Mark IIIA Simulation Center Diagnostic Software

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The expansion and reconfiguration of the Deep Space Network (DSN) simulation center to the Mark IIIA configuration necessitated the modification of existing diagnostic software and the development of new diagnostic and test programs. This article describes the characteristics of the diagnostics which were developed for the EMR 6050-Univac 1108 interface and the Interactive Alphanumeric Television Display System.

I. Introduction

The Mark IIIA Simulation Center is presently undergoing development activity in preparation for *Mariner* Mars '71 and *Pioneer F* support. This activity was described in Ref. 1.

The expansion and reconfiguration of the input/output necessitated the modification of existing diagnostic software and the development of new diagnostic and test programs for the SIMCEN. This article describes the characteristics of the diagnostics which were developed for the EMR 6050–Univac 1108 interface and the Interactive Alphanumeric Television System. The EMR 6050–Univac 1108 interface is described in Ref. 2 and the Interactive Alphanumeric Television System is described in Ref. 3.

Other changes were made to the SIMCEN diagnostic software to update the diagnostics to conform to the Mark IIIA configuration as described in Ref. 1.

II. Description

A. EMR 6050–Univac 1108 Interface Diagnostic Software

The EMR 6050–Univac 1108 interface diagnostic software tests the 50-kbits/s serial interface by sending selected patterns to the Univac 1108, receiving the same patterns back, and comparing the data received with the data sent. If the data does not compare, both the sent and received words are printed on the line printer. Additional error detection is provided by a priority interrupt.

There are five individual tests provided by this program. Each of these tests uses a different bit pattern. Any one or all of these tests may be run, depending on the option selected by the operator:

Test 1. Run all tests.

Test 2. Square wave pattern.

Test 3. All zeros pattern.

Test 4. Alternate bits pattern.

Test 5. Random pattern.

Test 6. Six-bit alphanumeric progression pattern.

A separate test (Test 99) has been added to notify the 1108 of the termination of testing. When Test 99 is selected, one block of data with a unique code in data word No. 1 is sent to the 1108. This tells the 1108 that testing is being terminated and it is no longer necessary for the user program that services the 6050 diagnostic to remain in core. The diagnostic does not wait for a reply but immediately terminates itself.

Data is always sent from the 6050 in 100-word blocks preceded by a sync word and followed by an end-of-text word (see Fig. 1 for format).

Data received has the control words stripped off by the hardware. Data may be received in either of two ways (modes) determined by the selected option. In the "single mode," one 100-word block is received for each 100-word block sent. The 100 words received are actually the first 100 words of a 250-word transmission from the 1108. The entire 250 words are received by the 6050 but only the first 100 are checked. In the "multiple mode," five 100-word blocks are received for each 100-word block sent. These five blocks are identical; however, they actually are sent from the 1108 and received by the 6050 as two 250-word blocks.

The data received is compared word-for-word with the data sent; and, if an error is detected, both words are printed in octal under the headings of "expected" and "received." Also included is the block number and the relative location of the word in the block (0–99). An alternative is available as an option. This alternative is to print all data received whether in error or not. This data is printed in the form of an octal dump one block at a time.

Added error detection consists of an interrupt which is activated by one of five error conditions detected and indicated by the interface assembly. The five error conditions are:

(1) *Collision* indicates an attempt to transmit data from the 1108 to the 6050 during the time that data is being transmitted to the 1108 from the 6050.

(2) *Parity* indicates incorrect parity exists in the data received from the 1108.

(3) *Data set* indicates a condition exists at the data set which will not allow successful transmission of data.

(4) *Underflow* indicates the number of words received is less than the number of words expected.

(5) *Overflow* indicates the number of words received is greater than the number of words expected.

There is no software method of indicating which of the five conditions caused the interrupt; however, indicators on the interface assembly panel are available for visual use.

The diagnostic will not transmit a second block of data to the 1108 until the first block has been received back from the 1108.

If the 1108 program is operating in the Real Time mode, an inquiry message or request-to-send block must be sent (see Fig. 2 for format) prior to sending a block of data; however, no response is required from the 1108, and the data block may be sent 10 ms after sending the inquiry message. If the 1108 program is operating in the Super Demand mode, the inquiry or request-to-send is not used. The data block is sent immediately.

B. Interactive Alphanumeric Television Display System Diagnostic Software

The Interactive Alphanumeric Television (IATV) Display System diagnostic software consists of seven tests and an executive routine. The executive routine and the tests are described in the following paragraphs:

Executive Routine. The executive routine operates a pre-test initialization sequence which determines which tests and equipment are required and whether or not the required units are ready. It then sequences the station and test operation.

Test One. This test mode operates all the tests described in the succeeding paragraphs.

Test Two—Basic Channel Functions. This test generates conditions and issues commands to test the channel adapter status word and the multiplexer status word. One of the two printers is used to generate interrupts. If a printer is not available, interrupt status bits in the channel adapter and the multiplexer will not be tested.

Test Three—Station Functions. The following station control functions are tested:

(1) Select alphanumeric mode

(2) Select graph mode

(3) Enable refresh

(4) Disable refresh

(5) Enable transmit

(6) Disable transmit

(7) Request status

Test Four—Cursor Addressing and Movement. Cursor address register functions are tested by loading and reading a complement pattern and by issuing all cursor control characters in displaying a visual pattern.

Test Five—Marching Alpha and Data Transfer. In this test, a marching alphanumeric pattern is written and read back to detect data transfer and interrupt sequence errors. An error summary is printed at the end of each pass, and (with the log option) data errors are logged in hexadecimal.

Test Six—Echo Test. The stations are polled for transmit ready or interrupt conditions. When one of these conditions exists, the line on which the cursor is located is read in and then written to the station 19 times to fill the screen.

Test Seven—Hardcopy Test. An 80-character, marching alpha pattern is cycled in six 12-line blocks so that each character is printed in every type position. End of print operation interrupts are monitored and errors are logged.

III. Summary

In this era of expanding technology, it is becoming commonplace to interface data processing devices such as the EMR 6050 and the Univac 1108 computers and to have alphanumeric CRT-keyboard display systems as computer input/output devices. Given these types of systems, it is important to design meaningful diagnostic and test programs to provide a high level of assurance that the devices are working properly, and if not, to provide some meaningful error indications so that the problem can be fixed in a short time.

These were the problems here. The diagnostic routines generated were conceptually relatively simple, but in their simplicity, they were able to accomplish the complex task of providing a high level of confidence that the computers were talking to each other in the same language and without errors and that the IATV system was working properly.

References

1. Polansky, R. G., "DSN Mark IIIA Simulation Center Development," in *The Deep Space Network*, Space Programs Summary 37-65, Vol. II, pp. 94–96. Jet Propulsion Laboratory, Pasadena, Calif., Sept. 30, 1970.
2. Leahey, C. F., "Mark IIIA Simulation Center EMR 6050–Univac 1108 Computer Interface," in *The Deep Space Network*, Technical Report 32-1526, Vol. I, pp. 88–92. Jet Propulsion Laboratory, Pasadena, Calif., Feb. 15, 1971.
3. Leahey, C. F., "Mark IIIA Simulation Center Interactive Alphanumeric Television System," in *The Deep Space Network*, Technical Report 32-1526, Vol. II, pp. 100–107. Jet Propulsion Laboratory, Pasadena, Calif., Apr. 15, 1971.

SYNC WORD	26_8	26_8	00	00
DATA WORD 1	XX	XX	XX	XX
DATA WORD 2	YY	YY	YY	YY
DATA WORD 100	ZZ	ZZ	ZZ	ZZ
END-OF-TEXT WORD	00	00	00	00

Fig. 1. Data block format

WORD 1	03_8	05_8	26_8	26_8
WORD 2	00	00	00	00

Fig. 2. Request-to-send block format