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IBM 1414 Model 4 or 5 with IBM 1050 Data Communications System for IBM 7040/7044 Systems

This bulletin describes the connection of the IBM 1050 Data Communications System to the IBM 7040/7044 Systems via the IBM 1414 Model 4 or 5 Input-Output Synchronizer. Basic concept of the system is presented. Included is a description of the receive and transmit operations using the polling and automatic answering features.

A detailed description of the 1050 Data Communications Systems, the data set, and the 1414 Model 4 and 5 is not presented. This information can be found in one or more of the following publications:

IBM 1050 Data Communications System, Form A24-3020

IBM 7040-7044 Principles of Operation, Form A22-6649

IBM 1414 Input/Output Synchronizer, Original Equipment Manufacturers' Information, Form A22-6701

IBM 1414 MODEL 4 OR 5 WITH IBM 1050 FOR IBM 7040/7044

The communications line adapter feature for the IBM 1414 Model 4 or 5 Input-Output Synchronizer links the IBM 1050 Data Communications System to the IBM 7040/7044 Data Processing System. The 1050 Data Communications System provides communication between remote locations and a central data processing location (7040/7044) over communications lines. A system configuration utilizing the 7040/7044 system and the 1050 Data Communication System (hereafter called terminal) is illustrated in Figure 1.

A communications line adapter attaches the tele-communications line to the 1414-4 or 5. A maximum of two communications line adapters may be installed in a single 1414. The communications line adapter is installed in lieu of the telegraph input-output feature. The adapter provides an 80-character buffer for input message from terminals serviced by the line, and another 80-character buffer for output messages to the terminals. Further, the adapter

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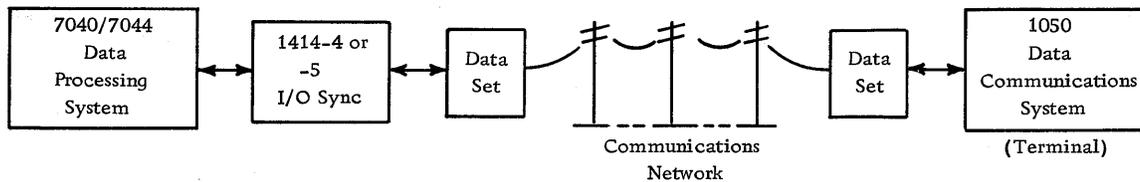


Figure 1. 7040/7044 System and 1050 Data Communications System Configuration

provides controls for data transfer between the 1414 buffers and the processor, for the asynchronous receipt and transmission of data between the buffers and a terminal, and for any code translation required.

The adapter connects directly to the AT&T 103 Dataset, the IBM Modem, or equivalent. Only one type of data set can be used on any one line. The normal two-wire telephone line facility attached by this adapter must provide for half duplex operation (transmission in one direction at a time) only. Direct terminal-to-terminal communication is not possible, only communication between the terminal and the 1414.

A detailed description of the read/write operation codes can be found in the IBM 7040-7044 Principles of Operation, Form A22-6649. The operator must be familiar with the channel translation of messages when the channel is selected in BCD mode.

A terminal may transmit a message to the input buffer in response to an invitation-to-transmit from the communications line adapter. The user may specify that the adapter generate invitations to transmit indications either automatically by polling, or in response to a manual request-to-transmit signal from a terminal.

AUTOMATIC INVITATION--TRANSMIT

The term "message" defines all of the data to be received or transmitted at one time. Each message consists of an administrative (line control) portion, and a text portion or portions. The text portion of a message may consist of one or of many blocks (records) of data. Also, a block of data can be one buffer full or many buffers full.

The write instruction is used to transfer a storage field to the buffer. The outquiry status latch is turned on when the output buffer has completed transmission of the buffer contents to a terminal if the terminal answers that it is not ready, or if there is no answer from the terminal within 650 (+50, -0) milliseconds (address time-out). The outquiry status latch informs the program that the output buffer is ready to accept information from storage. The text portion of the first buffer load of a message must be preceded by an administrative portion consisting of:

1. An initiate administrative control character (EOT): $\sqrt{(C8421)} \textcircled{C}$. This puts the adapter in the control mode, indicating that all characters following will be address control characters. This is the beginning of the administrative (line control) portion of the message. (See Figure 2 for example format.)
2. An alphabetic character terminal address: (A through Z) or group address character / (BA1). Any 1051 may be jumpered to have any letter as its address. Also, any combination of 1051 control units can be jumpered to recognize a common address.
3. A numeric digit identifying device used at terminals 1 through 4 and 9. (Codes 1 through 4 may also be jumpered at the customer's option as to which device each is to represent.)

1 -- Printer one	3 -- Punch one
2 -- Printer two	4 -- Punch two
9 -- Common address selects all or any available.	

This procedure is followed until all devices on a 1051 control unit are selected. Do not attempt to change the 1051 address in a given message; repeat the 1051 address (A) and follow it by the next device address (see Figure 2).

4. An optional two-character group designating the same terminal but with a second choice.

5. An end-of-address (EOA) code # (821) (D) ends administration control. After all addresses have been put in message, the last control character should be EOA. The adapter is then switched to "text" mode.

Terminal control characters, except administrative control characters, must be preceded by an escape character (CA841) in storage. The escape characters distinguish a terminal control character from a data character. The text of the message should then follow the administrative portion of the message and will actually be transmitted to the devices selected. No more than 14 words (80 characters) should appear in one write select to the adapter. All control characters (carriage return, tab, etc.) in the text portion of the message must be preceded by an escape character (C).

An optional end-of-block (EOB) character \ (CA842) may be placed within the body of the text to cause a longitudinal redundancy check (LRC) to take place. The LRC checks the validity of all the transmitted data from the last LRC check up to the EOB, inclusive. The EOB will cause a buffer empty interrupt. This interrupt should be followed by a sense instruction to the adapter, checking for possible errors; this should be followed by another write select. The adapter will stay in text mode until the end-of-transmission (EOT) indication is detected. The last write select containing the last portion of the text must have an EOT character (C8421) preceded by the escape character (C). No EOB character should appear in this buffer load.

An EOB character is automatically sent to the terminal after the 80th character of each buffer full, or it can be sent by the program by placing an EOB character (\) at the end of a block of less than 80 characters. This prevents the sending of blank characters over the lines if the block is less than 80 characters in length. If the buffer of information has less than 80 characters and it is the last buffer of a message, an EOT character (preceded by the escape character) instead of the EOB character should follow the last information character in the buffer.

After the EOB, EOT, or 80th character is sensed, the adapter sends an EOB character followed by an LRC character to be checked by the receiving terminal. The terminal then responds with a (Y) "yes," (N) "no," or "does not answer." When the adapter receives the answer back, or times out (answer not received in 16 seconds), the appropriate I/O status indicator or indicators are turned on and an outquiry is sent to the processor. If the 80th data character or an EOB character in the buffer was sent, and the terminal replied with a (Y) "yes" (LRC characters compared correctly), no I/O status indicators will be turned on.

If the terminal replied with a (N) "no" (LRC characters did not compare), the condition (I/O status 2) indicator will be set. If there is no answer back within 16 seconds (LRC time-out), the no transfer (I/O status 1) indicator will be turned on. An optional feature provides that if the output buffer is not re-filled within 16 seconds following an outquiry sent to

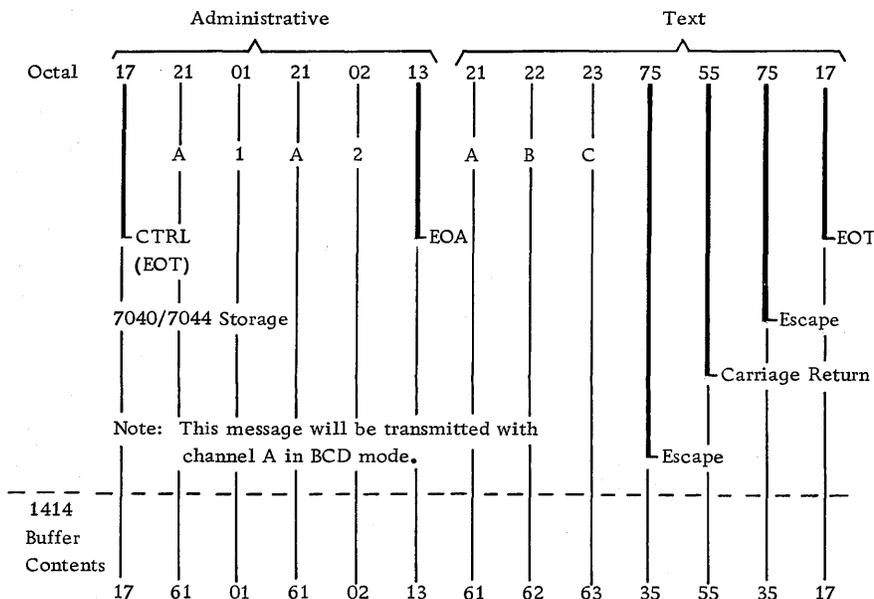


Figure 2. Message Format Example--Communications Line Adapter

the processor, the adapter will set the no transfer and condition (I/O status 2 and 1) indicators, automatically send an EOT to the terminal, and resume polling.

If an EOT character was sensed as the last character of a buffer and a (Y) "yes" answer was received, an EOT is sent to the terminal, and polling resumes. If a (N) "no" answer is received, the EOT is not sent to the terminal. The processor must therefore resend the message or block having the EOT.

In summary, "automatic invitation--transmit" may be outlined as follows:

1. Transmission message format predetermined.
2. CPU moves message to output buffer.
3. Adapter addresses terminal and waits for reply.
4. Adapter transmits message.
5. Adapter ends transmission and resumes polling. A Tele-processing interrupt is generated when a buffer empties or fills.

AUTOMATIC INVITATION--POLLING

Polling is an automatic procedure by which terminals are scanned in a definite sequence to determine if they are requesting service. Polling, following a power-on reset, begins at station A, continues automatically through sequential stations B, C, D, etc., and finally returns to station A. The polling feature provides for 1 to 3, 1 to 9, or 1 to 26 polling stations. If a polled terminal responds with a transmit condition, polling stops at that point, the adapter sets receive status, and the terminal address is entered into the buffer followed by the message from the terminal. Polling then resumes after the receive operation is ended by the terminal, provided that the output buffer has not been filled. If the buffer is filled, the adapter transmits the output message and polling is resumed after the transmission operation is ended by the processor. Polling will be resumed at the next sequential poll address.

AUTOMATIC INVITATION--RECEIVE

During the receive operation, only the text portion of the message enters the 1414 input buffer. The composition of the input message differs only slightly from that of the output message.

The first character of the input message is an alphabetic character indicating the address of the 1051 terminal sending the message. This character is automatically inserted into the buffer by the adapter upon receipt of an acknowledgement to transmit from the terminal. The remainder of the text consists of data characters and transmission code

control characters with associated escape character. An escape character is automatically inserted into the buffer by the adapter when a line control character is received, except for the following characters which do not enter the buffer and do not allow the escape character to enter: IL (idle), DEL (delete), UC (upper case), LC (lower case), EOB (end-of-block), and EOT (end-of-transmission). The remaining line control characters follow the escape character into the buffer. Subsequent sensing of the escape character enables the 7040/7044 program to recognize the following character as a terminal control character rather than a data character. Care should be taken by the operator that the automatic insertion of escape characters does not fill the buffer unknowingly. Control characters, except for line feed (LF), will not be translated. The line feed character will be translated to the ♂ (A bit only) substitute blank character.

The end of a block of data is identified by an EOB character. When the EOB condition is recognized, an LRC is performed to determine if there has been an LRC error for the block of data just transmitted. This is accomplished by comparing the received LRC with the LRC accumulated by the adapter. In addition to the LRC, the adapter makes a VRC (vertical redundancy check) for each character as it is entered into the buffer.

The Tele-processing Interrupt (TP interrupt) latch will be turned on as a result of:

1. The input buffer being filled (80 characters), provided the following character is a data character (not EOB) and there has been no VRC error.
2. An EOB character received by the adapter, provided there has been no VRC or LRC error.

The program should exit to an interrupt routine and sense the 1414 (1050 adapter) to check for possible errors. The program should then read in the buffer to the CPU and determine which input device on the transmitting 1051 caused the interrupt. Some identification must be placed in the input message to determine the message as belonging to, for example, the 1052. This must be done to all input devices on a 1050 system for at least the first buffer load from the device. When the 1414 transfers the contents of the input buffer to storage, the TP interrupt latch is reset. The TP interrupt latch will also be reset by the appropriate sense instruction.

When the input buffer is filled and no EOB character is received, the 7040/7044 program has 67 milliseconds to empty the buffer before more data are placed into the buffer. If more than 67 milliseconds are required to service the buffer, the terminal operation can provide a delay in data transmission. This is done by placing idle characters on the line following the last character of each buffer

load. The adapter deletes these characters so that they do not enter the input buffer, but each idle character then provides the 7040/7044 program with an additional 67 milliseconds in which to service the full buffer. If the buffer is not emptied before the 67 milliseconds has expired, a buffer pile-up condition will occur.

When a block of text is 80 characters or less, including control characters, and the next character is an EOB, no pile-up condition will occur. The terminal stops transmission after sending the EOB-LRC and cannot resume until after the data have been transferred to storage and the LRC response is received from the adapter. After the LRC response is sent to the terminal, one of the following can occur:

1. More data or idle characters are received from a terminal.
2. If no data are received for more than 16 seconds, a receive time-out will occur and polling will resume after the buffer is cleared.
3. If an EOT character is received, the adapter receive operation is terminated, and polling will resume after the buffer is cleared. (The 1414 communications adapter does not automatically place the EOT indication in the buffer and no status latches are set to indicate the end of the message. The EOT character must be generated by the programmer.)

In summary, "automatic invitation--receive" may be outlined as follows:

1. Message format predetermined.
2. Adapter polls 1050 terminal.
3. Terminal requests service.
4. Adapter receives message.
5. CPU reads the message from the input buffer and the adapter resumes polling.

AUTO ANSWER--RESPOND

With the auto answer feature, request for receiving and transmission of data is initiated verbally by phone (dial-up connection) between the data set and the processor center. Once procedure is established, the transmission line is set to data mode at the data set. The 1414 adapter answers the call by sending a (C) (set administrative control) character, addresses the calling station as A0, and waits for an answer-back.

If the terminal answers with a (D), indicating that a message is to be transmitted, the adapter operates in receive status and stops polling. The auto answer receive is the same as the polling receive except that the terminal address is not entered into the buffer. Polling resumes after the receive operation is complete unless the output buffer is filled. In this case, the output message is transmitted before polling is resumed.

If the terminal responds with a "no," indicating that there is no message to transmit, or does not reply within 650 milliseconds (poll time-out), the polling will continue unless the output buffer is filled. The message must be transmitted to the terminal before polling can be resumed.

When the output message is completed (EOT sent), the adapter will poll the terminal again and one of the following will occur:

1. If the terminal responds with a (D), the adapter again operates in receive to accept the message.
2. If the terminal responds with a "no," indicating that no message is to be transmitted, or does not respond within 650 milliseconds (poll time-out), the adapter then transmits a (C) and automatically disconnects the communication line.

If the adapter does not transmit an output message, the communication line must be disconnected manually at the terminal or the processor.

I/O INSTRUCTIONS

<u>Function</u>	<u>Symbolic</u>	<u>Actual</u>
Write	PWRA 769, , 3	-1766 0300 1401*
Sense Input Buffer	SENA 769, , 11	-1762 1300 1401*
Sense Output Buffer	SENA 769, , 27	-1762 3300 1401*
Read	PRDA 769, , 3	-1762 0300 1401*

* For adapter 2 selection, the address will be 1402.

TELE-PROCESSING INTERRUPT

1. Enable mask (bit 8)
2. Store on interrupt (bit 9)

Refer to IBM 7040-7044 Principles of Operation, Form A22-6694, for detailed description of the Tele-processing interrupt.

1050 SYSTEM COMPONENTS

The IBM 1050 Data Communications System (Figure 3) is available with various component combinations in the two basic system configurations. These modular input, output, and control components are:

- IBM 1051 Control Unit Model 1
- IBM 1051 Control Unit Model 2
- IBM 1052 Printer-Keyboard
- IBM 1053 Printer
- IBM 1054 Paper Tape Reader
- IBM 1055 Paper Tape Punch
- IBM 1056 Card Reader
- IBM 1057/1058 Card Punch or Printing Card Punch

The organization of the terminal is truly modular; the components can operate in a wide variety of combinations with complete flexibility.

The 1051 control unit provides the base (stand) and the controls for the communication lines and is

essential to each configuration. All components are electrically connected through the control unit.

The printer and the keyboard are electrically interconnected, and are cable-connected to the control unit so that they can be operated independently. Configurations are available with a maximum of two machine-readable inputs, one of which can be a card reader; and two machine-readable outputs, one of which can be a card punch.

The character rate of the system is 14.8 characters per second, except during keyboard operation, in which rate speed depends upon keying speed. Maximum keying speed is 14.8 characters per second.

REFERENCE SECTION

I/O status indicators set during communications line adapter operations are shown in Figure 4.

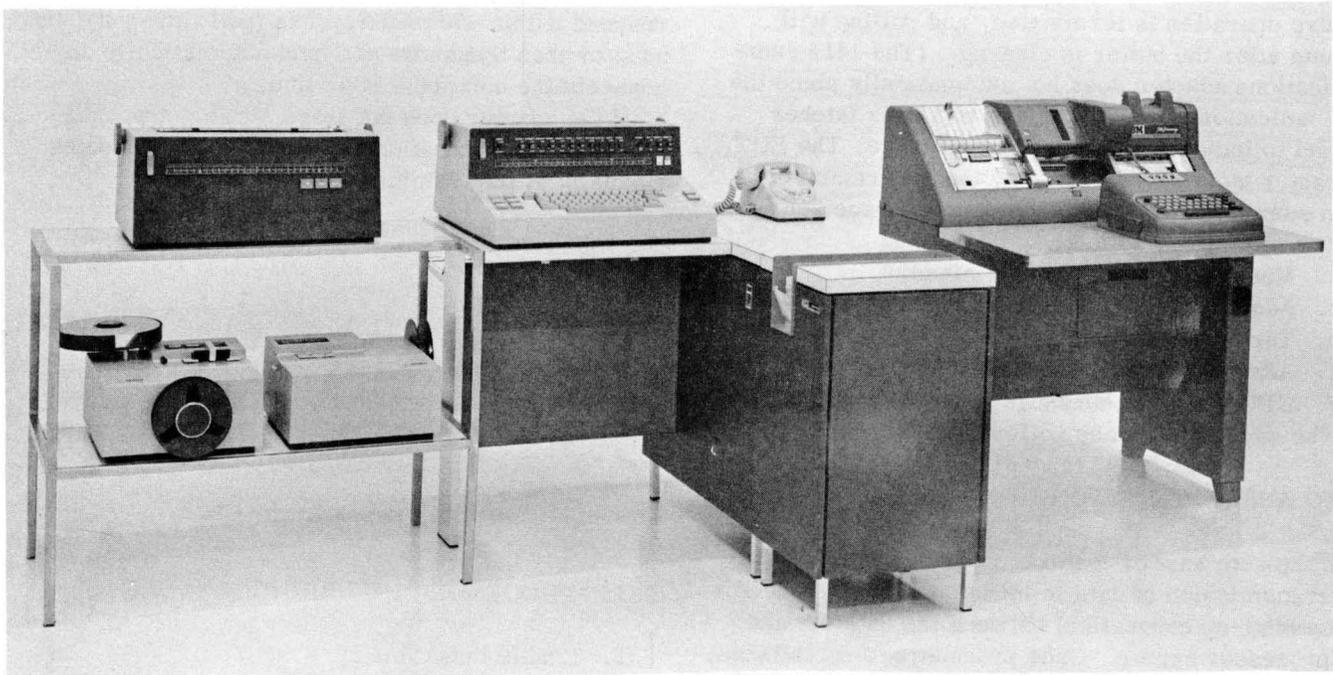


Figure 3. IBM 1050 Data Communications System

Indicator	Bit Position	BCD Code	Condition	
Not Ready	Sign	B	Read/Write	Power off in 1414, buffer being operated in off line position, or external common carrier data set is not in data or operating condition.
Not Used	1	A	Read/Write	Denotes wrong length record (used in 1410).
Data Check	2	8	Read	Parity error detected during transfer from the 1414 buffer to the processor or on serial scan to input buffer.
	2	8	Write	Parity error detected during data transfer from the processor to the 1414 buffer.
Busy	3	4	Read	Input buffer being filled or empty and waiting to be filled.
	3	4	Write	Output buffer engaged in transmitting an output message to a terminal.
Condition	4	2	Write	End-of-block has been sent and LRC error occurred.
No Transfer	5	1	Read	A buffer pile-up condition occurred. (Input buffer was not emptied before another data character was received from terminal.)
	5	1	Write	Terminal responded with a "no" answer, did not respond (address time-out), or did not respond after EOB and LRC characters were sent by adapter (LRC time-out).
No Refill	5 & 4	2 & 1	Write	These two indicators together indicate that the processor failed to refill the output buffer in the middle of a long message in the required time (16 seconds). Polling has resumed or disconnect has occurred if auto answer. (optional)

Figure 4. I/O Status Indicators-- Communications Line Adapter

	BA	BA	BA	BA
8421	00	01	10	11
0000	SP	@	-	&
0001	1	/	j	a
0010	2	s	k	b
0011	3	t	l	c
0100	4	u	m	d
0101	5	v	n	e
0110	6	w	o	f
0111	7	x	p	g
1000	8	y	q	h
1001	9	z	r	i
1010	0	+	MZ	PZ
1011	#	,	\$.
1100	PN @/1 _M	BYP %/(₃₉	RES * ₅₄	PF □/) ₃₄
1101	RS : ₁₅	LF ⌘ ₇₅	NL] ₃₅	HT [₃₅
1110	UC > ₁₄	EOB \ ₇	BS ; ₉₁	LC < ₃₁
1111	EOT ✓ ₁₇	PRE # ₇₇	IL Δ ₅₇	DEL # ₁₃₇

} All control characters must be preceded by the escape character (m).

Figure 5. 1050 Transmission Code (Odd Parity)

NOTES:

- The 44 graphics are as shown in Figure 5 (Lower Case Mode).
- All lower case transmission codes are the same as the BCD Interchange Code except the @ which is transmitted as an A bit only. Control codes are untranslated, except for LF where a ⌘ (A bit) in the processor is translated to a LF transmission code (A841).
- Administrative (line control) characters:
 - ⓐ ✓ (TM) Set Administrative control (EOT).
 - ⓓ # End of Address and Start of Message text.
 - Ⓝ - No Answer; sent only by an adapter or terminal.
 - Ⓨ . Yes Answer; sent only by an adapter or terminal.
 - A-Z Terminal Addresses.
 - 0-9 Terminal Devices.
- The escape character is a m (BCD-CA841) character.
- PN and PF are not used in the 1050 system (no function).
- UC, EOB, LC, EOT, IL, and DEL characters are not entered into the input buffer.
- EOB and EOT may be part of output message or can be automatically inserted by the adapter.
- PRE cannot be used in the 80th position of the output buffer with prefix control character in the first position of the following buffer. (Automatic EOB sent after 80th position resets prefix control in 1050 terminal and prefix control character will be sent as data.)
- | | | |
|--------------------|--------------------|---------------------------|
| 9. MZ - Minus zero | RS - Reader stop | BS - Backspace |
| PZ - Plus zero | LF - Line feed | LC - Lower case |
| PN - Punch on | NL - New line | EOT - End of transmission |
| BYP - Bypass | HT - Horiz. tab | PRE - Prefix |
| RES - Restore | UC - Upper case | IL - Idle |
| PF - Punch off | EOB - End of block | DEL - Delete |

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