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COMMERCIAL SATELLITE-DERIVED SPACECRAFT BUS FOR BEYOND EARTH ORBIT EXPLORATION

Abstract

Geosynchronous Earth Orbit (GEO) satellites have revolutionized global communications since the Syncom 3 launch in 1964. As a result, a multi-billion dollar industry has emerged with a field of providers engaged in fierce competition for each sale. Industry continually invests in technologies that provide more capability in terms of lifetime, reliability, performance, and lower costs. They are designed to operate in harsh environments (radiation, thermal, electromagnetic interference (EMI)) for well over 15 years. Current generation GEO satellites incorporate the latest developments in materials, avionics, propulsion, power generation and management, and communications. They also utilize modern production and test equipment, facilities, and processes as well as a robust supply chain that provides economy of scale benefits for components. These factors combine to significantly reduce the cost and production time of each satellite as compared to unique "one off" designs. GEO communications satellites are many times bought in "block" buys to further reduce the per unit cost and provide operators frequent opportunities to refresh their platforms with the latest developments in communications technology to improve bandwidth and coverage.

The same characteristics that define state of the art GEO communications satellites are directly applicable to future Exploration missions. In fact, these platforms provide an ideal point of departure for derivatives that can execute a wide range of deep space missions beyond geosynchronous orbit. Our analysis will examine how a typical GEO satellite would need to be modified to perform these missions including NASA's proposed Deep Space Gateway (DSG) and Mars exploration. We will develop a candidate set of requirements and objectives for several deep space mission applications. We will assess product line satellite subsystem performance in these new environments/mission roles including margins. Key performance parameters such as power, propulsion (Delta Velocity), mass properties, trajectory, and attitude control will be assessed in detail. Subsystem trade studies will be performed to identify and evaluate potential changes required to meet specific mission requirements. We will also assess the effect on Exploration mission/program cost by quantifying cost deltas for these changes as compared to the typical cost of a GEO communications satellite.