ANTENNAS AND PROPAGATION

Modeling, Simulation & Measurements

Edited by

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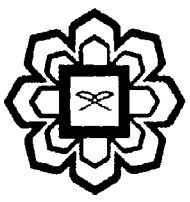

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Table of Content

Chapter 21

Rain Rate Conversion Factor in Malaysia

Jalel Chebil[1] and Tharek Abd. Rahman[2]

21.1 Introduction

In meeting the rapidly growing demand for radio telecommunications in Malaysia, there is a need to use frequency band above 10 GHz for terrestrial and satellite communication systems. However, at such frequency range, rainfall is a serious cause of attenuation for the radio wave propagation. It is important for any microwave system designer to predict accurately the fading outage due to rain attenuation. The common rain attenuation prediction methods require one-minute rain rate data [1, 2, 3]. However, the availability of such data is generally limited in the tropical regions. Most investigations of rainfall have been carried out for meteorological, hydrological and agriculture purposes. The rain data is usually taken for intervals of one hour or longer. The purpose of this chapter is to examine the relationship between the hourly and one minute cumulative rain rate distribution at three locations in Malaysia, and determine an empirical form which might serve the needs of the microwave systems designer.

21.2 Methodology

The transformation of τ-min rainfall distributions into equivalent 1-min distribution may be carried out in a number of different ways. In a preliminary study [4], the authors have compared between three methods for rain rate conversion. It was shown that Segal's method [5] for rain rate conversion can produce better results in Kuala Lumpur-Malaysia. Segal define the rain rate conversion factor (CF_τ) as the ratio of rain rates $R_1(P)$ and $R_\tau(P)$ for a given percentage of time P with an integration time of 1-min and τ-min respectively and is given by

$$CF_\tau = R_1(P) / R_\tau(P) = a\, P^b \qquad (21.1)$$

where *a* and *b* are regression coefficients. To compute the measured values of CF_{60} for different percentage of time, we need to detemine the one-minute and the hourly cumulative distribtion which is discussed in the coming sections.

21.3 Measurements and Data Collection

Two types of data are used in the analysis: hourly and one-minute rain rate data. The one-minute rain rate data were measured for three years in the Universiti Teknologi Malaysia-

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