CARRIER SENSING INTERFERENCE IN WIRELESS MESH NETWORK

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GANGUAN PENDERIAAN PEMBAWA DALAM RANGKAIAN JEJARING TANPA WAYAR

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

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Dedicated to my family, supervisor and friends

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ABSTRAK

Rangkaian Jejaring Tanpa Wayar (WMN) adalah salah satu topologi yang digunakan dalam teknologi tanpa wayar yang meningkatkan kapasiti dan mengurangkan penyelenggaraan. Namun, gangguan diyakini adalah salah satu faktor yang mengurangkan prestasi WMN. Walau bagaimanapun WMN menggunakan saluran yang sama untuk berkomunikasi dengan penghala yang lain, ganguan saluran sama (CCI) diyakini mempengaruhi prestasi WMN. Selain itu, ganguan penderiaan pembawa juga diyakini mempengaruhi WMN prestasi dengan mekanisme pembawa penderiaan seperti Penderiaan Pembawa Pelbagai Akses dengan Mengelak Pelanggaran (CSMA / CA) ketika dua haluan lalu lintas berlaku. Gabungan ke dua gangguan, kesan terhadap prestasi WMN menjadi suatu kajian yang menarik untuk diuji dan siapa yang lebih dominan dapat ditentukang berdasarkan fakta yang tepat. Tujuan utamanya adalah untuk menyiasat apakah CSI atau CCI lebih mendominasi jika kedua-dua gangguan berlaku pada waktu yang sama di WMN. Dalam tesis ini, uji kaji telah dilakukan dengan menyediakan raikaian model daripada 16 kes yang berbeza dari segi gangguan untuk menganalisis daya pemprosesan yang diterima pada penerima dalam WMN. Keputusan kajian menunjukkan bahawa pada protokol yang berbeza mempunyai gangguan yang berbeza mendominasi. Pada akhir tesis ini menyimpulkan bahawa protokol yang berbeza mempunyai gangguan yang berbeza yang perlu ditanggulangi.

ABSTRACT

Wireless mesh network (WMN) is one of the topology used in wireless technology that enhanced the capacity and reduced the maintenance. However, interference is believed can be one of the factors that reduce the performance of WMN. Since WMN is using the same channel to communicate with other router, Co Channel Interference (CCI) was believed to affect WMN performance. Besides that, Carrier Sensing Interference was also believed to affect WMN performance with the carrier sensing mechanism such as Carrier Sensing Multiple Access with Collision Avoidance (CSMA/CA) when two traffic links occurred. Combining the two interferences, it is interesting to see which of the interference affected the most of the goodput performance in WMN and which of the effect is dominating by supporting some facts. The main objective is to investigate whether CSI or CCI is more dominate if both interferences occur at the same time in WMN. In this thesis, the experimental test was carried by setting up the test-bed of 16 different cases of interference to analyze the goodput of WMN. The result finding showed that in different protocols has different interference dominate. In the end of this thesis conclude that different protocols have different interference that need to be tackled.

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LIST OF ABBREVIATIONS

ACI	Adjacent-Channel Interference
CSI	Carrier Sensing Interference
CCI	Co-Channel Interference
EMI	Electromagnetic Interference
RSSI	Received Signal Strength Indicator
SIR	Signal to Interference Ratio
WLAN	Wireless LAN
WMN	Wireless Mesh Network

CHAPTER 1

INTRODUCTION

1.0   INTRODUCTION

Wireless mesh network (WMN) was believed to be one of the ways to extend wireless coverage. Other than that, it also used to provide good Internet connectivity by using only one channel. By doing this, it actually reduce the cost of maintaining and deployment. Besides that, it also has the ability to heal the connection as when the connection is broken or loss, it can find other route to stay connected [2]. However, there are some disadvantages in WMN. Since it uses only one channel to connect with other routers, it can accidentally bring interference into the network. The interference can cause the performance of WMN to be decreased.

Carrier sensing is one of the network protocols that actually prevents the data from collision. The mechanism is to allow other nodes to transmit first rather than transmitting at the same time. The carrier sensing method can be seen occurred in wireless mesh network where in this topology; the nodes must in range with each other to make the connection. In this thesis, the analysis of how carrier sensing interference affecting the wireless mesh network is presented.

The thesis proposed that carrier sensing may affects wireless mesh network when there are more than one link involved. When talking about two links, there are two senders that will transmit data and two receivers that will receive the data send

by the senders. However, these links are independent and supposedly the goodput received at the receivers should not be affected. This is where the mechanism of carrier sensing can be seen. By analyzing the possibilities, it can form sixteen cases. The sixteen cases are actually been done with two bits of binary of carrier sensing where 11 consist of both senders node are in range and can sense each other [1]. These bits followed by 10, 01 and 00. Other than that, these method also used to highlight the Co-Channel Interference (CCI) occurred where 11 shows that the two receiver node are interfered by both senders and vice versa [1].

1.1   PROBLEM STATEMENT

In mesh network, the nodes are in range with each other. This means that the coverage of the node makes them can sense each other. When talking about sensing, it means that both nodes' coverage's cover both nodes. This is apply in carrier sensing where to sense the other node, the coverage of the node are overlapping. When there are two senders S1 and S2, both senders are in range with each other. This will make them can sense each other. That is where overlapping coverage creates CSI.

Interference can happen in mesh network. There are two types of interferences that are Adjacent Channel interference (ACI) and Co-Channel (CCI) interference. In this thesis, it we analyzed the interference that can affect the performance of WMN. CCI occurs in mesh network when there are nodes that are in the same channel and also in range with each other.

As the topic proposed, the investigation is looking forward to how can carrier sensing affects the goodput received at the receiver. At the first impression, this topic was to actually see any changes of the goodput. Besides that, the received signal at the receiver also plays a role in this project where CCI occurs at the receivers. However, CCI was believed to occur when the signal to interference ratio (SIR) was low. The SIR was calculated by subtracting the signal of sender one (S1) and sender two (S2) in decibel. There are 2 hypotheses this thesis has to answer:

- If both CSI and CCI exist in wireless mesh network, which one affected the most the goodput performance?

- If (from the first hypothesis) CSI effects dominate, what feature(s) in carrier sensing mechanism leading to such severe degradation? If CCI effects dominate, how the CCI reduce the goodput performance?

1.2 OBJECTIVES

The objective to write this thesis was:

    I.   To analyze which of the interference effect the most in wireless mesh network when both CSI and CCI occurs at the same time

    II.   To analyze if one of the interference is dominate, what are the reason that leads to that domination.

The objectives were created based upon the hypothesis created from the previous part. This is to have a clearer statement which of the interference is affecting WMN. Besides that the analysis also consist of explanations why the domination of the interference with supporting facts.

1.3 SIGNIFICANT

Performance of the wireless mesh network can be hard to maintain. One of the reasons to continue this research was to learn the knowledge on how to minimize the interference. By knowing this knowledge, it helps many people to deploy wireless mesh network with high performance. It encourages me to keep on doing this research where the knowledge that I will found will help other people in the future.

1.4   THESIS ORGANIZATION

The project consists of the introduction of the project where the background explains the project briefly.   The literature review will be discussed in chapter 2 where all the basic knowledge will be explained.   The next chapter consists of research methodology where it will discuss how the measurement will be done. Analysis of the measurement will be in chapter 4 which the result of the measurement will be discussed.   Lastly the conclusion will be at chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

In this chapter, the basic of wireless topology such as Wireless LAN (WLAN) and Wireless Mesh Network (WMN) is covered. In addition, it also included the basic of electromagnetic interference and Carrier Sensing.

2.1   WIRELESS LAN

Networking allows users to access other computers or through the Internet. The idea of doing this wirelessly has been a great impact as it helps people to simplify the network by using air as the medium to communicate. The old fashion way to setup a network using wired is kind of the need of using a lot of cables and it would end up very untidy. Besides that, drilling the walls to make hole so that the cable can go through the walls makes the installation of the network much more complicated. As there is wireless technology, all of those things can be avoided. There are two types of setting that can be used in WLAN that is either using Ad Hoc mode or Infrastructure mode. For Ad Hoc mode or also known as Independent Basic Service Set (IBSS), it uses peer-to-peer connection with using the wireless card to communicate with other user [3]. It is easy and convenient for a simple and quick network setup.
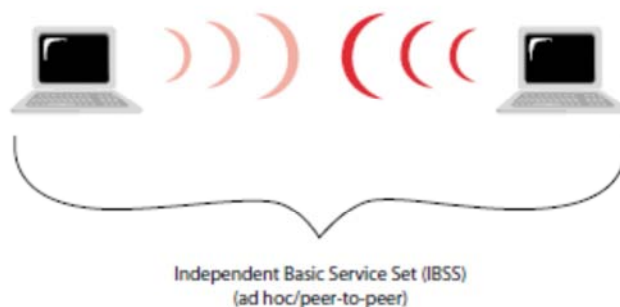
Independent Basic Service Set (IBSS)
(ad hoc/peer-to-peer)

Figure 2.1: Ad hoc mode [3]

Infrastructure mode in the other hand let the wireless and wired network can communicate with each other. This is done when an Access Point (AP) used as middle man making the wired LAN and wireless LAN communicate with each other. The AP performs the conversion of 802.11 packets to 802.3 Ethernet LAN packets. A basic wireless infrastructure with a single access point is called a Basic Service Set (BSS). When more than one access point is connected to a network to form a single sub-network, it is called an Extended Service Set (ESS) [3].
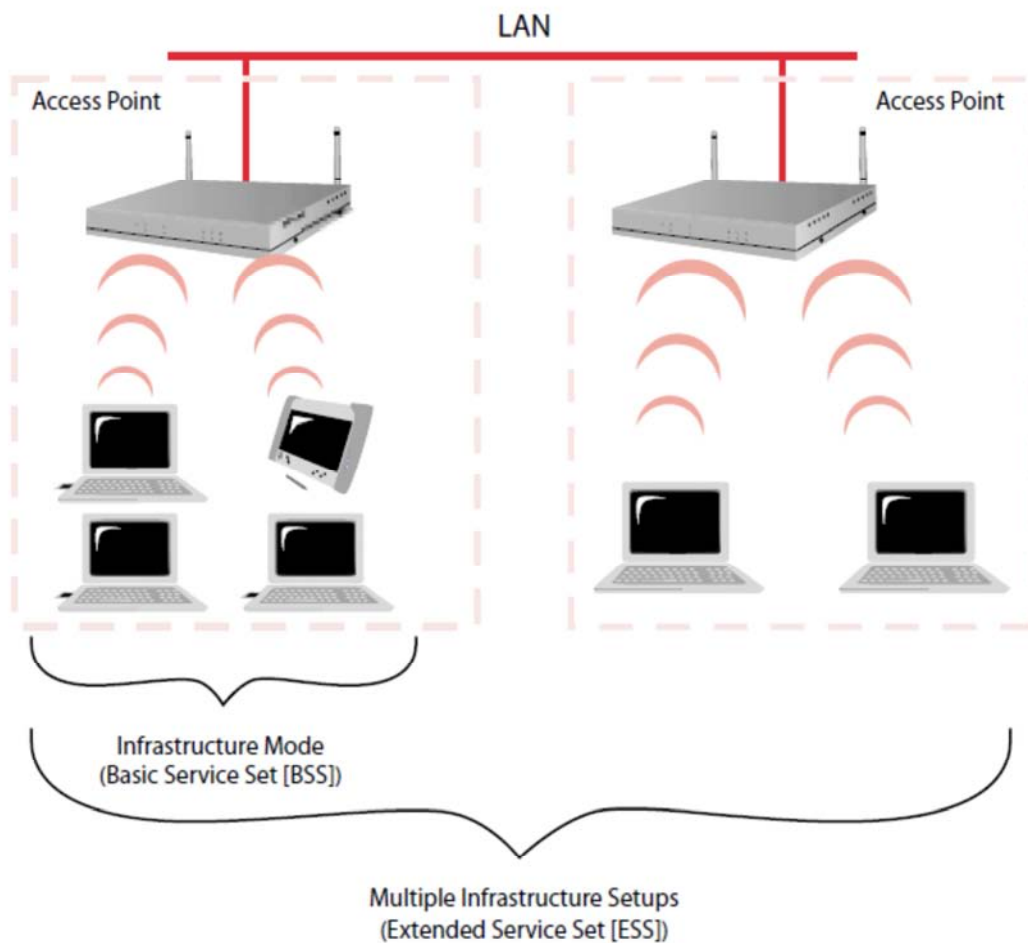
Figure 2.2: Infrastructure mode [3]

2.2   WIRELESS MESH NETWORK

Mesh is one of the topologies uses in networking. Mesh is one of the solutions to make the coverage of the network become larger. The topology was brilliant as when one node is down, other node can help it to reroute so that the connection is still not broken. However, to apply mesh in wireless network, it must first follow several conditions. First of all, it must use only one channel. This is to make sure that the node is connected in one channel. Next is the node use must be more than two. There are several advantages of wireless mesh network that can be found in the internet. Most of them state that the coverage can be widened. Moreover, the connection of the wireless is simpler as if one node down, it will search the shortest route to reroute the connection [6]. Other than that, it also useful for non – line – of sight network where in real life, obstacles are everywhere [6]. The illustration can be seen when there is obstacle blocking two nodes. Other node