Appears in Proceedings of the 1997 IEEE Aerospace Conference, Aspen, CO, February 1997.

Resource Scheduling for a Network of Communications Antennas

S. Chien, R. Lam, and Quoc Vu*
Jet Propulsion Laboratory, California Institute of Technology
4800 Oak Grove Drive, M/S 525-3660
Pasadena, CA 91109-8099
{steve.chien, raymond.lam, quoc.vu}@jpl.nasa.gov

Abstract—This paper describes the Demand Access Network Scheduler (DANS) system for automatically scheduling and rescheduling resources for a network of communications antennas. DANS accepts a baseline schedule and supports rescheduling of antenna and subsystem resources to satisfy tracking goals in the event of: changing track requests, equipment outages, and inclement weather.

TABLE OF CONTENTS

1. INTRODUCTION

The Deep Space Network (DSN) [2] was established in 1958 and since then it has evolved into the largest and most sensitive scientific telecommunications and radio navigation network in the world. The purpose of the DSN is to support unpiloted interplanetary spacecraft missions and support radio and radar astronomy observations in the exploration of the solar system and the universe. There are three deep space communications complexes, located in Canberra, Australia, Madrid, Spain, and Goldstone, California. Each DSN complex operates four deep space stations -- one 70-meter antenna, two 34-meter antennas, and one 26-meter antenna. The functions of the DSN are to receive telemetry signals from spacecraft, transmit commands that control the spacecraft operating modes, generate the radio navigation data used to locate and guide the spacecraft to its destination, and acquire flight radio science, radio and radar astronomy, very long baseline interferometry, and geodynamics measurements.

From its inception the DSN has been driven by the need to create increasingly more sensitive telecommunications devices and better techniques for navigation. The operation of the DSN communications complexes require a high level of manual interaction with the devices in the communications link with the spacecraft. In more recent times NASA has added some new drivers to the development of the DSN: (1) reduce the cost of operating the DSN, (2) improve the operability, reliability, and maintainability of the DSN, and (3) prepare for a new era of space exploration with the New Millennium program: support small, intelligent spacecraft requiring very few mission operations personnel.

This paper describes the DANS system for rescheduling and resource allocation for antenna and subsystem resources in the DSN. DANS works from an initial schedule and uses prioritized pre-emption and localized search to find antenna and other equipment resources required to support changes to schedule requirements which may be caused by a wide range of circumstances including: changing track requirements from the flight projects, equipment outages, and inclement weather.

* This work was performed by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.