Mariner Venus/Mercury 1973 Mission Support

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Major planning and design activities and the associated reviews and documentation have been completed for Mariner Venus/Mercury 1973. This article summarizes achievements of the past year as the DSN fully enters the implementation and test phase.

I. Introduction

During the past year, the DSN Support Team for Mariner Venus/Mercury 1973 (MVM 73) has been involved primarily in planning and designing activities, including their review and documentation. These activities were completed in October 1972 as scheduled, and the DSN has fully entered the implementation phase. This article summarizes the key plans, design achievements, implementation/tests, and operations activities of the previous year. Additional information regarding DSN support for MVM 73 is contained in Refs. 1 through 5. Future articles will follow the progress of implementation and tests to DSN operational readiness.

II. Planning Activities

A. NASA Support Plan

The approved Support Instrumentation Requirements Document and the NASA Support Plan preparation guidelines were received from NASA Headquarters in July 1972. These documents provided the basis for final DSN capability and commitment planning. The NASA Support Plan preparation guidelines gave instructions for supporting real-time 117.6-kbps data from DSS 14 to JPL and for expedited return of high-rate data from DSSs 43 and 63. These instructions provided for closure of the major open areas in DSN planning. Subsequently, the preliminary NASA Support Plan, which was produced in December 1971, was updated, coordinated with implementing organizations, and correlated with DSN budget plans. The NASA Support Plan was approved by JPL in September 1972 and forwarded for NASA Headquarters review and approval.

B. Project Management Plan

To clearly define the working interfaces and responsibilities for planning and control among Project elements, the DSN supported the Project's publication of the Mission Operations System-Tracking and Data System-Mission Control and Computing System Management Plan. Included are agreements regarding organizational interfaces, documentation, schedules, financial responsibilities, reviews, reporting, testing, configuration control, and operations support. These agreements, along with NASA Support Plan commitments, provide the basis for DSN detailed planning.

C. Project Master Test Plan

Extensive testing/training activities are required among the Project Systems [Mission Operations System-Tracking and Data System-Mission Control and Computing Center System-Spacecraft (MOS-TDS-MCCCS-S/C)] to achieve total readiness for mission operations support. To ensure coordinated planning, compatible schedules, and integrated objectives, the named Project Systems produced a preliminary Mariner Venus/Mercury 1973 Mission Operations Master Test Plan in September 1972. Open areas and recommendations from a formal review of the plan in September have been worked out. Approval and publication of the final plan is scheduled for November 1972. A new concept in this plan involves identification and testing of the Ground Data System (GDS), consisting of DSN, MOS, and MCCCS elements, under Space Flight Operations Section direction.

Included is DSN agreement to progress from Deep Space Station level testing to tests involving MCCCS and MOS technical elements to accomplish GDS end-to-end test and integration objectives concurrently with DSN subsystem/system tests. Basically, Deep Space Station (DSS) internal tests are to take place in April and May 1973, DSN tests and GDS integration in May and June 1973, and DSN operational verification tests/training in July 1973. Support for MOS test/training shall begin August 1, 1973, and continue to mid-October 1973.

D. DSN Support Plan

The DSN Support Plan for MVM 73 was published in October 1972. In addition to communicating commitments and agreements in the documents described above, the DSN Support Plan translates detailed requirements contained in the MOS Design Book level 3 specifications and communicates them in terms of DSN facility subsystems to an assembly level. Included are DSN internal requirements and guidelines regarding schedules, control, reviews, reports, test/training, documentation, and operational support. Required configurations specified in this plan are the result of the work of the DSN System Engineering Capability Planning Team and the DSN Support Team for MVM 73.

III. Design Activities

A. Functional Design

A joint MOS-DSN Functional Design Review was held in December 1971. A copy of the DSN material presented is contained in Ref. 4. Organizational changes made prior to the review which established the Office of Computing and Information Systems (OCIS) resulted in uncertainties regarding interfaces and responsibilities for data processing, data records, and simulation support. Functional elements of each organization presented the design in an end-to-end manner without resolving these issues. These open areas were satisfactorily closed as the detailed design progressed.

The DSN DSS Telemetry and Command Data subsystem software functional design review was held in June 1972. DSN and Project representatives were included on the review board. The Project did not agree with the design for manual command entry/display in octal, since commands issued by the Project in pseudo-octal would require translation. This problem was resolved as discussed in the next section.

B. Detailed Design

A joint MOS-TDS-MCCCS detailed design review was held on July 11–12, 1972. A copy of the DSN material presented will be published in a future TDS Progress Report (No. 6). Included were DSS configurations for telemetry, tracking, command, and simulation which highlighted new hardware/software implementations and associated schedules. Detailed ground communication designs for wideband, high-speed, voice, and teletype circuits and associated implementation schedules were covered for DSN and Project support locations. A detailed design for supporting real-time 117.6-kbps data from DSS 14 to JPL was not presented, since approval was received only a few days prior to the review. However, this major open area was worked on and completed prior to the end of July.

The Telemetry and Command Data (TCD) software detailed design review was held by the Development Project Engineer in October as scheduled. The design included pseudo-octal entry/display of manual commands and accommodation of a critical command list as required, closing this MVM 73 open area. A design feature placing all projects on one TCD system tape caused concern because of the requirements for change and revalidation during flight operations. Continuing discussions are being held on this issue. In general, the TCD software design and development schedule is satisfactory for MVM 73.

C. Interface Design

The Project Systems have identified interfaces between systems which shall be controlled to maintain compatibility. These interfaces and general procedures regarding

their control are listed in Ref. 6. Appendices to this document containing detailed interface descriptions are scheduled to be completed in November 1972. DSN inputs to the appendices are being made based on DSN RF interface parameters contained in Ref. 7, on real-time data format descriptions contained in Ref. 8, and on hardware/electrical descriptions provided through the DSN Support Team for MVM 73.

IV. Implementation and Test Activities

With the completion of detailed design and interface definitions, DSN implementation has been initiated according to schedule. Major implementation activities include: S/X-band at DSS 14; subcarrier demodulator modifications to accommodate interplex modulation; simulation conversion assembly changes to provide interplex modulation, high data rates and tracking data for testing; monitor and control/digital instrumentation modifications to provide tracking data via high-speed lines; TCD software; and wideband ground communications. Implementation progress reports will be included in future issues of this series.

Wideband and high-speed circuits between Boeing-Kent and JPL are now being implemented and were to complete testing in October 1972 for a November 1, 1972, operational date. These circuits provide for communications between the Mission Test Computer (MTC) being used at Boeing for spacecraft system tests and the MTC at JPL, which is being implemented for telemetry processing during mission operations. However, the MTC at JPL will not be ready to receive data until December 1972. Therefore, to save lease costs, readiness of the support circuits has been moved to December 1, 1972.

During Flight 1 spacecraft component testing at the Telecom Development Laboratory (TDL), three 12-h tests were scheduled with CTA 21 to perform command and telemetry compatibility and system performance measurement tests. Because of schedule and hardware problems in the TDL, availability of spacecraft components for CTA 21 testing was reduced to one 12-h period. Command tests were satisfactory, but telemetry tests conducted gave less than satisfactory results. The unavailability of subcarrier demodulator modification kits and tuning procedures for interplex modulation apparently contributed to the results. Appropriate action has been taken to assure the availability of adequate time, procedures, and equipment to accomplish the compatibility testing in December 1972 during Flight 2 spacecraft component tests.

V. Operations Activities

DSS 14 continues to provide operational support to meet Venus/Mercury planetary ranging and radar requirements for ephemeris improvement and Mercury mapping.

VI. Areas Requiring Special Attention

DSN-Spacecraft RF compatibility testing has been flagged as an area of concern for the reasons stated in Section IV. This item was discussed during the Project's Ninth Quarterly Review on October 26, 1972, and specific action items were assigned.

References

1. *TDS Report for MVM'73,* TDS Progress Report No. 1, 615-13, Jet Propulsion Laboratory, Pasadena, Calif., Apr. 1, 1971 (JPL internal document).
2. *TDS Report for MVM'73,* TDS Progress Report No. 2, 615-14, Jet Propulsion Laboratory, Pasadena, Calif., July 1, 1971 (JPL internal document).
3. *TDS Report for MVM'73,* TDS Progress Report No. 3, 615-40, Jet Propulsion Laboratory, Pasadena, Calif., Jan. 15, 1972 (JPL internal document).
4. *TDS Report for MVM'73,* TDS Progress Report No. 4, 615-47, Jet Propulsion Laboratory, Pasadena, Calif., March 1, 1972 (JPL internal document).
5. *TDS Report for MVM'73,* TDS Progress Report No. 5, 615-61, Jet Propulsion Laboratory, Pasadena, Calif., Sept. 1, 1972 (JPL internal document).
6. *MVM'73 Spacecraft-Mission Operations System-Tracking and Data System-Mission Control and Computing System Interface Control Document,* 615-95, Jet Propulsion Laboratory, Pasadena, Calif., Sept. 20, 1972 (JPL internal document).
7. *DSN/Flight Project Interface Design Handbook,* 810-5, Jet Propulsion Laboratory, Pasadena, Calif. (JPL internal document).
8. *DSN System Requirements Detailed Interface Design,* 820-13, Jet Propulsion Laboratory, Pasadena, Calif. (JPL internal document).