PROPAGATION COVERAGE FOR INDOOR OFFICE AREA USING RAY TRACING TECHNIQUE

NURAFIFI BT CHE AP

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Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
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JUWITA BINTI MOHD SULTAN
Pensyarah
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Kampus Durian Tunggal
Pejabat Pos Durian Tunggal
76109 Durian Tunggal, Melaka

3/5/2011

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Tarikh : 3 / 05 / 2011

"For my beloved parent."

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ABSTRACT

Wireless communication is a very important and compromising technology nowadays. Having a good coverage is vital but how to achieve it is the question. This project is about predicting propagation coverage in indoor scenario. The environment chose for this project is office area environment. The main objective of this project is to predict the propagation coverage in office area so that, the information of thing such as the best distance to place a router, and how the router should be place can be obtain. Three parameter had been choose which is concrete, ceiling and gypsum board. This material is the most common material encounter in office area environment. The method that will be use is Ray Tracing Technique with the consideration of three main phenomena in indoor propagation which is reflection, transmission and diffraction. Reflection and transmission will be considered in one equation since both depend on the degree of angle which is had been fixed from 0 to 90 degrees. Two type of router placing is considered. It is in parallel and perpendicular. Result will show the best placing for a better coverage. MATLAB approach is used to yield the result. A Graphic User Interface will be constructed to give convenience to users.

ABSTRAK

Komunikasi secara tanpa wayar adalah technologi yang penting dan mempunyai banyak masa depan yang cerah pada masa kini. Liputan tanpa wayar yang baik adalah sangat penting tetapi perkara inilah yang menjadi persoalannya. Projek ini adalah untuk meramal perambatan gelombang bagi situasi dalam rumah. Kawasan yang telah dipilih ialah kawasan pejabat. Objektif utama bagi projek ini adalah untuk meramal perambatan gelombang bagi liputan dalam kawasan pejabat supaya maklumat seperti tempat terbaik untuk router diletakkan dan bagaimana router diletakkan boleh didapatkan. Tiga jenis bahan akan diambil kira untuk situasi ini ialah konkrit, syiling, dan papan gypsum. Bahan-bahan ini adalah bahan yang biasanya terdapat dalm kawasan pejabat. Kaedah yang akan digunakan adalah kaedah Ray Tracing yang mana tiga jenis fenomena yang sering berlaku dalam situasi dalam rumah iaitu pantulan, pembiasan dan pembelauan gelombang akan diambil kira. Pantulan dan pembiasan akan dikira sebagai satu persamaan memandangkan kedua-duanya berkaitan dengan sudut yang mana telah ditetapkan kepada 0 hingga 90 darjah. Dua cara peletakan router juga diambil kira iaitu sama ada dalam keadaan selari atau dalm keadaan tegak. Hasil kajian akan menunjukkan cara letakkan terbaik untuk liputan tanpa wayar yang lebih baik. Pendekatan yang digunakan untuk mendapatkan keputusan ini adalah dengan menggunakan MATLAB. Graphic User Interface (GUI) akan dijana bagi memudahkan pengguna.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

After the great success of wireless communications in land mobile radio, "wireless" becomes more and more interesting for other applications. The steadily increasing demand for multimedia applications and new safety technologies in vehicles encourage the usage of inexpensive and wireless transmission systems. Thus, knowledge about the channel or about the distribution of the field strength in a certain area is needed. Base on this sense, wireless communication is not only just the last-mile communication but the communication itself already. Despite the rapid growth of wireless coverage around Malaysia, the strength and the limitation of signal are always questionable. Therefore, the need to predict the coverage before placing the router is very important to avoid signal loss due to reflected signal, scattering and diffraction. Thus, using the ray tracing technique, the wave propagation can be predicted.

1.2 Objectives

To predict the propagation coverage for indoor scenario (office area) using Ray Tracing Technique.

1.3 Problem Statement

There's some problem faced during the completion of this project such as:

1. Choosing the suitable parameters for office environment. There's a lot of material involve in office environment. However, not every material exists as major environment. Thus, careful measures need to be done in choosing the material.
2. Reflection and diffraction will involve angle measurement. The range of the degrees needs to be choose so that a suitable measurement can be achived.
3. In creating a Graphic User Interface (GUI) for this project, the suitable push button is being considered. Too much push button is better but it might confuse the user. On the other hand, if the push button is not enough, user cannot see the result clearly.

1.4 Scope

The scope of this project is to predict the propagation coverage in indoor area which specifically in office environment. The method that will be use is Ray Tracing Technique. Three wave phenomena will be considered which are reflection, transmission and diffraction. The software that will be used is MATLAB version 7.10.

1.5 Methodology

First Phase: Literature reviews

A literature reviews on related topic for this project will be done in order to gain better understanding so that this project can be carried out smoothly.

Second Phase: Determine the parameters use

After done with literature review, a suitable parameter can be chosen. All the parameters choose will regard on all the literature review that had been studied.

Third Phase: MATLAB coding

Base on the parameters and the equations, a MATLAB coding can be generated in order to get the result of the propagation coverage in office area scenario.

1.6 Report Structure

Chapter 1: Introduction

Chapter 1 of this report will consist all the introduction to this report such as the introduction, objective, problem statement, scope and methodology. This chapter will brief about this report roughly.

Chapter 2: Literature Reviews

In Chapter 2 the literature reviews on related topic of this project will be presented. Topics such as Wireless Mesh Network, Radio Wave Propagation and Ray Tracing Technique will be elaborated.

Chapter 3: Methodology

This is the chapter that will brief on the methodology of completing this project. The project planning and how all the process done in this project will be explain in detail in this chapter.

Chapter 4: Result and Discussion

All the results and finding of this project will be presented in this chapter. This chapter will discuss about the result that had been obtain in detail.

Chapter 5: Conclusion and Recommendation

The last chapter will conclude the result and finding of this project. A recommendation will be done base on the finding.

CHAPTER 2

LITERATURE REVIEW

Literature review of this report will be on wireless mesh network, radio wave propagation and Ray Tracing Technique.

2.1 Wireless Mesh Network

2.2.1 Introduction

A Wireless Mesh Network (WMN) is a communications network made up of radio nodes organized in a mesh topology. Wireless Mesh Network often consist of mesh clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward traffic to and from the gateways which may but need not connect to the Internet [1]. The coverage area of the radio nodes working as a single network is sometimes called a mesh cloud. Access to this mesh cloud is dependent on the radio nodes working in harmony with each other to create a radio network.

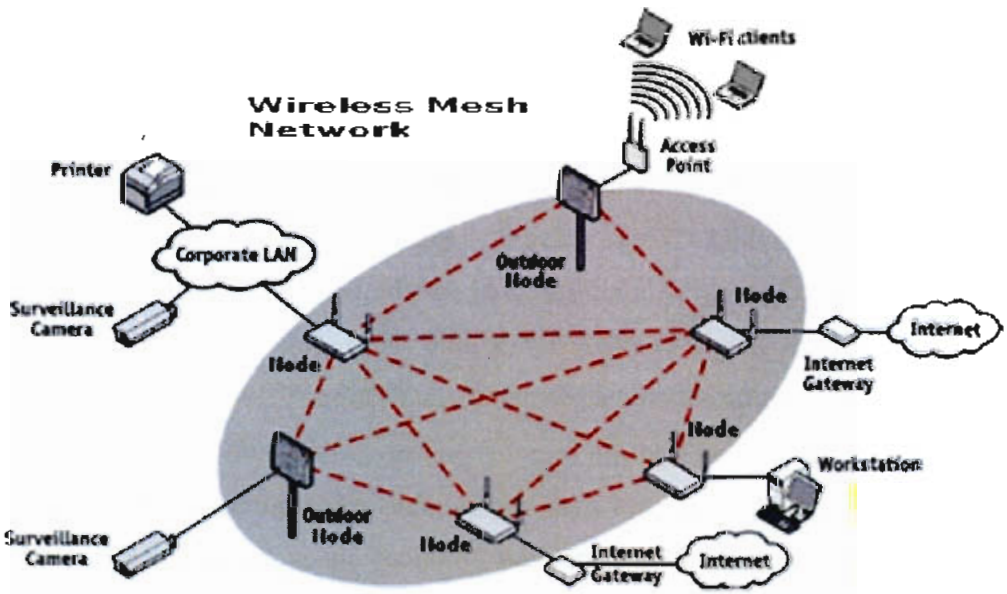

Figure 2.1.1 : An example of Wireless Mesh Network [2]

A mesh network is reliable and offers redundancy. When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes. Wireless Mesh Network can be implemented with various wireless technology including 802.11, 802.16, cellular technologies or combinations of more than one type.

A Wireless Mesh Network can be seen as a special type of wireless ad-hoc network. It is often assumed that all nodes in a wireless mesh network are immobile but this need not be so. The mesh routers may be highly mobile. Often the mesh routers are not limited in terms of resources compared to other nodes in the network and thus can be exploited to perform more resource intensive functions. In this way, the wireless mesh network differs from an ad-hoc network since all of these nodes are often constrained by resources.

2.2.2 Network Architecture

Wireless mesh architecture is a first step towards providing high-bandwidth network over a specific coverage area. Wireless mesh architectures infrastructure is, in effect, a router network minus the cabling between nodes. It's built of peer radio devices that don't have to be cabled to a wired port like traditional Wireless Local Area Network (WLAN) access points (AP) do. Mesh architecture sustains signal strength by breaking long distances into a series of shorter hops. Intermediate nodes not only boost the signal, but cooperatively make forwarding decisions based on their knowledge of the network, in example perform routing. Such architecture may with careful design provide high bandwidth, spectral efficiency, and economic advantage over the coverage area.

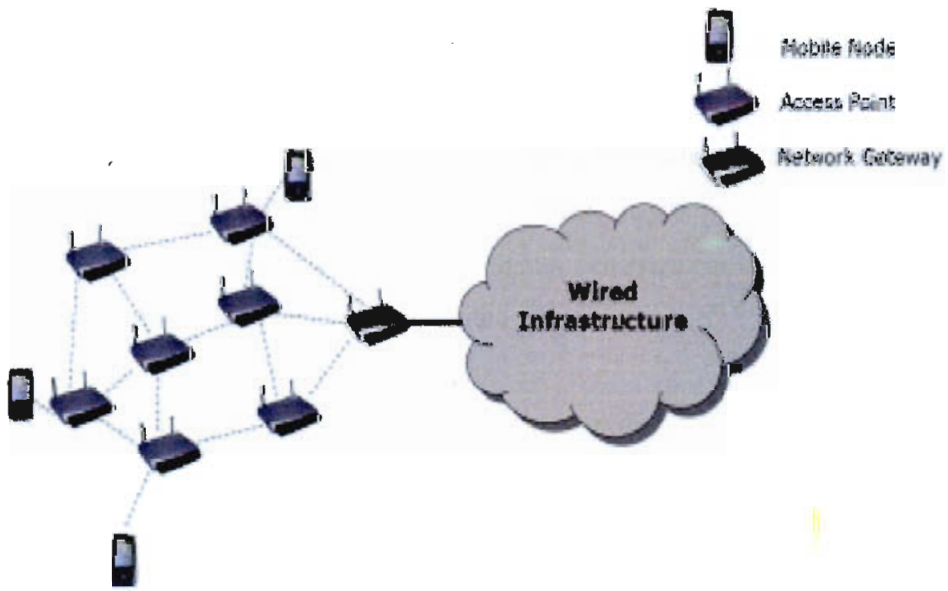

Figure 2.1.2. : A mesh network topology. A mesh topology provides redundant communication paths between some or all devices (partial or full mesh). [4]

Wireless Mesh Networks are composed of three distinct network elements:

- Network Gateway: one (or more) gateway can be deployed to allow access to a different Internet Protocol (IP) subnetwork (usually wired infrastructure).
- Access Points: the access points form a wireless backbone, providing connectivity in places otherwise difficult to access through traditional wired infrastructure. The wireless communication between the access points can use different technologies such as IEEE802.11a/b/g or IEEE802.16 and different hardware (directional or omnidirectional antenna).
- Mobile Nodes: any device embedding wireless capabilities (e.g. PDAs, laptops, etc.) can access the network gateway through direct or multi-hop communication (using the access points as relays).

Example of three types of wireless mesh network:

- Infrastructure wireless mesh networks: Mesh routers form an infrastructure for clients.
- Client wireless mesh networks: Client nodes constitute the actual network to perform routing and configuration functionalities.
- Hybrid wireless mesh networks: Mesh clients can perform mesh functions with other mesh clients as well as accessing the network.

Wireless Mesh Network has a relatively stable topology except for the occasional failure of nodes or addition of new nodes. The traffic, being aggregated from a large number of end users, changes infrequently. Practically all the traffic in an infrastructure mesh network is either forwarded to or from a gateway, while in ad hoc networks or client mesh networks the traffic flows between arbitrary pairs of nodes.

2.1.3 Network Topologies

Network topology is the layout pattern of interconnections of the various elements (links, nodes, etc.) of a computer network. [5][6] Network topologies may be physical or logical. Physical topology means the physical design of a network including the devices, location and cable installation. Logical topology refers to how data is actually transferred in a network as opposed to its physical design. In general physical topology relates to a core network whereas logical topology relates to basic network.

Topology can be considered as a virtual shape or structure of a network. This shape does not correspond to the actual physical design of the devices on the computer network. The computers on a home network can be arranged in a circle but it does not necessarily mean that it represents a ring topology.

Any particular network topology is determined only by the graphical mapping of the configuration of physical and/or logical connections between nodes. The study of network topology uses graph theory. Distances between nodes, physical interconnections, transmission rates, and/or signal types may differ in two networks and yet their topologies may be identical.

A local area network (LAN) is one example of a network that exhibits both a physical topology and a logical topology. Any given node in the LAN has one or more links to one or more nodes in the network and the mapping of these links and nodes in a graph results in a geometric shape that may be used to describe the physical topology of the network. Likewise, the mapping of the data flow between the nodes in the network determines the logical topology of the network. The physical and logical topologies may or may not be identical in any particular network.