

Flight Software Implementation of the Beacon Operations Experiment on the NASA New Millennium Deep Space 1 (DS-1) Mission

The New Millennium Program (NMP) involves a series of advanced technology validation missions defined and implemented as an integrated program for NASA by the Jet Propulsion Laboratory. Deep Space One is the first NMP deep-space mission. The main objective of the DS-1 mission is to space validate a suite of advanced technologies -- the payload for these missions -- that hold promise for enabling desired 21st-century space science missions for low life-cycle mission cost. DS-1 will be the first spacecraft with ion propulsion as its primary propulsion system, which poses new mission design and implementation challenges, addressed prior to this time only by conceptual mission and system studies. After systematically working through a large set of candidate mission profiles for DS-1 from 1994 July through 1995 September, the NMP arrived at a baseline profile involving a near-Earth asteroid flyby and comet flyby.

A new technology that will lower the cost of mission operations on future spacecraft will be tested on the DS-1 Mission. This technology, the Beacon Monitor Experiment, can be used to reduce the Deep Space Network (DSN) tracking time and its associated costs on future missions. The DS-1 spacecraft includes an autonomous planning and scheduling capability that requires very few ground uplink contacts to operate. The beacon experiment works in conjunction with the DS-1 autonomous capabilities to reduce the amount of required downlink. With beacon monitor operations, overall spacecraft health is translated into one of four states. Each of these states is represented by a tone which indicates how urgent it is to track the spacecraft for telemetry. These tones will provide assurances to the ground team that the spacecraft is functioning as expected.

In order for beacon monitor operations to be viable, it is necessary to provide ground operators with concise summaries of onboard events since the last contact. The DS-1 technology experiment will consist of several approaches to summarization including a capability to produce value-added derived information from telemetry channels. The derived information is used to output an overall spacecraft health summary, a summary of spacecraft anomalies (or episodes) and user-defined summary packets. The data in the anomaly summary packets are related to the current mission activities (i.e. maneuvers, instrument operations, telecommunication modes.) The episodes and their related data are either pre-defined in a table or defined using envelope functions for more precise selection of the episode data.

This paper will describe the implementation approach of the beacon monitor experiment on the DS-1 spacecraft. The discussion will include a short 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 DS-1, and a description of the validation objectives for the experiment.