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CALIBRATION AND PERFORMANCE MEASUREMENTS FOR THE NASA DEEP SPACE
NETWORK APERTURE ENHANCEMENT PROJECT (DAEP)

Abstract

The NASA Deep Space Network (DSN) has recently constructed two new 34-meter antennas at the Canberra Deep Space Communications Complex (CDSCC). These new antennas are part of the larger DAEP project to add six new antennas to the DSN, including two in Madrid, three in Canberra and one in Goldstone (California). The DAEP project included development and implementation of several new technologies for the S, X, Ka (26 GHz) and Ka (32 GHz) -band uplink and downlink electronics, as previously reported. The electronics upgrades were driven by several different considerations, including parts obsolescence, cost reduction, improved reliability and maintainability, and capability to meet future performance requirements. The new antennas are required to support TTC links for all of the NASA deep-space spacecraft, as well as for several international partners. Some of these missions, such as Voyager 1 and 2, have very limited link budgets, which results in demanding requirements for system G/T performance. These antennas are also required to support radio science missions with several spacecraft, which dictate some demanding requirements for spectral purity, amplitude stability and phase stability for both the uplink and downlink electronics. After completion of these upgrades, a comprehensive campaign of tests and measurements took place to characterize the electronics and calibrate the antennas. - Radiometric measurement techniques were applied to characterize, calibrate, and optimize the performance of the antenna parameters. These included optical and RF high-resolution holographic and total power radiometry techniques. These techniques, which are described in the article, resulted in the highest antenna aperture efficiency in the DSN, of 66% The first antenna (DSS-35) was entered into operations in October, 2014 and the 2nd antenna (DSS-36) in October 2016. This paper describes the measurement techniques and results of the testing and calibration for both antennas, along with the driving requirements.