Ka-Band Propagation Experiment at a Tropical Site

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Abstract - Results from a tropical Ka-Band propagation measurement experiment conducted with the Global Broadcast Satellite are presented. The measurements were made at a site in Humacao, Puerto Rico. The experiment included Ka-band beacon signals, Ka-Band sky noise and rain rate. The measurements were started in April 2002 and extend to December 2002. Results presented are annual monthly distributions of rain rate, attenuation, fade durations, and inter-fade intervals. The results are compared with available models to ascertain their applicability in tropical climates.

Introduction -Since the early years of satellite telecommunications, the evolution of systems has led to a strong increase in satellite capacity, a decrease of boarded equipment size and a significant cost reduction. From the technical point of view, the congestion of primary allocated frequency bands resulted in the use of higher and higher bands from L, S or C bands to X and Ku bands, and in the near future up to Ka, V and EHF bands. One of the main concerns with these higher frequency bands is the influence of the atmosphere on radio wave propagation. Until now, some studies have shown that the feasibility of such links seems to be guaranteed, especially in the Ka-band. Several propagation experiments have been conducted, mainly in mid-latitude climates, with the OLYMPUS, ITALSAT, and ACTS satellites. However, it is still necessary to determine what service availability will be supplied to the user, and to predict the behavior of these systems when affected by high fading conditions. In particular, the knowledge of propagation issues in wet climates has to be improved.

Satellite telecommunication links in the EHF band are disturbed by troposphere phenomena, which can severely degrade service quality. First, attenuation is caused by atmospheric gases (mainly oxygen and water vapor), by clouds (liquid water and ice particles) and by precipitation (hail, snow and particularly rain). Scintillation appears as rapid fluctuations of signal amplitude or phase caused by tropospheric turbulence in clear sky conditions or by precipitation. Depolarization is due to non-symmetrical particles such as raindrops, snowflakes, and especially ice particles.

The statistical models have been validated up to Ka band (20/30 GHz) in temperate areas, in particular with the OPEX (OLYMPUS Propagation Experiment) campaign. Currently, the ITALSAT propagation experiment studies the validity of these models in the EHF band (40/50 GHz) in European countries. The ACTS campaign was concerned with the Ka-band (20/29 GHz) in the U.S.A.