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ACM ALGORITHMS WITH PERFORMANCE OPTIMIZATION FOR Q/V BAND SATELLITE LINKS

Abstract

The information society of the 21st century always requires more performing communication links characterized by high stability and elevated throughput. This infrastructure is a complex network in which both ground- and space-based components are coexistent and interconnected; space nodes, in particular, are deemed necessary, especially to cover those remote areas where the classical terrestrial options are commercially unsustainable. In this scenario, the use of extremely high-frequency (EHF) bands, which are still not congested, is becoming a common goal. Unfortunately, severe limitations exist, starting from the strong propagation impairments that significantly affect these frequencies. As a consequence, research must be carried out to mitigate the existing limiting factors, thus increasing the economical appeal of EHF bands for future applications in the commercial satellite communication market. In this framework, this paper will summarize the most recent results obtained within the Q/V-band “Aldo Paraboni” payload experimental campaign; it will focus on the optimization of the adaptive coding and modulation (ACM) techniques, introducing innovative hysteresis-based algorithms together with the necessary evaluation metrics to quantify the results achieved during an intensive experimental campaign on real communication data. In particular, after defining the proper modulation and coding (MODCOD) schemes thanks to the experimental determination of the Frame Error Rate vs Signal to Noise Ratio curves, a 17 MODCOD ACM “state-machine” hysteresis-based algorithm will be introduced and tested on real SNR time series, demonstrating how the ACM performance can be improved adopting this innovative approach. An optimization problem based on two metrics (communication failure probability and average spectral efficiency) will be solved, guaranteeing in almost 80% of the analyzed test cases a failure probability reduction bigger than 30%, with a limited efficiency decrement of approximately 10% associated to a major drop in the MODCOD switching rate (approximately 30%). Finally, a simplified version of the hysteresis algorithm, based on a lower number of MODCODs, will be introduced, and the results of preliminary tests carried out under extremely degraded channel conditions will be presented demonstrating the achievable advantages.