

## ABSTRACT

## The Mars Observer-DSN Ka-Band Link Experiment

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After a decade of planning and anticipation the era of Ka-band (32-35 GHz) communications with deep space probes was ushered in on January 8, 1993. On that day, a 0.025 watt Ka-band beacon from Mars Observer, then at a distance of 50 million km, was acquired and tracked by "NASA's Deep Space Network (DSN) Research and Development station at Goldstone, California. On January 17, 1993 telemetry at 250 bits/second was received. That is the first time that telemetry was received from a deep space probe using a Ka-band link. Subsequently, the spacecraft-to-Earth distance was measured using round-trip time-of-flight ranging. The Ka-band beacon was successfully tracked until the spacecraft fell silent, prematurely, on August 21, 1993. Performance was consistent with flight-ground system capabilities and atmospheric propagation effects, thereby raising our confidence in the benefits of Ka-band for deep space missions.

This paper describes the planning and implementation for the Ka-band Link Experiment (KABLE), including the use of advanced technology.

The low-cost beacon is the fourth harmonic (33.7GHz) of a sample of the 20 watt operational 8.4 GHz X-band down link on the spacecraft and is launched from the 28 cm subreflector on the 1.5 m high gain X-band antenna. The ground station features a new 34-meter beam wave guide antenna and uses a low-loss dichroic mirror to allow simultaneous tracking of both the Ka-band and the X-band signals. The extremely weak Ka-band signal was received through a liquid helium cooled feed and cavity maser amplifier to minimize noise. Acquisition and tracking was accomplished by a digital receiver aided by a programmable local oscillator to remove doppler broadening.