High-Speed Data Communication: A Description of Software Techniques

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Some methods are described of using the high-speed data assembly of the Ground Communications Facility operating at 4.8 kbps and the Xerox Data Systems (XDS) 920 computers for keeping the Deep Space Stations supplied with up-to-date programs and documentation. The present method for transmitting this information employs magnetic tapes, punched tapes, and hardcopy documentation transmitted by mail or air freight.

I. Introduction

The present system of keeping stations supplied with up-to-date programs and documentation is to dispatch magnetic tapes, punched tapes, and documentation by mail or air freight. This article describes some methods of using the high-speed data assembly (HSDA) operating at 4.8 kbps and Xerox Data Systems (XDS) 920 computers for this communication.

II. Description of Data Transmission

Blocks of high-speed data (HSD) require codes such as a synchronization code for the start of a block, source, and destination code and a code to route the block to the appropriate computer. During initialization this information is entered on the typewriter connected to the computer in the form of answers to an interrogation (e.g., STATION ID=). After these codes have been allocated space in the HSD block, the programmer is left with 44 full 24-bit words for other information. The method of transmission adopted requires the following extra information to be included in a block of HSD:

(1) An indication to the remote station that a block has been received with a bad error status and not stored.

(2) Address information of where to store the message or effective data of the block.

(3) Whether it is a one-only block.

(4) Whether it is a first block with more to follow.

(5) Whether it is a last block.

(6) Whether it is an intermediate block.

(7) If it is (3) or (5), an indication of which peripheral device the data are for and how much are to be outputted.

(8) A serial number for each block.

The desired information for (1) to (6) uses one 24-bit word. An additional three words are used for blocks of type (6) with information for peripheral devices and where programs should commence. The serial number of (8) is accommodated in a ½ word available in word 49. This leaves space for 43 words of data in the first and intermediate blocks. Last blocks have space available for 40 words of data.

III. High-Speed Data Validation Techniques

A simplified flowchart of HSD validation is presented in Fig. 1.

A. Sending

A HSD block is sent with an initial serial number of zero.

B. Receiving

The receive computer examines the GCF error status. If the block is in error the data are not stored and word 4 is made all 1s and the block sent back for verification. If the error status is good, words 5 to 48 are stored in the area indicated by word 4 and sent back for verification. If the block serial number is the same as a previous block received, the data are not stored and the block is sent back for verification.

C. Sending

After sending a block, the sending program waits for a block to be returned for verification. If a block is not returned within 2 s, the block is sent again. If the error status of the returned block is bad, the block is sent again. Word 4 is examined and if it is all 1s (indicating an error at the receive station) the block is sent again. If word 4 is not all 1s, words 4 to 48 are then compared with the original data sent. If they do not compare, the block is sent again. If the data verify correctly, the serial number is incremented by 1 and the next block of data is sent.

IV. Media Validation Techniques

After a program has been received and punched on paper tape or written on magnetic tape, two levels of validation are available:

(1) A simple check sum is made of all characters with a punched tape. Similarly a check sum is made of all words on a magnetic tape.

(2) An extremely accurate check can be made by using the Ground Communications Facility (GCF) error detector encoder. The HSD program is initialized to return data to itself while simulating transmission of a program. As each HSD block is returned, the 33-bit polynomial check code is punched onto tape. The resultant tape must be the same every time the check is performed with an identical program.

V. Documentation Preparation

The Editor Program DOI-5250-SP can be used to produce a punched paper tape ready for transmission. Source programs which are stored on punched cards can be transferred to punched paper tape by use of the Media Program DOI-5012-SP-A. Then the program can be assembled locally by use of Monarch DOI-5254-SP-A, and the receiving station can produce as many listings of the program as desired.

Standard forms can be prepared by use of the Editor Program and stored on punched paper tape. The typist can then make the required entries and produce tapes for transmission.

VI. Future Expansion

Very often a computer is not available for document preparation. Preparation on an off-line teletype machine could be performed. A simple conversion program to convert from 5-level TTY code to 7-level XDS code is being considered. An addition to the Editor Program to enable direct writing onto magnetic tape is also being considered.

The program has also included an option which allows programs to be sent to core and operate, e.g., a magnetic tape test. By careful programming it can be arranged to return to the HSD program with results of the test. This portion of the program has not been exercised at the time of writing this article.

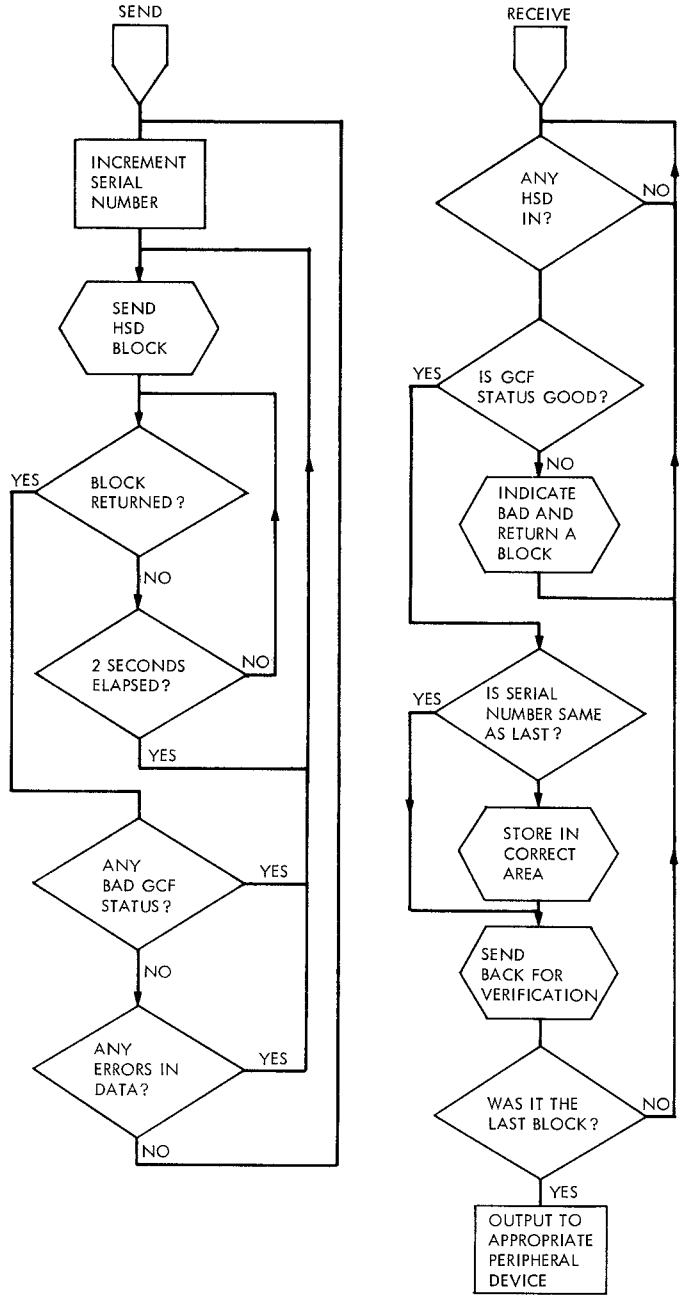

Fig. 1. Simplified flowchart of HSD validation