

EDITED BY CUSTOMER ENGINEERING DIVISION

October 25, 1978

WANG HASP EMULATOR WITH 2200 SYSTEMS

1.	INTRODUCTION	2
1.1	DESCRIPTION OF HASP WORKSTATION EMULATOR	2
1.2	HASP SPECIFICATION	3
2.	SYSTEM REQUIREMENTS	6
2.1	MINIMUM SYSTEM REQUIREMENTS	6
2.2	COMMUNICATIONS CONTROLLER INSTALLATION PROCEDURE	7
2.3	MODEMS	7
2.4	MODEM INTERFACE (RS-232-C)	13
3.	OPERATING PROCEDURE FOR THE HASP EMULATOR	15
4.	DIAGNOSTICS	15
4.1	OFF-LINE DIAGNOSTICS	15
4.2	ON-LINE SYSTEM CHECKOUT	15
4.2.1	GENERAL	15
4.2.2	WANG DATA CENTER PHONE NUMBERS	16
4.2.3	PREPARING JCL FILE	16
4.2.4	SIGNON PROCEDURE	17
4.2.5	BRIEF ON-LINE SYSTEM CHECKOUT	18
4.2.6	ON-LINE SYSTEM CHECKOUT (TRANSMIT JCL)	19
5.	WANG HASP EMULATOR	20
5.1	MULTI-LEAVING	20
5.2	WANG HASP PERFORMANCE CONSIDERATIONS	30

NOTICE:

This document is the property of Wang Laboratories, Inc. Information contained herein is considered company proprietary information and its use is restricted solely to the purpose of assisting you in servicing Wang products. Reproduction of all or any part of this document is prohibited without the consent of Wang Laboratories.



LABORATORIES, INC.

1 INDUSTRIAL AVENUE, LOWELL, MASSACHUSETTS 01851, TEL (617) 851-4111, TWX 710 343-6769, TELEX 94-7421

Printed in U.S.A.
13-210A

1. INTRODUCTION

1.1 DESCRIPTION OF HASP WORKSTATION EMULATOR

As an extension to IBM's System/370 Operating Systems, HASP provides supplementary job management, data management, and task management functions such as control of job flow, ordering of tasks, and spooling. Special HASP programs allow remote IBM systems and terminals equipped with binary synchronous communications (BSC) facilities to operate as HASP Multi-leaving remote workstations.

Multi-leaving is an advanced technique which improves the throughput capability of half duplex BSC protocols. During transmission to and from a central computer site, multiple batch jobs are inter-leaved to accommodate differences in the data handling rates of various input and output devices.

Wang's HASP Multi-leaving Emulation software, in conjunction with a communications controller, allows particular Wang systems to communicate with any host computer supporting HASP or equivalent BSC multi-leaving protocols. A Wang system, while operating as a remote HASP workstation, supports bidirectional data stream transmission between the central and the local site. It is possible to transmit a file, receive print data to a printer and punch data to a disk or diskette, and exchange console messages with the central site - with all the operations inter-leaved and seemly concurrent.

A HASP multi-leaving environment is suitable for high volume batch data communications requirements. Input, output, and command processing can be achieved concurrently to increase the system throughput. Efficient record blocking with space and character compression minimizes line transmission time for high volume communications users.

The HASP Workstation Emulation software is available as a part of the new Binary Synchronous I (BSC I) Telecommunications Package.

FEATURES

- . Full HASP multi-leaving compatibility
- . Line speeds up to 4800 bps (bits per second)
- . Space and character compression
- . Card reader, printer, disk or diskette support
- . Concurrent input, output, and console operations
- . Transparent or non-transparent transmission
- . Automatic disk overflow handling
- . Print spooling to disk or diskette for print data streams

1.2 HASP SPECIFICATIONS

PACKAGE NUMBER

195-2057 (BSC-1) - Diskette (#701-2357)

195-2057-8 (BSC-1) - Mini-diskette (#701-8111)

EMULATION

HASP Multi-leaving protocol.

LINE DISCIPLINE

BSC point-to-point operation on dial-up or leased lines
(half duplex).

LINE SPEEDS

1200, 2000, 2400, or 4800 bps.

MODEMS

For local connections up to 100 feet (30.5m) at speeds up to 4800 bps, a 2228N (W.L. #177-2228N) null modem (available from Wang) may be used RS-232-C cables.

For connections up to 25 miles (40.2km) over private lines, Short Haul modems may be used.

For connections over common carrier telephone lines, the following Bell or equivalent modems may be used. Refer to Tables 2.1 and 2.2:

Bell 212A for 1200 bps.

Bell 201A for 2000 bps.

Bell 201B for 2400 bps.

Bell 201C for 2400 bps.

Bell 208A for 4800 bps.

Bell 208B for 4800 bps.

CONTROLLER

Depending upon the Wang system, one of the following communications controllers is required: 2228B, Option 62B or 9019B.

HARDWARE

Disk or diskette based system:

- . PCS II with Option 62B.
- . 2200 Workstation with Option 9019B.
- . 2200T, VF or MVP with a 2228B.

MEMORY REQUIRED

16K for receive to printer only.

24K for disk receive support.

CODE TRANSLATION

From ASCII to line code (EBCDIC) for non-transparent send (optional translation for transparent send).

From line code (EBCDIC) to ASCII for non-transparent receive (optional translation for transparent receive).

ERROR DETECTION

Receive block sequence checking and CRC block checking.

RECORD LENGTH

Variable (up to 132 bytes).

BLOCK SIZE

Up to 512 bytes, including line control.

COMMUNICATES WITH

Any host system supporting HASP or equivalent multi-leaving protocol.

OPERATION MODES

- . Keyboard, card reader, or disk/diskette send (non-transparent).
- . Card reader or disk/diskette transparent send.
- . Printer or disk/diskette (non-transparent).
- . Disk/diskette transparent receive.
- . Attention (to specify a receive file name).

TRANSMITS FROM

- . Keyboard
- . Card reader
- . Disk or diskette

RECEIVES TO

- . CRT for console data streams.
- . Printer or optionally spooled to disk/diskette for print data streams.
- . Disk or diskette for punch data streams (unless optionally disabled).

DISK FILE FORMAT

Wang's TC file format supporting variable length records is used for disk/diskette transmission or reception. A Wang-supplied program handles offline printing of spooled print files.

CUSTOMIZING

None required for described operation.

OPTIONS

- . Print streams received to printer or spooled to disk/diskette.
- . Punch streams disabled or received to disk/diskette with or without translation.
- . Multiplexed disk (yes or no).

2. SYSTEM REQUIREMENTS

2.1 MINIMUM SYSTEM REQUIREMENTS

The following items are required for use of the HASP emulator software with a Wang computer system:

1. Diskette or mini-diskette based system:
 - . PCS II with Optional 62B
 - . 2200 Workstation with Option 9019B
 - . 2200T, VP, or MVP with a 2228B
2. Peripheral devices:
 - . CRT
 - . Keyboard
 - . Disk/diskette/mini-diskette drive
 - . Line printer
 - . Hopper feed card reader (Optional)
3. Wang HASP emulator program:
 - . Diskette version (WL #701-2357)
 - . Mini-diskette version (WL #701-8111)

4. T.C. cable (WL #220-0113):

- . One for modem connection
- . Two for 2228N null modem connection

5. Modem:

- . Either a 2226N null modem (WL #177-2228N) for local connections up to 100 feet, or
- . Bell or equivalent modem (customer supplied). Refer to Section 2.3

2.2 COMMUNICATIONS CONTROLLER INSTALLATION PROCEDURE

Refer to Service Bulletin No. 77 for the installation procedure of either a 2228B (Section 2.2) or an Option 62B (Section 2.3). Since the Option 9019B is actually an Option 62B used with a 2200 workstation, the installation procedure for the Option 9019B is the same as for an Option 62B.

2.3 MODEMS

The modem, or dataset, used with system may be rented from the telephone company or purchased from any one of several modem vendors. If the modem is purchased from a commercial modem vendor, then it may be connected to the switched telephone network in one of two ways, depending upon the modem selected. As of June 1, 1977, the telephone companies will provide dial-up telephone lines with data jacks to allow direct connection of FCC certified modem equipment to the telephone line. If this is the case, then ensure that the telephone company has installed the data jack before installing the TC option. If the modem is not a certified modem for direct connection, then the modem must be connected to the telephone network via telephone company installed data access arrangement (DAA). The DAA consists of a telephone handset and a modem interface rented from the telephone company. Usually a modem, data jack, or DAA is permanently wired to a wall; therefore, it should be installed as close as possible to the Wang computer system.

NOTE:

Ordering of a modem, DAA, or data jack for a Wang Customer is not the responsibility of a Wang Salesman nor is the installation of these devices the responsibility of a Wang Serviceman. Refer to Table 2.2 for a list of the options that must be selected for each modem.

The modems used at both ends of a communications line must be compatible. For example, if a BELL 201C type modem is used at one end, another BELL 201C or equivalent must be used at the other end (not a 201A, 208B, 202C, or 202S). The modems listed in Table 2.1 or their equivalent may be used.

Compatible Modems for the 3275 Software

Short haul modems may be used for connections up to 25 miles (40.2 km) over private lines. For connections over common carrier telephone lines, the following modems may be used:

<u>Modem</u>	<u>Line Speed</u>
(Bell type of equivalent)	
212A	1200 bps (with restrictions)
201A	2000 bps (dial-up line)
201B	2400 bps (leased line)
201C	2400 bps (dial-up/leased line)
208A	4800 bps (leased line)
208B	4800 pbs (dial-up line)

Usually, modem which support higher line speeds are more expensive; however, expense is not the only criterion to use when choosing a modem.

A modem must be compatible with the host system's communications requirements, also. For example, although Wang's HASP software supports use of a Bell 212A modem (strapped for synchronous, internal timing at 1200 bps), this modem operates only in the full duplex mode and is not suitable for a host system which requires true half duplex operation. If a host system requires active Request to Send (RTS) and Clear to Send (CTS) modem signals, the continuous CTS signal presented by the 212A modem is not acceptable.

Sometimes a facility has several telephone numbers representing separate lines for communications, but the modem characteristics and line speed associated with these telephone lines may differ. The Wang system user who is responsible for coordinating communications with a particular facility should determine which telephone numbers are appropriate, and these numbers should be posted near the Wang system for the convenience of other users who may need to communicate with the host system.

NOTE:

Modems used at both ends of a communications line must have the same characteristics, including the line speed. Do not expect to communicate with a remotely located host system if the modem connected to the Wang system is not compatible with the HASP software and the remote system.

TABLE 2.1
SYNCHRONOUS BELL MODEMS

<u>BELL MODEM</u>	<u>SPEED (bps)</u>	DESCRIPTION
201A	2000 bps	- obsolete - half-duplex (dial-up or 2-wire private line) - full-duplex (4-wire private line)
201B	2400	- half-duplex (2-wire private line) - full-duplex (4-wire private line)
201C	2400	- half-duplex (dial-up or 2-wire private line) - full-duplex (4-wire private line)
208A	4800	- half-duplex (4-wire private line) - full-duplex (4-wire private line)
208B	4800	- half-duplex (dial-up line)
212A	1200	- full-duplex (dial-up line) - also operates in asynchronous mode

TABLE 2.2
REQUIRED MODEM OPTIONS

<u>BELL MODEM</u>	<u>OPTIONS</u>
201A or 201B	<ul style="list-style-type: none">. internal transmitter timing. EIA electrical interface. half-duplex circuit type. carrier controlled by Request-to-send (RTS). without new Sync
201C	<ul style="list-style-type: none">. internal transmitter timing. EIA electrical interface. 2-wire data set line interface. switched carrier control. Request-to-send (RTS)/ Clear-to-send (CTS) delay of 150ms (dial-up operation). without new Sync. AB (signal ground) connected to AA (frame ground)
208A	<ul style="list-style-type: none">. internal transmitter timing. switched carrier control. switched Request-to-send (RTS). without new Sync. CC (Data Terminal Ready) indication of Analog loopback ON. AB (signal ground) connected to AA (frame ground)
208B	<ul style="list-style-type: none">. internal transmitter timing. CC (Data Terminal Ready) indication of Analog loopback ON. AB (signal ground) connected to AA (frame ground)

TABLE 2.2 (Continued)

212A

- . internal transmitter timing
- . synchronous 1200 bps operation
- . high speed mode
- . CB (Clear-to-Send) and CF
(Carrier Detect) indications
common
- . CC (Data Terminal Ready)
indication of Analog loopback ON
- . AB (signal ground) connected to
AA (frame ground)

2.4 MODEM INTERFACE (RS-232-C)

The 2228C controller conforms to the nationally recognized EIA RS-232-C and the internationally recognized CCITT V.24 standards for voltage levels and pin connections (refer to PRODUCT SERVICE TELEPROCESSING GUIDE, page 76). The signal polarity and the voltage of driven and detected signals are as follows:

<u>Logic Level</u>	<u>Applied Voltage</u>	<u>Detected Voltage</u>
0 or ON (Spacing)	+8 vdc	+5 to +15 vdc
1 or OFF (Marking)	-8 vdc	-5 to -15 vdc

The pin assignments are listed in Table 2.3 with both the EIA and the CCITT designations given for the circuit associated with each pin. Also, the signal descriptions and sources are included in the table.

TABLE 2.3
RS-232-C CONNECTOR PIN ASSIGNMENT

<u>PIN</u>	<u>EIA</u>	<u>CCITT</u>	<u>SIGNAL DESCRIPTION</u>	<u>SOURCE</u>
1	AA	101	Protective Ground	
2	BA	103	Transmitted Data	Controller
3	BB	104	Received Data	Modem
4	CA	105	Request to Send	Controller
5	CB	106	Clear to Send	Modem
6	CC	107	Data Set Ready	Modem
7	AB	102	Signal Ground	
8	CF	109	Received Line Signal Detector	Modem
9*				
10*				
11	SCA	120	Secondary Request to Send	Controller
12	SCF	122	Secondary Rec'd Line Sig. Det.	Modem
13*	SCB	121	Secondary Clear to Send	Modem
14*	SBA	118	Secondary Transmitted Data	Controller
15	DE	114	Trans. Signal Element Timing	Modem
16*	SBB	119	Secondary Received Data	Modem
17	DD	115	Receiver Signal Element Timing	Modem
18*		124	Select Frequency Groups	Controller
19	SCA	120	Secondary Request to Send	Controller
20	CD	108.2	Data Terminal Ready	Controller
21*	CG	110	Signal Quality Detector	Modem
22*	CE	125	Ring Indicator	Modem
23*	CH/CI	111/112	Data Signalling Rate Selector	Controller/ Modem
24*	DA	113	Trans. Signal Element Timing	Controller
25*			Unassigned	

*Denotes signals not used by the 2228B/Option 62B/Option 9019B

3. OPERATING PROCEDURE FOR THE HASP EMULATOR

The configuration generation and operating procedure for the HASP Workstation Emulator are contained in Service Bulletin No. 77.1. Please refer to page 34 for the HASP emulator configuration generation instructions and page 54 for the HASP emulator operating procedure.

4. DIAGNOSTICS

4.1 OFF-LINE DIAGNOSTICS

Please refer to Service Bulletin No. 77 for the operating procedures for the off-line diagnostics for the 2228B (Section 4.1.2) and the Option 62B (Section 4.1.4). Since the hardware of the Option 9019B is functionally equivalent to that of the 2228B, the same diagnostics used for the 2228B can be used to check an Option 9019B.

4.2 ON-LINE SYSTEM CHECKOUT

4.2.1 GENERAL

The suggested method of on-line system checkout (when applicable) for the Communications Controller using the HASP emulator is a telephone hook-up with a Remote Job Entry (RJE) port with the IBM 370/158 host computer at the Wang Data Center in Burlington, MA (business telephone number (617) 272-8550). The Data Center supports HASP protocol. An alternate method of on-line checkout is to arrange a test with the Home Office.

NOTE:

These methods are only to be used if the on-line checkout with the customer's remote site fails.

RULES FOR USING DATA CENTER FACILITIES

1. The signon procedures and keywords are strictly for customer engineering personnel use only.

2. Under no circumstances the signon or keyword be given to a customer for the protection of data base at the Wang Data Center. Please remember that IBM 370 at Wang Data Center is a time sharing system used by many of its customers.
3. Please limit your on-line checkout time to 10-15 minutes at a time as you may tie up the line for data center customers.
4. Before calling Home Office for assistance, the on-line check must be performed.
5. Successful checkout does insure that you have checked out functioning of hardware, software and modem. It does not checkout any variations in protocols or signon procedure customer may encounter when using other remote host computers.

4.2.2 WANG DATA CENTER PHONE NUMBERS

*Model 201A MODEM (2000 BAUD) 617-272-9460
*Model 201C MODEM (2400 BAUD) 617-272-6223,24
*Model 208B MODEM (4800 BAUD) 617-272-4060

*or equivalent Modems

4.2.3 PREPARING JCL FILE

JCL Records

Prepare JCL (Job Card Language) records as a file, exactly as shown below.

Column 1

28

```
//W42 JOB MAC,PRTY=8,CLASS=A  
/*ROUTE PRINT REMOTE31  
// EXEC PGM=IEBGENER  
//SYSPRINT DD SYSOUT=A  
//SYSIN DD DUMMY  
//SYSUT2 DD SYSOUT=A  
//SYSUT1 DD *
```


4.2.4 SIGNON PROCEDURE

- A. Load the HASP emulator program in the 2200 system according to the instructions in Service Bulletin No. 77.1.
- B. Enter the SIGNON ENTRY mode by keying S.F. '4 (SIGNON). The CRT will display:

```
ENTER SIGNON '0 ABORT  
....!....1....!....2....!....3....!....4....!....5....!....6....!
```

- C. Key in the following signon:

```
....!....1....!....2....!....3....!....4....!....5....!....6....!  
/*SIGNON REMOTE31 WDFJCASN
```

- D. Dial the appropriate Data Center phone number listed in Section 4.2.2 for your particular modem. Remember that the phone numbers are assigned according to the type of modem.
- E. After a few rings, the Data Center modem will answer itself automatically and present a clear carrier tone on the line. Push the DATA button on the modem telephone set. The DATA button light must be lit once the phone connection is established in the above fashion: it will stay lit until the phone line is disconnected.
- F. Key the RETURN(EXEC) key to transmit the signon. When the transmission has been completed, the message "SIGNON MESSAGE SENT" will be displayed on the 2200 workstation screen. At this point, you should be signed on to the computer (NOTE: the computer will not normally transmit anything in response to a proper signon unless the results of the previously queued job are ready). If the line is dropped from the remote end, then signon may have been incorrect or transmission problems may have occurred. For this case, repeat the signon procedure.

4.2.5 BRIEF ON-LINE SYSTEM CHECKOUT

After successfully completing the signon procedure in Section 4.4.4, the following brief on-line system checkout is suggested.

- A. Enter the CONSOLE ENTRY mode by keying S.F. '3 (CONSOLE). The CRT will display:

```
CONSOLE ENTRY '0 ABORT
....!....1....!....2....!....3....!....4....!....5....!....6....!
```

- B. Key in the following HASP command which will display all active HASP jobs:

```
....!....1....!....2....!....3....!....4....!....5....!....6....!
$DA
```

- C. Key the RETURN(EXEC) key to transmit the console message.

When the transmission has been completed, the message "CONSOLE MESSAGE SENT" will be displayed on the 2200 workstation screen.

- D. The computer should reply with a list of all active HASP jobs on the system. The received console message will be of the form:

CONSOLE MESSAGES RECEIVED

```
$10.52.02 JOB 9188 DTCAFLAD ON PRINTER2 PRIO 15
$10.52.02 JOB 8401 PE$AEL45 ON RM23.PR1 PRIO 13
$10.52.02 JOB 9242 W5$AELTJ ON RM14.PR1 PRIO 12
$10.52.02 JOB 9254 ST$AELX9 ON RM12.PR1 PRIO 10
$10.52.02 JOB 9251 WO$AFLXQ ON RM40.PR1 PRIO 9
$10.52.02 JOB 9246 DAKAFLT8 EXECUTING B PRIO 6
$10.52.02 JOB 9181 DT#AFK8R EXECUTING A PRIO 6
$10.52.02 JOB 9265 W2$AFL4T EXECUTING E PRIO 6
$10.52.02 JOB 9148 MD$AFKXM ON RM22.PR1 PRIO 3
$10.52.02 JOB 9093 W45AFJ6G EXECUTING M PRIO 2
```

4.2.6 ON-LINE SYSTEM CHECKOUT (TRANSMIT JCL)

After successfully completing the signon procedure in Section 4.4.3, the following on-line system checkout is suggested.

- A. Enter the SEND mode by keying S.F. '2 (SEND). The CRT will display:

```
SEND FROM DISK '0 ABORT  
1 = NORMAL 2 = TRANSPARENT
```

- B. Key 1 and RETURN(EXEC). The CRT will display:

```
ENTER DISK ADDRESS. 1 = 310 2 = B10 3 = 320 4 = B20
```

- C. Key in the number corresponding to the address of the disk/diskette where the JCL file of Section 4.2.3 was stored. Key RETURN(EXEC). The CRT will display:

```
ENTER FILE NAME 01
```

- D. Enter the name of the file that contains the proper JCL file. Key RETURN(EXEC). The CRT will display:

```
ENTER FILE NAME 02
```

- E. Key the RETURN(EXEC) key to transmit the file from disk. When the transmission has been completed, the messages "SENDING" and then "DONE" will be displayed on the 2200 workstation screen. The computer should immediately respond with a console message of the form:

```
CONSOLE MESSAGES RECEIVED  
$ 10.40.36 JOB 5924 ON RM31.RD1 -- W4$AS1YK
```

- F. This message indicates that JCL job just transmitted is now queued on the computer. Depending on the time of the day that you dial the computer, 10 to 15 minutes may elapse before any data is received from the computer. During this time, no data activity is taking place. When data is received, it will contain the same JCL that you sent to the computer, plus certain miscellaneous information relating to your job ID number, computer center notice, etc.

NOTE:

Make sure that the printer is selected; otherwise the reception of the data from the computer will be inhibited.

NOTE:

(OPTIONAL)

If you do not get a response within 5 minutes, disconnect (hang-up) and re-dial after 15 or 20 minutes. When you re-dial you must send just the SIGN-ON message so that computer can recognize your terminal number and route the data. You may come across situations where during waiting someone else may sign on with same sign on procedure and your data may be routed to his system.

5. WANG HASP EMULATOR

5.1 MULTI-LEAVING

"MULTI-LEAVING is a term which describes a computer-to-computer communication technique developed for use by HASP. In a gross sense, MULTI-LEAVING can be defined as the fully synchronized, pseudo-simultaneous, bi-directional transmission of variable number of data streams between two or more computers utilizing binary synchronous communications (BSC) facilities. The following informatin describes, in general terms, the basic structure of MULTI-LEAVING.

The basic element for MULTI-LEAVING transmission is the character string. One or more character strings are formed from the smallest external element of transmission - the physical record. These physical records are input to MULTI-LEAVING and may be any of the classic record types (card images, printed lines, tape records, etc). For efficiency in transmission, each of these data records is reduced to a series of character strings of two basic types. These two types are: (1) a variable length nonidentical series of character and, (2) a variable number of identical characters. Because of the high frequency occurrence of blank characters, a special case is made in 2 when the duplicate character is a blank. An eight bit control field, termed a String Control Byte (SCB), precedes each character string to identify the type and length of the string. Thus, a string as in 1 above is represented by an SCB followed by the nonduplicate characters. A string of consecutive, duplicate, nonblank characters can be represented by an SCB and a single character (the SCB indicates the duplication count and the character following indicates the character to be duplicated. In the case of an all blank character string, only an SCB is required to indicate both the type and number of blank characters. A data record to be transmitted is, therefore, segmented into the optimum number of character strings (to take full advantage of the identical character compression) by the transmitting program. A special SCB is utilized to indicate the grouping of character strings which compose the original physical record. The receiving program can then reconstruct the original record for processing.

In order to allow multiple physical records of various types to be grouped together in a single transmission block, an additional eight bit control field precedes the group of character strings representing the original physical record. This field, the Record Control Byte (RCB), identifies the general type and function of the physical record (input stream, print stream, data set, etc). A particular RCB type has been designated to allow the passage of control information between the various systems. Also, to provide for simultaneous transmission of similar functions (i.e., multiple input streams, etc.) a stream field, the Sub-Record Control Byte (SRCB) is also included immediately following the RCB. This field is utilized to supply additional information concerning the record to the receiving program. For example, in the transmission of data to be printed, the SRCB can be utilized for carriage control information.

For actual MULTI-LEAVING transmission, a variable number of records may be combined into a variable block size, as indicated previously (i.e., RCB, SRCB, SCB1, SCB2, ...SCBn, RCB, SRCB, SCB1,...etc.). The MULTI-LEAVING design provides for two (or more) computers to exchange transmission blocks, containing multiple data streams as described above, in an interleaved fashion. To allow optimum use of this capability, however, a system must have the capability to control the flow of a particular data stream while continuing normal transmission of all others. This requirement becomes obvious if one considers the case of the simultaneous transmission of two data streams to a system for immediate transcription to physical I/O devices of different speeds (such as two print streams). To provide for the metering of the flow of individual data streams, a Function Control Sequence (FCS) is added to each transmission block. The FCS is a sequence of bits, each of which represent a particular transmission stream. The receiver of several data streams can temporarily stop the transmission of a particular stream by setting the corresponding FCS bit off in the next transmission to the sender of that stream. The stream can subsequently be resumed by setting the bit on.

Finally, for error detection and correction purposes, a Block Control Byte (BCB), is added as the first character of each block transmitted. The BCB, in addition to control information, contains a module 16 block sequence count. This count is maintained and verified by both the sending and receiving systems to exercise a positive control over lost or duplicated transmission blocks.

In addition to the normal binary synchronous text control characters (STX, ETB, etc.), MULTI-LEAVING utilizes two of the BSC control characters - ACKO and NAK. ACKO is utilized as a "filler" by all systems to maintain communications when data is not available for transmission. NAK is used as the only negative response and indicates that the previous transmission was not successfully received. The following figure indicates the format of a typical MULTI-LEAVING transmission block.

bytes

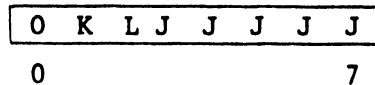
DLE	-	BSC Leader (SOH if no transparency feature)
STX	-	BSC START-OF-TEXT
BCB	-	Block Control Byte
FCS	-	Function Control Sequence
FCS	-	Function Control Sequence
RCB	-	Record Control Byte for record 1
SRCB	-	Sub-Record Control Byte for record 1
SCB	-	String Control Byte for record 1
DATA	-	Character String
SCB	-	String Control Byte for record 1
DATA	-	Character String
SCB	-	Terminating SCB for record 1
RCB	-	RCB for record 2
SRCB	-	SRCB for record 2
SCB	-	SCB for record 2
DATA	-	Character String
SCB	-	Terminating SCB for record 2
RCB	-	Transmission Block Terminator
DLE	-	BSC Leader - (SYN if no transparency feature)
ETB	-	BSC Ending Sequence

Typical MULTI-LEAVING Transmission

MULTI-LEAVING Control Specification

The following pages indicate the bit-by-bit definitions of the various MULTI-LEAVING control fields and notes concerning their utilization.

String Control Byte (SCB)



Usage: Control field for data character strings

Bit Meanings: 0 = 0 = End of record (K L J J J J J = 0)

0 = 1 = All other SCBs

K = 0 = Duplicate Character String

L = 0 = Duplicate Character is blank

L = 1 = Duplicate Character is nonblank
(and follows SCB)

JJJJ = Duplication count

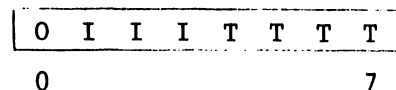
K = 1 = Nonduplicate Character String

LJJJJ = Character String Length

NOTES:

1. If KLJJJJ = 0 and 0 = 1, SCB indicates record is continued in next transmission block.
2. Count units are normally 1 but may be in any other units. The units utilized may be indicated as function control sign-on or dynamically in the SRCB.

Record Control Byte (RCB)



Usage: To identify each record type within a transmission block

Bit meaning: 0 = 0 = End of transmission block (I I I T T T T = 0)

0 = 1 = All others RCBs

III = Stream identifier - used to identify streams of multiple identical functions (i.e., multiple print streams to a multiple printer terminal, etc.)

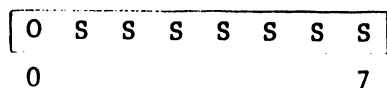
III = Control information if TTTT = 0 (control record)

- = 000 = Reserved for future expansion
- = 001 = Request to initiate a function transmission (Prototype RCB for function in SRCB)
- = 010 = Permission to initiate a function transmission (RCB for function contained in SRCB).
- = 011 = Reserved
- = 100 = Reserved
- = 101 = Available for local modification
- = 110 = Available for local modification
- = 111 = General Control record (type indicated in SRCB)

TTTT = Record type identifier

- = 0000 = Control record
- = 0001 = Operator message display request
- = 0010 = Operator command
- = 0011 = Normal input record
- = 0100 = Print record
- = 0101 = Punch record
- = 0110 = Data set record
- = 0111 = Terminal message routing request
- = 1000 - 1100 = reserved for future expansion
- = 1101 - 1111 = Available for local modifications

Sub-Record Control Byte (SRCB)

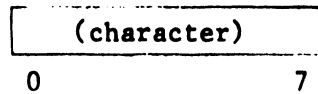


Usage: To provide supplemental information about a record

Bit Meanings: 0 = 1 (Must always be on).

SSSSSS = Additional record information - actual content is dependent on record type. Several examples are listed below:

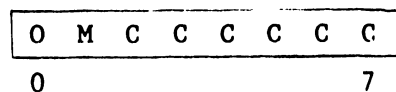
SRCB for General Control Record



Usage: To identify the type of generalized control record

- Bit Meanings: character = A = Initial terminal SIGN-ON
= B = Final terminal SIGN-OFF
= C = Print initialization record
= D = Punch initialization record
= E = Input initialization record
= F = Data set transmission initialization
= G = System configuration status
= H = Diagnostic control record
= I - R = Reserved
= S - Z = Available for local modification

SRCB for Print Records



Usage: To provide carriage control information for print records

Bit Meanings: 0 = 1 (must always be on)

M = 0 = Normal carriage control
= 1 = Reserved for future use

CCCCC = Carriage control information
= 1000NN = Space immediately NN spaces
= 11NNNN = Skip immediately to channel NNNN
= 0000NN = Space NN lines after print
= 001100 = Load 3211 FCB image
= 01NNNN = Skip channel NNNN after print
= 000000 = Suppress space

SRCB for Punch Records

O	M	M	B	R	R	S	S
0							7

Usage: To provide additional information for punch records

Bit Meanings: 0 = 1 (Must always be on)

SS = Punch stacker select information

B = 0 = Normal EBCDIC card image
= 1 = Column Binary card image

M = 00 = SCB count units = 1
= 01 = SCB count units = 2
= 10 = SCB count units = 4
= 11 = Reserved

RR = Reserved for future expansion

SRCB for Input Record

O	M	M	B	R	R	R	R
0							7

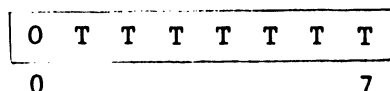
Usage: To provide additional information for input records

Bit Meanings: 0 = 1 (Must always be on)

- M = 00 = SCB count units = 1
- = 01 = SCB count units = 2
- = 10 = SCB count units = 4
- = 11 = Reserved

RRR = Reserved

SRCB for Terminal Message Routing Record

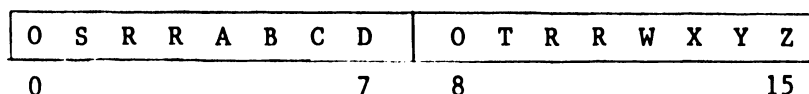


Usage: To indicate the destination of a terminal message

Bit Meanings: 0 = 1 (Must always be on)

- TTTTTTT = Remote system number ($1 \leq T \leq 127$)
- TTTTTTT = 0 = Broadcast to all remote systems

Function Control Sequence (FCS)



Usage: To control the flow of individual function streams

Bit Meanings: 0 = 1 (Must always be on)

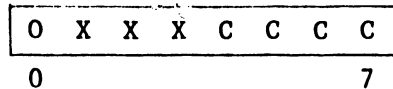
- S = 1 = Suspend all stream transmission (WAIT=A-BIT)
- = 0 = Normal state

- T = Remote console stream identifier
- R = Reserved for future expansion

ABCD...WXYZ = Various function stream identifiers
(oriented only to recipient)
- Normal print (or input) = A,B,C,...
- Normal punch streams = Z,Y,X,...

NOTE - a bit on = continue function transmission
- a bit off = suspend function transmission

Block Control Byte (BCB)



Usage: Transmission block status and sequence count

Bit Meanings: O = 1 (Must always be on)
CCCC = Modulo 16 block sequence count

XXX = Control information as follows --
= 000 = Normal Block
= 001 = Bypass sequence count validation
= 010 = Reset expected block sequence count to CCCC
= 011 = Reserved
= 100 = Reserved
= 101 = Available for user modification
= 110 = Available for user modification
= 111 = Reserved for future expansion

MULTI-LEAVING In BSC/RJE

The previous sections have grossly outlined the specifications of a comprehensive, MULTI-LEAVING communications system. While the HASP support for programmable BSC workstations is completely consistent with the MULTI-LEAVING design, it does not utilize certain of the features provided in MULTI-LEAVING. These feature limitations include:

1. The transmission of record types other than print, punch, input, console and control is not supported.
2. The only general control record types utilized are the terminal SIGN-ON.
3. Only SCB count units of 1 are utilized.
4. No support is included for column binary cards.

5.2 WANG HASP PERFORMANCE CONSIDERATIONS

The HASP Multi-leaving protocol was designed to increase transmission throughput by allowing concurrent data streams to be active for the various devices on a remote station. Therefore, to utilize the capabilities of the protocol's design and in turn realize increased throughput advantages, an application should have several data streams.

Also, the protocol provides for character and space compression of records. Therefore, depending on the nature of the data being transmitted, significant reductions in transmission time might be realized due to the reduction in the number of actual characters being transmitted.

Because of the I/O device handling required to support concurrent streams, the HASP emulator operates slightly slower than the 2780 and 3780 emulators. Therefore if a user is not going to realize any throughput gains due to character compression or concurrent I/O stream capability, it is suggested that he stay in the 2780 or 3780 mode. Estimations from benchmarks show that HASP will run about 7% slower than 2780/3780 on a 2200VP and about 15% slower on a 2200T processor using data files with NO COMPRESSION and ONE STREAM TO A 600 LPM PRINTER. This tradeoff must be considered by the customer in light of the unique application.

The above figures reflect software throughput delays with no consideration for devices which may operate slower than the incoming data rate. When receiving to diskette rather than to a hard disk, benchmarks have shown that an additional 10% reduction in throughput may occur on data which is not compressable. Similar reductions may occur for printers under 200 cps. on a 2400 BPS line or 350 cps. on a 4800 BPS line, again without allowance for character compression.

Overall, we feel that the HASP Multi-leaving emulation software can produce significant increases in throughput for some applications. If there is a question regarding which emulation best fits the situation, benchmarks should be performed before selection.

END