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BENEFITS OF INTERSATELLITE CONNECTIVITY FOR BACKHAUL NETWORKS BASED ON SMALL SATELLITES

Abstract

In the last decade, a fast increase in the opportunity to access space has been observed. The remarkable miniaturization and the reduction of launch costs deriving from technological improvements have allowed to drastically reduce the overall cost of space services, substantially increasing the potential of small satellites applications. Among the many applications enabled by the possibility to connect through space using small satellites, services prioritizing low latency and high reliability instead of broadband have raised particular attention. Simultaneously, a great increase in ground and space generated data volume has occurred. This brings about the necessity for higher satellite communication performance, especially in terms of total available throughput and data latency. Given all these premises, the need for the development of solutions allowing increased satellite communication capabilities is crucial in order to make the realization of large-scale satellite data relay services and backhaul/backbone networks a reality. In this paper, the opportunities offered in this regard by the implementation of LEO constellations based on small satellites is considered, with particular focus on the improvements offered by the integration of ISLs (Inter-Satellite Links) in satellite constellations dedicated to backhaul connectivity in the context of M2M and IoT related services. Networks provided with ISLs are compared with configurations that only comprise ground-to-space and space-to-ground links, statistically evaluating how the number of available network hops reduces the average time necessary to reach visibility with a ground station. This information is also correlated to a set of distribution models describing the communication demand originated on ground for IoT and M2M applications. The number and distribution of ground stations is also considered. The major performance parameters taken into account are total constellation throughput and data latency, which represent two of the most important performance indicators for a communication network. The analysis considers the ISL performances offered by LaserCube, an optical communication terminal for small satellites developed by Stellar Project. The terminal fits in 2 CubeSat units and is currently at a late stage of development (TRL 6). The Engineering Model of the terminal has been validated through laboratory tests simulating operational conditions and the Flight Model is under development for in-orbit validation.