Helios Mission Support

P. S. Goodwin
TDA Mission Support

E. S. Burke and T. P. Adamski
DSN Network Operations Section

This article reports on activities of the Network Operations organization in support of the Helios Project during October and November 1976.

I. Introduction

This article is the thirteenth in a continuing series of reports that discusses Deep Space Network support of Helios mission operations. Included in this article is information concerning Spacecraft Tracking and Data Network (STDN)-DSN telemetry and command cross-support, the Helios-2 ranging anomaly, the first operational demonstration of the Mark III Data System for Helios support, and other mission-oriented information.

II. Mission Operations and Status

Helios-1 continues to operate normally in its extended mission. Perigee occurred on November 30 when the spacecraft was approximately 52 million kilometers from Earth. The fourth aphelion will occur on January 9. Deep Space Network coverage during October and November is shown in Table 1.

The Helios-2 spacecraft is operating normally with the exception of the ranging anomaly reported in Ref. 1. After extensive troubleshooting, the Project has determined that traveling wave tube (TWT) number 2 cannot be turned on in either the high- or medium-power modes. They have further theorized that the attempt to turn on the spacecraft's ranging channel somehow damaged its transmitter logic circuit. As a result, ranging will not be attempted until the entire failure has been analyzed and is well understood.

Helios-2 passed through inferior conjunction on November 18. The data "greyout" due to solar interference lasted for approximately 26 hours, but was covered with an onboard memory read-in operation. Greyout entry was at a Sun-Earth-probe angle of 0.4 degrees; exit was at 0.7 degrees. The spacecraft will pass perigee (minimum distance of 4 million kilometers) on January 4 and aphelion on January 21. Table I shows the tracking coverage provided this spacecraft by the DSN during October and November.

III. Special Activities

A. STDN-DSN Cross-Support

The previous article in this series (Ref. 1) reported on the configuration used by the Goldstone STDN station to support the two Helios spacecraft and presented some preliminary comparative results of that support. The cross-support period ended on November 15 when the STDN station was taken down for extensive reconfiguration. Up to that point, the station had tracked Helios-1 eleven times and Helios-2 five times. It was found that the STDN station could support Helios at a signal-to-noise ratio approximately 4 dB below that of a 26-meter DSN station. This difference was due primarily to a higher system operating temperature and a lower receiver sensitivity at the STDN site.

Based on this 4-dB offset, it was possible to predict STDN performance relative to DSN stations. The signal-to-noise ratios of data received from Helios-1 during the period of cross-support were consistently within one-half dB of the predicted values, but the SNRs of Helios-2 data were an average of 2.5 dB lower than predicted. The reason for this difference is presently unclear, but it is anticipated that further study will be possible during future STDN support of the Helios spacecraft.

B. Mark III Data System Support of Helios

Implementation of the Mark III Data System equipment has been completed at the Goldstone Echo Station, DSS 12. The first in a series of demonstration tracks was conducted on December 21 to exercise the new equipment in a Helios support configuration and to provide an opportunity for operator training. The initial configuration used for the track is shown in Fig. 1.

Activities during the demonstration were designed to emulate a typical Helios track. The station acquired the downlink signal, performed an uplink acquisition, commanded the spacecraft, and attempted to output monitor, radio metric, and telemetry data. The individual subsystems appeared to function normally, but extreme difficulty was experienced in maintaining data flow from the Communications Monitor and Formatter Assembly (CMF). The most common failures involved cessation of high-speed output during failures of the digital recorder, or losses of the interface between the CMF and the high-speed communication buffers.

Although the track was less than successful as a demonstration of equipment reliability, the troubleshooting performed on-site provided valuable hands-on training for the station operators. Future Helios demonstration tracks should be more successful as minor hardware and software problems are resolved and as familiarity with the new equipment increases.

Reference

1. Goodwin, P. S., Burke, E. S., and Morris, R. E., "Helios Mission Support," in *The Deep Space Network Progress Report 42-36*, pp. 28-34, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1976.

Table 1. Helios tracking coverage

Month	Spacecraft	Station type	Number of tracks	Tracking time, h, min
October	Helios-1	26-m	37	121:14
		64-m	3	9:48
	Helios-2	26-m	25	191:10
		64-m	22	63:17
November	Helios-1	26-m	41	381:30
		64-m	2	6:04
	Helios-2	26-m	35	297:34
		64-m	3	19:14

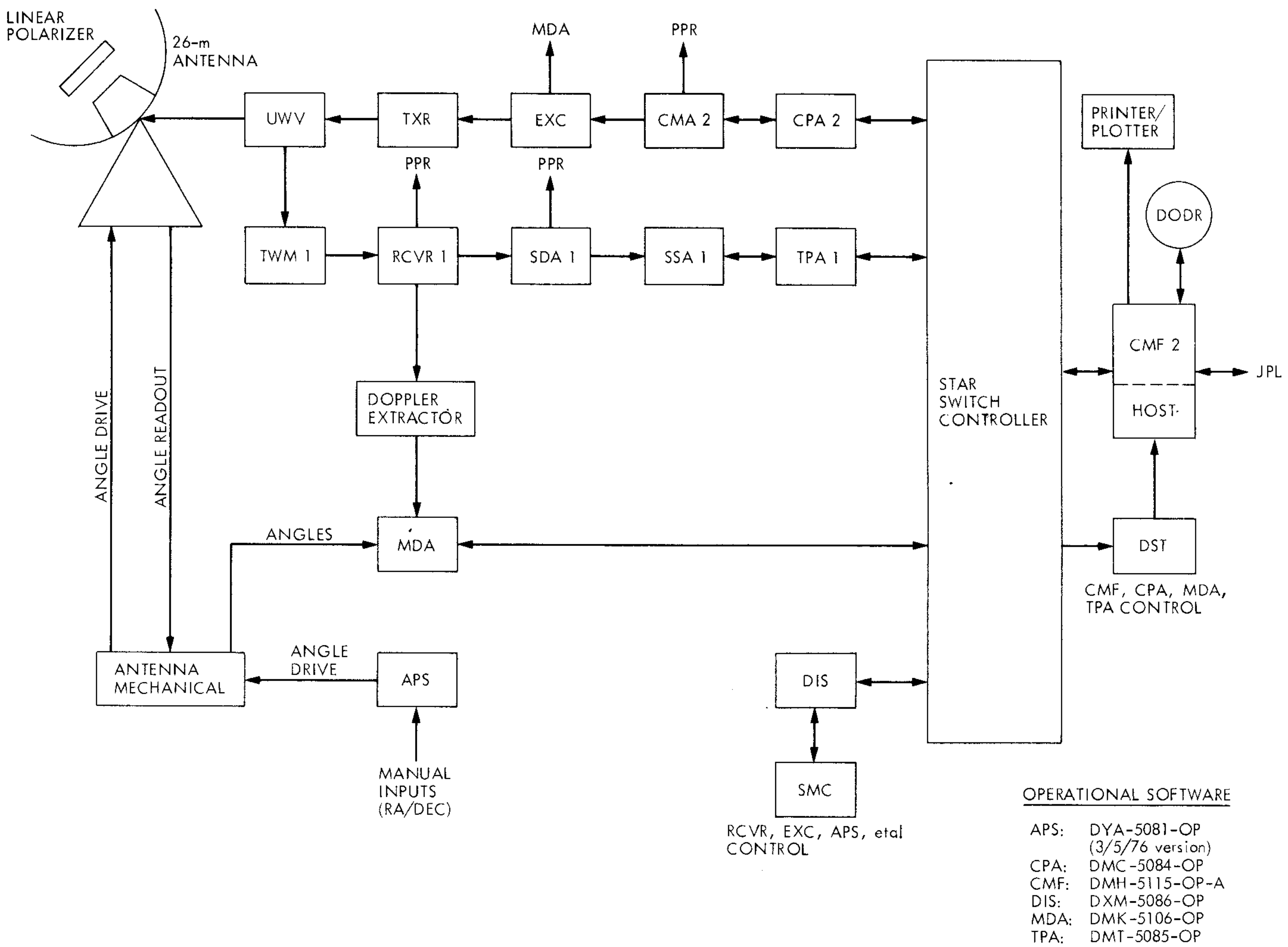

Fig. 1. DSS 12 support configuration