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Author: Mr. Gary Barnhard
XISP-Inc, United States

Dr. Seth Potter
XISP-Inc, United States

CHALLENGES OF SPACE POWER BEAMING: FORGING PRODUCTION SERVICES FROM THE TECHNOLOGY DEVELOPMENT TRADE SPACE

Abstract

This paper and presentation is intended to address the challenges of power beaming from the perspective of a focused incremental Technology Development, Demonstration, and Deployment (TD**3) mission for Space-to-Space Power Beaming (SSPB) to be implemented as a commercial International Space Station (ISS) TD3 mission. The SSPB mission builds on foundational research in the field and mission development work accomplished to date by XISP-Inc.

The SSPB mission is intended to help mitigate cost, schedule, and technical risk associated with the short-, mid-, and long-term application of space power and ancillary services (e.g., data, communications, navigation, time, etc.) beaming technology. This mission involves significant technology development, demonstration, and deployment elements, orchestrated and implemented in a manner that delivers significant value to a number of customers coorbiting with the ISS, and will serve as a testbed environment for more expansive SSPB TD**3 efforts.

The latest estimated deliverable power-density and power-received values based on the collection efficiency calculations (which have been correlated to ground tests by other researchers) provide a compelling comparison between estimated delivered power density and the Solar Constant for the orbital distance of immediate interest. The calculated values clearly show that the low end of the Ka band (i.e., 26.5 GHz shown), with a delivered power density an order of magnitude less than the Solar Constant, is very benign. The high end of the Ka band (i.e., 36 GHz shown) can actually meet some customer requirements, though at best at a small multiple of the Solar Constant. However, the W band (i.e., 95 GHz) can provide a power density an order of magnitude or higher than the Solar Constant.

The challenge in all instances is engineering systems with an end-to-end efficiency which is satisfactory and sufficient for the application. The ability to provide power when and where needed is essential to virtually all aspects of human endeavor, and is enabling for any form of space development/settlement. Space solar power technology holds the promise of being one of the few large-scale energy generation options that can scale to meet the growing electrical energy demand in space.

This mission is a unique opportunity to foster the development of SSPB by leveraging ground based piecewise testing and ISS resources to create an integrated SSPB testbed environment on and near the ISS that supports the development of frequency-agnostic-radiant-energy beaming technology.