Paper Title: Long-Range Planning for the Deep Space Network

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Abstract

Since its inception in 1963, NASA's Deep Space Network (DSN) has been developing, implementing, and operating state-of-the-art communication and navigation services for use by a variety of U.S. and international-cooperative space science missions. To ensure that these services evolve to meet future mission needs, the DSN's long-range planners regularly monitor NASA strategic directions, track and analyze future mission trends, study options for addressing such directions and trends, and, with guidance from NASA Headquarters, develop long-range plans for realizing the preferred options.

Recently, NASA, in its *2003 Strategic Plan*, published a new vision and mission focused on the pursuit of the "compelling questions that drive exploration." Namely, "how did we get here?" "Where are we going?" And, "Are we alone?" NASA also identified and resolved to surmount four technological barriers to pursuing these questions. One of the barriers was communications – more specifically, "providing efficient data transfer across the solar system."

Consistent with this new strategic emphasis on communications, mission trend analyses by the DSN's long-range planners have revealed significant capacity and capability challenges looming in the network's future. Changes to the fundamental mission paradigm are occurring that are leading to more spacecraft supports, greater mission operations complexity, greater reliance on coordinated operations between separate spacecraft elements within a mission or between missions, order-of-magnitude or more increases in downlink data volumes and associated data rates over the next 10 years, and, similar magnitude increases in required uplink data volumes and associated data rates over the next 20 years.

To accommodate these trends and address the communications barrier identified in NASA's *2003 Strategic Plan*, the DSN's long-range planners have identified a number of strategic focus areas for further study, development, and/or possible implementation. Examples of such areas include increasing the reliability and availability of the current DSN, improving RF flight components, exploring the use of large arrays of small antennas, developing and demonstrating optical communications, developing techniques for networking *in situ* exploration elements, advancing navigation tools and techniques to make maximum use of these other capabilities, and developing the standards and protocols, tools, and techniques needed to make all of these areas reliably play together in the end-to-end provision of cost-effective multi-mission services.

To guide and unify the efforts in these strategic focus areas, DSN personnel are working with NASA Headquarters to develop a shared vision, architecture, and associated long-range plan for the DSN of the future -- a plan for a truly Interplanetary Network.