SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

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ADAPTIVE CODING MODULATION FOR EARTH OBSERVATION SATELLITES IN LEO ORBIT

Abstract

Future Earth Observation missions on LEO orbit are targeting the migration towards the K-Band (25.5 – 27 GHz), to cope with the demand of high data rate downlink, as driven by the payload instrument increasing performance. For the sizing of a K-Band downlink system, a special care shall be paid to the dynamic of the atmospheric attenuation, being the total attenuation exceeded during rain events several dBs larger than attenuation during favourable atmospheric conditions. On the basis of the recent CCSDS 131.2-B-1 standard, communication system engineers are now focusing on adaptive systems based on Variable Coding Modulation (VCM), with the objective of optimizing the on-board resources by adapting throughout the whole satellite pass, the spectral efficiency of the transmission. The sequence of coding schemes is programmed before the satellite pass in accordance to atmospheric propagation statistics. Compared to Constant Coding Modulation (CCM), VCM already demonstrated the improvement of downlink data rate of Earth Observation satellite in LEO orbit. Recent studies on atmospheric attenuation models have also shown that a system sized to achieve to high link availability (e.g. 99.5This assessment made attractive the implementation of Adaptive Coding Modulation (ACM) systems, based on real-time adaptation of modulation coding schemes in accordance to actual link budget conditions. In the frame of the ESA study "Definition and End to End system analysis for the use of ACM techniques in the 26 GHz data downlink in future EO mission", the system architecture enabling ACM technique and SW necessary to its implementation are being studied. This article will provide a comprehensive comparison of achievable performance using both VCM and ACM. In particular, the advantages of flexibility of an ACM system will be shown: compared with VCM, system performance can be boosted or, alternatively, same performance can be achieved reducing key resources (i.e. EIRP, Ground Station antenna size or bandwidth).