

Lessons Learned During Implementation and Early Operations of the DS1 Beacon Monitor Experiment

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ABSTRACT

A new approach to mission operations will be flight validated on NASA's New Millennium Program Deep Space One (DS1) mission which launched in October 1998. The beacon monitor operations technology is aimed at decreasing the total volume of downlinked engineering telemetry by reducing the frequency of downlink and the volume of data received per pass. Cost savings are achieved by reducing the amount of routine telemetry processing and analysis performed by ground staff. The technology is required for upcoming NASA missions to Pluto and Europa. With beacon monitoring, the spacecraft will assess its own health and will transmit one of four sub-carrier frequency tones to inform the ground how urgent it is to track the spacecraft for telemetry. If all conditions are nominal, the tone provides periodic assurance to ground personnel that the mission is proceeding as planned without having to receive and analyze downlinked telemetry. If there is a problem, the tone will indicate that tracking is required and the resulting telemetry will contain a concise summary of what has occurred since the last telemetry pass. The primary components of the technology are a tone messaging system, AI-based software for onboard engineering data summarization, a ground visualization system for telemetry summaries, and a ground response system. This paper will include a brief description of the Beacon monitor concept, the trade-offs with adapting that concept as a technology experiment, the current state of the resulting implementation on DS1, and our lessons learned during the initial checkout phase of the mission. Applicability to future missions will also be included.