

Telemetry and Command Multiple-Mission Software (Model A)

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This article gives the status of the Deep Space Station Telemetry and Command operational software central to the support of Mariner Venus/Mercury 1973. The program was implemented by developing mission-oriented segments and integrating with a basic software nucleus. The selected method of implementation is an outgrowth of a feasibility study, conducted by the Data Systems Development Section.

I. Introduction

This article describes the Model A version of the Telemetry and Command (TCD) operational software which supports the Mariner Venus/Mercury 1973 (MVM'73) mission. This software is multiple mission in structure and serves as the basic building block which will also support the Helios and Viking missions. Individual program elements that reside in the TCD computers (XDS 920 and ID4) form building blocks which can be selected and integrated to perform specific functions, viz., transmission of the Ground Communications Facility (GCF) blocks formatted in accordance with the Deep Space Network/Mission Control and Computing Center Interface Docu-

ment (820-13). The ID4 computers are configured as a peripheral to the XDS 920, and program functions are input and controlled through the XDS 920 computer.

II. Major Categories and Support Software

The basic software categories are Executive Control, Command, Telemetry, and support programs. Each software category consists of many data sets. A brief description of functions is as follows:

- (1) *Executive.* Loads all routines central to a given function, processes and routes input messages,

queues and outputs messages to the Monitor System, GCF blocks, local alarms, and logs the Telemetry and Command Processor (TCP) Digital Original Data Record (DODR) as required.

- (2) *Telemetry*. Assembles newly acquired data for transmission to user in real time. Functionally, monitors all telemetry-related assemblies (subsystems) and reports their status to the user.
- (3) *Command*. Dedicated to controlling, monitoring and supplying the Command Modulator Assembly (CMA) with command data for radiation.

Support software has been written to perform the following functions:

- (1) *Program Tape Maintenance*. TCP resident routine which adds, deletes or replaces routines or data sets on magnetic tape—the TCD system tape.
- (2) *Punched Paper Tape and Edit Routine*. Prepares paper tape with input messages for subsequent processing by the TCP Executive.
- (3) *Bootstrap Loader*. Bootload (on punched paper tape) to load the controller from the system tape.

III. TCD System Tape

The system tape (program tape) houses all the data sets required for anticipated missions through 1975. A data set may be viewed as a self-contained mission-dependent routine. Each data set is characterized by a label and resident computer (TCP or Data Decoder Assembly (DDA) Central Processor). The program tape is prepared by the maintenance (update) routine.

Previous operational programs featured a program tape which contained a complete TCP memory image. To increase reliability, several images were usually written. The TCD system tape is organized so that a given data set appears only once. Each data set is preceded by a label record which provides a unique name and date. Each physical record after the label record has a checksum field which is computed at the time of the update and is recomputed by the Executive at load time. The checksum algorithm is a “folded” checksum and is compatible with the requirements of the XDS Monarch Loader. Loading is aborted whenever the checksum criterion fails.

Dummy data sets are provided in order to satisfy all references and interface requirements at load time. Finally, a terminating record is provided to signify the end of the tape.

IV. Executive Data Sets

Basically, the Executive can be partitioned into two segments. Each segment, in turn, consists of its own data sets. The partitioning of the Executive is necessary because the program has two phases of operation—loading and actual monitoring and control:

- (1) Data sets for the loading phase (software configuration generator)
 - (a) *Configuration Monitor*. Processes and responds to manual directives and builds loading tables.
 - (b) *Table Module*. Pre-assembled tables which link data sets. This element may be altered without affecting the Executive. This is the “Configuration List.”
 - (c) *General Loader*. Loads all data sets into destination computer(s) as required.
- (2) Data sets for real-time phase
 - (a) *Supervisor*. Controls execution of subprograms queued as the result of some real-time event.
 - (b) *Utilities*. Magnetic tape output routines, GCF block input and output routines, monitor output and TTY output routines.
 - (c) *Common Data Base*. Constants and parameters available to all data sets.

V. Data Sets for Model A

The TCD software Model A is restricted to MVM73 support. The Executive was treated separately because it must remain intact regardless of mission. The MVM73 command format is 1 bit/s, phase-shift keying/pseudonoise. A self-contained data set performs the command function. Due to storage limitations, the telemetry software category was subdivided into three basic software configurations or functions. These functions are (1) the internal bit synchronization algorithm, (2) processing of coded or uncoded data by the DDA, and (3) DDA processing of uncoded data and Block Decoder Assembly processing of coded data. Hence, the telemetry subdivisions correspond to the low-, medium- and high-rate channels, respectively. Data sets common to all telemetry configurations are listed in Table I. Specialized data sets would be the GCF block formatters and interrupt processors written specifically for a given function. The low-rate channel utilizes a formatter, interrupt processor, and a routine to control and monitor the digital phase shifter. The medium- and high-rate configurations utilize for-

matters and Symbol Synchronizer Assembly and DDA control routines in addition to self-contained DDA resident programs. The high-rate DDA program logs a 9-track DODR and outputs on wideband lines when required.

VI. Summary

Mission-dependent routines or data sets may be specified in the Configuration List portion of the Executive. This allows integration of new application programs with the existing Executive. Since the Executive would not be altered by this process, previous configurations will re-

main valid and the total collection of program elements on a given system tape will form a multiple-mission software package.

The Model A version of this program has been implemented and transferred to the program library and will be used for MVM⁷³ support. This includes the additional configuration and data sets necessary for 9-track DODR replay. Model B, which adds those functions necessary to support Helios, is currently undergoing acceptance testing. The Model C version for Viking support is in the final implementation stages.

Table 1. Common telemetry data sets

Data set name	Function
DISGEN	Formats all telemetry monitor messages
SNCAL	Computes SNR whenever channel or decoder statistics are available
LOMSG	Edits all telemetry input messages entered via punched paper tape or keyboard and builds parameter tables for channel operation
TMINT	Telemetry initialization, i.e., channel start
TMRNT	Terminates telemetry
TMAGC	Processes receiver AGC
MSTAT	Monitors telemetry assemblies and initiates alarms when necessary