SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Small Satellite Operations (3)

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THE IMPACT OF GLOBAL NETWORKS FOR SATELLITE OPERATIONS ON ACADEMIC SPACE MISSIONS

Abstract

Large-scale ground station networks like GENSO (the Global Educational Network of Satellite Operations), a project under auspices of ISEB (International Space Education Board), will strongly increase the possible mission data return from academic and other non-commercial space missions by interconnecting former stand-alone ground stations using the internet. As a consequence, such networks increase the possibility of mission success and are even required by some kinds of missions to become successful. Though the impact of public ground station networks is considered to be self-evident, their real potential has never been scientifically investigated.

Global ground station networks offer manifold prospects for optimizing current and future space missions. One important factor is the amount of payload data that can be received from a satellite. But other parameters are important as well, for example the maximum time frame for uninterrupted communication by enabling "station hand-over" for LEO satellites using interconnected ground stations. Also important is an efficient and fair distribution of communication time to both the participating missions and ground stations.

Those and several more quantities and how they are impacted by the usage of global ground station networks, especially GENSO, have been scientifically investigated and empirically evaluated. The results provide novel insights into the real potential of such networks and how they will influence the design of future missions. We also provide novel, generally applicable calculation rules for determining the maximum possible data throughput and communication timeframes for both ground stations and spacecrafts. Furthermore, the difference between uni-directional, passive satellite links and bi-directional, active satellite links is discussed and the different impacts of ground station networks are observed. Simulations also provide precise details about the optimal relation between the amount of ground stations and spacecrafts in large-scale networks. All investigations have been performed and validated using a novel framework for generic ground station network scheduling, simulation, and optimization.

In addition to general investigations on ground station network performances, the GENSO project has been evaluated regarding its scalability in respect to participating ground stations and spacecrafts. A detailed analysis of ground-bound bandwidth and data storage consumption has been performed which clearly demonstrates both the possibilities but also the restrictions of the current network architecture.