Near Earth Architectural Options for a Future Deep Space Optical Communications Network

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In the near future the National Aeronautics and Space Administration anticipates a significant increase in demand for long-haul communications services from deep space to Earth. Distances will range from 0.1 to 40 AU, with data rate requirements in the 1's to 1000's of Mbits/second. The near term demand is driven by NASA's Space Science Enterprise which wishes to deploy more capable instruments onboard spacecraft and increase the number of deep space missions. The long term demand is driven by missions with extreme communications challenges such as very high data rates from the outer planets, supporting sub-surface exploration, or supporting NASA's Human Exploration and Development of Space Enterprise beyond Earth orbit. Laser communications is a revolutionary communications technology that will dramatically increase NASA's ability to transmit information across the solar system. Lasercom sends information using beams of light and optical elements, such as telescopes and optical amplifiers, rather than RF signals, amplifiers, and antennas.

This paper provides an overview of different network options at Earth to meet NASA's deep space lasercom requirements. It is based mainly on work done for the Mars Laser Communications Demonstration Project, a joint project between NASA's Goddard Space Flight Center (GSFC), the Jet Propulsion Laboratory, California Institute of Technology (JPL), and the Massachusetts Institute of Technology Lincoln Laboratory (MIT/LL). It reports preliminary conclusions from the Mars Lasercom Study conducted at MIT/LL and on additional work done for the Tracking and Data Relay Satellite System Continuation Study at GSFC. A lasercom flight terminal will be flown on the Mars Telesat Orbiter (MTO) to be launched by NASA in 2009, and will be the first high rate deep space demonstration of this revolutionary technology.