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TELECOMMUNICATION DESIGN AND ANALYSIS FOR THE EUROPA LANDER MISSION

Abstract

Europa Lander is a proposed mission to look for evidence of biosignatures that could have geysered up from the liquid ocean below to the near surface ice layer. This mission concept has been studied at the Jet Propulsion Laboratory (with partnerships from Applied Physics Laboratory, Marshall Space Flight Center, and Sandia National Laboratories) for many years and it has evolved across different design configurations. The current mission concept has eliminated relay telecommunication support in favor of a lower cost and lower mass direct-to-Earth only communication subsystem. The current design includes: a new technology, all metal, high gain antenna conceived specifically for this mission; a Frontier Radio to communicate directly with Earth but also with Europa Clipper; and traveling wave tubes amplifiers (TWTA) instead of solid state power amplifiers (SSPA) to provide the power required to close the link at a distance of 5 AU. In addition to the development of the components, new analyses were performed to quantify the performance of the telecommunication system across multiple configurations. Specifically, we optimized data rate, encoding scheme, and link margin for the following mission scenarios: direct to Earth communication versus relay to Clipper communication; high gain antenna link versus low gain antenna link; sensitivity of the low gain antenna for different off-boresight angles; and use of different Deep Space Network configurations (34 m antennas, 70 m antennas, array of antennas). This paper presents an overview of the direct-to-earth telecommunication design, a description of the main components focusing on the new high gain antenna and on the radio, and the results of all the telecommunication analysis to characterize system performances during Deorbit, Descent and Landing (DDL) and during surface operations. Descriptions of the remaining challenges and of the work ahead for the telecommunication system are also presented.