Beacon Monitor Operations on the Deep Space One Mission

E. J. Wyatt, R. L. Sherwood, M, K. Sue

Jet Propulsion Laboratory
California Institute of Technology

4800 Oak Grove Drive
Mail Stop 301-160
Pasadena, CA911 09-8099
818-354-1414 Voice
818-393-6004 FAX
e.j.wyatt@jpl.nasa.gov

A new approach to mission operations will be flight validated on NASA's New Millennium Program Deep Space One mission scheduled to launch in July of 1998. The beacon monitor technology is an operational concept for reducing deep space mission operations cost and decreasing the loading on ground antennas. 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. When an event occurs requiring ground intervention, the spacecraft will downlink telemetry summaries to quickly provide the necessary context information to ground operators.

Several key components are being developed to implement the technology. The Small Deep Space Transponder has been built to transmit beacon tone signals. A 26m Deep Space Network (DSN) antenna has been assigned to support DS- 1 beacon monitor operations and to evaluate how to best support adaptively tracked missions in the future. Flight software for tone selection and adaptive onboard data summarization is being readied for integration into the DS- 1 flight system. Ground software for visualizing

summary data is being developed to provide operators with a means for quickly assessing spacecraft health. Also under development at JPL are an automated ground station for handling tone messages and a method for dynamically scheduling DSN antennas based on demand rather than pre-negotiated agreements.

Operations team size is directly related to the amount of downlinked engineering data. Operations cost is reduced by reducing the frequency of tracking and the amount of telemetry downlinked at times when tracking is required, Loading on ground antennas is reduced by decreasing the frequency of tracking and by scheduling antenna networks dynamically based on demand. Since DSN antennas are already oversubscribed, methods for conserving antenna resources are especially important if NASA's new vision "darkening the skies" with small autonomous spacecraft is to be realized.

This paper will describe the operational concept, key hardware/software components, the flight validation appoach and the DS- 1 development status. Insights into how the technology can be applied to DS- 1 extended mission and future mission operations will also be provided.