IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Space-based Optical and Quantum Communications (4)

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OPTICAL FEEDER-LINKS ACCESS ANALYSIS FOR NON-GEOSTATIONARY LARGE CONSTELLATIONS

Abstract

Optical satellite links (OSL) are increasingly popular, due to their undisputed advantages with respect to standard radio communications in terms of achievable bandwidth and virtually non-existent band interference issues. Several Large Constellations that are currently operating or being designed foresee the use of OSL, at the very least, for the Inter-Satellite Link segments. As for the optical Feeder-Link part, cloud blockage still poses a considerable availability limitation factor for optical Ground-to-Space Links. For this reason, multiple Optical Ground Stations (OGS) are needed to allow for site diversity, thus increasing link availability to the satellite constellation. We present a study on the coverage and access availability performance of two LEO constellation design options that use Optical (Uplink) Feeder-Links and Optical Inter-Satellite Links (OISL), while keeping an RF-based User Downlink. We then present the main results of the End-to-End (Ground-to-User) access availability, targeting Users in the European region. Furthermore, the performance increase on coverage and availability when implementing OISL in the communications architecture is discussed. The main focus is posed on the logic and implementation of a Python-based Network Optimisation Algorithm. The tool significantly improves the analysed availability results by identifying the optimal OGS network to guarantee User access availabilities above 99% with the least number of OGSs possible. User links have been modelled as a target grid across the European region. The Optimisation Algorithm is able to discriminate targets based on their priority ranking. One of the significant results was that a high-altitude low-density constellation needs significantly less OGSs than a low-altitude high-density constellation to reach an optimal User coverage and User access availability for all the most important targets. Finally, other aspects of the constellation options performances, such as latency, manufacturing, life-on-orbit and operations will be discussed as well.