Rain Attenuation Measurements in Malaysia

Kesavan Ulaganathen [1,2] and Mauro S. Assis *[3]

[1] Wireless Communication Center – University Technology Malaysia

[2] Electrical Engineering Department Haji Ahmad Shah Polytecnic of Malaysia

e-mail : kabilan2000@hotmail.com

[3] Brazilian Committee of URSI – Rio de Janeiro, Brasil

e-mail: msassis@openlink.com.br

Within a research programme dealing with the development of a 5.8 GHz link to be used as redundancy for a 26 GHz terrestrial point-to-point microwave link in the equatorial region, two problems are discussed in this paper. a) Drop size distribution (DSD) and the associated specific rain attenuation and b) Frequency scaling of rain attenuation statistics. Measurements were carried out in a 1.3 km long radio link located in the Skudai campus of Universiti Teknologi Malaysia (UTM). Simultaneous rainfall rate measurements were carried out in the same site with a Casella tiping bucket size of 0.5 mm rain gauge along with one minute interval. Both measurements cover the period from June 2011 to May 2012.The specific attenuation due to rain *As*(dB/km) is obtained from the rainfal rate *R*(mm/h) using the power relationship, $As = kR^{\alpha}$ where k and α are functions of frequency, rain drop size distribution (DSD), temperature e polarization of the radio wave. The most common DSD model used in temperate climate is the Marshall and Palmer negative exponential function, while the log-normal distribution applies to tropical and equatorial climates. In this paper the specific attenuation has been determined directly from the collected rain attenuation. Since the path length of the experimental link is 1.3 km, the distribution of rainfall has been assumed to be uniform along the propagation path. The nonlinear relationship between specific attenuation and the rainfall intensity given in the above equation was transformed into a linear form based on a logarithmic transformation. Then a linear regression model was fitted to the measured specific attenuation and the measured rainfall rate. Based on one year of rain attenuation measurements at both frequencies, the following values of k and α were estimated,

f = 5.8 GHz   k = 0.138 ;   α = 0.63

f = 26 GHz   k = 0.389 ;   α = 0.89

On the other hand, scaling of rain attenuation statistics in frequency is a useful technique if attenuation data are available at the desired locality. Many scaling models have been developed from various propagation experiments. In this paper the Rain Attenuation Statistics (*RAS*) is modeled according to a simple power law model given by,

$$RAS = \left(f_2 / f_1\right)^n$$

where f_1 is the lower frequency and f_2 the higher one. Three pair of frequencies, 5.8 GHz, 15 GHz and 26 GHz have been analysed and compared. The rain attenuation data for 5.8 GHz and 26 GHz were taken from the same link used before for the specific attenuation study, while the 15 GHz data has used previous rain attenuation information from another radio link located also in UTM. This intermediate frequency has been also used as a check for the results derived from 5.8 and 26 GHz. In summary, the analysis of the rain attenuation data has indicated the value of **n = 1.57** for the power law model to be used in the frequency range from 5 to 26 GHz. In the final paper the results presented here will be compared to data from several other tropical and equatorial countries, such as Brazil, India, Nigeria, Singapore and South Africa.