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SAT-COMM – Fade Inteferance and Band Mitigation Analysis

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Abstract

When it comes to address the capacity issue in satellite communication, the first technique to consider is the multi-beam coverage, with a high number of beams that allow a high degree of frequency reuse. In order to increase even more that capacity, the second step is to utilize higher frequency bands such as Ka (20-30 GHz), Q/V (40-50 GHz) or EHF (20-45 GHz) bands, where respectively, 1 GHz, 3 GHz and 2 GHz are allocated to the Fixed Satellite Service (FSS). The first c ommercial satellites with Ka-band transponders are today in operation, and it is expected that the congestion in lower fre quency bands like Ku-band will push new systems into moving progressively to Ka band and, in a longer term, to Q/V b and. Depending on the type of mission, Ka-Q/V band satellite could be envisaged as, for example, for two way broadba nd access services characterised by a high asymmetrical traffic, using part of the Ka-band for user access while data dist ribution service could take most advantage of wider bandwidth in Q/V band. Although Ka and Q/V bands are attractive from the point of view of the amount of frequency bandwidth that the satellit e can potentially use, some important limitation could moderate the enthusiasm of using them if specific techniques wer e not implemented in the satellite system to guarantee the capacity, the availability and the quality of service. The major limitation is the effect of radio-wave propagation through the lowest layers of the atmosphere. As the operating frequenc y is increased, the attenuation and scintillation effects of atmospheric gas, clouds and rain become more severe, the direc t consequence is the need to implement high system static margins, in order to insure a minimum outage duration of the service, for a given objective of link availability. However, technology limitation (on both terrestrial and space segments) combined with cost efficiency requirements refrain from considering fixed static margins as the only mean to compens ate propagation impairments at high frequency bands, and push towards the implementation of Fade Mitigation Techniq ues (FMT). The aim of this paper is to present the main issues in designing FMTs for Ka-Q/V band satellite communica tion systems. First of all, the conventional design of the physical layer of a satcom system is outlined. Afterwards, a revi ew of FMT concepts and related interference issues are presented followed by the examination of the impact on upper la yer. Finally, the main aspects of FMT design are investigated before proposing some recommendations. IFMT practical implementation (detection scheme and estimation techniques, consequences on signalling and impact on synchronisatio n) will not be dealt with in this paper as it is the object of [3].

Keyword: SAT-COMM, Fade Inteferance, Band Mitigation