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PLANNING MISSIONS FOR LARGE CONSTELLATIONS

Abstract

Recent growth in nanosatellites is creating an interest in development of large constellations. Because nanosatellites have less capability than larger classes of spacecraft the motivation is to take advantage of the lower costs for individual satellites to allow a larger volume in the constellation. Larger volumes of satellites compensate for lower fidelity of sensors due to more frequent overpasses, better temporal information, and more opportunities to gather data.

Nanosatellites are typically flown without active propulsion or deorbit mechanism so are limited to Low Earth Orbit altitudes. Lower altitudes equate to shorter overpass times and larger numbers of satellites are required to minimize overpass gaps. Their small size also equates to reduced power budgets which in turn creates challenges in link budgets and data rates.

This paper discusses development of the operational plan for the Fleet Space mission, a 100- nanosatellites constellation designed to service the Internet of Things (IoT). Each satellite is a 12-U Communications payload intended to service low bandwidth subscribers in remote locations, or in populated areas needing 3G/4G gap filler.

A range of feasible orbits were investigated to solve Fleet Space requirements. Constellation size, orbital planes, altitude, and inclination are critical drivers. The Saber Astronautics Predictive Groundstation Project (PIGI) was used in conjunction with MATLAB to produce full overpass and gap analysis, and quality of service. After 300 simulations, an optimal mission was found which takes into account the complex combination of satellite design, orbital parameters, and available sensors.