information about the performance of Wireless Mesh Networks by using three types of MAC protocols, in terms of throughput and average delay time. It is very common nowadays that every building and even houses have their own wireless network connection. The problem that always faced by users is the availability of the wireless coverage in a wide area, especially in a multilevel building. Users might need to spend higher cost and go through such complicated implementation of wireless routers in order to extend their wireless network coverage. By using Wireless Mesh Network, it probably could solve those problems in future. The main objective for this paper is to evaluate individually the performance of wireless mesh network for each type of MAC protocols, which are Pure ALOHA, Slotted ALOHA and np-CSMA. We will see the performance for each of them based on their throughput performance and average delay. In this project, we have developed and simulated a set of MATLAB coding which was used to do performance analysis for wireless mesh network in MAC protocols. Testing in real environment is not covered in this project.

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DLL	Data Link Layer
LAN	Local Area Network
LLC	Logical Link Control
MAC	Multiple Access Control
MAN	Metropolitan Area Network
np-CSMA	Non-Persistent Carrier Sense Multiple Access
OSI	Open Systems Interconnection
WAN	Wide Area Network
WLAN	Wireless Local Area Network
WMN	Wireless Mesh Network

CHAPTER I

INTRODUCTION

Borderless world introduces a necessity to have reliable and mobile connectivity in order to gain a lot of information. From the first invention of telephone by Alexander Graham Bell in 1876 until the Internet has been introduced in 1950s, the world of networking has been evolved rapidly. It can be said that almost every building in this world have been equipped by wireless internet connection, or at least, wired connection. WiFi facilities are everywhere, with a large number of mobile users.

Now, the performance of wireless network has been one of the concerned issues by users. Before this, people did not care about how fast the data will be sent to them as long as they get the data correctly, but as time goes by, most of the Internet users, especially those who are using wireless connection, really take seriously into account about the speed and delay that might they face during their usage time.

It is also will be great if the Internet connection can always be ready as they move within certain distance in an area. However limited coverage area limits the Internet connectivity. Wireless Mesh Network (WMN) is one of the

ways can be used to extend the coverage of wireless network and thus expand the Internet connectivity. The WMN infrastructure could be used for home environment, office area and multilevel building, such as apartment, shopping complex and even communication towers.

In this thesis, we will discuss the performance evaluation of WMN in terms of throughput and average delay for three types of MAC protocols namely Pure ALOHA, Slotted ALOHA and Non-Persistent Carrier Sense Multiple Access (np-CSMA). Each type of protocols applies different ways of forwarding packet through the communication link.

1.1 Problem Statement

Usually, at an environment like shopping complex, where the building has several floors, users cannot surf Internet via wireless network when they are at the different floor because of several factors, such as barriers from wall and glass. So, in this project, we propose to improve this situation. By using Wireless Mesh Network, it probably will help to enlarge the coverage received by users and also solve users' problem when implementing large and complex wireless network, which using many routers where each of them is connected to the Internet individually. This kind of network also requires higher cost and complicated deployment.

As the performance of the internet connection has always been concerned, people are always questioned about how fast the data will be sent to them (how much the delay would be?) and also how perfect the data that they will receive. Speed of an Internet connection may affect throughput performance. Logically, when the speed is high, throughput received also might be high. So, suitable algorithm or protocol might need to be adapted in a network in order to get the best performance through it. For example, in MAC protocols that was used in this project, each of them has their own way of transmitting packets, and hence

has different effect on their throughput performance and delay introduced in the link.

1.2 Objectives and scope

This project aims to implement WMN by applying three different MAC protocols, which are Pure ALOHA, Slotted ALOHA and Non-Persistent Carrier Sense Multiple Access (np-CSMA) by using MATLAB programming. Basically, this kind of implementation can be very useful in many kind of environment, especially for multilevel building so that everyone in the building can access wireless internet network at any level.

Evaluate performance (throughput and average delay) based on simulation is also the purpose for doing this project. By using those three types of MAC protocols as mentioned above, we analyzed their throughput and average delay for each of them.

1.3 Motivation

This project was motivated by difficulty faced by users when accessing Internet in a wide area, especially in different levels of a building. If we use the normal way of setting up large wireless network, it requires higher cost and complicated deployment.

1.4 Contribution

This thesis provides the results and analysis about performance of WMN by using different kinds of MAC protocols. From this, we produce a conclusion from those results with suggestion for future works.

1.5 Thesis Organization

In this chapter, there only will be the explanation of background idea about this research. The next chapter will discuss more on the literature review, where we will see different types of wireless connection (WLAN and WMN) along with different types of MAC protocols that have been used in implementing WMN, which are Pure ALOHA, Slotted ALOHA and np-CSMA. In Chapter 3, we will explain more on the methodology that was used in this project, which covers the explanation of mesh grid and also simulation environment. The next chapter will present the analysis result that is obtained from the simulation, and lastly, in Chapter 5, there will be the conclusion for overall project and also some suggestions for future work.

CHAPTER II

LITERATURE REVIEW

2.0 Introduction

In this chapter, we will present about the variation kind of network and their details. Firstly, we will go through some types of network which are suitable to be implemented in certain environment. After that, there is the explanation about protocols that are used in a network, such as bus topology, star topology, ring topology and mesh topology. From there, readers can get some information about how a network can be organized effectively. Next section is about Network Protocol Design, where it explains about some parts that are involved in the development of a network. In this section also, there is a brief about MAC protocols that have been used in this research. Here, readers can understand the behavior of each protocol that is implemented in the simulation. Lastly, at the end of this chapter, a summary of the whole chapter is provided.