Tutorial A1: DVB-S2/RCS: Propagation and physical Layer
Part 1: Fade mitigation techniques matched to the dynamic behaviour of the propagation channel for Ka-Q/V band DVB-S2/RCS systems

Dr. Laurent Castanet - Prof. Michel Bousquet
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The mid to long-term perspectives for geostationary satellites are challenged by their capability to remain competitive, in terms of capacity versus cost and supported services, with regards to the evolution of existing terrestrial technology and the emergence of new ones. For the satellite to keep playing a major role, it should offer wide capacity, good availability, high flexibility, and guarantee the required quality of service in a cost efficient way. In order to increase system capacity, high frequency bands such as Ka (20-30 GHz) or Q/V (40-50 GHz) bands have been allocated. However, the major limitation of these bands is the influence of propagation through the atmosphere. As the operating frequency is increased, gas, clouds and rain attenuation as well as scintillation become more severe. On the other hand, technology limitations prevent the use of large static margins and push towards the implementation of Fade Mitigation Techniques (FMT). Among those techniques, adaptive modulation/coding are of high interest as they allow the performance of individual links to be optimised, and the transmission characteristics to be adapted to the propagation channel conditions and to the service requirements of the given link.

The aim of this tutorial is to demonstrate the advantages of FMT and in particular of Adaptive Coding and Modulation as defined in DVB-S2/DVB-RCS standard when considered in a distributed access satellite broadband system using Ka-band for user links and Q/V band for feeder links. The influence of the propagation channel is introduced first to present advanced models of the dynamics of the propagation channel. Then, a methodology to assess system performance with and without FMTs is outlined and applied to the considered system to select the best combination of FMTs to comply system requirements expressed in terms of availability, coverage area and capacity. Finally, implementation issues are addressed, in terms of detection and decision scheme, estimation techniques and control loop optimisation thanks to the introduction of propagation fade events.

Contents:
- Review of propagation impairments
- Advanced propagation models
- Basics of Fade Mitigation Techniques (FMT)
- FMT control loop architecture
- FMT implementation issues: estimation, prediction, activation
- Example of system and performance assessment.

CASTANET & BOUSQUET - CURRICULUM VITAE

Dr. Laurent CASTANET works as research engineer in the radiowave propagation field at ONERA Toulouse. His main research interests are Earth-Space propagation (dynamics and spatial variability of the propagation channel, development and validation of propagation models) and Fade Mitigation Techniques (design and performance simulation).

He is involved in propagation and FMT studies for satellite telecommunications systems at Ku, Ka and Q/V-bands in the framework of space industry, CNES, ESA and EU projects. He has participated to the design of the STENTOR EHF propagation payload and on the preparation of several propagation experiments (e.g., EXPRESS).

He has been a French expert in the COST 255 and COST 280 European projects. Laurent Castanet is involved in the European Network of Excellence “SatNEx”, in which he chairs the propagation joint action, He is also a French representative in ITU-R Study Group 3 which deals with radiowave propagation.

Prof Michel Bousquet is in charge of the Aerospace Electronics and Communications Programmes (graduate and post-graduate) at SUPAERO, the top-ranked French Institute of Higher Education (Grandes Ecoles) dedicated to aerospace engineering education.

Prof. Bousquet has given lectures in seminars and short-courses world-wide in the fields of satellite communications, spacecraft engineering…His research interests cover many aspects of satellite communications and navigation (physical and access layers, system engineering...) within the TeSA co-operative research laboratory. He has co-authored many publications in satellite communications, including the authoritative text book “ Satellite Communications Systems ” published by Wiley (Fourth Edition 2002).

Co-Editor-in-Chief of the Space Communications Journal, member of the Editorial Boards of several technical journals, he plays an active role in promoting R&D results from European universities and industry through active participation in Technical Committees of IEEE and AIAA international conferences.