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Advance Higher Throughput Communications for GEO and LEO satellites (3)

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BROADBAND LEO CONSTELLATION SERVICE SCHEDULING: COEXISTENCE OF GLOBAL CONNECTIVITY WITH GSO SYSTEMS

Abstract

The objective of the study is to design a satellite-to-user-terminal allocation algorithm that complies with the International Telecommunications Union (ITU) interference regulations. Nongeostationary orbit (NGSO) and geostationary orbit (GSO) satellite networks share the same spectrum resources in several frequency bands. Regulations have been introduced by the ITU for NGSO operators to minimize the interference with both GSO space and ground segments. In Ku/Ka bands, Article 22 of the ITU Radio Regulations provides equivalent power flux-density (EPFD) limits for NGSO to protect GSO. The algorithm to determine whether these limits are met is specified in Recommendation ITU-R S.1503.

We have developed a high-fidelity simulator that allows modeling the orbital motion and attitude regimes of all satellites in a constellation, configuring each satellite in terms of the antennas it is equipped with, and taking into account beam management algorithms. We can compute the combined radiation from all visible constellation satellites — both from the main or side lobes of their antenna radiation patterns — in the direction of any possible location of a geostationary system ground receiver. The simulation results indicate zones on the Earth surface where the prescribed EPFD limits are not met by the system. For such zones, exclusion angles (the off-axis angle between the boresight of the antenna of the geostationary-satellite system receive station and the direction of the transmit station considered in the non-geostationary-satellite system) are introduced. It is then shown by simulations that allocating the problematic zones to those satellites that are not within the obtained exclusion angle bounds leads to admissible epfd estimates. It is thus clear that if the requirement of global coverage is imposed on the constellation, its orbital configuration should allow for double coverage of such zones that might suffer from the additional constraint of the satellite exclusion angle due to interference mitigation measures.

The procedure we propose is not computationally intensive, easily adjustable for any configuration of satellite orbits and antenna radiation patterns. Examples are given to show how the proposed procedure is instrumental in composing a satellite-to-terminal allocation.