IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Extra-Terrestrial and Interplanetary Communications, and Regulations (5)

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ADDRESSING THE CHALLENGES OF FUTURE DEEP SPACE COMMUNICATIONS AND NAVIGATION SERVICES

Abstract

Ground networks currently operated by space agencies for deep space mission services include NASA's Deep Space Network (DSN) and ESA's ESTRACK, as well as antennas built and operated by other space agencies. These networks face current-day and future growing challenges for providing the deep space service capacity and performance that deep space missions require. The capacity challenge reflects the fact that both the DSN and ESTRACK networks have significant increasing demand which is likely to be unmet by the current deep space capacity of these networks. The performance challenge reflects growing requirements for higher data rates and data volumes of current and future deep space missions; this performance challenge may be related to the capacity challenge, as increasing performance requirements can lead to growing capacity requirements. In addition, as the number of crewed missions to the Moon and eventually to Mars grows, it is expected that coverage and performance requirements for those missions will increase. This presentation quantifies these challenges for both robotic and crewed missions and explores a number of mitigations or potential solutions to address them. These may include: expansion of the networks to include additional ground systems provided either by space agencies or by the private sector; implementing improvements in the deployed systems in order to increase network capacity; changing the architecture for both ground-based and space-based elements for deep space missions; and implementation of new technologies or capabilities. The presentation covers use of these deep space ground networks for lunar, Lagrange point, interplanetary, and other deep space missions and the unique challenges that are faced in each of these regimes. The presentation will include network loading, the Mars Relay Network, deep space optical communication, and results from recent field tests that could serve as a pathfinder for future commercial deep space services.