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AN ORBITAL SYSTEM FOR POWER PRODUCTION AND DISTRIBUTION FOR LEO/MEO SATELLITES

Abstract

Space-Based Solar Power (SBSP) is an innovative solution for providing power to satellites in orbit. The concept involves positioning one or several high-powered photovoltaic solar stations on a highly and if possible continuously sunlit orbit and transmitting the harvested energy via narrow radio power beams to LEO or MEO satellites, around the clock. These client satellites equipped with rectennas will convert the RF power of the beams into electricity for their own energy supply, eliminating the need to be equipped with solar panels for daytime operation and batteries during eclipse. This paper will develop a Thales Alenia Space-France internal project aiming at designing an Orbital System for Power Production and Distribution for satellites. After defining and selecting use cases, we tackle the intricate problem of selecting the orbits for the solar power stations that meet the often contradictory criteria of continuous sun exposure and visibility of client satellites. The selection for the working frequency of the wireless power transfer system naturally tended towards ultra-high frequency (¿ 100GHz) in order to have narrow beams and so to minimize the sizes of antennas and rectennas. Preliminary and schematic designs of solar stations are proposed as well as the performance and efficiency of the WPT. The study is complemented by a preliminary economic analysis to estimate the added value of such a system. This paper promises ground-breaking insight into the evolving field of SBSP. The exploration of this technology could revolutionize power supply methods for satellites and significantly improve energy management in space.