Voyager Mission Support

N. Fanelli and H. Nance
Deep Space Network Operations Section

This is a continuation of the Deep Space Network report on Tracking and Data Acquisition for Project Voyager. This article covers the period for February through April 1980.

I. Introduction

Both Voyager 1 and 2 have continued on the Jupiter-Saturn cruise phase of the mission. In addition to the normal cruise activities, Voyager 1 has performed some preliminary maneuver and imaging activities in preparation for the Saturn encounter.

II. DSN Support

The engineering and science activities continued with both Voyager spacecraft on the predetermined requirement sequence. Some representative tests and the number of times each was supported by the DSSs during the reporting period are given in Table 1.

In addition to the routine test/calibration activities, some special events were participated in by the stations.

(1) On 20 and 21 February, a cruise science maneuver was performed by Voyager 1. The maneuver went well and the spacecraft reacquired after the antenna came back to Earth point.

(2) The scan platform was calibrated and on 20 March and 22 April, Saturn exposures were made and received.

(3) On 31 March, a stellar reference activity was performed. On 2 April, the Canopus star tracker sensitivity was checked and on 3 April, a Titan Moveable Block Capability Demonstration Test was conducted.

(4) During the period, there were six navigation cycles completed with Delta differential one-way ranging (Delta DOR) activities occurring twice during each navigation cycle. The Delta DOR activity was conducted by the 64-meter stations during mutual view periods. During the time DSS 14 was down, DSS 13 provided the Delta DOR support.

(5) During the period 4-11 March, real-time combiner (RTC) and arraying training and operations indoctrination were conducted at Goldstone. Representatives from DSS 43 and 63 attended and returned to their stations to prepare for the training and support at the conjoint facilities. The training period included classroom training, hands-on training, and actual support of three scheduled array passes. Applicable operations procedures were evaluated and updated as required.

(6) During the month of March, the X-band drivers were turned off on Voyager 1 three different times for a total of 148 hours, 42 minutes. During these times, only S-band telemetry was received and processed by the stations.

III. DSS Status

A. DSS 61

The implementation of the S/X-band capability and upgrade of DSS 61 from a 26-meter-diameter antenna to a 34-meter-diameter antenna was completed on 1 March 1980. The subsystem testing was completed at the same time and System Performance Tests (SPTs) started the following day. The SPTs were essentially completed on 12 March. These tests were divided into two phases, one with antenna operation and one without antenna operation. This was necessary because previous inspection had determined that repair was required on the antenna gear boxes prior to returning the station to an operational status. This gear box repair work was accomplished during the SPT time frame, restricting antenna operation during that repair function.

The Network Operation Project Engineer (NOPE) for Voyager conducted Operational Verification Tests (OVTs) following the SPTs as the final testing step in returning the station to an operational status. The OVTs were structured so as to meet the verification requirements for all projects. These tests were conducted long-loop with telemetry data being generated by NOCA SIM and/or MCCC SIM and transmitted to the station for standard processing. This mode of testing not only verified the normal station processing equipment, but the Simulation Conversion Assembly (SCA) in preparation for future encounter Ground Data System (GDS) testing. Each station operational crew supported two OVTs so that a training requirement was likewise completed.

At the conclusion of the OVT testing, demonstration tracking passes were scheduled for all projects to validate actual spacecraft data processing. The demonstration passes were completed on 1 April 1980 and the station declared operational for Project support on 2 April 1980.

B. DSS 42

The implementation of the S/X-band capability and upgrade of DSS 42 from a 26-meter-diameter antenna to a 34-meter-diameter antenna was completed on 28 March 1980. The subsystem testing was completed at the same time and the SPTs started the following day. The SPTs progressed on schedule and were completed on 15 April. The OVTs were started on 16 April and completed on 24 April. Demonstration tracks followed the OVTs.

The same philosophy was followed at DSS 42 for verification of operations as was followed for DSS 61. Under this testing and training philosophy the maximum return is realized from the utilization of the station resources and results in the highest degree of confidence as to the station's operational capability.

C. DSS 14

DSS 14 was removed from operational status on 14 March 1980 for an estimated 60-day period. During this time period the antenna subreflector was to be replaced, the antenna panels realigned and a controller installed. It has been found that the time necessary for panel realignment was overestimated and that the station will become operational on 9 May. The work was completed on 30 April. During the period 4-8 May, SPTs will be conducted at the station and an OVT will be performed on 8 May 1980. The first scheduled tracking passes after the OVT will be considered demonstration tracks for final station validation.

D. DSS 62

DSS 62 was removed from operational status on 17 April for an estimated 25-day period. During this time period the antenna gear boxes will be inspected and repaired as required. This work is the same as was acomplished at DSS 61 during the 34-meter upgrade activity. The station will be returned to operational status on 12 May 1980.

During the time that DSS 61 was undergoing conversion, the Programmed Oscillator Control Assembly (POCA) was removed from DSS 61 and installed at DSS 62. This gave DSS 62 the capability of uplinking with Voyager 2. The POCA was removed from DSS 62 and reinstalled at DSS 61 on 21 March as part of the 34-meter capability.

E. DSS 44

During the DSS 42 conversion, the POCA was likewise removed from the station and installed at DSS 44. This provided the 26-meter station uplink capability for Voyager 2 and, like the DSS 62 operation, relieved some of the load on the 64-meter net. The POCA was reinstalled at DSS 42 on 9 April 1980.

IV. Software

During this reporting period several new software packages providing the required capabilities for the Saturn encounters were tested and accepted for operation at the Deep Space Stations. Companion packages for the Network Data Processing Terminals were also tested and accepted for operation at JPL in Pasadena.

(1) Antenna Pointing Subsystem (APS). New software has completed probationary testing and is awaiting anomaly resolution.

(2) Communication Monitor and Formatter (CMF). Major upgrade completed and now in operational use.

(3) Command (CMD). Completed probationary and Ground Data System testing and now scheduled for operational use.

(4) Metric Data Assembly (MDA). Major anomalies encountered and software package returned for correction and incorporation with capabilities of the next version. New release date established.

(5) Meteorological Monitor Assembly (MMA). Tested and in operational use. Provides interface with MDA for Very Long Baseline Interferometer (VLBI) support.

(6) Occultation Data Assembly (ODA). Tested and in operational use for VLBI and other baseline data recording.

(7) Planetary Ranging Assembly (PRA). Tested and in operational certification cycle.

Table 1. Type and number of activities support for both Voyager spacecraft, February–April 1980

Test/Calibration	Number supported
Ultrastable oscillator	16
Tracking loop capacitor	11
Ultraviolet spectrometer sun col	2
Ultraviolet spectrometer star col	7
Imaging science subsystem calibration lamps	1
Plasma subsystem/magnetometer	7
Command detector unit/signal-to-noise ratio	10
Scan hysteresis	2
Scan platform cal	1
Periodic engineering and science cal	10
Plasma wave subsystem	2
Radio frequency subsystem/auto gain control	5
High gain antenna and sensor cal	5
Magnetometer boom alignment	1
Infrared interferometer spectrometer flash off heater sequence	9
Flash off heater sequence	7
Canopus star tracker sensitivity	1