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Solar Power Satellite (1)

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SOLAR SPACE - THE IN-ORBIT POWER SUPPLIER

Abstract

The recent development of reusable rockets and the rise of private launch providers, such as *SpaceX* and *Blue Origin*, has made access to space more affordable than ever. This critical shift has opened the way for innovative new space companies, mostly funded by private investors such as venture capital, radically changing the space industrial landscape and boosting the investments in the sector: in 2018, *Morgan Stanley* estimated that in the next two decades the commercial space market currently valued at $400 billion is set to triple. Among these emerging space actors, mega-constellation manufacturers are attracting a major part of the attention, and investments. Of these, at least 15 companies are planning on creating LEO and MEO constellations ranging from 10 to more than 4,000 satellites, to provide broadband services. As a consequence, the number of operational satellites in orbit could increase by as much as 15,000 or more than sevenfold in the next decade.

With this new era comes a new set of challenges. Energy is one of the most crucial. Indeed for each one of these thousands of new satellites, energy supply and management is the main limiting factor in terms of design, performance and lifespan. By externalizing the energy supply, the size and weight of the batteries and solar panels could be lowered, substantially reducing design constraints and costs, while allowing the consideration of new kinds of optimized and more performant payloads (communication or observation) and platforms (plasmic propulsion). To some extent, this idea consists in adapting the concept of in-flight refueling largely used for military aircraft to space applications.

Solar Space intends to tackle this issue by developing a constellation of solar station satellites in a 90 θ solar angle sun-synchronous orbit, with large surface solar panels in constant sun illumination, remotely providing energy to LEO / GEO satellites via laser-based power transmission. This transmission is the most innovative / critical aspect of the system. Therefore, this paper aims to investigate eligible optical systems focused on an Inter-Satellite Link and wireless powering technologies. In addition, a trade-off analysis of the power transmission efficiency offered by the two main power laser transfer solutions will be considered: amplified low power laser (while also considering amplifier efficiency) and high power laser (such as YAG). Thus, based on previous research and methodical analysis, this paper will give a preliminary assessment of the feasibility of the *Solar Space* proposed architecture.