The Use of an Extended Mini-Computer as a Compatibility Test System Controller

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The transfer of the Digital Instrumentation Subsystem from the Spacecraft Compatibility Station in Cape Kennedy to Deep Space Station 61/63 in the Madrid Deep Space Communication Complex necessitated the fabrication of a new system to utilize as a controller for the Compatibility Test System. An automatic data processing equipment acquisition plan for category B equipment was submitted in July 1972 for this purpose. Implementation of the new Compatibility Test System hardware and a discussion of the functional design considerations is presented.

I. Introduction

The Compatibility Test System (CTS), at the Spacecraft Compatibility Station in Cape Kennedy, Florida, utilizes an Interdata Model 4 mini-computer for controlling the spacecraft/Deep Space Network compatibility test function. The test function consists of the following subsets:

(1) Ground receiver frequency control

(2) Ground exciter frequency control

(3) Received signal amplitude control

(4) Transmitted signal amplitude control

(5) Automatic ranging control

(6) Telemetry spectrum analysis and control

(7) Subsystem monitoring

(8) Real-time display information

(9) Test analysis

(10) Operator alert information

(11) Closed-loop RF link control

The compatibility test function was formerly controlled by the Digital Instrumentation Subsystem (DIS II), prior to the transfer of this equipment to DSS 61/63 (Madrid DSCC, Spain) in August 1972 to support the 64-m-diam antenna site. In order to maintain the CTS capability and to minimize cost, it was decided to utilize the Data Decoder Assembly (DDA) spare model 4 mini-computer to satisfy the requirement. An automatic data processing equipment (ADPE) acquisition plan was submitted to procure the necessary additional hardware and peripheral equipment required to implement the new system.

II. CTS Implementation

To maintain existing CTS integrity and to allow for future expansion, the new system consists of the following equipments:

(1) An Interdata model 4 mini-computer with 16K bytes of core memory

(2) An additional 16 K bytes of core memory

(3) A 9-track magnetic tape drive and interface

(4) A card reader and interface

(5) A digital input/output (I/O) controller and interface

(6) A 32-channel analog-to-digital converter and interface

(7) An 8-channel digital-to-analog converter and interface

(8) A line printer and interface

(9) An I/O expansion chassis

(10) A floating point instruction set

The equipment is housed in three standard DSN 48 cm (19-in.) racks and interfaces with the S-Band receiver/exciter and ranging subsystems through standard connectors. The block diagram in Fig. 1 illustrates the hardware configuration of the compatibility test function.

III. CTS Functional Design

A memory expansion of 16K bytes and floating point instruction set are required to utilize the Interdata Fortran IV system. FORTRAN is the primary high-level language utilized in support of project requirements as it provides rapid response to changes in test specifications.

A magnetic tape drive and interface is required to support rapid data storage capabilities and to provide a high-speed loading device for entering large programs into the CPU.

A card reader and interface provides the capability of rapid assembly and compilation of programming. Utiliza-
tion of cards also provides more efficient and economical updating and maintenance of existing software.

A digital I/O controller is required to provide an interface between the CPU and ancillary digital registers. This capability allows for the transfer of input and output information for controlling, monitoring and display.

Analog-to-digital (A-D) and digital-to-analog (D-A) converters and interfaces are required for monitoring numerous system checkpoints for computational and control purposes. The analog interface module is required to interface the A-D and D-A units to the CPU.

A line printer and interface is required to provide a hard copy of compatibility test results. The line printer outputs all pertinent test data and status results. The line printer also provides the capability of high speed listing during the assembly and compilation processes.

An I/O expansion chassis is required to house the additional I/O devices, converters, and extended memory.

IV. CTS Support Capabilities

The CTS provides the following capabilities:

(1) Control of the programmed exciter oscillator

(2) Control of the programmed receiver local oscillator

(3) Control of the programmed received signal amplitude attenuator

(4) Control of the programmed transmitted signal amplitude attenuator

(5) Control of the Ranging Subsystem

(6) Control of status and parameter displays

Control of all functions listed above is under software direction and is performed from the automated control console. From this position, one operator has the ability to control transmitted and received frequencies, simulate RF doppler for both up and down links, establish telemetry signal-to-noise ratios, automatically compute spacecraft ranging delays and RF spectrum analysis. This total capability is unique within the DSN.

Reference

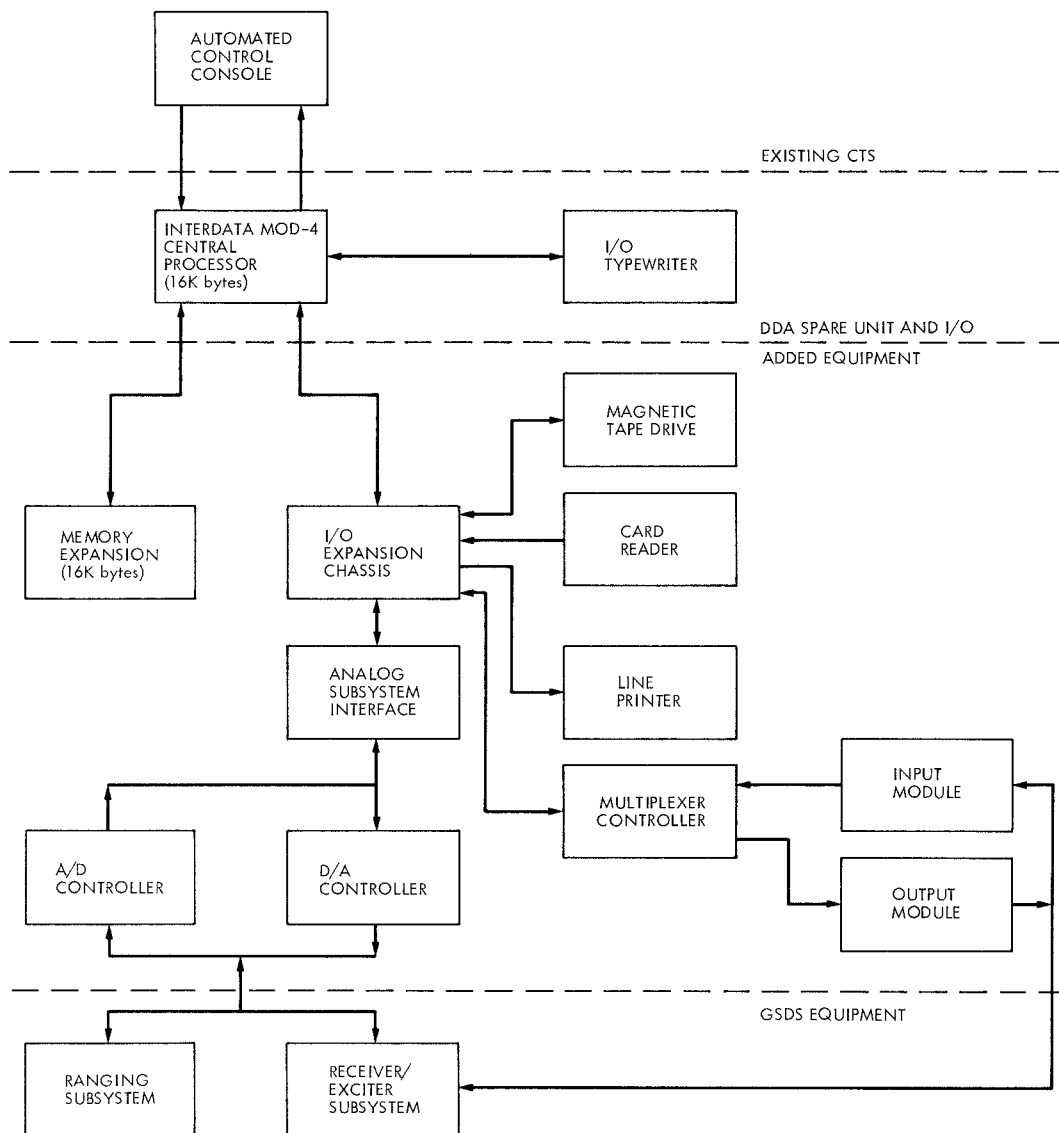1. *Systems Interface Manual,* Publication 29-003R02, Interdata, Inc., Oceanport, New Jersey, August 1969.

Fig. 1. Interdata Model 4 compatibility test system configuration