Multiple-Mission Telemetry

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This article contains a status update of the Deep Space Instrumentation Facility (DSIF) Multiple-Mission Telemetry (MMT). Although the equipment covered in this report has been described in detail in earlier Deep Space Network (DSN) Space Programs Summary articles, it is now appropriate to provide information on the changes and new developments to the MMT system. Block diagrams depicting the various DSIF station MMT configurations and telemetry processing equipment added to support the Mariner Mars 1971 flight project are also included in this article.

I. Introduction

The Multiple-Mission Telemetry (MMT) *Mariner* Mars 1971 update has been successfully completed and the equipment is currently supporting the *Mariner* Mars 1971 flight project at the prime *Mariner* Mars 1971 DSIF stations. The MMT equipment added to the stations to support the mission is shown in Figs. 1 to 4. Four basic configurations have been implemented with the signal flow of each depicted in the figures. Detailed descriptions of the equipment involved were covered in Refs. 1 and 2. The purpose of this report is to provide an update on the status of the MMT *Mariner* Mars 1971 implementation.

The major elements of addition and change to the DSIF Multiple-Mission Telemetry System configuration for *Mariner* Mars 1971 were:

(1) Subcarrier Demodulator Assemblies (SDAs).

(2) Symbol Synchronizer Assemblies (SSAs).

(3) Block Decoder Assemblies (BDAs).

(4) Telemetry and Command Data Handling (TCD) modifications.

(5) MMT test software.

(6) High/low density digital tape recorders.

The current status of each of the above items is described below.

II. Subcarrier Demodulator Assemblies

Additional SDAs were procured to support the *Mariner* Mars 1971 mission requirements. Ten new units were obtained and implemented in the net. Deep Space Stations 12, 41, 62, 14, and CTA 21 received and installed two new SDAs.

In addition, all SDAs were implemented with new wide-band coherent amplitude detectors which provided better dc drift stability. The interface circuitry on all

SDAs was also modified to provide an additional output port of an unintegrated data stream to the Symbol Synchronizer Assembly.

III. Symbol Synchronizer Assemblies

The production model SSAs were fabricated and tested by Motorola, Inc., Government Electronics Division, Scottsdale, Arizona. A total of 19 SSA units and 9 sets of subassembly spares were procured by JPL under the Motorola contract.

All SSA units, subassembly spares and supporting documentation (e.g., O & M Manuals) have been supplied and installed in the DSN. The Deep Space Stations (DSSs) implemented with SSAs are: DSSs 12, 14, 41, 42, 51, 61, 62, 71, and CTA 21. Implementation was carried out jointly by Motorola, JPL, and station personnel. Training sessions at each DSS and at the GDSCC Training Center were held to familiarize site personnel with the theory and operation of the SSA.

The DSIF Maintenance Facility has been supplied with all the necessary test fixtures and test procedures with which to maintain all the SSAs in the DSIF.

Procurement action is presently underway to obtain two additional SSAs and one set of subassembly spares for MMT implementation at DSS 11.

IV. Block Decoder Assemblies

All BDAs were delivered on schedule and installed at DSSs 12, 41, 62, 14, 71, and CTA 21. There were no major problems at installation and system integration. The few failures were primarily due to circuit module component breakdown. Failures were disposed of by simple substitution. System checkout and evaluation indicated that the BDAs operated in accordance with specifications and operating curves. The operating BDAs have given no indication of any degradation from expected operating characteristics. All BDA spare assemblies, test fixtures, and documentation have been delivered to the network.

V. Telemetry and Command Data Handling Subsystem Modifications

The original article covering the modifications that were made to the TCD subsystem as a part of the MMT 1971 update was presented in Ref. 2. There are no functional changes to the TCD modification functional block diagram originally presented. However, certain engineering changes have been implemented to the TCP subassemblies to provide for better interface with the TCP computers:

(1) The TCP PIN/POT Interface Buffer Subassemblies have been modified with the addition of cable driver logic to provide for better buffered POT line signals to the HSD/WBD I/O Assemblies.

(2) The HSD/WBD I/O Assemblies have been modified with an automatic shut-down to eliminate a hang-up condition in the transmit mode as a result of either a computer halt or an operator-incurred halt. Modifications are also in progress in the HSD/WBD I/O Assemblies to eliminate susceptibility to noise.

(3) The TCP's Millisecond Clocks have been modified to operate with negative logic 1-pps and 1-kpps input signals from the Frequency Timing Subsystem (FTS).

The modifications as previously outlined in Ref. 2 have been implemented at all specified DSIF stations on schedule. The engineering changes listed above have been implemented and checked out at CTA 21. Subsequent implementation at all other DSIF Stations is presently being scheduled.

VI. MMT Test Software

As a part of the *Mariner* Mars 1971 MMT implementation, test software was developed to run in the TCP computers to verify proper operation of the new MMT assemblies added. This program exercises all equipment interfaces to the TCP computers and provides performance measurements to determine if the hardware is performing to specifications. The software assisted in the prototype development phase of the MMT equipment and was used to verify performance of the production model equipment when it was installed in the DSIF.

This test program has been identified as DOI-5087-TP by the DSIF program library. Program documentation was completed December 1, 1970 and transferred to the DSIF program library. The symbolic listing and magnetic tape containing complete source input accompanied the transmittal to the library.

The documentation covering the program capabilities, operation, and program listing was released by the DSIF program library in March 1971.

VII. High/Low Density Magnetic Tape Recorders

In order to provide the capability to create an ODR for telemetry data at the stations at the high data rates to be received at *Mariner* Mars 1971 encounter, new high-density tape recorders were procured. DSS 14 has been provided with two high-density recorder units to support the *Mariner* Mars 1971 mission. Each unit consists of dual tape recorders. The new recorders operate up to a recording density of 800 characters per inch versus 200 characters per inch on the old low-density recorders. This provides an advantage of being able to record a single reel of tape at the *Mariner* Mars 1971 high data rate for 85 minutes while the low-density unit would complete recording of a single reel in just 21 minutes. Thus, a great saving in tape usage is obtained. In addition, since each high-density unit has dual recorders, each TCP computer can switch over to the second recorder without any loss of data when a reel is full.

The dual high-density units were also installed on the TCP computers at CTA 21 and DSS 71 to assist in spacecraft compatibility testing and pre-launch checkout. At the stations where the high-density units were installed, the existing low-density units were replaced. The removed low-density units were then installed at the *Mariner* Mars 1971 prime 26-meter stations (DSSs 12, 41, and 62) to provide a dual low-density recording capability on each TCP computer for recording the lower data rates that occur at these stations.

References

1. Frey, W., Petrie, R., and Greenberg, R., "Multiple-Mission Telemetry System Project," in *The Deep Space Network*, Space Programs Summary 37-61, Vol. II, pp. 121–147. Jet Propulsion Laboratory, Pasadena, Calif., Jan. 31, 1970.
2. Frey, W., Petrie, R., Greenberg, R., McInnis, J., and Wengert, R., "Multiple Mission Telemetry 1971 Configuration," in *The Deep Space Network*, Space Programs Summary 37-63, Vol. II, pp. 63–77. Jet Propulsion Laboratory, Pasadena, Calif., May 31, 1970.

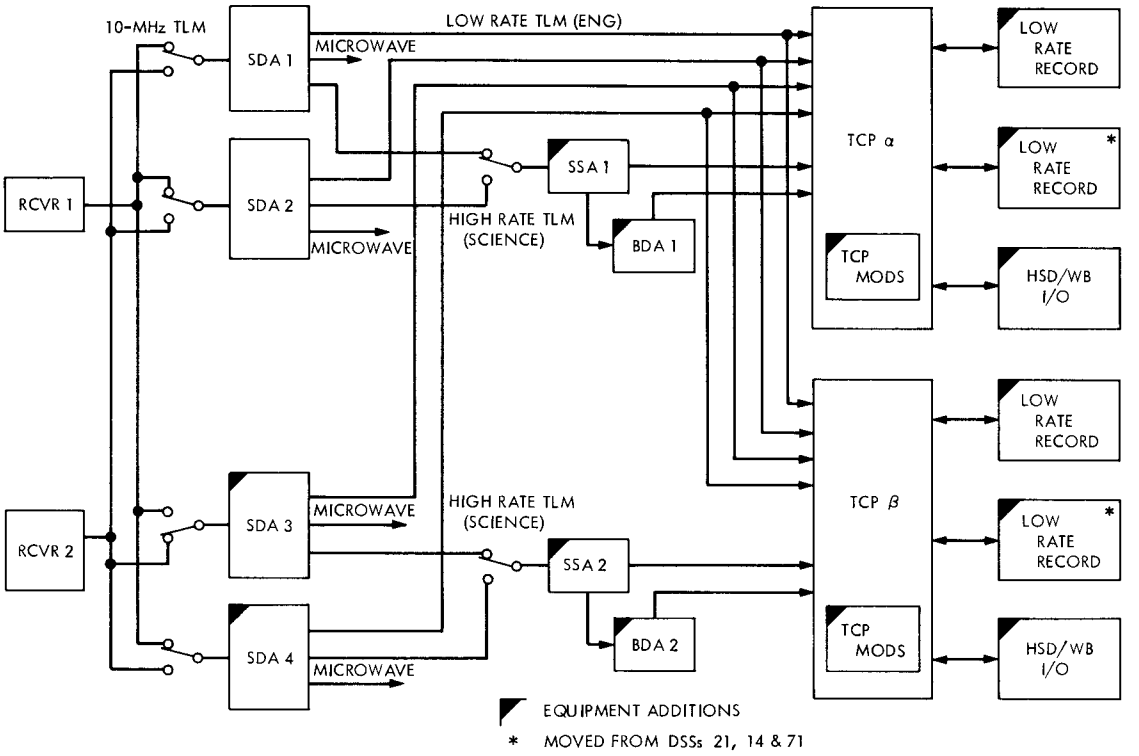

Fig. 1. MMT 1971 configuration signal flow diagram (DSSs 12, 41, and 62)

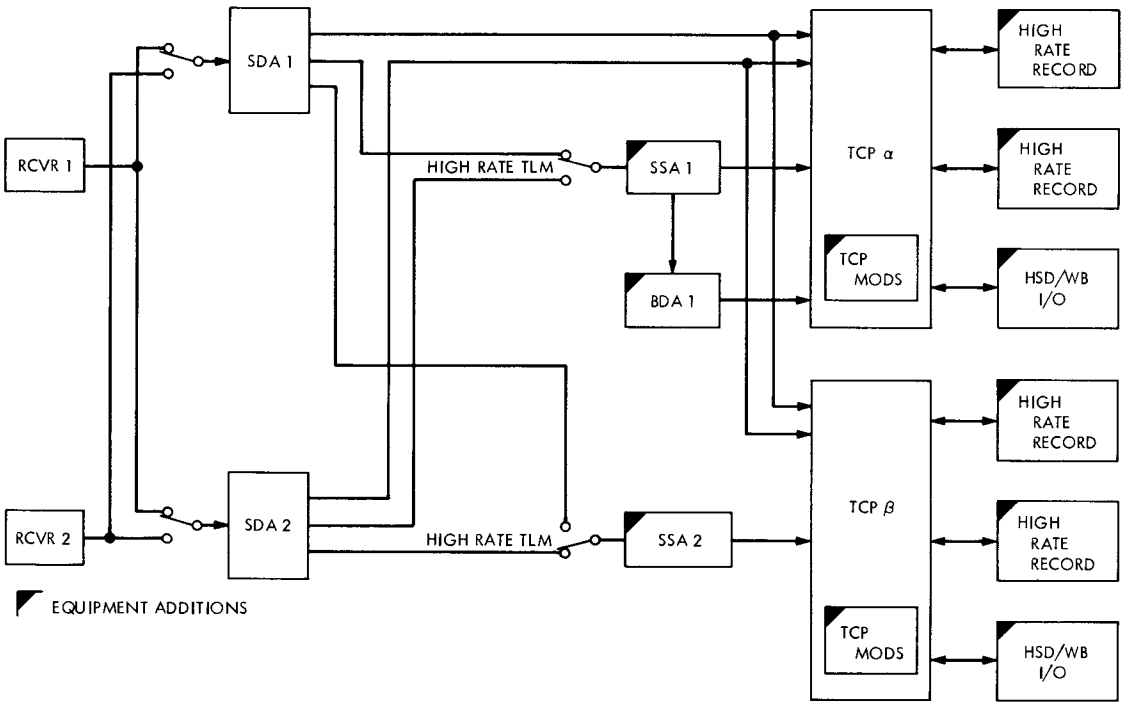

Fig. 2. MMT 1971 configuration signal flow diagram (DSS 71)

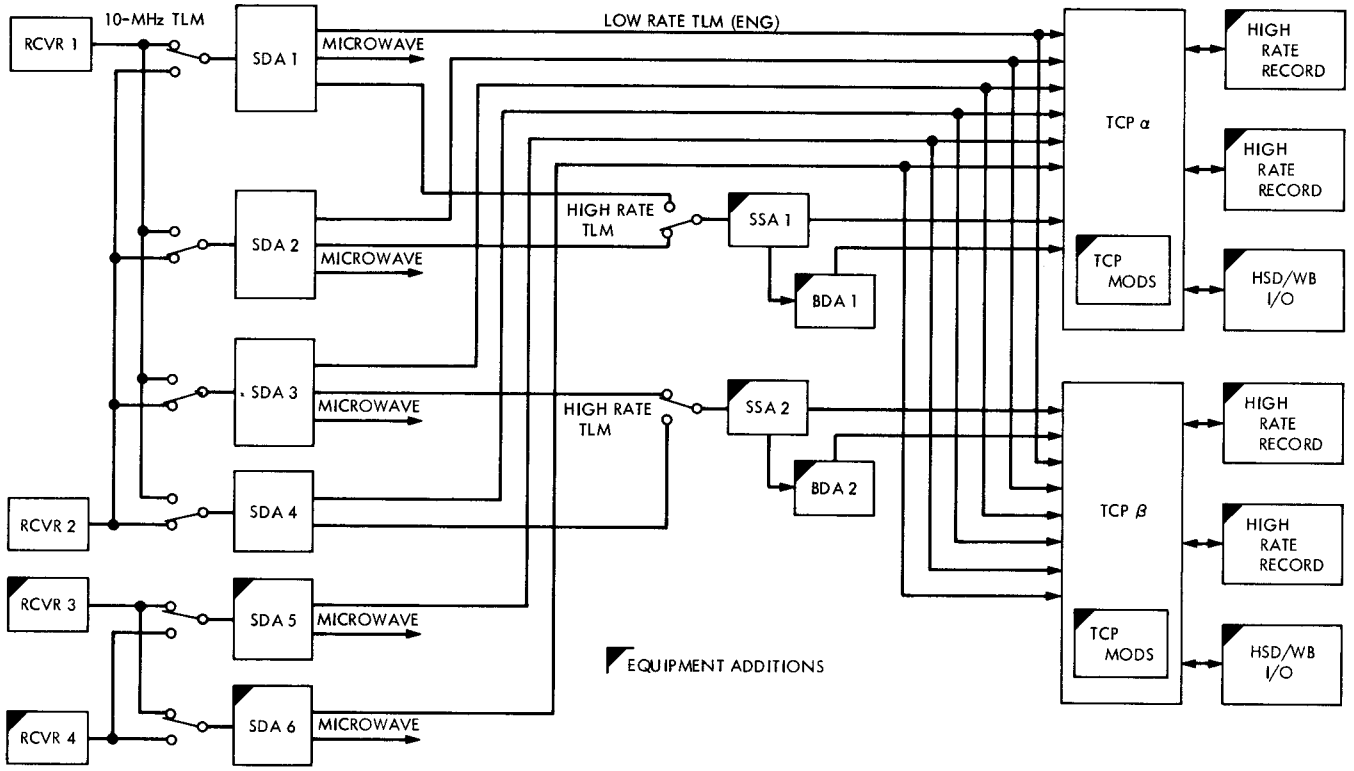

Fig. 3. MMT 1971 configuration signal flow diagram (DSS 14)

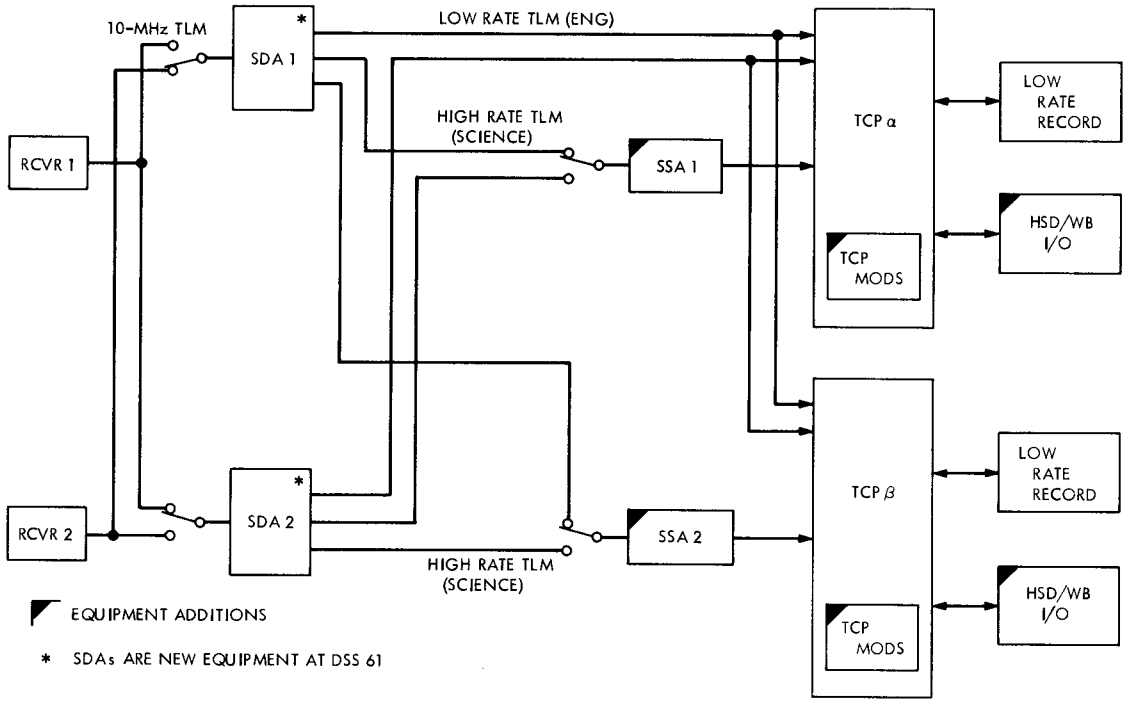

Fig. 4. MMT 1971 configuration signal flow diagram (DSSs 42, 51, and 61)