MEASUREMENT OF ATTENUATION OF MICROWAVE SIGNALS

This thesis is presented in partial fulfillment for the award of the Bachelor in Electrical Engineering (Hons.) UNIVERSITITEKNOLOGI MARA



ZAIRIISMAEL BIN RIZMAN FACULTY OF ELECTRICAL ENGINEERING UNIVERSITY TECHNOLOGY MARA 40450 SHAH ALAM SELANGOR DARUL EHSAN MALAYSIA

ACKNOWLEDGEMENT

In the name of Allah, the Most Beneficent and the Most Mercifiil, I pray for giving me patience in completing my project.

I owe many people many things for the help and guidance throughout this project. Deep appreciation to my project advisor, Puan Norasimah Khadri and also to Associate Professor Dr. Nasir Bin Taib for his advice, guidance and great support in making this project report a success.

Furthermore, I like to express my appreciation to all staff and technicians in the Communication Laboratory especially to Mr. Kamarulzaman, Mr Azman Misroo and Mr Khalim Kamsan. Thanks a lot to my brother; Yuzri Harjoni Bin Rizman and my friend, Saiful Azhar Mat Saad, who directly involved during the experimentation for their persistence assistance in carrying out all the laboratory equipments with, regard this project.

The final and most important acknowledgement is owed to my family for their understanding, support and expectations. To my parents, thank you for your love and support which have been a constant source of strength.

ABSTRACT

Attenuation of microwave propagation in the estate of palm oil trees was investigated at microwave frequencies (0.9, 1.8 and 2.3 GHz). In order to perform the measurements under well defined, reproducible conditions, a regularly planted, well groomed stand of palm oil trees of about the same growth was chosen as the test site. The experiments were repeated, over the same transmission paths, under different number of trees (1, 2, 3 and 4) which obstructing the signal path, with different height (measure on height of trunk, fruit and leave). The particular interest was the attenuation of microwave with increasing number of trees in the signal path.

TABLE OF CONTENTS

CHAPTER TITLE PAGE INTRODUCTION OF RADIO FREQUENCY 1 1.1 What are microwaves? 1 1.2 Microwave Propagation 2 1.2.1 The electromagnetic field 2 1.2.2 Propagation phenomena 5 1.2.3 Propagation paths 7 1.2.3.1 Ground wave 8 1.2.3.2 Tropospheric propagation 13 1.2.3.3 Unusual propagation modes 16 1.2.3.4 Inospheric effects 17

2 MICROWAVE FREQUENCY PROPAGATION

2.1	Introd	uction				
2.2	Factor	r Affecting Coverage	19			
	2.2.1	Fringe Areas	19			
		2.2.1.1 Foliage	19			
		2.2.1.2 Subscriber Unit Location	20			
		2.2.1.3 Subscriber Unit Orientation	20			
		2.2.1.4 Terrain Variations	21			
	2.2.2 RF Dead Zones					
		2.2.2.1 Excessive Building-Caused Signal Loss	21			
		2.2.2.2 Terrain Variations	22			
		2.2.2.3 Low Signal Areas	22			
		2.2.2.4 High Noise Level Areas	23			
2.3	Propa	Propagation Variations				
	2.3.1	Signal Reflections	23			
	2.3.2	Variations in Terrain	24			
	2.3.3	Atmospheric Bending of Radio Waves	24			
	2.3.4	Electrical Noise	24			

- 2.4 Overview Measurements of Radio Wave 25 Attenuation on Foliage Loss
 - 2.4.1 Distance Dependence of Radio Wave Attenuation 26
 - 2.4.2 Frequency Dependence of Radio Wave Attenuation 28
 - 2.4.3 Polarization Dependence of Radio Wave 28 Attenuation

CHARACTERISTIC OF ELECTROMAGNETIC WAVES

3.1	Introd	uction				29
3.2	Charac	cteristic	of	electromagnetic	waves	29
	3.2.1	Wave vel	ocity			29
	3.2.2	Frequency and wavelength				30
	3.2.3	Space-Ti	ne Rela	ationships		32
3.3	The Uniform Plane Wave					34
	3.3.1	Wave Pro	opagatio	on in Free Space		34
	3.3.2	Wave Pro	opagatio	on in Dielectrics (Mate	erial)	36

BASIC CONCEPT OF ANTENNA

4.1	Introduction				
4.2	Basic antenna properties				
	4.2.1	Size	39		
	4.2.2	Shape	40		
	4.2.3	Directivity	41		
	4.2.4	Radiation mechanism	41		
	4.2.5	Radiation pattern	44		
	4.2.6	Polarization	45		
4.3	Half-v	Half-wave dipole antenna (Yagi antenna)			
4.4	How half-wave dipole antenna (Yagi antenna) works 40				

EXPERIMENTAL TECHNIQUE

49
4