DSN "Load and Go" Pre-track Preparation for Voyager Support

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The use of Level 4 Prepass Readiness Tests ("load and go" pre-track preparation) provides an efficient increase in Network productivity. Application of this method of operation was evaluated for Voyager support, so that increased tracking could be provided to all projects during a period of continued interproject conflicts.

I. Introduction

Pre-track preparation time is scheduled at each Deep Space Station (DSS) prior to direct spacecraft tracking operations. This time is used to configure and calibrate DSS equipment based on predefined "level of support" requirements. Reduction of this time increases the number of station hours available for spacecraft support, a measure of Network productivity.

Prepass Readiness Tests (PRTs), Levels 1 through 4, formally define pretrack preparation time and activities. Level 3 is normally used for prime mission cruise support, and Level 4, commonly called "load and go," is used for extended mission support. Due to DSS loading and interproject conflicts, the Voyager Project and DSN Operations mutually agreed to a trial period of Level 4 PRTs to evaluate the effectiveness and inherent risks involved during actual cruise phase support.

II. Procedure

The procedure followed was the same as that used for the Level 4 PRT evaluation for Pioneer, Helios, and Viking. This procedure was documented in *The Deep Space Network Progress Report* 42-34, May and June 1976. The key characteristics of the Level 4 PRT are reiterated here:

(1) No equipment calibrations are performed except for ranging. Use is made of the latest previous calibration data available.

(2) Subsystem software programs are not exercised as required for other levels of support. The programs are merely loaded and initialized to commence running at the beginning of the pass. However, prior to acquisition, two test commands are sent locally (at the DSS) to a dummy load to validate the on-site command system interface.

(3) No subsystem data transfer tests are run between the DSS and NOCC. Instead, the first 30 minutes of each pass are used for this purpose and to validate the data. The data obtained during this period are provided to the project.

(4) Discrepancy Reports (DRs) are handled differently in those cases where equipment calibrations are out of limits, equipment failures and procedural errors occur

during the first 30 minutes of a pass, and acquisition of spacecraft signal (AOS) is not accomplished on time.

On these types of problems, DRs are closed out on the basis of having resulted from a "load and go" countdown, with its attendant and recognized higher risk.

III. Performance Analysis

Level 4 PRTs were implemented on about 43% of the Voyager tracks during the month of January 1978. Significant data are summarized in Tables 1-4 and accompanying comments.

IV. Conclusion

The trial period ended satisfactorily with the Voyager Project utilizing about 21 h of the additional tracking time made available. The efficiency of this method of operation has clearly been established and, with pre-defined scheduling criteria based on activities programmed to occur during each pass, the Project and the DSN have agreed to schedule Level 4 PRTs during the cruise phase of the Voyager Mission.

Reference

1. Hatch, J. T., "Use of Load and Go Countdowns by the DSN Deep Space Stations", in the *Deep Space Network Progress Report 42-34,* May and June 1976, pp. 124-128, Jet Propulsion Laboratory, Pasadena, Calif., Aug. 15, 1976.

Table 1. PRT schedule

DSS	Support requirement	Level 3 time, h	Level 4 time, h
26 m	Standard support	2.0	0.5
	Add ranging (0.5 h)	2.5	1.0
64 m	Standard support low-rate telemetry (HSDL), S-band ranging	2.5	1.0
	Add high-rate telemetry (WBDL) (0.5 h) or X-band ranging (0.5 h)	3.0	1.5
	Add high-rate telemetry and X-band ranging	3.5	1.5

1.5 h are saved in all cases above except the last one, where the time requirements are non-additive to each other for Level 4, and 2 h are saved.

Table 2. Level 4 DSS AOS record

No. of times		Time average, min	Total, min
Early	14	2.2	31
On schedule	11	–	–
Late	18	5.7	103

The numbers in Table 2 cannot be directly compared with Level 3 AOS records because of the flexibility allowed to make up lost time when delays occur during the longer preparation period. The average times, both early and late, for this trial were closer to schedule than the trial for the other Projects. The average during that trial was 6.5 min for early and 7.2 min for late AOS. The latest Level 4 AOS for Voyager was 16 min.

Table 3. Discrepancy report (DR) comparisons

Countdown	No. of DRs
Level 3	17
Level 4	12

The respective number of Discrepancy Reports is comparable to the trial period for the other Projects. The ratio of Level 3 vs Level 4 is about the same as the respective number of tracks and hours tracked. This indicates that there is no significant increase in risk for Level 4 tracks.

Table 4. DSS pre-track preparation and tracking time comparisons

	Tracks		Pre-track preparation, h	Total time, h
	No.	Hours		
Level 3	58	580	144.5	724.5
Level 4	43	442	32.0	474.0

Additional tracking time realized: 64.5 h.