

**PERFORMANCE EVALUATION OF WIRELESS LAN WITH
PACKETSTEERING™ TECHNOLOGY.**

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Dedicated to my beloved family especially my father and mother, sister, brother, and
also to all my friends

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ABSTRACT

In Wireless LAN outdoor deployment at the large scale, some problem maybe will be occur such as RF interference, poor performance of throughput, landscape interference and wireless security weakness. Co-channel and adjacent channel interferences are among the factors that affecting the performance of throughput for the outdoor Wireless LAN deployment. Auto selection channel option inside the smart antenna interface is the best way to prevent these kinds of interferences, unlike the ordinary AP, where it's very important to choose carefully the channel to prevent the interference.

This thesis identified possible problems about the connectivity and coverage of wireless network in large scale (outdoor) and the objective is to evaluate the performances of Wireless LAN system with PacketSteering™ Technology that be used in smart antenna system. PacketSteering™ has ability to move the data to the client by allows the beam to be narrow to the client and once the signal is locked, the beam will directed to the client to transmit data on a packet by packet basis. The measurements of performance had been done in Selangor Darul Ehsan at Shah Alam with 41 measurement points with different locations and distances between client and server.

During the measurement campaign, the scenario of line-of-sight (LOS), non-line of sight (NLOS), had be taken into consideration. The collected data from the measurement campaign was analyzed to evaluate the performance of PacketSteering™ technology in terms of connectivity and coverage.

ABSTRAK

Dalam penyebaran rangkaian tanpa wayar diluar pada skala yang besar, beberapa masalah mungkin akan terjadi seperti gangguan RF, prestasi yang buruk dari *throughput*, gangguan landskap dan kelemahan keselamatan tanpa. Gangguan dari saluran yang sama dan gangguan saluran berdekatan adalah salah satu faktor yang mempengaruhi prestasi *throughput* dalam penyebaran diluar rangkaian tanpa wayar. Pilihan saluran automatik pilihan di dalam antara muka antena cerdas adalah cara terbaik untuk mengelakkan jenis-jenis gangguan, tidak seperti AP biasa, di mana ia sangat penting untuk memilih dengan hati-hati saluran untuk mencegah gangguan.

Tesis ini mengenalpasti masalah yang mungkin tentang penyambungan dan liputan rangkaian tanpa dalam skala besar dan tujuannya adalah untuk menilai prestasi sistem rangkaian tanpa wayar dengan *PacketSteering*TM teknologi yang digunakan dalam sistem antena cerdas. *PacketSteering*TM memiliki kemampuan untuk memindahkan data ke pelanggan dengan membolehkan sinar pancaran untuk menjadi tertumpu kepada pelanggan dan sekali isyarat dikesan, sinar akan diarahkan ke pelanggan untuk menghantar data pada pakej dengan pakej asas. Pengukuran prestasi telah dilakukan di Selangor Darul Ehsan di Shah Alam dengan 41 mata pengukuran dengan lokasi dan jarak yang berbeza antara pelanggan dan pelayan.

Sepanjang kerja pengukuran dibuat, senario garis-melihat-*(LOS)*, bukan garis melihat-line *(NLOS)*, telah diambil kira. Data yang dikumpul dari kerja pengukuran dianalisa untuk menilai prestasi teknologi *PacketSteering* dalam hal penyambungan dan liputan.

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CHAPTER 1

INTRODUCTION

1.0 Project background

Wi-Fi wireless networks more days booming and the choice of number one at all levels of society, to ensure the mobility of wireless network systems can be beneficial to all users, wireless network systems necessary to support a variety of applications ranging from basic email and Internet access with heavy bandwidth application voice and video.

The performance of wireless network systems may experience disruptions in the Wi-Fi and non Wi-Fi such as Interference from microwave ovens, Bluetooth devices, wireless devices where the entire device operates at the same frequency spectrum of Wireless LAN. By doing the measurement of the performance of Wireless LAN will determine the factor affecting the performance of the Wireless LAN.

There are many commonly used network performance characteristics such as Latency, throughput, response time, arrival rate, utilization, bandwidth, loss, routing, and reliability. In this project, an only throughput and response time characteristic was used to measure the performances of Wireless LAN by using measurement software.

Deploy the Wi-Fi at the large scale (outdoor) is more challenging than indoor deployment. Wireless LAN poses very unique challenges because of the medium and this is particularly true in large deployments. These issues are installations, network management, quality of service, and additionally the control of security both from a wireless and authentication side. Smart antenna using PacketSteering™ technology is one of the technologies that used for outdoor Wi-Fi deployment to increase the standard coverage of Wi-Fi signal. By using the smart antenna with PacketSteering™ technology to provide up to large coverage area of Wi-Fi products with fewer Wi-Fi devices will reduce the equipment cost and the installation time of the Wireless LAN outdoor deployment and it makes easier to manage and secure the Wireless LAN system. PacketSteering™ technology able to changes the channel automatically to avoid interference by using phase array antenna (beam steering). By measuring and evaluate the performance of wireless using software or tools will indentify the problem during wireless network deployment.

1.1 Problem statements

1.1.1 The Challenges of Wi-Fi in Large Deployments

Quality of service is one of the issues when the Wireless LAN were deploy at the large scale. Interference between others channel will effect the performance of Wireless LAN. When a lot of Access Point deploy with the same channel, the co-channel interference will occur and the Access Point need to re-configure the channel manually to overcame the interference. This issue can be solving by using Smart antenna with PacketSteering™ technology. PacketSteering™ technology can change the channel automatically to avoid interfering nodes.

1.2 Objective

The objectives of this project are to evaluate performance of Wireless LAN using PacketSteering™ Technology.

1.3 Scope of work

The scopes of the project are:

1. Determine the Wireless LAN network with PacketSteering™ technology coverage.
 - Determine 41 of measurement points using the Google Earth to evaluate the performance of Wireless LAN with PacketSteering™.

2. Measurement campaign
 - The measurement campaign is done to measure the throughput, SNR and the RSSI of the Wireless LAN using the measurement software such as Ixchariot, Netstumbler, inSSIDer and Xirrus.
 - ❖ Ixchariot
 - Measure the throughput of Wireless LAN.
 - ❖ Netstumbler
 - Monitor the SNR value.
 - ❖ inSSIDer
 - Monitoring the channel of Wireless LAN.
 - ❖ Xirrus
 - Monitoring the RSSI value

3. Evaluation

Each data from the performance measurement will be collected to do the evaluation of performance Wireless LAN using PacketSteering™ technology and identify the problem or the challenge in deploying Wireless LAN at the large scales.

1.4 Significant of project

This research is done to identify the main cause that affects the wireless outdoor performance. By doing this research we can improve the performance of outdoor at the large scale wireless by identify and reduce the factor that affects the outdoor wireless performance.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Information from the previous research and related sources are the important to indentify the ideas and the method in project development. Understanding theory and the related information from the others source are useful as a guideline in developing a new project and produce a general understanding for the project. In this chapter basically is about the previous information and theory about the factor affect the throughput performance in wireless LAN deployment, the overview about the smart antenna with PacketSteering™ technology and the advantages using the smart antenna will discussed throughout this chapter.

2.1 Smart Antenna



Figure 2.1 Smart Antenna ^[1]

Definition -

- A smart antenna is a digital wireless communications antenna system that takes advantage of diversity effect at the source (transmitter), the destination (receiver), or both.

2.2 How Do Smart Antenna Systems Work? ^[2]

“Traditional switched beam and adaptive array systems enable a base station to customize the beams they generate for each remote user effectively by means of internal feedback control.

Generally speaking, each approach forms a main lobe toward individual users and attempts to reject interference or noise from outside of the main lobe.” ^[2]

2.3 Overview of the smart antenna with PacketSteering™ technology.

The smart antenna with PacketSteering™ technology that we used in this project can be define in Vivato Wi-Fi base station where it provides continuous, high speed access between IEEE 802.11 b/g wireless client or wired Ethernet networks and it is one of solution for long range Wireless LAN deployment. This type of Wi-Fi Base station came with Wi-Fi radio system and a central microprocessor which

has ability to coordinates all the Wi-Fi activities. Concentration and directional control of Wi-Fi transmission are provided by an integral phase array antenna. The transmission and reception of signal was control by six radios within a 15° section of the antenna pattern. The antenna pattern is 90°horizontal by 12° vertical. Radio 0 controls the 15° area of coverage at the far left and radio 5 covers the 15° area at the far right of the pattern. [3]

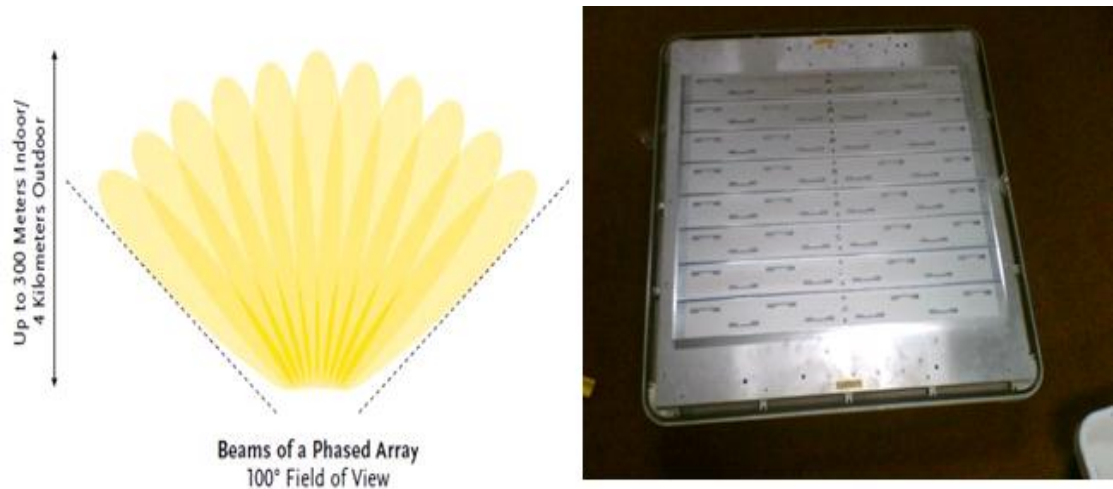


Figure 2.2 Phase Array Antenna



Figure 2.3 Temperature controller

It also has the ability to maintain the temperature by using build in heater to establish the correct temperature (temperature range: -40°C to $+55^{\circ}\text{C}$) during cold or hot weather operation.

2.4 What is the PacketSteering™ technology?

PacketSteering™ technology with phased array antenna which has multiple shaped packet beams that can be used to transmit and receive and it allowed the beams to be very narrow. Once the signal is locked in, the appropriate beam is directed to the client to transmit data on a packet by packet basis. PacketSteering™ has an ability to move data where it's done in non overlapping channels of 1, 6 and 11, compared with the ordinary AP; the data are blasted out from an Omni-directional antenna with any control to reach to the client. The RF transmission operation become more efficient and secure environment with the PacketSteering™ technology because the beam are narrow and active when needed. It works like the function of RADAR where the beams are transporting data to the active user only and at the same time it increasing the range of coverage and reducing the interference because of the narrow of the high gain beams makes all around the beam is quiet. [3]

2.5 Auto Channel Selection (ACS)

Auto selection channel is one of the benefits using this type of smart antenna. Many Wi-Fi devices typically using channel 6 as a default from the manufacture. The result highly interference channel with many device competitive over the access. To solve this problem, Auto Channel selecting the cleanest channel available. It does so by scanning all available channels, evaluating the interference level and Wi-Fi activity then selecting the optimal channel for use for the large scale area.

2.6 Line Of Sight (LOS) and Fresnel Zone

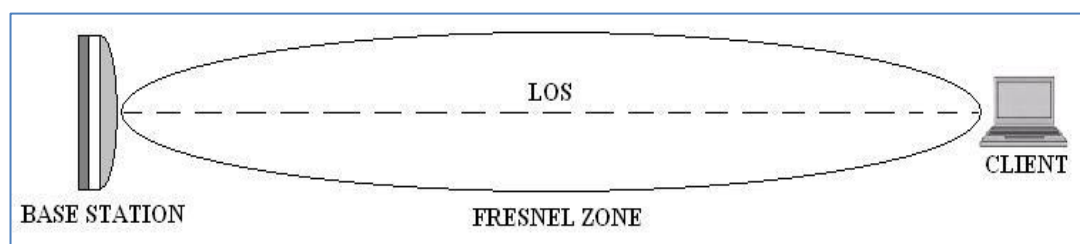


Figure 2.4 Fresnel Zone and Line of Sight

Line of sight (LOS) means that we can see the receiving and transmitting devices from each other's position. Signal from the radio didn't propagate through the space in very thin beams. The area around the LOS path carries a considerable amount of the signal as it travel and it is called the Fresnel zone. Varies in size with wave length (λ) of the signal and the distance between the transmitter and receiver.

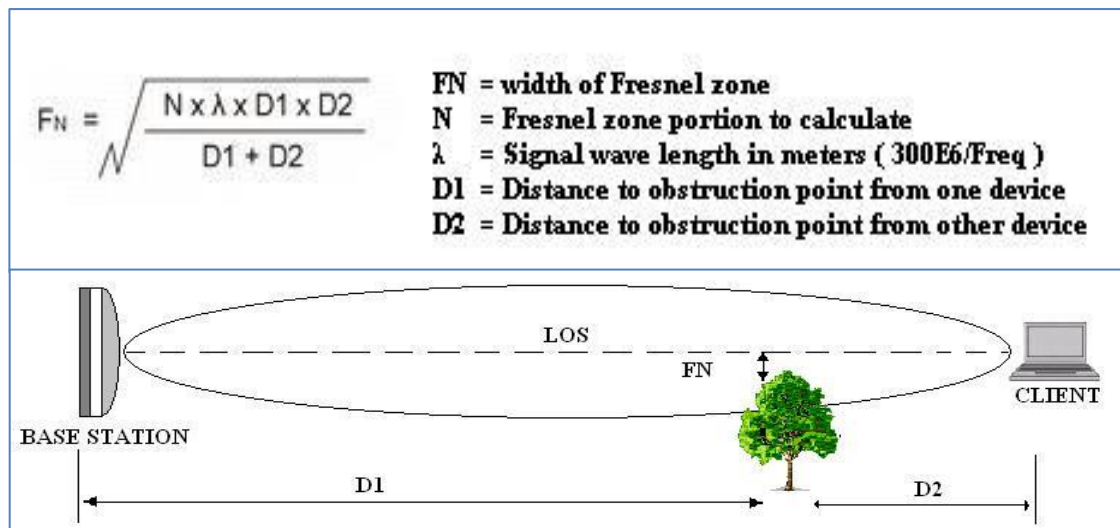


Figure 2.5 Calculating the Fresnel zone

The Fresnel zone width is calculated at a specific point in the signal path using the distances (in meters) from the transmitter and the receiver to that point. As an example, in figure 5 the Fresnel zone is calculated for a point where tree is close to the line of sight path. F_N represents the width of the Fresnel zone perpendicular to

the line of sight at the obstruction (tree). **D1** and **D2** represent the distances from the base station and the client card to the obstruction and **N** represent the portion of Fresnel zone to use in calculation.[5]

2.7 ISM-Band Channel Spacing.

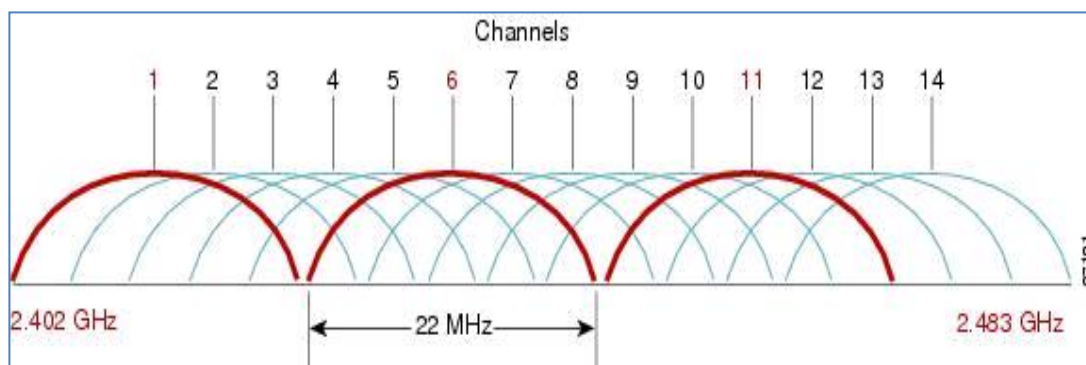


Figure 2.6 ISM Band Channel Spacing for Channel 1 to 14

The ISM Channels have a bandwidth of 22 MHz, but are only spaced 5 MHz apart. This means that transmissions on any channel can interfere with operation on channel that is within four channel spacing (20 MHz) above or below that channel. As shown in figure 6 this leaves channel 1, 6 and 11 as the only channels that can be used at the same time with minimum interference with each other.[6]

Many device are deploying using channels other than 1,6, or 11. This means that they can interfere with 802.11 devices using these non overlapping channels. For example, a wireless video link operating on channel 4 will interference with 802.11 operations on channels 1 through 8. In return, other devices operating on those channels could also interfere with the video link. Therefore, it is very important that channels for Wi-Fi operation are choose carefully to prevent interference from other system and to prevent creating interference for other system.

2.8 The factor affecting throughput .[7]

➤ Antenna Type

- ❖ Antenna Gain
- ❖ Antenna Diversity
- ❖ Antenna Cable Lengths

- Antenna gain is the power gain in comparison to an isotropic antenna measured in isotropic decibels (dBi).
- Antenna directivity increases antenna gain in a given direction.
- In client devices, omnispherical antenna is most suitable as it allows the device to operate in any position

➤ System Design

- ❖ Receiver sensitivity
- ❖ Transmit power
- ❖ Turn-around time

- The receiver has a minimum received power threshold that the received signal must have to achieve certain bit rate.
- If the received signal power is lower than the threshold, the maximum bit rate could be decreased, impacting performance.
- Receiver sensitivity depends both on RF and baseband design