

PERFORMANCE EVALUATION OF AN EMPIRICAL SITE DIVERSITY GAIN MODEL FOR SOUTH-SOUTH NIGERIA

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ABSTRACT

Site diversity is an effective technique to mitigate rain attenuation, especially in regions where rainfall rates are high. The South-South region of Nigeria is characterised by the tropical rain forest climate, exhibiting high rainfall rates almost all year round. This paper investigates site diversity gain in the South-South Nigeria at Ka-band frequencies of 20 GHz. Rainfall data obtained from the Nigerian Meteorological Agency (NIMET) over a period of five years for four selected earth stations (University of Uyo (UNIUYO), Uyo; Akwa Ibom International Airport (AKIA), Uyo; Margaret Ekpo International Airport (MEIA), Calabar; and Port Harcourt International Airport (PHIA), Port Harcourt) were analysed to derive a one-minute rainfall rate distribution. The link parameters of NigComSat-1R were incorporated with the International Telecommunication Union-Radiowave (ITU-R) model for rain attenuation to estimate the rain attenuation distribution through an annual cumulative distribution and percentage of outage time between 0.001 to 100 %. Site diversity was implemented. The results obtained from the analysis were used to develop a prediction model for site diversity gain using statistical and regression analysis based on the dependence of site diversity gain on other link parameters such as single site attenuation, site separation distance, operating frequency, elevation angle and baseline orientation angle. The proposed model when compared with the Hodge and ITU-R prediction models for site diversity gives a better performance, which may be quantified with root-mean-squared error values ranging from 0.22 to 1.71.

Keywords: Rain rate, rain attenuation, cumulative distribution, site diversity.