ANTENNAS AND PROPAGATION

Modeling, Simulation & Measurements

Edited by

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IIUM PRESS

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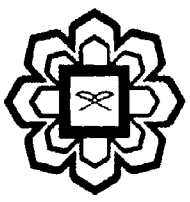

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Md. Rafiqul Islam & Jalel chebil: Antennas and Propogation: Modeling, Simulation & Measurements
Bibliography p.
Includes Index
ISBN

ISBN: 978-967-418-138-3

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed By:
IIUM PRINTING SDN.BHD.
NO. 1, JALAN INDUSTRI BATU CAVES 1/3
TAMAN PERINDUSTRIAN BATU CAVES
BATU CAVES CENTRE POINT
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Chapter 28

Rain Attenuation Prediction Models for Earth-Space Link

Ahmad Fadzil Ismail[1] and Khairayu Badron[1]

28.1 Introduction

Satellite communications systems were originally developed to provide long distance telephone services. Earth orbiting satellites are now extensively employed for relaying information in a vast array of telecommunications, meteorological, government and scientific applications. These satellite systems rely heavily on transmission quality of radio signals to and from the satellites. The fidelity of the signal is very much dependent on the propagation characteristics along its transmission path, primarily the earth atmosphere. Radio wave propagation thus plays a very important part in the design and eventually dictates performance of space communication systems. Over the years the requirements of satellites from a mere telephony tool have grown extensively where higher capacity communication systems are needed. The escalating demands of microwave and millimetre wave communications are indeed causing frequency spectrum congestion. Hence, existing and future satellite system operators will have no choice but to employ higher and higher frequency bands i.e. above 10 GHz. Consequently, alterations in the prediction models are required in order to make certain of their applicability at different frequencies and regions.

28.2 Earth-Space Rain Attenuation Prediction Models

In most radio system design, the operating limit is usually predetermined by the variation about the clear sky level. The negative variation below the mean clear sky level is called excess attenuation [1]. Attenuation is usually measured in decibel denoted by unit of dB. Signal attenuation on a path is sometimes referred as loss. Extinction on the other hand is the algebraic sum of loss components due to scattering and absorption [1]. The relative importance of scattering and absorption is due to the fact that it is a function of the complex refraction of the absorbing/scattering particle. The complex index of refraction itself is a function of signal wavelength, temperature, and the size of the particle relative to the wavelength of the radiowave. It is very critical to accurately predict the attenuation of a signal transmitted at certain frequencies especially in tropical region where heavy downpour frequently occur. Several methods have been proposed for predicting rain induced attenuation statistics for most part of the world. Some of them are discussed in the next section.

[1] *Department of Electrical and Computer Engineering, Kulliyyah of Engineering International Islamic University Malaysia (IIUM)*