

# Status of the Direct Data Distribution (D<sup>3</sup>) Experiment

NASA Glenn Research Center's Direct Data Distribution (D<sup>3</sup>) project will demonstrate an advanced, high-performance communications system that transmits information from an advanced technology payload carried by a NASA spacecraft in low Earth orbit (LEO) to a small receiving terminal on Earth. The space-based communications package will utilize a solid-state, K-band phased-array antenna that electronically steers the radiated energy beam toward a low-cost, tracking ground terminal, thereby providing agile, vibration-free, electronic steering at reduced size and weight with increased reliability. The array-based link will also demonstrate new digital processing technology that will allow the transmission of substantially increased amounts of latency-tolerant data collected from the LEO spacecraft directly to NASA field centers, principal investigators, or into the commercial terres-trial communications network. The technologies demonstrated by D<sup>3</sup> will facilitate NASA's transition from using Government-owned communication assets to using commercial communication services.

The hardware for D<sup>3</sup> will incorporate advanced technology components developed under the High Rate Data Delivery (HRDD) Thrust Area of NASA's Office of Aerospace Technology Space Base Program at Glenn's Communications Technology Division. The flight segment components will include the electrically steerable phased-array antenna, which is being built by the Raytheon System Corporation and utilizes monolithic microwave integrated circuit (MMIC) technology operating at 19.05 GHz; and the digital encoder/modulator chipset, which uses four-channel orthogonal frequency division multiplexing (OFDM). The encoder/modulator will use a chipset developed by SICOM, Inc., which is both bandwidth and power efficient. The ground segment components will include a low-cost, open-loop tracking ground terminal incorporating a cryoreceiver to minimize terminal size without compromising receiver capability. The project is planning to hold a critical design review in the second quarter of fiscal year 2002.



*Flight mockup of the Direct Data Distribution (D<sup>3</sup>) experiment in a GSFC Hitchhiker-G Canister.*

D<sup>3</sup> is a work area under the Advanced Communications campaign within the Space Operations Technology Project of NASA Johnson Space Center's Space Operations Management Office.

In fiscal year 2000, the D<sup>3</sup> team, composed of both civil servants and ZIN Technology contractor personnel, completed several major activities. The prototype version of the OFDM modulator board was completed and is currently being tested by Communications Technology Division personnel. The thermal and structural designs of the flight payload were completed based on the NASA Goddard Space Flight Center Hitchhiker-G carrier. A flight mockup, shown in the figure, was fabricated and assembled to aid in the internal layout of the D<sup>3</sup> avionics. The team successfully completed the optical proof-of-concept testing of various LEO spacecraft. This test focused on open-loop tracking of LEO spacecraft based on position information derived from simple two-line orbital element sets downloaded from the Internet. An inexpensive optical tracking pedestal was procured for the test, and various LEO spacecraft (including the shuttles and the International Space Station) were successfully tracked during their overhead passes from locations in northeast Ohio.

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