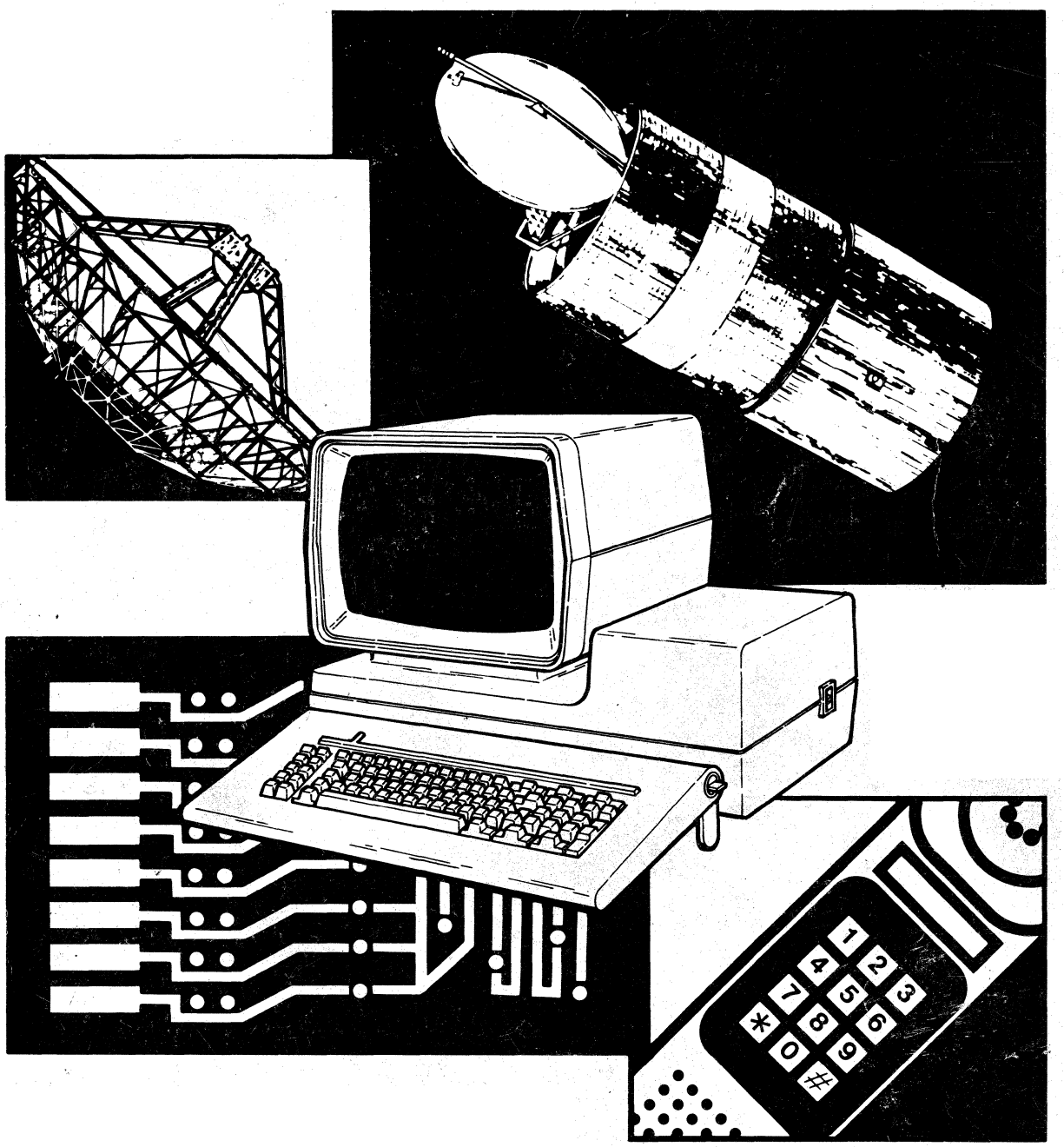
DATA COMMUNICATIONS CONCEPTS



IBM

GC21-5169-4

DATA COMMUNICATIONS CONCEPTS

GC21-5169-4

Fifth Edition (September 1983)

This major revision makes obsolete GC21-5169-3. Many changes and additions were made to this manual. Some of the changes include deletion of some systems and addition of other systems. Changes or additions to the text and illustrations are indicated by a vertical line to the left of the change or addition.

This publication contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

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Contents

About This Manual

PURPOSE OF THIS MANUAL

This manual contains general information about data communications. It is intended for persons planning or using a data communications system with IBM small and intermediate systems.

To understand the content of this manual, you must be familiar with data processing concepts.

The manual defines data communications, explains the benefits of data communications, and describes how data communications can be used with data processing.

ORGANIZATION OF THIS MANUAL

This manual is organized into seven chapters. Chapters 1 through 4 discuss data communications concepts. Chapters 5 through 7 discuss IBM small and intermediate systems that use data communications. Many illustrations and configurations are used to clarify some concepts.

To describe the components or parts of a data communications system, a typical system configuration is shown that includes all the basic components (such as terminals, computers, and programs) of a data communications system consisting of small and intermediate systems. The sample system also includes a brief description of the function of each component. Subsequent chapters then describe the components in more detail. In addition, there are sample data communications system configurations using IBM small and intermediate systems and other related IBM equipment.

This manual contains information about the following terminals and systems:

- *IBM Personal Computer*
- *IBM System/23 Datamaster*
- *IBM System/34*
- *IBM System/36*
- *IBM System/38*
- *IBM Series/1*
- *IBM Communicating Magnetic Card Selectric Typewriter*
- *IBM Office System 6 Information Processor*
- *IBM 3101 Display Terminal*
- *IBM 3270 Information Display System*
- *IBM 3600 Finance Communication System*
- *IBM 3741 Data Station and Programmable Work Station*
- *IBM 5230 Data Collection System*
- *IBM 5250 Information Display System*
- *IBM 5260 Retail System*
- *IBM 5280 Distributed Data System*
- *IBM 5520 Administrative System*
- *IBM Displaywriter System*
- *IBM 6670 Information Distributor*

The Glossary contains data communications terms and a bibliography of publications containing more information on data communications or the products discussed in this manual.

All examples and illustrations in this manual show typical uses of data communications and do not describe user systems now installed. Actual costs of equipment or transmission services are not listed in this manual. Contact your IBM marketing representative or your local IBM branch office for this information.

Note: The word *network* is used throughout this manual. This word has at least two meanings:

- A *public network* is a network established and operated by common carriers for the specific purpose of providing circuit-switched, packet-switched, and nonswitched-circuit services to the public.

- A *user application network* is a configuration of data processing products (such as processing units or work stations) established and operated by users for the purpose of data processing or information exchange; such a network may use transport services offered by common carriers or communications administrations.

Network, as used in this publication, refers to a user application network.

See the Bibliography for related publications, and the Glossary for definitions of related terms.

Chapter 1. Introduction to Data Communications

WHAT IS DATA COMMUNICATIONS?

Data communications is the process of transmitting information from one location to another. When data communications is used with data processing, data might be transmitted between one or more of the following data processing devices:

- From one computer to another computer
- From a computer to a terminal
- From a terminal to a computer
- From one terminal to another terminal

A data communications system consists of a group of terminals, computers, programs, and transmission equipment.

WHAT ARE THE BENEFITS OF DATA COMMUNICATIONS?

The ability to transmit data from one data processing device to another can offer many benefits. For example, data can be entered directly into remote data files to reduce the need for posting, recording, punching, or other controls. This data may be more accurate because it can be entered at its source by the people who are most familiar with it. Management can then use this accurate up-to-date data for better control of daily business transactions.

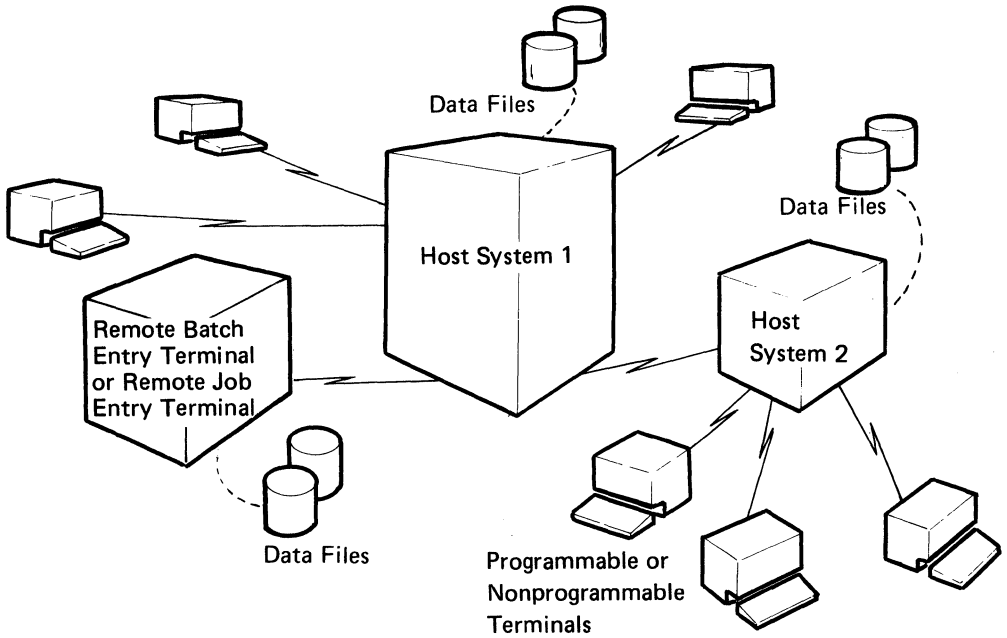
As the uses of data communications are presented, these benefits and others will be discussed. These benefits can improve user performance because businesses can provide faster, more accurate responses to customer orders or inquiries.

WHAT ARE THE USES OF DATA COMMUNICATIONS?

Most of today's data processing systems use data communications to perform one or more of the following functions:

- *Data entry:* Entering data directly into data files
- *Inquiry:* Searching data files for specified information
- *Record update:* Altering, adding, or deleting data stored in files
- *Remote batch entry:* Entering batches of data from a remote location into data files
- *Remote job entry:* Transmitting data and processing instructions to a remote data processing system for processing
- *Distributed data processing:* Locating some or all the data processing functions (such as main storage, control of the system, processing, input and output operations) on systems at different locations and connecting these systems, using communications lines and equipment

The following illustration shows an example of data processing systems and terminals in a data communications configuration.



This illustration may be helpful in the discussions of the following uses of data communications:

- Host system 1 is the controlling computer (controller) or the highest level system in a data communications system configuration. Host 1 contains the programs that start and check the communications programs in other attached hosts or terminals. In some configurations, all systems may have the same controlling tasks and thus, are called *peers*. There is no host system in a peer configuration.

- Host system 2 communicates with its attached terminals and with host system 1.

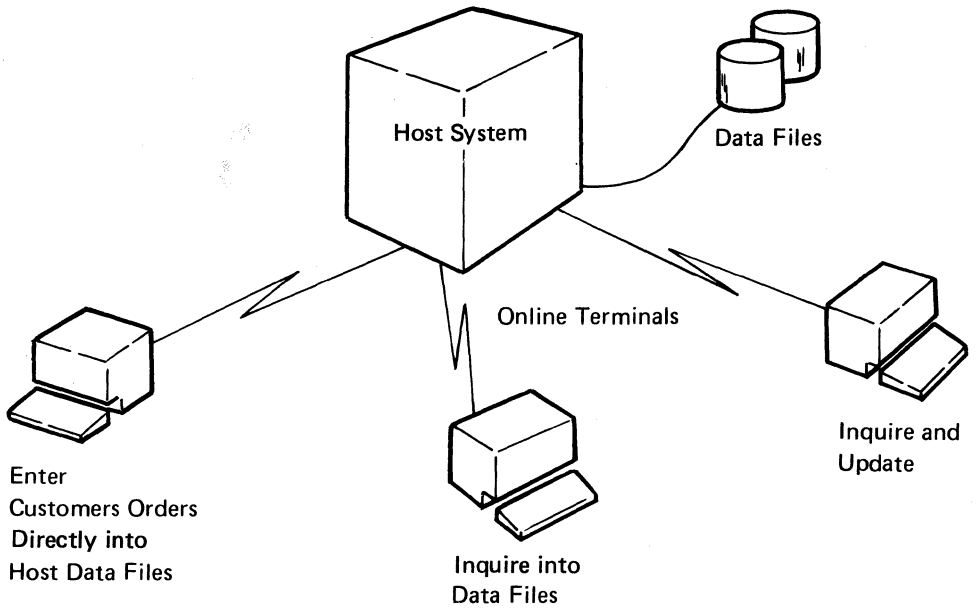
- The remote batch entry or remote job entry terminal is a computer or a programmable terminal that is used as a terminal when communicating with a host, and is used as a data processing system when not communicating with a host.

- A programmable terminal can perform some of the data processing before transmitting the data. For example, the attached remote batch entry terminal or a remote job entry terminal can be used to enter data into local data files, update local data files, inquire into local data files, and perform other host functions when not communicating with the host.

- A nonprogrammable terminal is the input and/or output station in a data communications system configuration, such as a printer or a keyboard/display terminal.

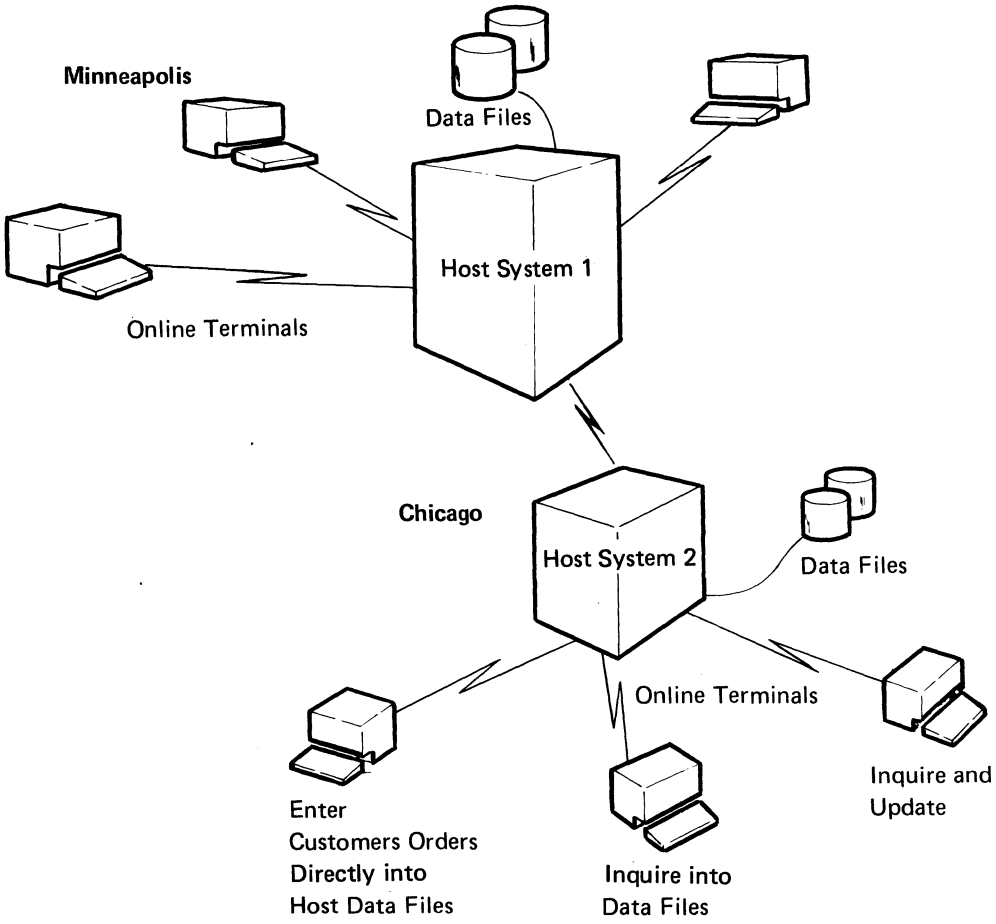
DATA ENTRY, INQUIRY, AND RECORD UPDATE

The following example shows a host system with attached terminals. This system can be used for data entry, inquiry, and record update.



With this system, customer orders can be entered directly into host system files from a remote terminal. At the same time, other terminals can be used to inquire into and/or update host system files. In this system, data is received and processed and is ready to use immediately by the host or terminals. This is called interactive communications or realtime data processing.

One host system can be connected to another host in addition to the terminals, as shown in the following example:



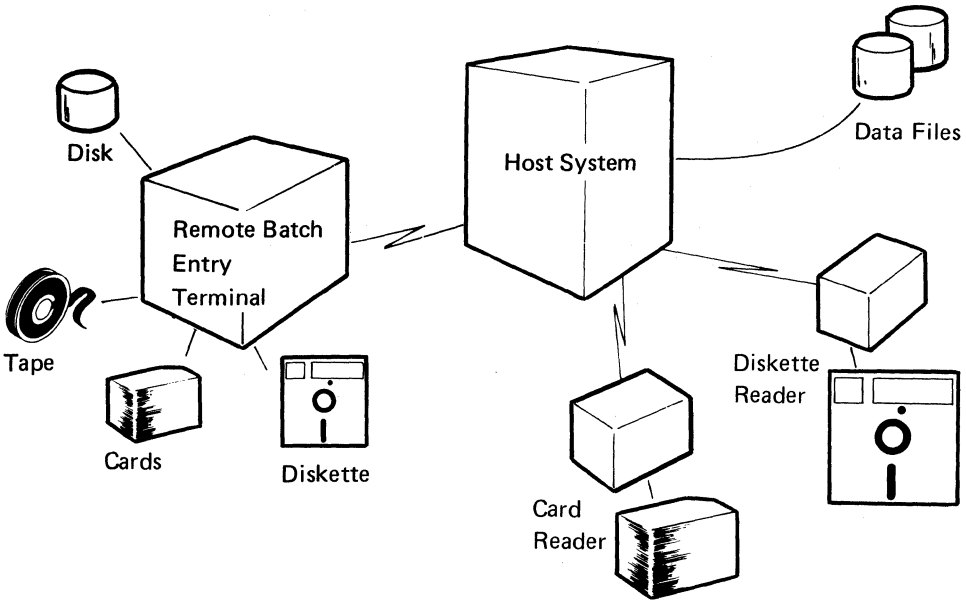
In this configuration, host system 2 is a host for its terminals and is a terminal for host system 1. Host system 2 performs the following:

- Sends summary data to host system 1
- Receives and processes data from host system 1
- Inquiries into its data files for the host system 1 operator
- Inquiries into host system 1 files for its operator or a terminal operator

Connecting host systems in this manner allows some of the data that is normally transmitted to a remote system for processing to be processed locally.

REMOTE BATCH ENTRY

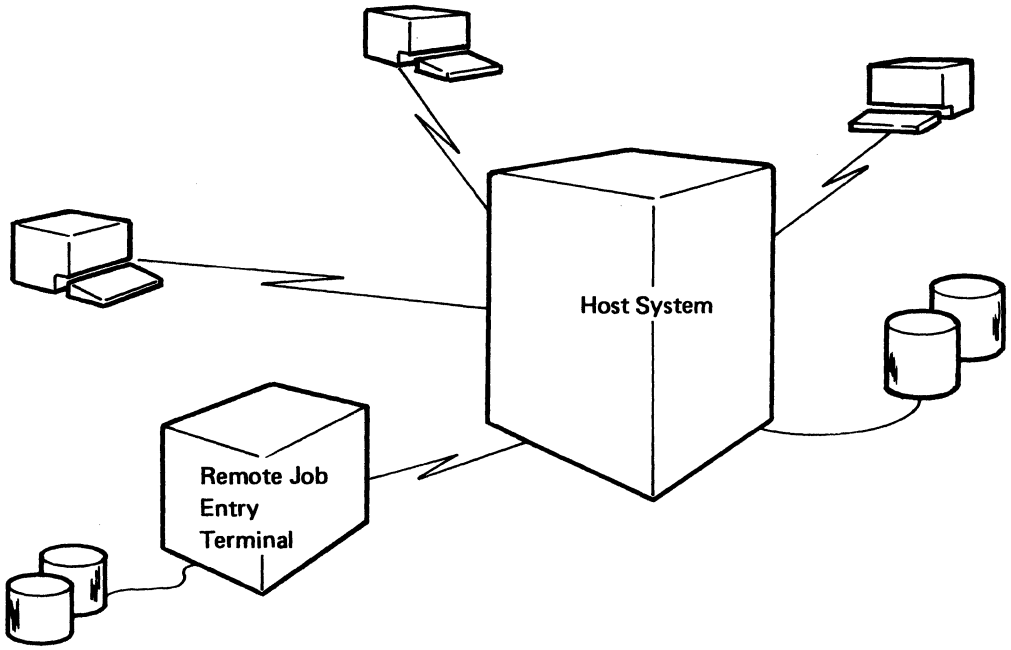
This example shows a host system as a remote batch entry system:



A remote batch entry host system operates as a data processing system without communications while you enter the data through a keyboard or other device and store the data on disk, tape, or other storage media at remote locations. Then, when appropriate, a communications line is used to connect the terminals to the host system so the stored data can be transmitted to the host for processing. A remote batch entry system can consist of nonprogrammable terminals, programmable terminals, remote batch entry terminals, or a combination of these.

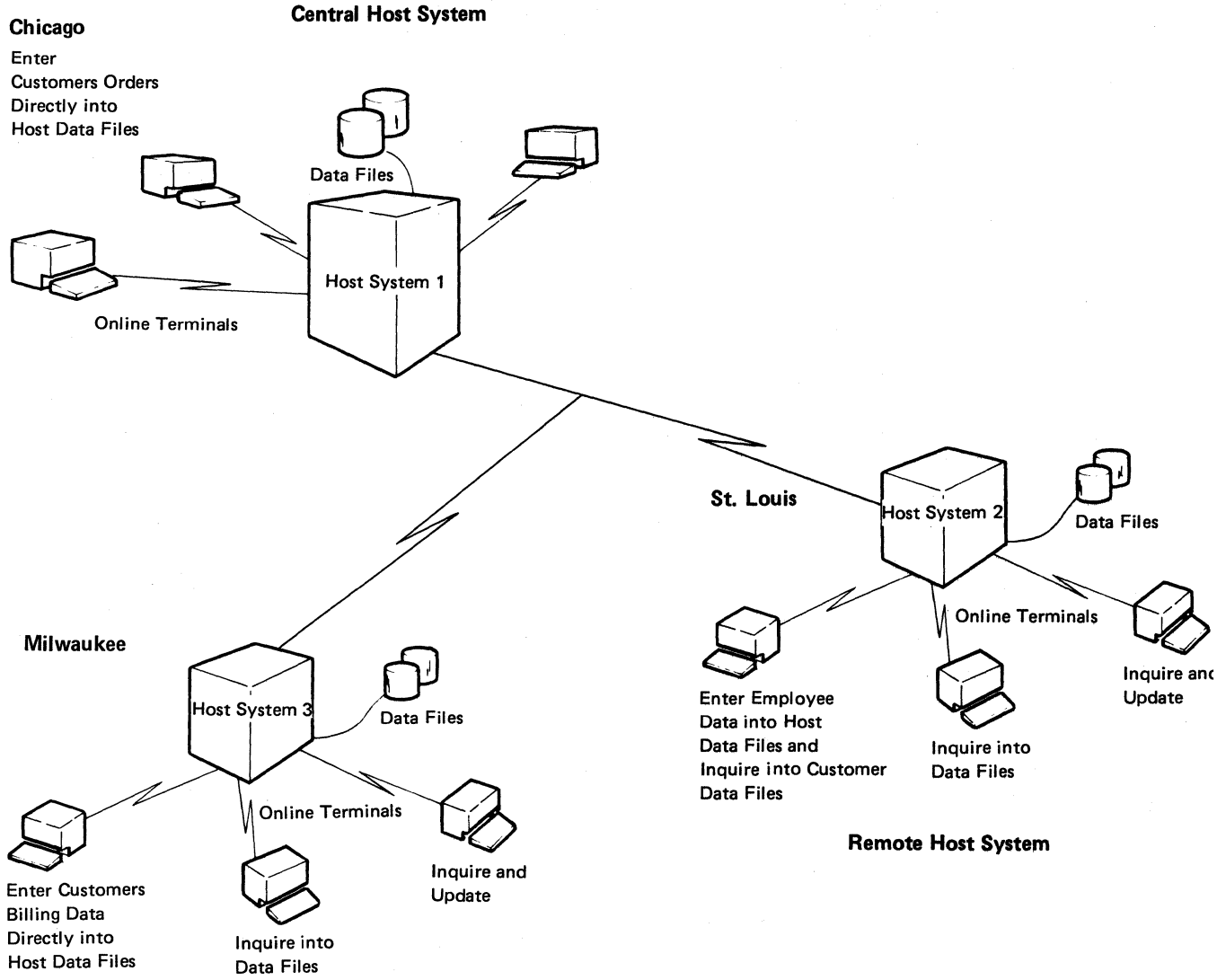
REMOTE JOB ENTRY

This example shows a remote job entry terminal:



When the remote job entry terminal is connected to the host, the remote job entry terminal user can send data and processing instructions to the host system. The host system then processes the data according to the instructions from the remote job entry user. Thus, the remote job entry terminal user can benefit from the processing power and storage capacity of a larger system. The results can then be transmitted back to the remote job entry terminal to be printed and/or stored for later use, sent to another terminal, or used by the host I/O devices. A nonprogrammable terminal or a programmable terminal can be used as a remote job entry terminal.

DISTRIBUTED DATA PROCESSING



This illustration shows a distributed data processing configuration. In the configuration, remote systems and terminals are connected to a central processing unit, host system 1.

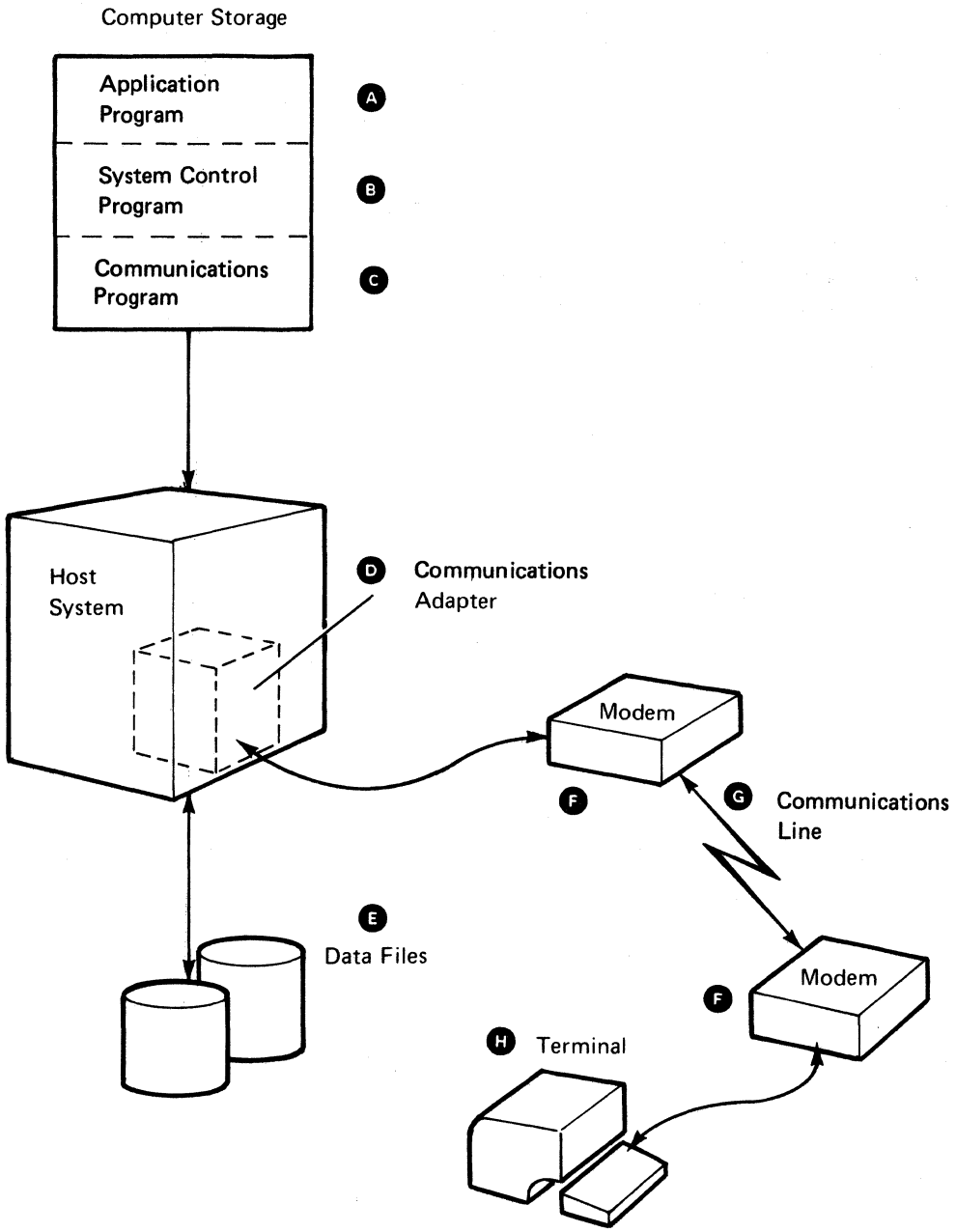
Each host processes its own data, and the users at each location can do the following:

- Enter customer orders, billing data, and employee data directly into their host data files
- Update their own data files
- Inquire into their own data files or inquire into data files on the system at another location
- Control their own system (that is, each location can turn on the power to their systems, supply and load their own system control programs, and maintain their system as their needs dictate)

In a distributed data processing configuration, some or all of the functions (processing, storage, control, input, and output) are situated in different places and connected by communications lines and equipment.

Chapter 2. Parts of a Data Communications System

The parts of a data communications system depend on how the system is used. There are, however, basic parts required for data communications. The following example shows a host system and a terminal in a configuration requiring all of the basic parts.


Computer Storage
Application Program
A
System Control Program
B
Communications Program
C
Host System
D
Communications Adapter
Modem
F
G
Communications Line
E
Data Files
Modem
F
H
Terminal

Ⓐ Application programs are the programs that perform user jobs. With most IBM systems, application programs are written with the same programming language (such as RPG II, FORTRAN, or COBOL) the customer uses for programs that are not data communications programs.

Ⓑ The system control program (when used) prepares the data from the application program for use by the communications program.

Ⓒ In this configuration, the host communications program controls communications between the host and the terminal. Some systems may also use a microprocessor(s) to help control data transmission.

Ⓓ A communications adapter connects the host system processing unit to the modem.

Ⓔ Disk data files allow the user to store and use data.

Ⓕ Modems convert computer signals to communications line signals at one end of the line and back to computer signals at the other end of the line. Modems may be external to or built into the host and/or terminal.

Several terms are used to described the equipment used to convert signals transmitted over communications lines: data circuit terminating equipment, line adapter, and modem. In this manual, the word *modem* is used to described the equipment that converts signals to be transmitted over communications lines.

Ⓖ A communications line transmits the data from modem to modem.

Ⓗ A display terminal is used to enter and send data to the host or to retrieve data from the host data files.

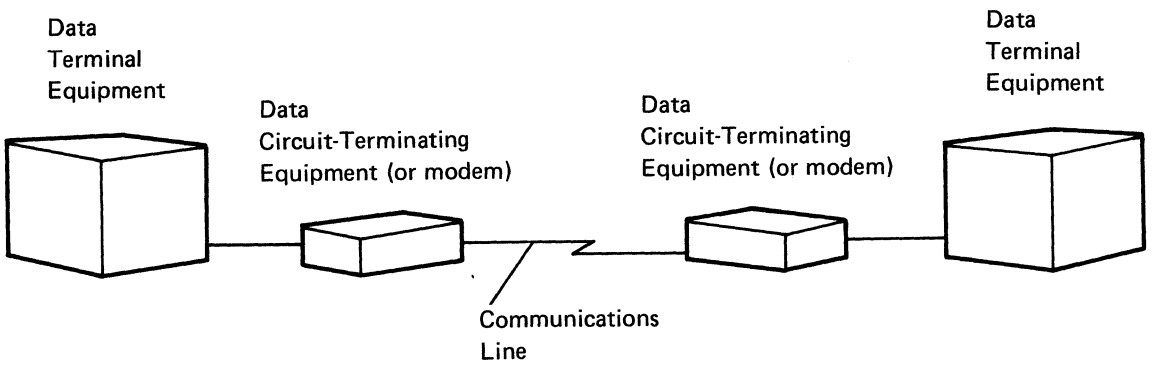
Communications adapters, lines, and modems are described in more detail in subsequent chapters.

Chapter 3. Communications Networks

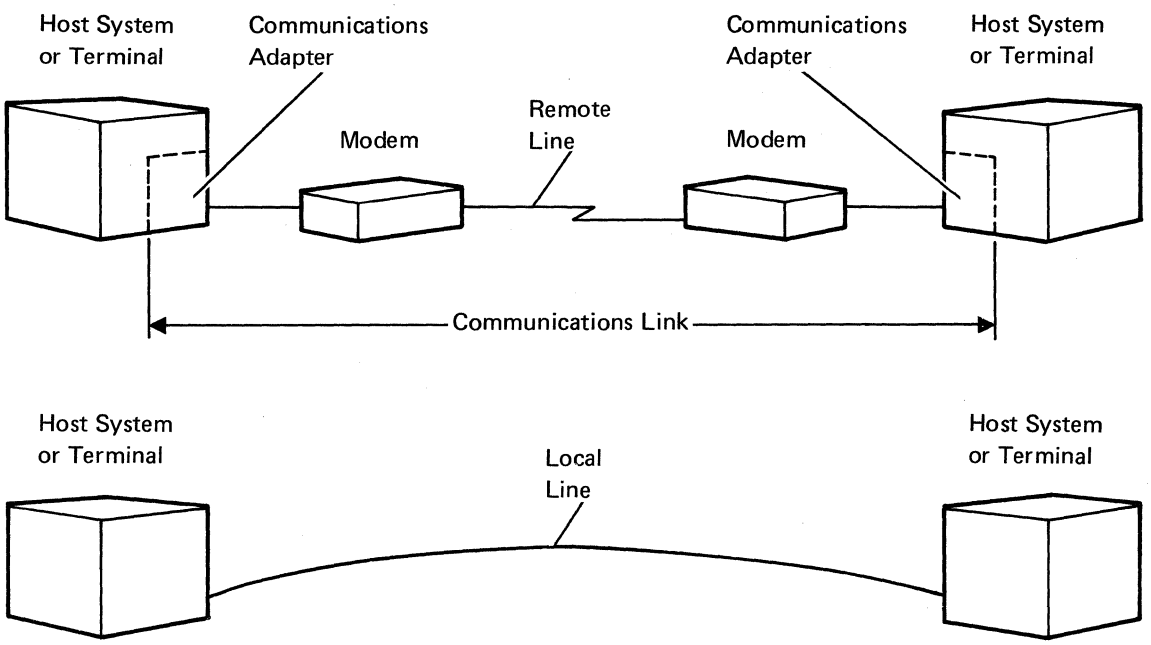
A communications network consists of the equipment and programs that transmit data between data processing or word processing devices. Network equipment consists of transmission lines (wires or cables), satellites, microwave equipment, switching equipment, and other devices used to transmit data. It is not necessary to understand how the network equipment works to use a data communications system.

Most communications networks are provided by communications common carrier companies. A communications common carrier company is one that supplies communications services to the public. For example, a telephone company is a common carrier company.

The equipment that a common carrier company uses to transmit data to and receive data from a communications line is called data circuit-terminating equipment (DCE), called data communications equipment throughout this manual; and the data or word processing equipment (such as a host or terminals) used for communications is called data terminal equipment (DTE) as shown:

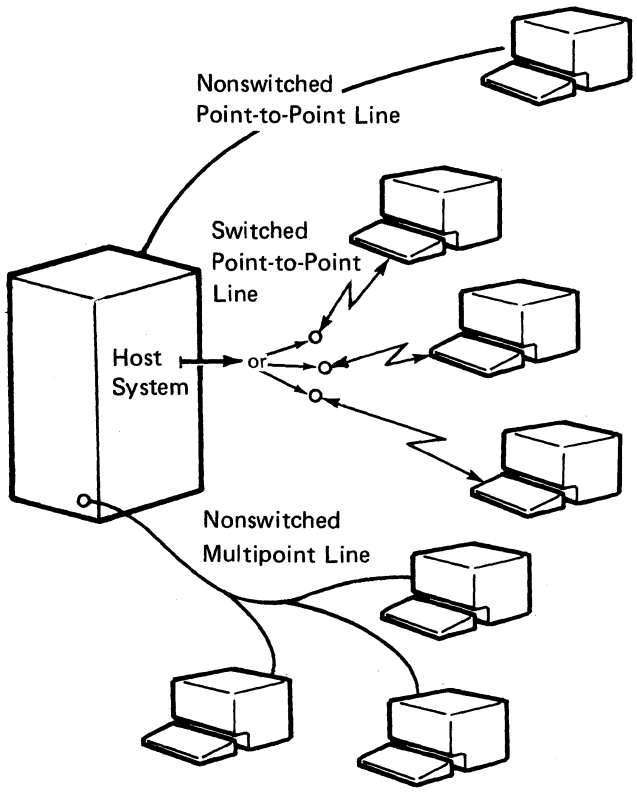


Several words are used to describe the electrical path between data processing devices in a data communications configuration: communications channel, communications lines, communications facility, and communications link. In this manual, the word *line* is used to describe all of the equipment that transmits the data from one modem to the other modem (remote line) or from one device to the other device (local line) as shown:



The communications link is the path from a computer to a terminal or another computer. The communications link includes the lines, modems (when used), and communications-controlling portions (programs and devices) of the terminal or other computer.

A communications network can consist of more than one line. For example, in the following illustration, the host system can communicate with more than one system, terminal, or station in the same network. (A station can consist of terminals only, both terminals and a controller, or a controller only.) A network can also consist of a combination of switched, nonswitched, point-to-point, and multipoint lines, as shown in the following illustration:



Each of these lines is described in the following topics.

SWITCHED LINES

Switched lines (also called dial lines or dial circuits) use the same equipment and transmission lines that are used for voice (telephone) communications. Before data can be transmitted, a connection must be established between devices. To establish a communications connection between a terminal and a host and to exchange information on a switched line, the following usually occurs via switching equipment in common carrier exchange offices:

1. The host system dials the call automatically (if the host supports an Automatic Calling feature), or the terminal operator manually dials the number of the host system location.

2. The host system automatically answers the call and establishes a communications connection (if the host is equipped with an Automatic Answering feature) or an operator at the host answers the call and establishes the connection.

3. The terminal operator then enters a sign-on code using the terminal keyboard to identify the terminal to the host.

4. When the host receives the sign-on code, it is checked for correct identification, and the host makes the appropriate response.

5. If the sign-on code is correct and is recognized by the host, the terminal operator can exchange information with the host.

6. The terminal operator signs off and disconnects the communications connection when the information exchange is complete.

NONSWITCHED LINES

Unlike switched lines, nonswitched lines (sometimes called leased or private lines) do not require dialing to establish a communications connection. The line is permanently connected and always available. Nonswitched lines often use the same network equipment as switched lines. They might even be routed through common carrier exchange offices; however, they are permanently connected instead of being routed through switching equipment.

Nonswitched lines that you own and maintain are called customer-owned lines. For example, if you connect several terminals to a host, and the terminals are located in the same building or a building nearby, you may install your own wires or cables and equipment to connect the terminals to the host system. Because these are your own lines, you do not need the services of a common carrier.

SWITCHED VERSUS NONSWITCHED LINES

Whether to use switched or nonswitched lines depends on the system configuration and how you will use the system. The following should be considered when determining whether to use switched or nonswitched lines:

- With a switched line, you can dial any terminal or host location that can communicate with your terminal or host. With automatic dialing and/or automatic answering equipment, dialing and answering can be done automatically under program control.

- With a switched line, you are charged for local and long distance calls. This charge depends on the amount of time spent using the line. Using switched lines could be an advantage if you have a low volume of transactions on long distance lines. For example, you could store data on diskette, tape, disk, or another storage media and transmit it when the rates are lowest.

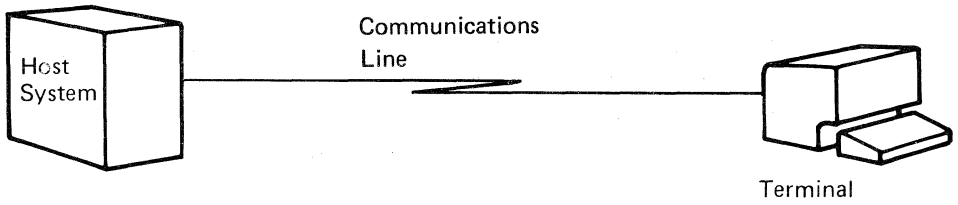
- Nonswitched lines (lines that are owned by a common carrier) have a fixed monthly rate. Using nonswitched lines could be an advantage if you have a large volume of transactions, such as an application that requires repeated inquiries or updates of files, and the line must be connected for long periods.

- Nonswitched lines can be improved (by conditioning, that is, adding certain devices to improve the data signal) to reduce transmission errors and increase the transmission speed of the line. Switched lines cannot be conditioned.

- Nonswitched lines might provide greater data security since you will be the only one using the line.

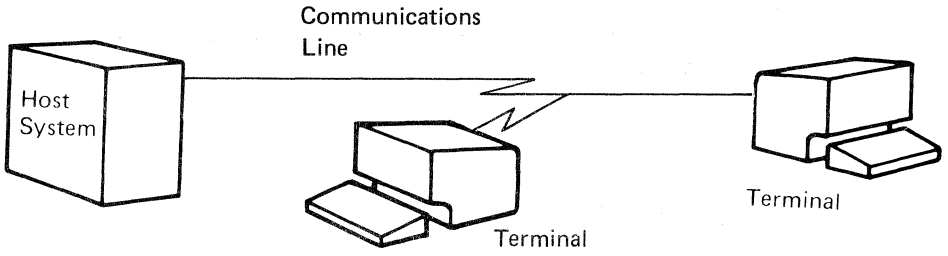
POINT-TO-POINT AND MULTIPOINT LINES

When a line connects only two stations, as shown in the following example, it is a point-to-point line:



A point-to-point line can be either switched or nonswitched.

When a line connects two or more stations, as shown in the following example, it is a multipoint line:

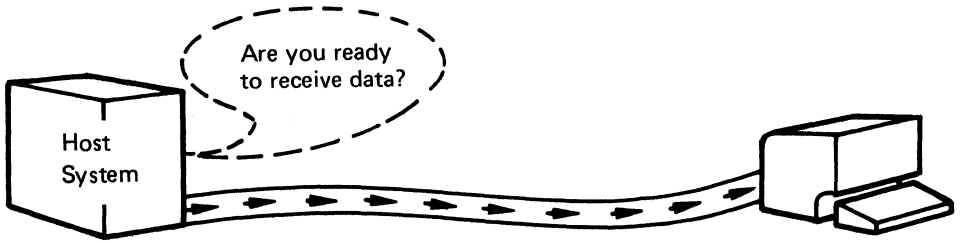


Three stations, a host and two terminals, are now connected to one line. Multipoint lines are usually nonswitched lines.

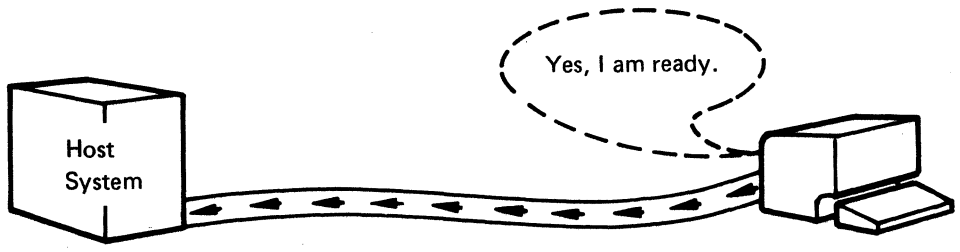
Controlling the Devices on a Point-to-Point Line

Because a point-to-point line connects only two devices, it is the easiest line on which to control communications. Communications between stations on a point-to-point line is normally controlled as shown in the following example using a host and a terminal:

1. The host first checks the terminal to determine if it is ready to receive data (also called a bid for the line):

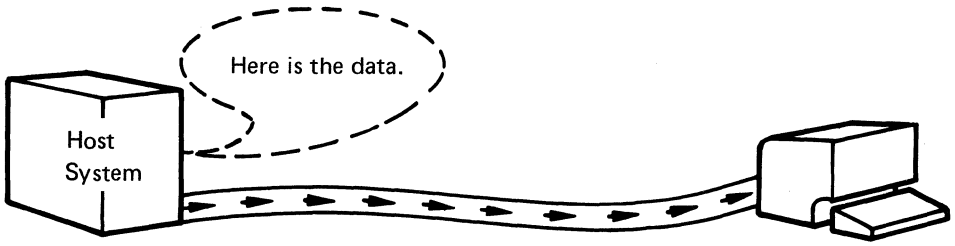


2. The terminal responds by indicating its status to the host. For example, a terminal might indicate that it is turned on, signed onto, and ready to receive data:



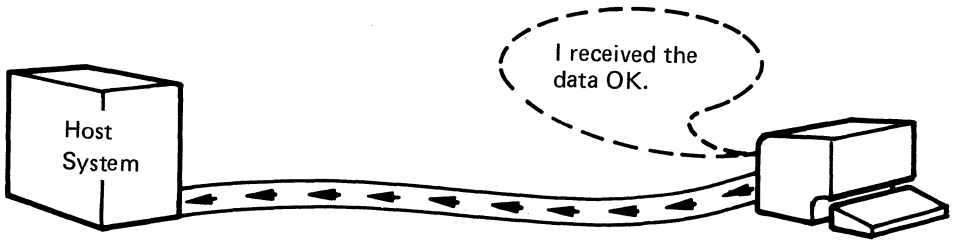
If the terminal is not ready to receive data, it would indicate this to the host system.

3. If the response from the terminal to the host system is no (the terminal is not ready to receive data), or if the terminal did not respond, the host normally indicates an error to the host system operator. If the response from the terminal is yes (it is ready to receive data), the host sends the data:

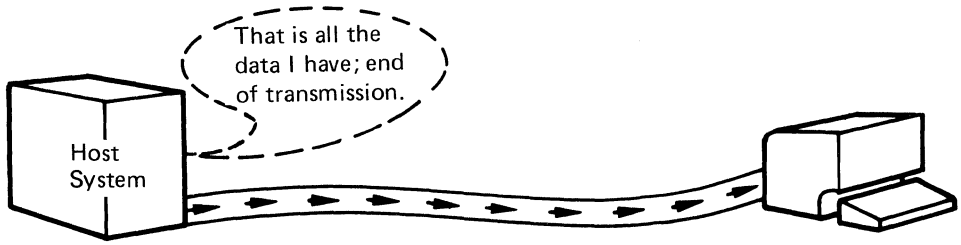


The terminal normally indicates to the host whether or not the data was received correctly.

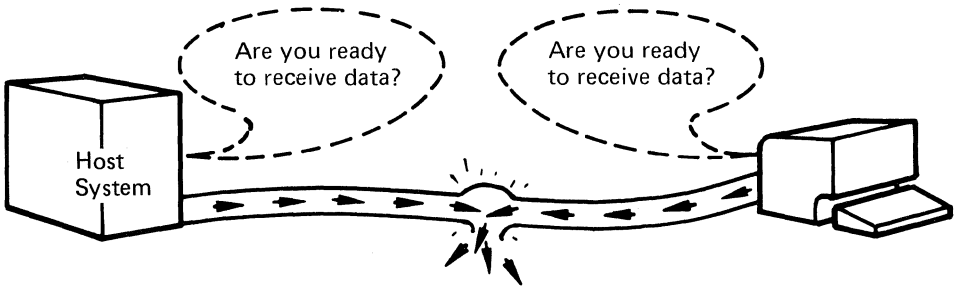
4. If the terminal receives the data correctly, it normally sends a positive answer (sometimes called acknowledgment) back to the host:



5. The host may then send more data or indicate that it has no more data to send. The host then ends the transmission.



Either station on a point-to-point line may start communications (bid for the line); therefore, both stations could bid at the same time:



When both stations bid at the same time, this is called *contention*. Both the host and the terminal would receive a negative answer or no response to their request.

Different methods are used to resolve contention. For example, one method is to assign one station as a *control* or *primary* station and the other as a *tributary* or *secondary* station. A control or primary station is designed to always gain control of the line first. The tributary or secondary station must then wait to send its data after the control or primary station indicates that it has finished transmitting.

Controlling the Devices on a Multipoint Line

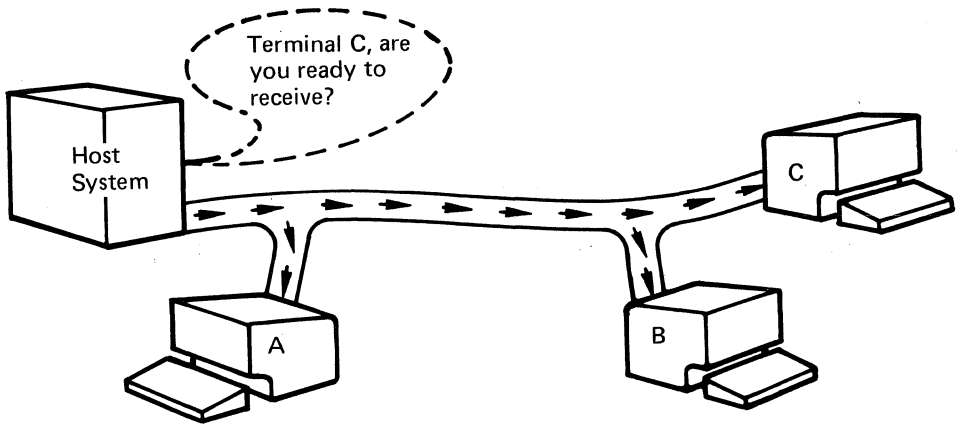
Controlling communications on a multipoint line is more complicated than on a point-to-point line because there is more than one terminal on a multipoint line. On a multipoint line, one station controls the communications by selecting and/or polling the other stations. The station controlling communications (usually a host system) is called the *control* or *primary* station and the other stations (usually terminals) are called *tributaries* or *secondary* stations.

Selecting

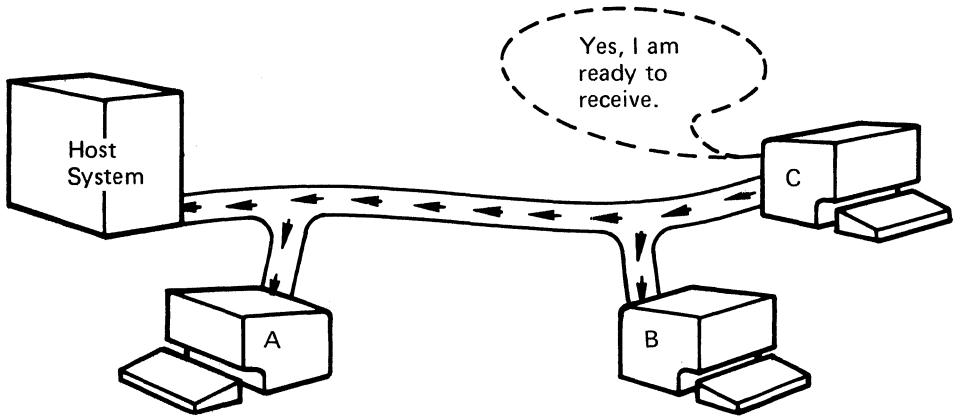
When the control or primary station sends data to a tributary or secondary station on a multipoint line, the data is available to all tributary or secondary stations on the line. Therefore, each transmission must be controlled so that the correct station receives the data. This is done by assigning each station an address, such as A, B, and C. The control or primary station selects the correct tributary or secondary station by sending the address of that station before sending the data. This is called *addressing* or *selection*. Once the station is selected and ready to receive data, the control or primary station sends the data on the line and the station that is selected receives it.

The following example of a host system (control or primary station) and attached terminals (tributary or secondary stations) shows how a host selects and sends data to terminals on a multipoint line.

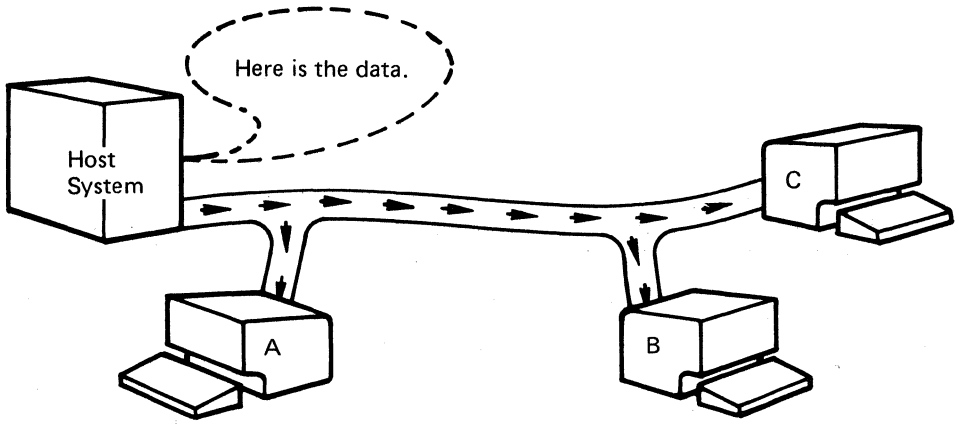
1. To send data to a terminal, the host system first selects the correct terminal (in this example, terminal C) by sending the address (C) of that terminal:



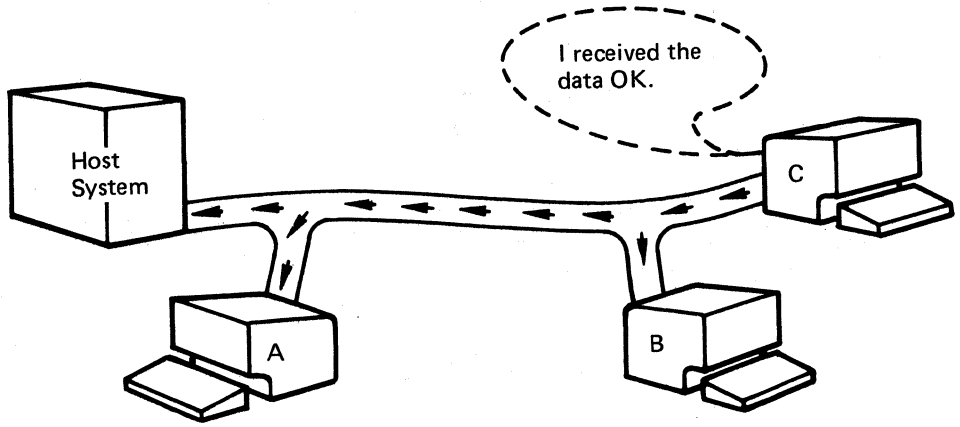
2. Only terminal C responds to the address sent by the host (the other terminals on the line receive the address sent by the host and the response sent by terminal C but ignore both):



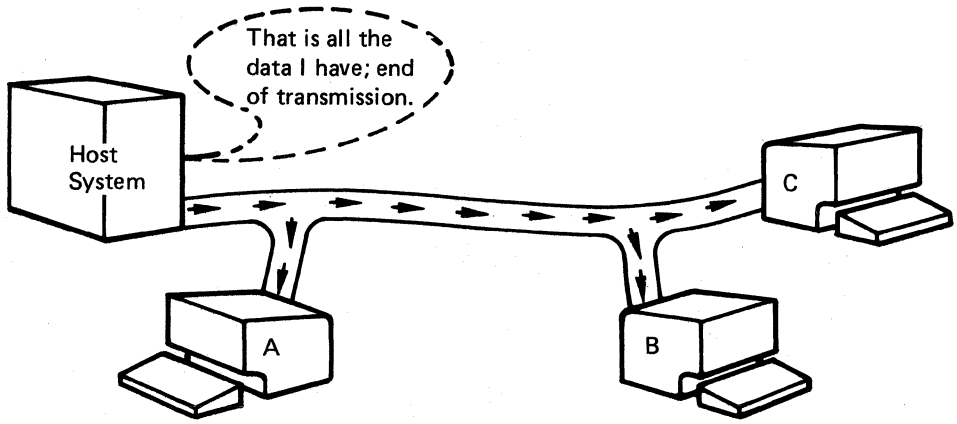
3. Having answered yes, terminal C is ready to receive the data. The host system sends the data and only terminal C processes it (terminals A and B ignore the data):



4. Terminal C informs the host system that the data was received correctly (terminals A and B ignore the response):



5. The host system then sends more data, or indicates the end of transmission (the end of transmission indicates that terminal C is no longer selected and the line is now available):

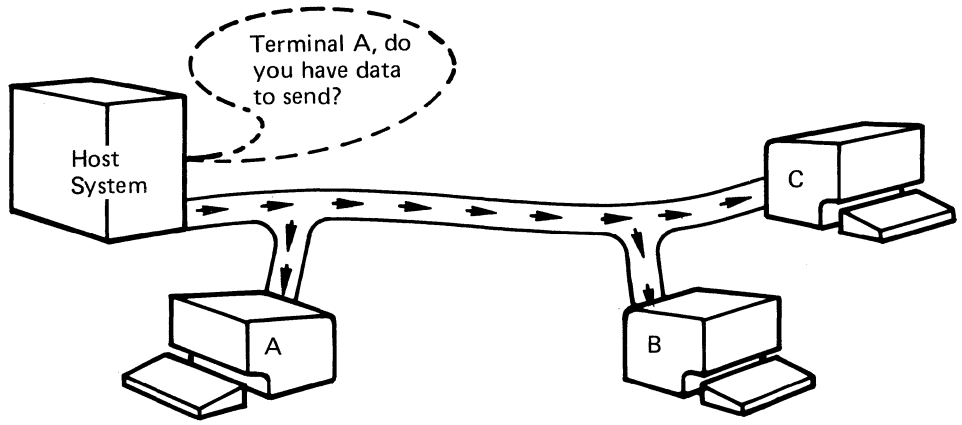


Polling

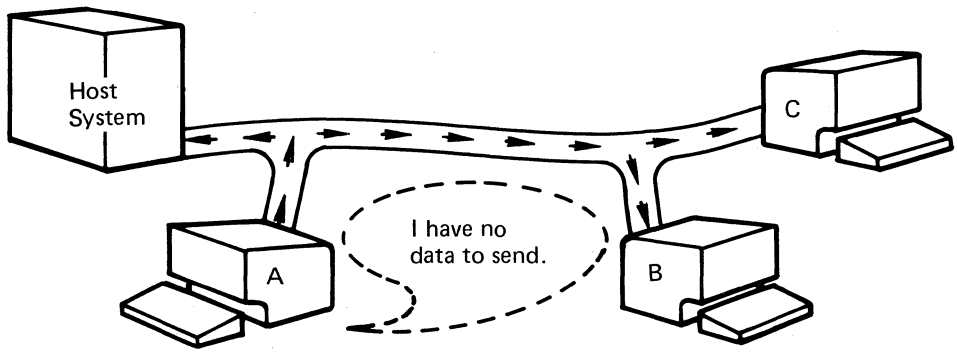
In the preceding example, the control station selected the station to which data was transmitted. The control or primary station must also control the other terminal(s) that transmit(s) data. If all terminals began sending at the same time, it would be impossible to determine which one was transmitting. Since each terminal has an address, the control station can send the address of each terminal, one at a time, to determine if any of them have data to send. This is called *polling*.

The following example of a host and attached terminals shows how a control station polls terminals on a multipoint line.

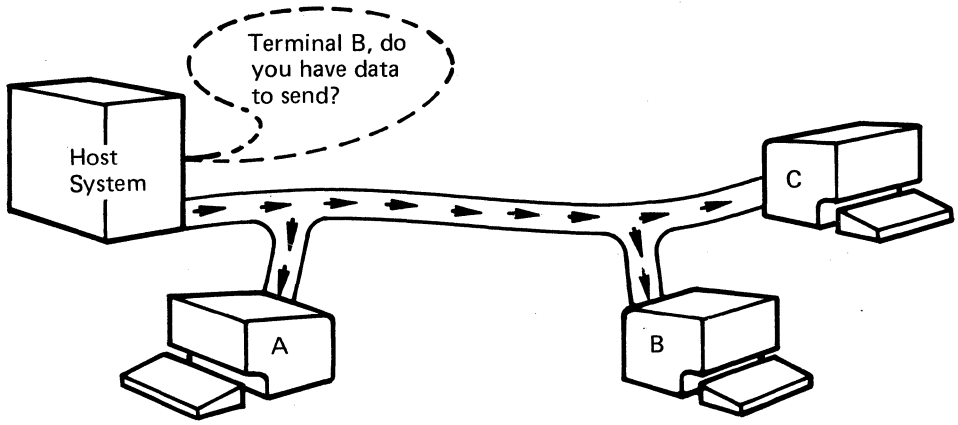
1. The host polls each terminal, one at a time, starting with terminal A:



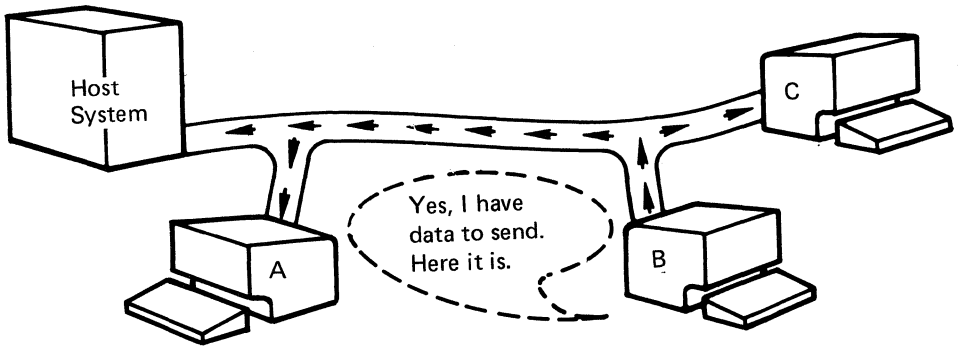
2. Although all terminals on the line receive the address for terminal A, only terminal A answers. (Terminals B and C receive the response but ignore it.) If terminal A does not have data to send or is not ready to send data, it indicates this in its response:



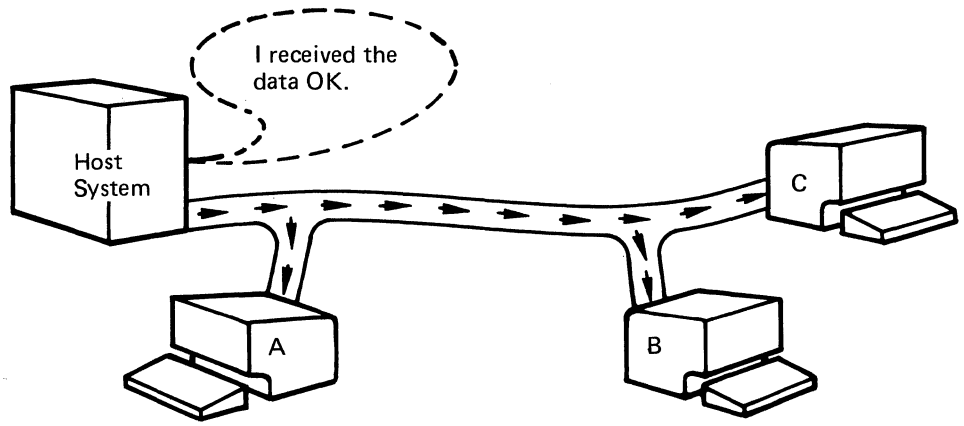
3. Since terminal A does not have data to send, the host system polls terminal B:



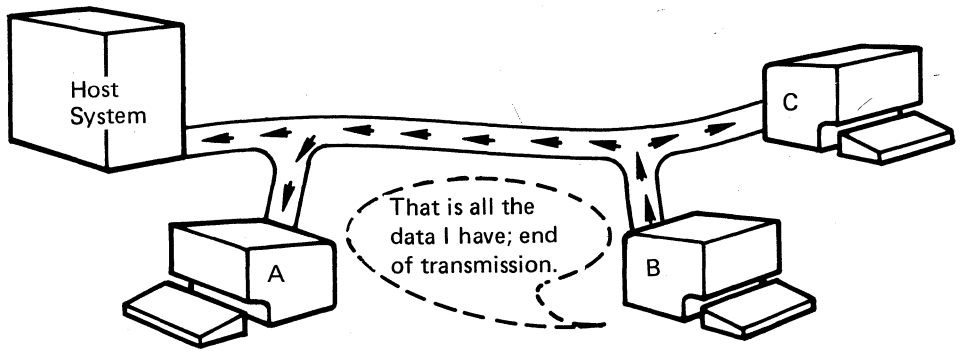
4. This time only terminal B answers. Terminal B is ready and has a message for the host system (terminals A and C ignore the data and the response):



5. The host responds to terminal B to indicate that the data was received OK (terminals A and C ignore the response):



6. Terminal B may send more data or indicate that it has no more data to send and that this is the end of its transmission (the end of transmission indicates that the line is now available):



Terminals do not have to be polled in sequence. A polling list can usually be set up for the most efficient operation. If a terminal is seldom used, it does not have to be polled as often as a more active terminal. For example, if terminal C is used less frequently than terminals A and B, the polling list could look like this:

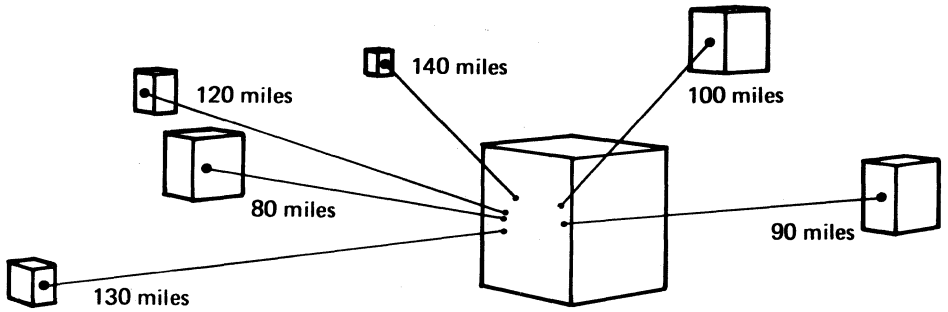
A B A B A B C A B . . .

Polling the seldom-used terminal less often permits more efficient use of system time.

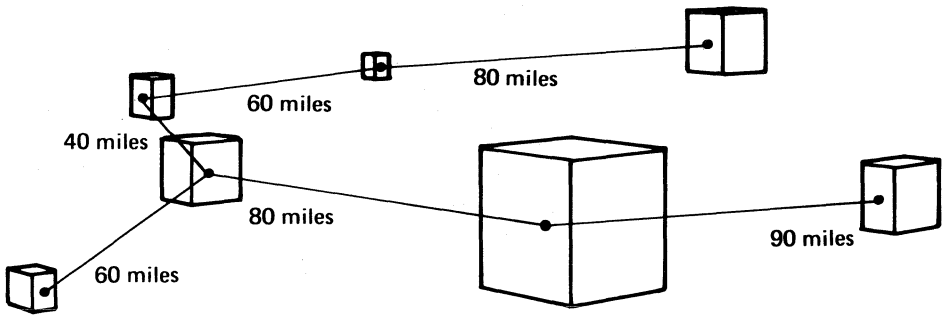
POINT-TO-POINT VERSUS MULTIPOINT TRANSMISSION

If controlling a point-to-point line is easier than controlling a multipoint line, why not always use point-to-point lines? The answer to this question involves how the common carrier company rates (or tariffs) are determined for nonswitched lines.

Common carrier companies generally charge for a nonswitched line by the length of the line in air miles. The following example shows the mileage of a network of nonswitched point-to-point lines as compared to the mileage of a network consisting of one multipoint line (both networks use the same host and terminals):



Point-to-Point Lines
Total Mileage; 660



Multipoint Lines
Total Mileage; 410

The example shows that the total line miles in the multipoint line network is shorter than the total line miles in the point-to-point lines network. Therefore, the multipoint network charges are less than the point-to-point network charges. Also, a modem is required at each end of a nonswitched point-to-point line. In the point-to-point example, six modems are required at the host system; whereas, in the multipoint example, only one modem is required at the host system. (Switched point-to-point lines might also use one modem at the host system; however, only one line at a time can be used.)

Another factor that affects the rates is whether the line is intrastate (within one state) or interstate (between two or more states). When the line is an intrastate line, the rates are controlled by the Public Utility Commission of that state. Therefore, intrastate rates may vary from state to state. When the line is an interstate line, the rates are controlled by the Federal Communications Commission and are usually the same throughout the United States.

TIME-OUTS

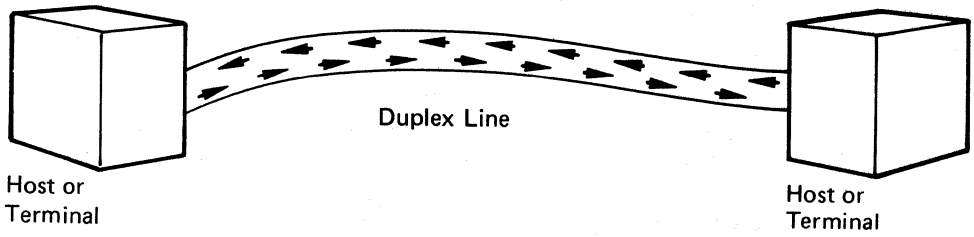
Another situation on a communications line that must be controlled is a station failing to answer a request (on either a switched or a nonswitched line).

If a station fails to respond to a request, the requesting station might wait for the response for an indefinite time and, therefore, tie up the line so that other stations cannot communicate. To avoid this, the requesting station must wait a short time, then retry the request or go to another station or another job. This wait is called a receive time-out. For example, if a host sends a message to a terminal that does not have its power on, the terminal cannot respond to the message. In this case, the host may transmit the message again after a specified time (time-out). If, after a specified number of retries, the terminal still does not respond, the host begins communicating with other terminals.

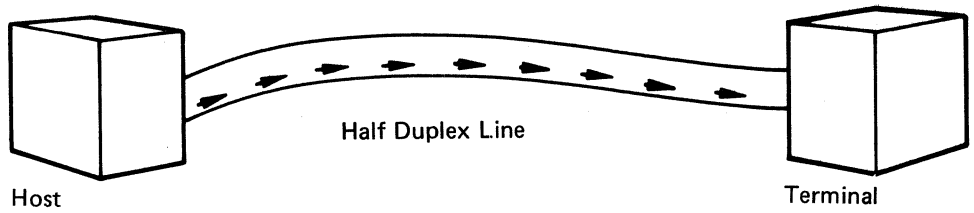
Time-outs can vary from one to 30 seconds, depending on whether the station is receiving or transmitting and depending on the type of response or acknowledgment expected.

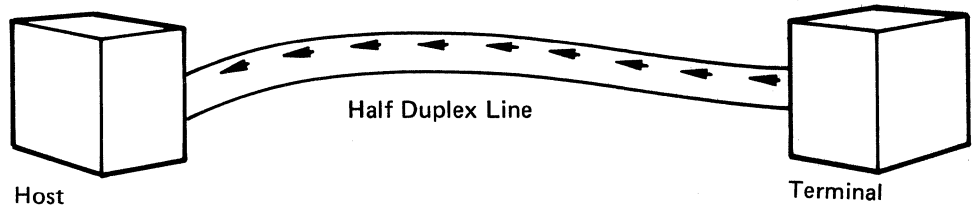
DUPLEX AND HALF-DUPLEX TRANSMISSION

Duplex (sometimes called full duplex) transmission is data transmission between two stations in both directions at the same time. An example of duplex data transmission follows:



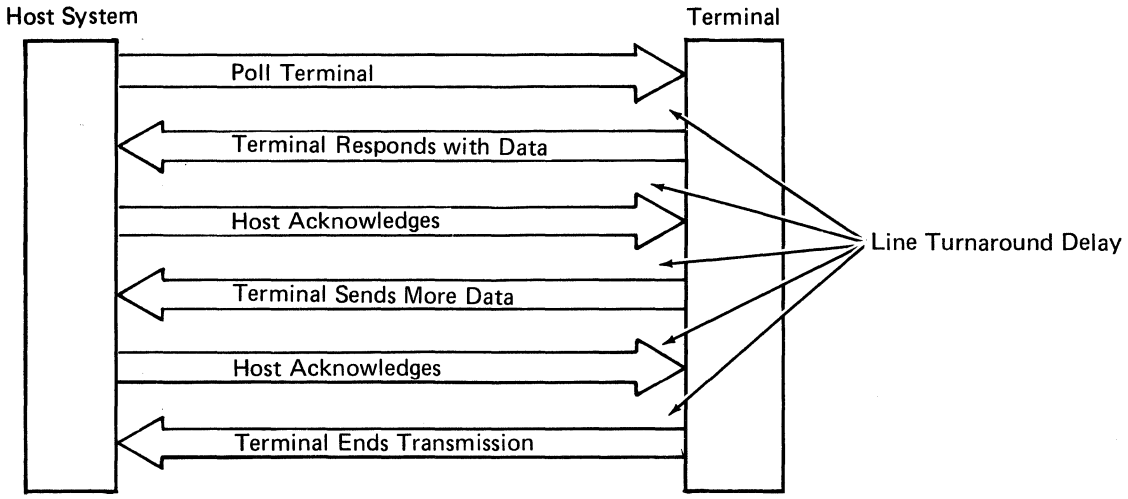
Half-duplex transmission is data transmission in both directions but not at the same time. Examples of half-duplex data transmission follow. In the first example, a host is the transmitter and the terminal is the receiver. In the second example, the terminal is the transmitter and the host is the receiver.





The terms 2-wire and 4-wire are sometimes used to mean half duplex and duplex; however, the number of wires in the communications line is not related to half duplex or duplex ability. See *Transmission Methods* later in this chapter for more information.

Most stations now in use cannot transmit and receive data in duplex mode; however, even if a station cannot transmit and receive data at the same time, there is an advantage in using duplex lines. The advantage is a reduction in the time required for the line to turn around. When a station changes from transmit to receive or from receive to transmit, there is a delay called line turnaround time. This delay allows modems and network equipment to switch the direction of transmission and to ensure that all data has reached its destination. Messages that require frequent line turnarounds can cause a significant increase in the time required to transmit a message. The following example shows how line turnaround time can affect transmission:



If a duplex line is used, the modems and network equipment are always ready to transmit and receive, and the line turnaround time is minimal.

TRANSMISSION METHODS

When the data leaves your location, it is normally transmitted to a common carrier company office, such as a local telephone company exchange office. A line called the local loop carries the data to the local office. The data is then transmitted from one local office to another local office by cable, satellite, or microwave signals.

The local loop can be either a 4-wire or a 2-wire circuit. With a 4-wire local loop, one pair of wires transmits data and the other pair receives data. With a 2-wire local loop, one pair of wires is used to both transmit and receive data. The terms 4-wire and 2-wire are sometimes used to indicate a duplex line or a half duplex line. However, the number of wires in the local loop is not related to duplex or half duplex. For example, some modems can transmit in duplex mode on a 2-wire local loop.

TRANSMITTING THE DATA

In data communications, several code structures are used to assign the combinations of bits (1's and 0's) to data characters. The most common code structures used are the EBCDIC (extended binary-coded decimal interchange code) and the ASCII (American Standard Code for Information Interchange) codes. All devices on the line must use the same code structure. For example, if a host is using EBCDIC, then all terminals or other systems with which the host communicates must also use EBCDIC.

Most stations transmit data serially, one bit at a time, over the communications line. The speed at which the bits are transmitted is specified in bits per second (bps) or bauds. (Baud indicates the number of signal changes per second on a line and does not always equal bits per second.)

Data communications lines are classified by maximum transmission speed. All equipment on a line must operate at the same transmission speed. For example, if a host operates at 9600 bits per second (bps), then the modems, lines, terminals, or other hosts must also operate at 9600 bits per second (bps). Channel conditioning, adding electrical or electronic devices to improve the data signal, may be necessary to get the required transmission speed.

Data Validity

Communications lines are subject to noise and interference which can change data bits so that they may not be recognized by the receiving station. In addition, the receiving station might accept noise as data bits. If a bit in a character is changed, that character and possibly the characters next to it will not be valid. Therefore, the data is usually checked for changed, lost, or gained bits.

There are three common methods to check data validity: vertical redundancy checking (VRC), longitudinal redundancy checking (LRC), and cyclic redundancy checking (CRC). A station normally uses either CRC, VRC, LRC, or VRC and LRC in combination, depending upon the type of data link control used.

Vertical Redundancy Checking (VRC): VRC checks each character for an odd or even number of 1 bits, which is called parity checking. For example, if the transmitting station ensures that every character transmitted has an odd number of 1 bits (called odd parity), then the receiving station must receive an odd number of 1 bits for each character or the character is invalid.

Longitudinal Redundancy Checking (LRC): LRC uses all the bits of each character of data to form a check character at both the transmitting and the receiving stations. At the end of each transmission, the transmitting station sends its check character to the receiving station where the two check characters are compared. If they are equal, the data is assumed to be correct.

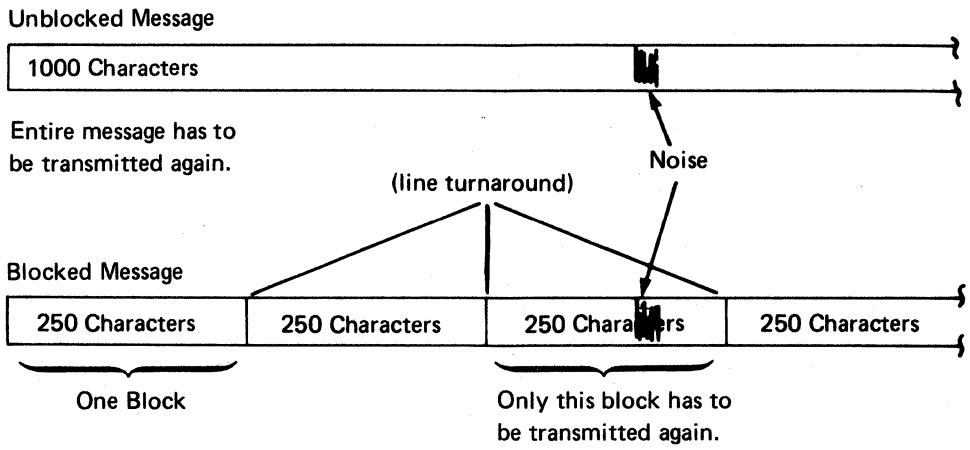
Cyclic Redundancy Checking (CRC): CRC uses a mathematical procedure to form a check sequence (usually 16 bits or two characters) using all bits of all characters in a group of data. The check sequence bits are usually referred to as block check characters (BCC), or frame check sequence (FCS) in SDLC, which are formed at both the transmitting and receiving stations. The transmitting station sends its check sequence bits or characters to the receiving station where they are compared to the sequence bits formed at the receiving station. If they are equal, the data is assumed to be correct. Cyclic redundancy checking is the most accurate method of error detection presently used.

These error checking methods are automatically performed by the device or communications program. Both the transmitting station and the receiving station must use the same error checking methods.

Transmission Efficiency

When an error is detected, the receiving station normally sends a negative answer to the transmitting station. The transmitting station then usually sends the data again. The longer the message, the greater the possibility of an error occurring. Thus, a long message may have to be transmitted several times before it is received correctly. This can greatly reduce transmission efficiency.

One method of improving transmission efficiency is to divide the message into blocks of data as shown below:



In this example, the transmitting station sending a blocked message only has to send 250 characters again instead of the entire message. The block size used depends on how the data communications system is used, the transmission speed, and the condition of the line. (Line conditioning occurs when certain devices are added to the line to improve the data signal.)

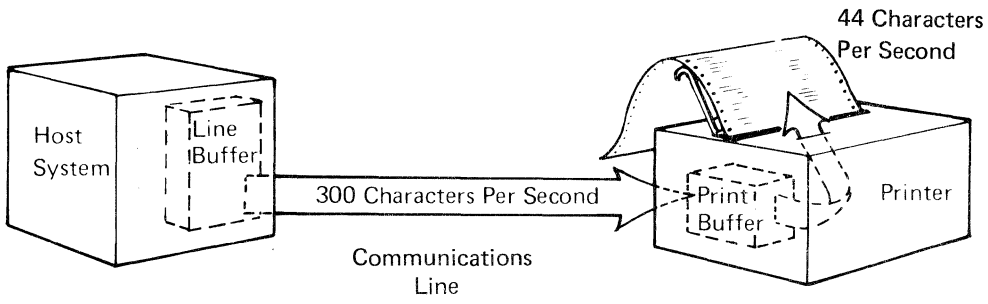
Sending data in blocks may increase the number of line turnarounds, which increases the time it takes to transmit the message. If possible, different block lengths should be tried to determine which block size is the most efficient. (Some devices specify a fixed or a maximum block size.)

Because signal distortion often decreases as the transmission speed is decreased, another possible method of increasing transmission efficiency is to reduce transmission speed.

Buffers

A buffer is a portion of computer or terminal storage that is used to store data temporarily to make up for a difference in time or rate when data is transmitted from one device to another. In data communications, a buffer allows the data to be transmitted at the speed of the communications line instead of the speed of an input or output device.

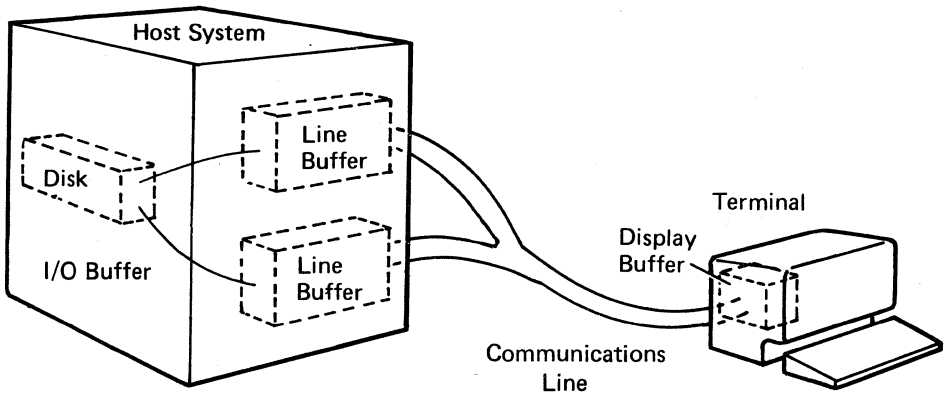
For example, suppose you are transmitting data to a 44-character-per-second printer on a line that can transmit data at 2400 bits per second (bps) (300 characters per second using an 8-bit code, such as EBCDIC). Since the printer cannot receive and print all the characters at once, but can only print 44 characters per second, the full ability of the line is not used. However, suppose the printer has a buffer as shown in the following example:



The data can be sent to the printer at line speed (300 characters per second), stored in the print buffer, then printed at printer speed (44 characters per second).

The previous example shows the printer receiving the data. A buffer can be used in the same manner when a terminal transmits data (for example, to transmit data from a diskette or data entered at a keyboard). Data can be read from diskette or entered at the keyboard and placed into the buffer at diskette or keyboard speed, then transmitted from the buffer at the line speed.

Double buffering (using two buffers) further increases the efficiency of data transmission. The following illustration shows how double buffering is used:



Two line buffers are used to store data that is being transmitted to the line or being received from the line. During a transmit operation, data can be transmitted from one line buffer while data to be transmitted next is placed in the other line buffer. During a receive operation, data from the line can be stored in one line buffer while previously received data, stored in the other line buffer, is processed.

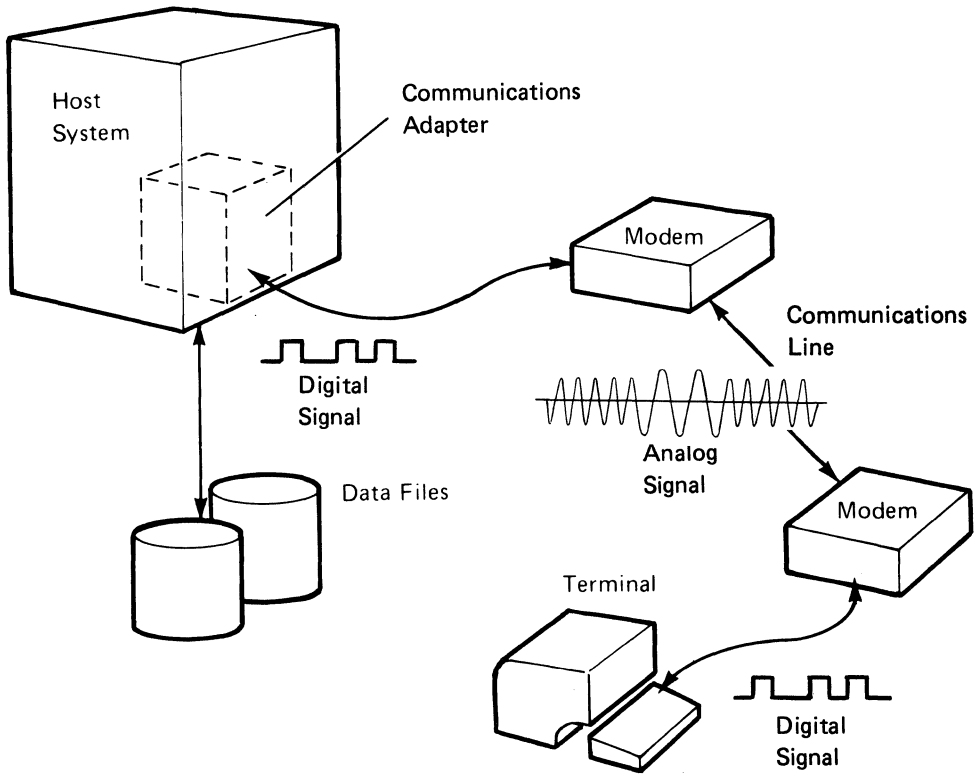
Buffers are also used to store data going to or coming from I/O devices (I/O buffer) as shown in the preceding example.

Buffers are fixed hardware storage, fixed program controlled storage, or program storage that is assigned and controlled by communications programs. The number and the size of the buffers used depend on the storage available in the hosts and terminals.

Modems

Most communications lines are not designed to transmit computer signals, which are called digital signals. They are designed to transmit voice signals, which are called analog signals. The digital signals must be converted to analog signals before they can be transmitted on a communications line that is designed for voice communications. (In this manual, data circuit-terminating equipment (DCE) is referred to as a modem. Data circuit-terminating equipment may be a telegraph adapter, a modem, a digital data service adapter, or any type of signal conversion equipment.)

A modem (modulator-demodulator) is a device that converts digital signals to analog signals, then transmits the analog signals to another modem over a communications line. The receiving modem converts the analog signals back to digital signals. The modem at the transmitting station and the modem at the receiving station must be compatible. For example, both modems must transmit data at the same speed and use the same modulation methods. The following illustration shows how modems are used to connect a host system to a terminal:



Modems may also be called data sets, data pumps, or line adapters. They can be external to, or enclosed in (integrated) a computer or terminal. There are a variety of modems available, some of which perform functions in addition to converting signals. Some of the additional functions (usually optional) that are available with modems are:

- Answering calls automatically on switched lines (called autoanswer)
- Using a switched line if the nonswitched line is not functioning properly (called switched network backup, SNBU)
- Selecting a lower transmission speed during periods of line interference (called half-rate selection)
- Isolating problems to the terminal, modem, or line by using diagnostics that reside within the terminal

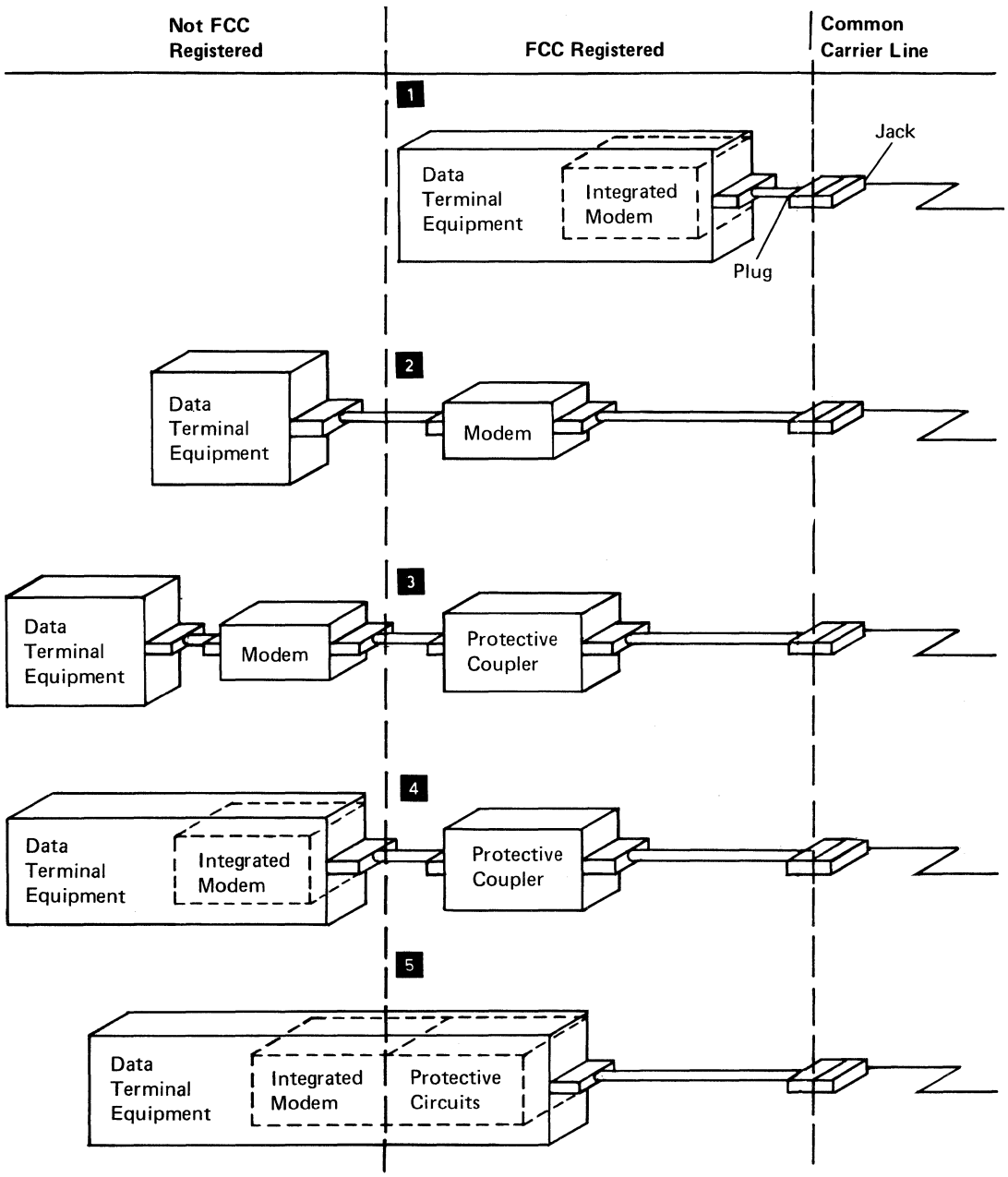
Your IBM marketing representative can assist you in selecting the proper modem.

CONNECTING AN IBM MODEM TO A COMMUNICATIONS LINE

When an IBM modem is connected to a communications line, the physical connection depends on the type of modem, the modem options, and whether the line is switched or nonswitched.

Connecting a Modem to a Switched Line

When an IBM modem is connected to a switched communications line, the modem is either registered by the Federal Communications Commission (FCC), or an FCC-registered protective coupler or registered circuitry is required to protect the communications line from excess power from the modem. The protective coupler also limits the modem power output to the line to a level specified by the common carrier. The following illustration shows several different configurations of modems, protective couplers, and protective circuits.



1 This example shows FCC-registered data terminal equipment with an integrated modem. The data terminal equipment is registered, therefore, it is connected directly to the communications line.

2 This example shows data terminal equipment that is not FCC-registered connected to a registered external modem. The external modem may be connected directly to the communications line.

3 **4** In these examples, neither the modems nor the data terminal equipment are registered. In this case, FCC-registered protective couplers are required to connect the modems to the line.

5 This example shows data terminal equipment with registered protective circuitry. In this example, the data terminal equipment can be connected directly to the line.

Connecting a Modem to a Nonswitched Line

An IBM modem is usually connected directly to the common carrier nonswitched line.

Manual Call/Manual Answer Coupler

The manual call/manual answer coupler is used to connect the modem to a switched line when the operator dials or answers a call manually.

Autoanswer Coupler

The autoanswer coupler is used when a call from another station will be answered without operator intervention. However, calls can be manually dialed or manually answered if necessary.

DIGITAL DATA NETWORKS

The communications networks discussed in other sections of this manual are designed for voice communications. Because voice signals are analog signals and computer signals are digital, the digital signals must be converted to analog (using modems) to be transmitted by voice lines. With a digital network, the data does not have to be converted to analog; therefore, modems are not required. Also, data can be transmitted at higher speeds with better reliability on networks designed for digital transmission.

One of the digital networks to which IBM equipment can be connected is the American Telephone and Telegraph Digital Data Service (DDS). Other digital networks (provided by several carrier companies) to which IBM equipment can be connected are designed according to the CCITT (International Telegraph and Telephone Consultative Committee) X.21 and X.25 interface standards. These networks are called circuit-switching data networks and packet-switching networks, respectively. Packet switching data networks are discussed later in this section.

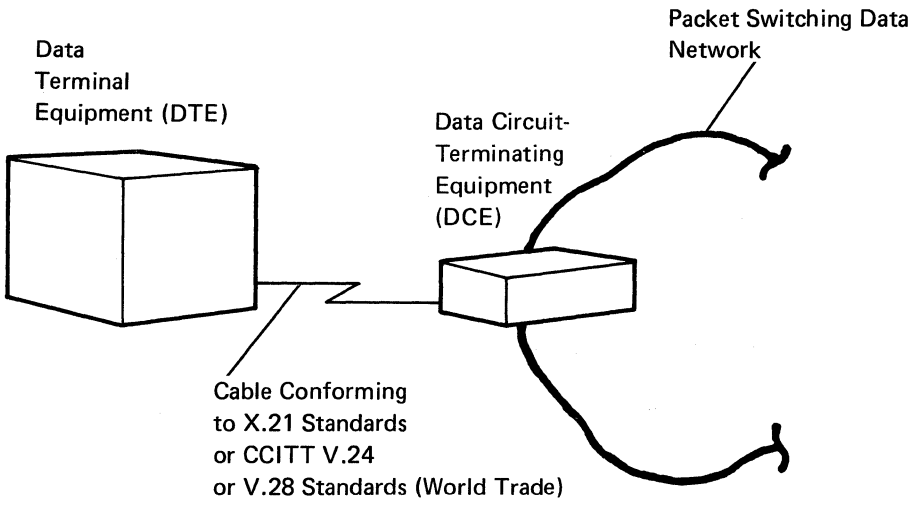
Digital Data Service Network

The American Telephone and Telegraph Digital Data Service (DDS) is a nonswitched digital network. This network is full duplex and can transmit data at transmission rates of 2400, 4800, 9600, and 56 000 bits per second. The transmission rate is set by the carrier as requested by the user.

IBM equipment is connected to a DDS network by a digital service unit (DSU) or channel service unit (CSU) provided by a common carrier.

Connecting to Packet Switching Data Networks

IBM equipment is connected to a packet network by an adapter provided by the network common carrier. The packet network adapter is connected to IBM equipment by cables, connectors, and interface signals defined by the CCITT X.21 interface standard as shown in the following illustration:



PACKET SWITCHING DATA NETWORKS

What is a Packet Switching Data Network?

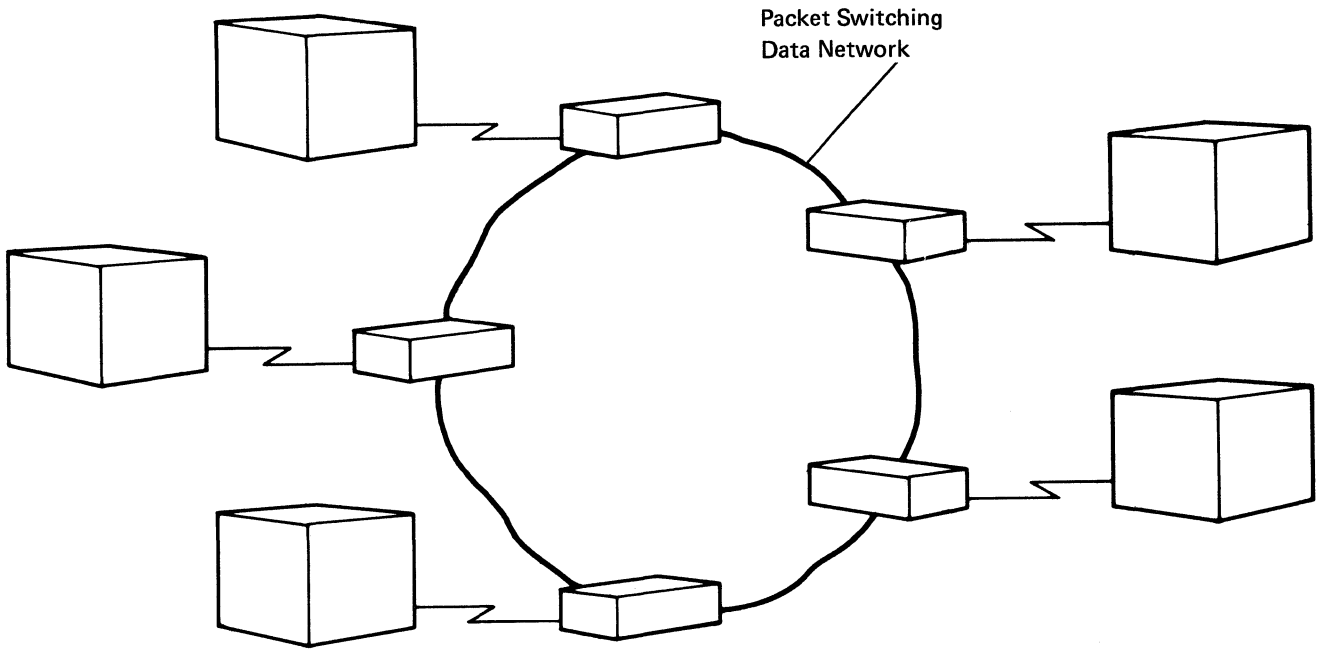
Packet switching is a data communications technique used to achieve greater use of data communications network resources in which multiple users share the same paths or channels at the same time. The network designed to provide this type of communications service is called a **packet switching data network (PSDN)**. Packet switching data networks are an alternative to networks made up of lines that are dedicated to pairs of users and multiple users.

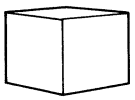
A packet switching data network carries units of information that are divided into segments called **packets**. You don't have to know how data is forwarded to its destination or what procedures are used within the network to transmit packets. To use a packet switching data network, you can connect your equipment, called **data terminal equipment (DTE)**, to the network through **data circuit-terminating equipment (DCE)**.

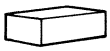
The DTE is a communicating device that is the orgin or destination of data flowing in the network. A DTE might be a host processor, a cluster controller, or a terminal.

The DCE is any common carrier equipment or service that is used to connect your equipment to the network. DCE might be an adapter or a modem that is usually provided by the network.

Many users from different locations can connect to a packet switching network, as shown in the following illustration:




Data Terminal Equipment (DTE)


Data Circuit-Terminating Equipment (DCE)

Advantages of Using Packet Switching Networks

Although transmission costs can vary from network to network and from country to country, there are some advantages of using packet switching data networks over other types of data transmission mediums. Some advantages are:

- You can transmit low volumes of data over long distances at relatively low costs.

- You can share the network's high-speed lines with large numbers of users; that is, you can take advantage of the network's technology and high speed lines. (Some networks can transmit data at speeds up to 56 000 bps.)

Because packets are self-contained, many users can efficiently share costly communications resources. All packets moving through the network are in a standard form and contain transmission information in their packet headers; therefore, the network need not reserve a physical path through the network for a communications session. Packets being forwarded to any destination can travel freely across the most efficient circuit in the network.

Packet Switching Data Network Performance Considerations

Performance of a network should be carefully evaluated and compared to the performance of the more traditional switched and nonswitched communications lines. Although there are many aspects that can affect the performance of a network, you should always examine two basic network characteristics:

1. **Delay characteristics** determine the speed at which a connection can be established and cleared and the average time that data spends in transit. The delay characteristics of a network influence the response time of an application using the network. If fast response time is important for an application, then network delay becomes a critical factor.

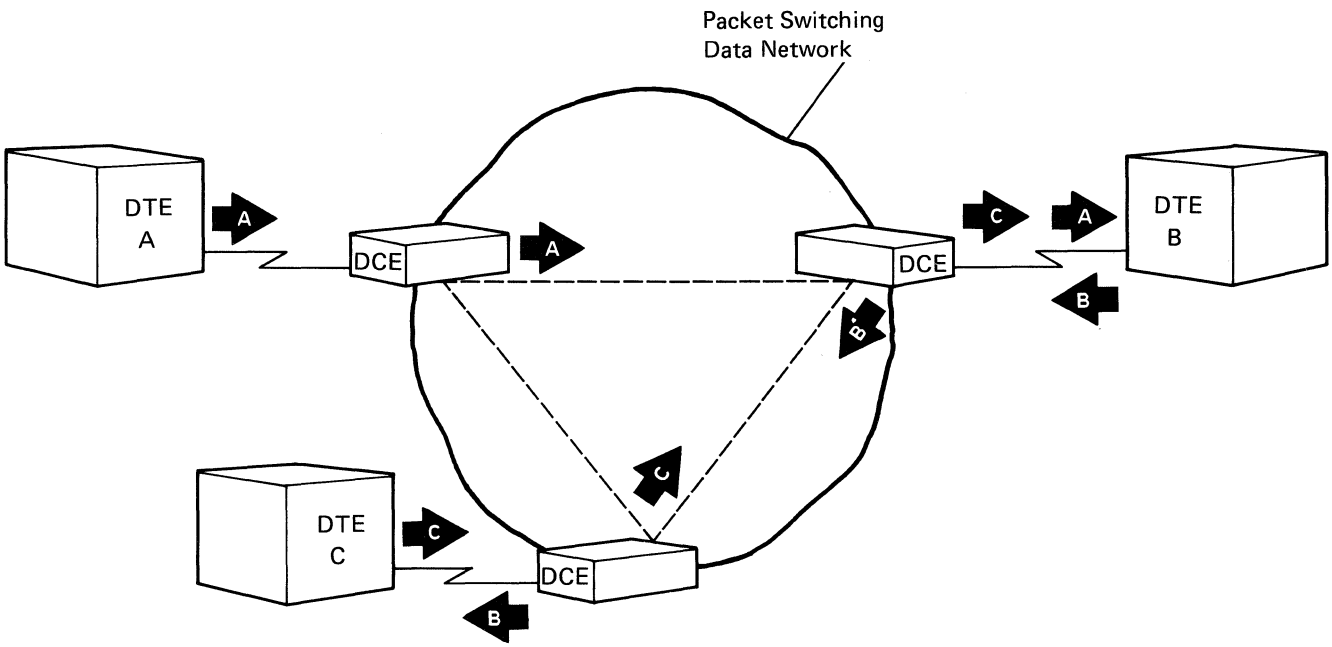
2. **Throughput considerations** are regulated by the network's allowable packet size and the number of packets that can be sent at a time.

How Does a Packet Switching Network Work?

Many of the operations performed on a packet network are similar to operations performed for letters in a post office. For example, your packet (like a letter), contains information stored in a fixed format (an envelope) with routing information (the address) clearly visible to the network processes. (The data packet sizes can range from 64 to 1024 characters. Although different packet networks transmit packets of different sizes, packets containing 128 characters is the most common size.)

Once a packet (letter) is sent to a **network node** (a mail box or a postal station), the network is responsible for forwarding the packet according to the address supplied. (A node can be a send or receive point, or a store and forward point in a packet switching data network.) Just as mail sorters examine the address on an envelope and direct a letter to its proper destination, nodes in a packet switching network examine the packet header and send the packet on to its destination.

The following illustration shows several users transmitting packets over a packet switching data network:



Data Terminal Equipment (DTE)
Data Circuit-Terminating Equipment (DCE)

In this example, packets are mixed (referred to as interleaved) as they flow through the network, however, the receiving locations, receive the packets in the order they were sent.

When you give a letter to the post office for delivery, you don't worry about how it moves through the various postal stations. Your job is to ensure that the letter has the correct address and is deposited in a postal station. The same holds true for a packet switching network. Because the network's internal forwarding processes are invisible to you, you need not be concerned with the movement of information between your equipment and the location you are sending the packet to.

Establishing a Communications Link in a Packet Switching Network

In a packet switching network, no real end-to-end physical transmission channels are assigned to the DTEs.

Data packets flow across paths (called **logical channels**) and **virtual circuits.** Logical channels exist between the sending DTE and the network, and between the network and the receiving DTE. Within the network, logical channels become virtual circuits. When the DTE sends a packet to the DCE, the DTE places a **logical channel identifier** in the packet header. The logical channel identifier associates the packet with a virtual circuit and routes the packet through the network across the assigned virtual circuit to its destination DTE.

The logical channels and virtual circuits form a logical end-to-end transmission path that makes the network appear to provide a switched or nonswitched, point-to-point connection between two communicating locations.

Because logical channel identifiers are defined strictly for communications between the DTE and the DCE, the logical channel identifier for each end of a virtual circuit are not necessarily the same.

Virtual Circuits

A **virtual circuit** is a logical path between the sending location and the receiving location that make it appear as if the two communicating locations are directly, physically attached to one another. In a packet switching network, there are two types of virtual circuits:

- Switched virtual circuit
- Permanent virtual circuit

Switched virtual circuit

A **switched virtual circuit** (SVC) (sometimes referred to as a virtual call) is a temporary logical connection between two locations. A virtual circuit is connected in the same way as a switched communications line, and it exists only until the communications session is ended. It is initiated by one DTE making a call request to the network. A virtual circuit appears to be an actual end-to-end connection, and requires each DTE to have a unique network address. A switched virtual circuit is generally used for applications that communicate with remote locations only occasionally.

Logical channels on switched virtual circuits can be of three types:

- **Call in** circuits permit systems to receive data only.
- **Call out** circuits allow systems to send data only.
- **Call in or out** circuits permit systems to both send and receive data.

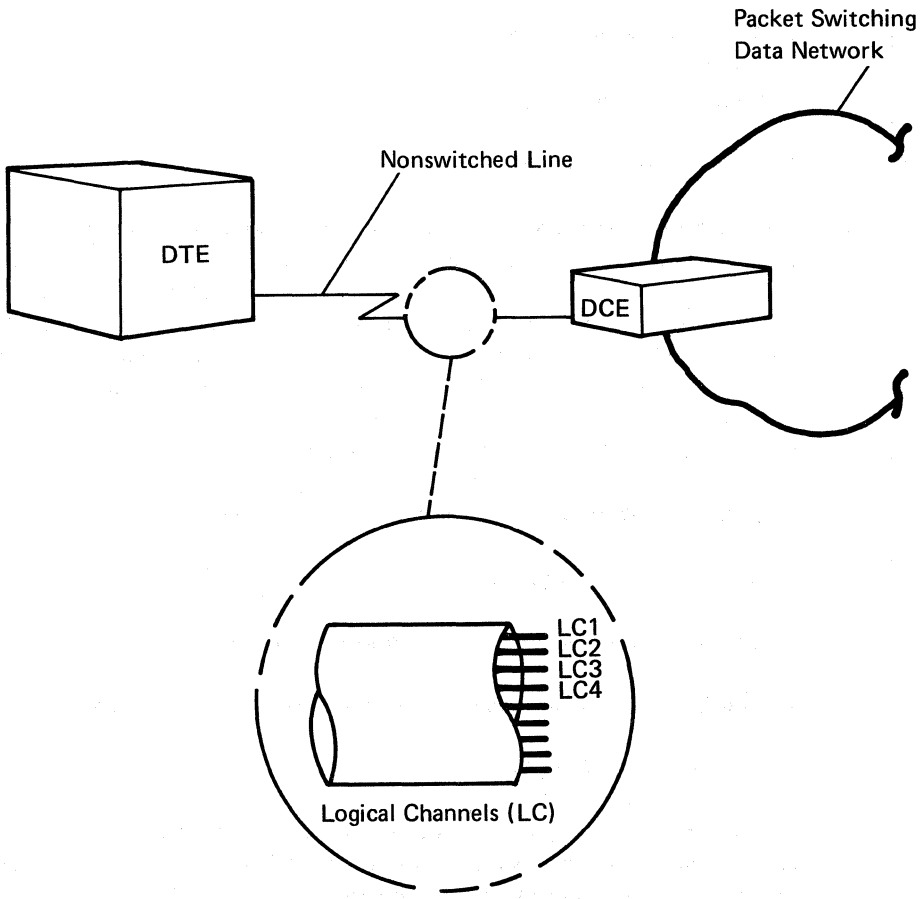
Permanent virtual circuits

A **permanent virtual circuit** (PVC) is similiar to a nonswitched, point-to-point connection. This circuit requires that each DTE permanently reserve logical channels for communicating with specific locations. This permanent connection requires no call setup or clearing (as a switched virtual circuit does) by the data terminal equipment. A permanent virtual circuit is generally used for applications that communicate frequently with a remote location.

Some networks may support only switched virtual circuits.

The types of circuits to be used are based on your system's requirements and the network offerings.

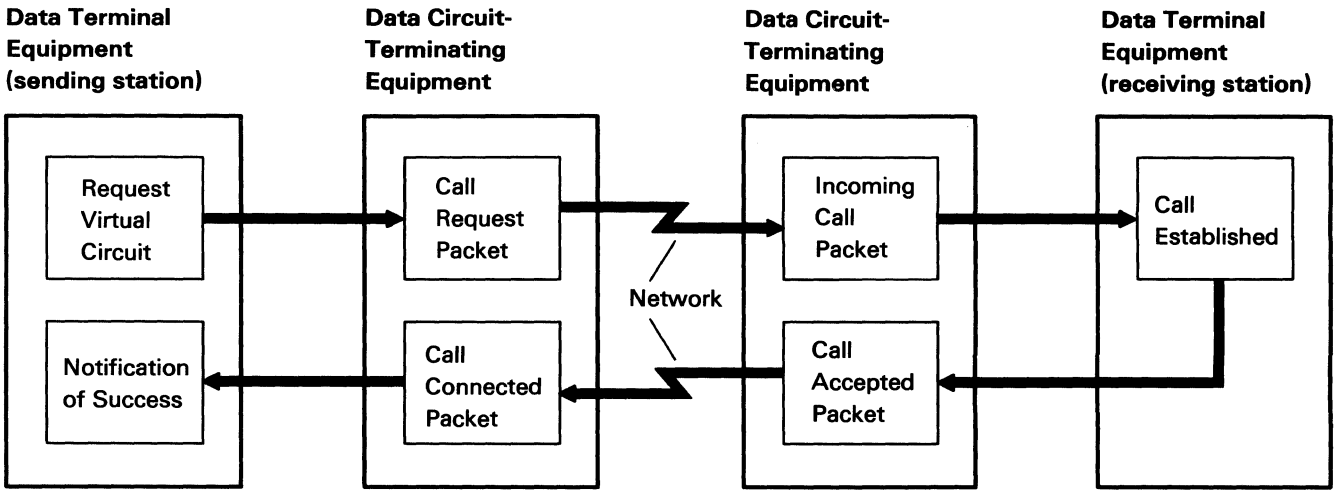
Different logical channels are represented by different numbers in the packet header, as shown in the following illustration:



Logical channel numbers are assigned to a virtual circuit only across the DTE and the DCE connection. In this example, logical channel numbers 1, 2, 3, and 4 are assigned to the line between your DTE and DCE. (Logical channel numbers would also be assigned to the link between the remote DTEs you will communicate with and their associated DCE.)

Connecting a Switched Virtual Circuit

The following illustrates how a switched virtual circuit is connected:



The calling station sends a call request packet to the remote location. At the receiving station, the incoming call packet is received and a call accepted packet is returned to the network. At the calling DTE, a call connected packet is returned, showing that the switched virtual circuit has been established.

Connecting a Permanent Virtual Circuit

When you use a permanent virtual circuit to communicate in a packet switching network, a permanent connection is reserved and logical channel addressing is established at the time you subscribe to a network; therefore, call setup is not required.

Controlling the Flow of Packets in a Network

When a DTE starts communicating with another DTE, the flow of packets must be controlled so that they are sent and received as they are intended. To move the packets through the network at a rate that both the data terminal equipment and the data communications equipment can handle, the network uses **windowing** (which is similar to pacing in SNA).

A **window** allows the DTE to send a specified number of packets before it receives an acknowledgement. For example, a window of three allows a location to send three packets, and then wait for an acknowledgement before sending more packets. By adjusting the window size, communicating systems and network equipment can transmit at a rate appropriate for both.

Chapter 4. Synchronization and Data Link Control

Synchronization means keeping the transmitting and receiving stations in step or in time with each other.

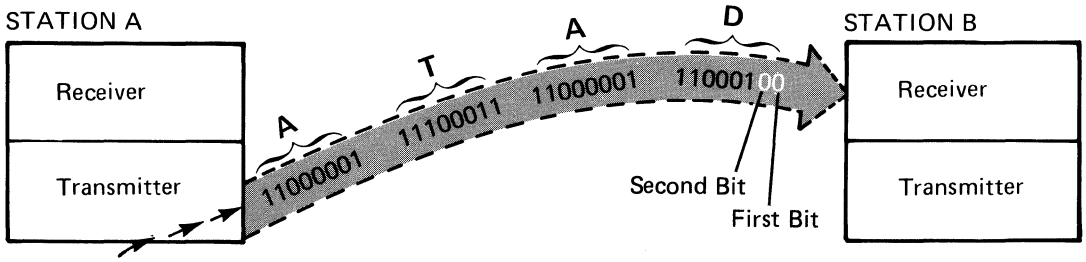
Each station, or its modem, has a timer called a clock. This clock times the data transmission. When the clock is in the computer, it is called a business machine or internal clock, and when the clock is in the modem, it is called a modem or an external clock. The clock at the transmitting station must be synchronized with the clock at the receiving station so the receiving station can recognize the bits from the transmitting station in the same pattern that they were sent.

Data link control means controlling communications between two or more stations.

Data link control is accomplished by sending control characters along with the data. The control characters indicate controls such as the beginning of a message, the end of a message, or the end of a block of data.

The methods used to synchronize and control communications between the transmitting station and the receiving station are asynchronous (also called start-stop), binary synchronous (also called BSC or bisync), and synchronous data link control (also called SDLC).

The following example shows why synchronization and data link control are needed. If data is being transmitted using the EBCDIC code structure, a series of bits representing the word DATA is transmitted:



11000100 D— First Character
11000001 A
11100011 T
11000001 A

The transmitting station converts the characters into bits and transmits them to the receiving station sequentially. The receiving station must assemble the bits again into characters so the data is usable. If the receiving station begins with the first bit transmitted, and counts every eight bits as a character, everything is fine. However, the receiving station must know which bit is first. For example, if it started counting with the second bit transmitted as shown in the preceding example, the receiving station would interpret the bits as something other than DATA, or indicate an error.

Once the stations are synchronized, the receiving station can recognize the characters from the transmitting station and perform the functions indicated by the data link control characters.

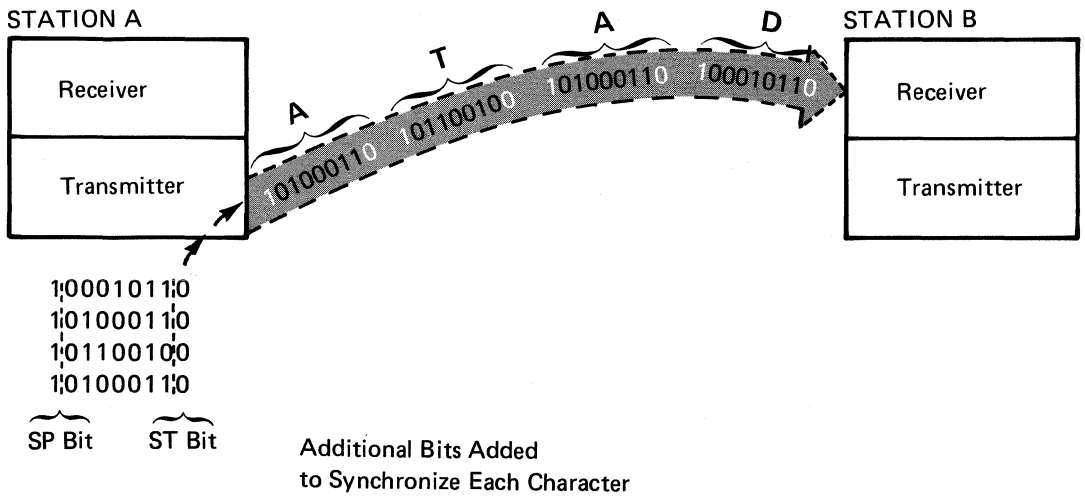
Except for unique situations, data link control characters are added to and removed from the data by devices or programs provided by IBM. If you are an application programmer, however, there may be situations that require a knowledge of the general function and sequence of data link control characters to write an efficient program. For example, your program may have to test indicators that are turned on when certain control characters are received, then perform operations based on those indicators.

ASYNCHRONOUS DATA LINK COMMUNICATIONS

With asynchronous (start-stop) data link control, the data characters are separated, and each character is synchronized individually. In asynchronous transmission extra bits are needed with each character to obtain synchronization. For example, the following series of bits are transmitted using the EBCD (extended binary coded decimal) code structure:

0001011	D
0100011	A
0110010	T
0100011	A

Additional bits are added to each character as shown:



Additional Bits Added
to Synchronize Each Character

The 0 bit in the beginning of each character is called a start (ST) bit. The 1 bit at the end is called a stop (SP) bit. The receiving station recognizes these additional bits as the beginning and end of each character. The start and stop bits of each character keep the clocks in sync for that character.

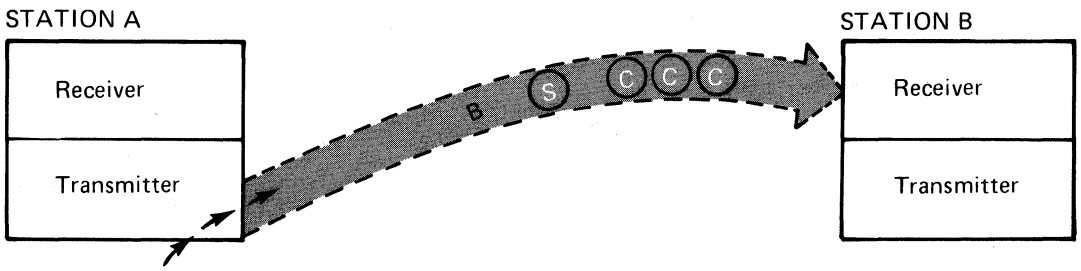
Since each character is synchronized individually, the characters need not be continuous on the line. A series of 1-bits (called mark hold) are transmitted between characters when the characters are not continuous on the line.

Asynchronous Data Link Control Characters

Commonly used asynchronous transmission data link control characters and what they indicate to the transmitting or receiving station are as follows:

Character	Alternate Designation	Use
Ⓑ (circle B)	EOB (end of block)	Indicates the end of a block of data
Ⓒ (circle C)	EOT (end of transmission)	Indicates the end of a message
Ⓓ (circle D)	EOA (end of address)	Indicates the end of the terminal address or the beginning of data
Ⓝ (circle N)	Negative response	Indicates that data was not received correctly
Ⓢ (circle S)	SOA (start of address)	Indicates the beginning of a terminal address
Ⓨ (circle Y)	Positive response	Indicates that data was received correctly

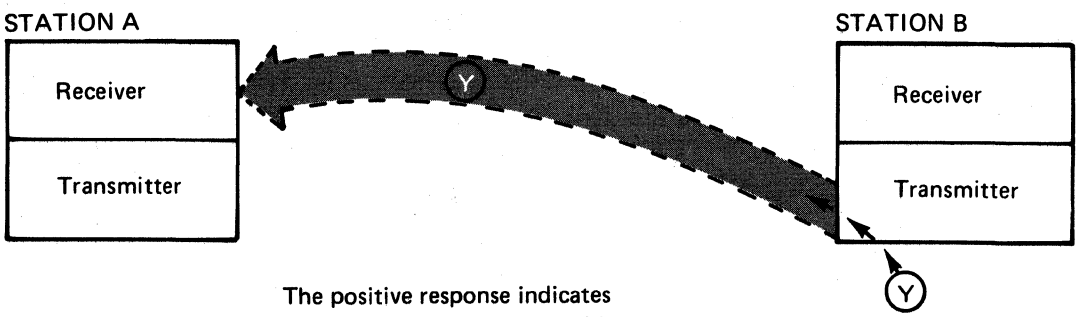
The following example of control character sequence shows how a transmitting station might control the data link, using the data link control characters, to address and send data to another asynchronous station:



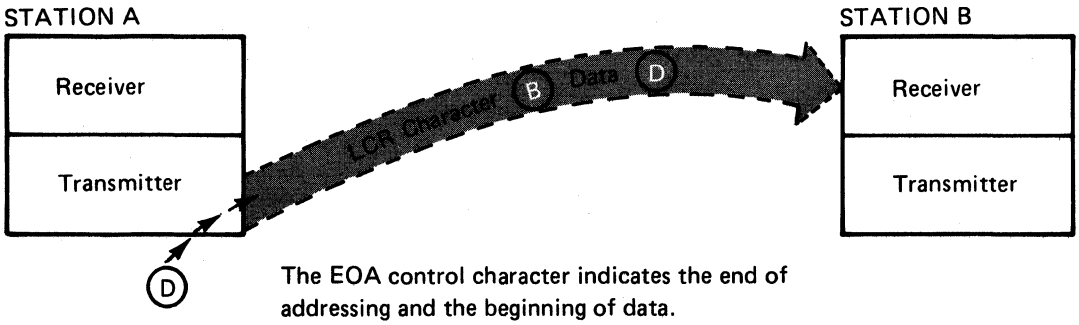
Ⓒ The EOT control characters reset all stations on the channel. (Only one Ⓒ is necessary; however, two or three are sometimes sent to ensure that the terminals are reset.)

Ⓢ The SOA control character tells all stations that an address follows.

B The address (B) selects station B.



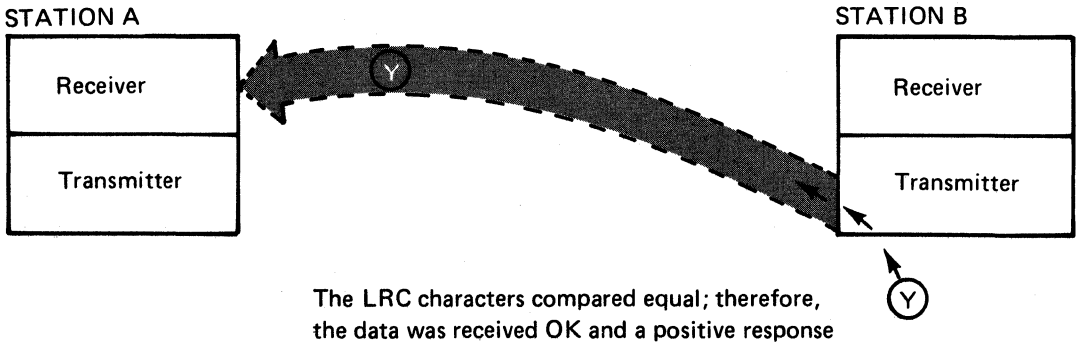
The positive response indicates that station B accepts the address.



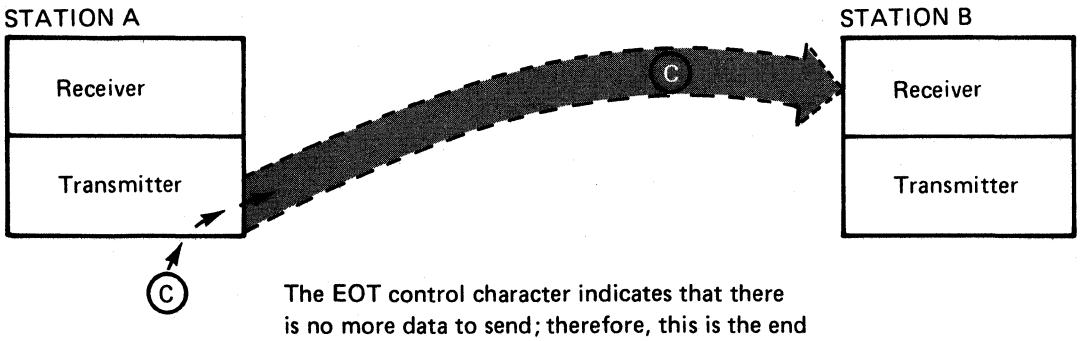
The EOA control character indicates the end of addressing and the beginning of data.

B — The EOB control character indicates the end of this block of data.

LRC — The LRC character from station A is compared with the check character at station B.



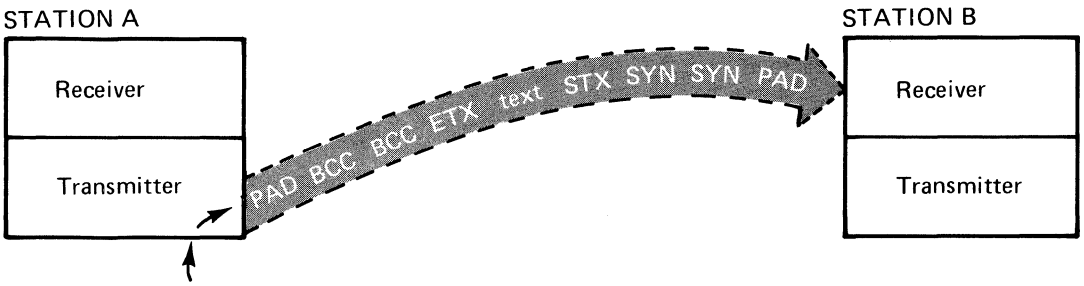
The LRC characters compared equal; therefore, the data was received OK and a positive response is transmitted.



The EOT control character indicates that there is no more data to send; therefore, this is the end of the transmission.

BINARY SYNCHRONOUS COMMUNICATIONS

Binary synchronous communications (BSC) is synchronous transmission of binary coded data. In asynchronous transmission (start-stop), extra bits are needed with each character to obtain synchronization, and each data character is transmitted separately. In binary synchronous transmission, data, data link control characters, and other characters are transmitted together in a continuous series of bits as shown in the following illustration. Extra bits are not required with each character to synchronize transmission. Synchronization is performed at the start of each message. Binary synchronous communications uses clock pulses to control the synchronization of data and control characters.



PAD **FIRST CHARACTER**–A *padding character* (PAD) to ensure that the modem transmits all bits of the first *SYN* character.

SYN SYN At least two *synchronization* (SYN) characters to establish synchronization, or clocking process.

STX A *start of text* (STX) data link control character to indicate the beginning of data.

text The data.

ETX An *end of text* (ETX) data link control character to indicate the end of data.

BCC The *block check characters* (BCCs) for error checking to ensure that all bits transmitted are also received. (BCCs are used with EBCDIC only. For ASCII, a single LRC character is used.)

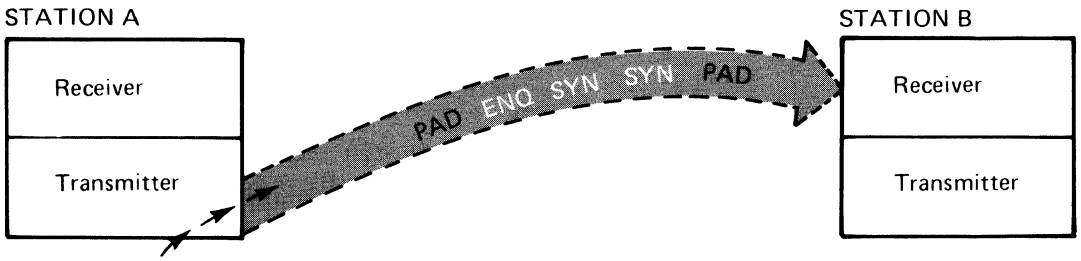
PAD A *PAD* character ensures that all bits of the last data link control or error checking character are transmitted.

BSC Data Link Control Characters

The following is a list of the data link control characters used in binary synchronous communications and a brief description of their use:

Character	Use
SYN (sync)	Establishes and maintains synchronization
SOH (start of header)	Indicates the start of heading information
STX (start of text)	Indicates the start of text
IRS (interchange record separator)	Ends an information block called a record
ITB (intermediate text block)	Divides a block of text into smaller groups of text (intermediate text blocks) for error checking
ETB (end of text block)	Indicates the end of a block of data but not the last block transmitted
ETX (end of text)	Indicates the end of a message and the last block of text
EOT (end of transmission)	Indicates the end of the transmission
ENQ (enquiry)	Has three uses: (1) initiates a request for control of transmission on a point-to-point line; (2) indicates the end of a polling or address sequence on a multipoint line; and (3) indicates a request for a station to repeat its response
ACK0/ACK1 (alternating positive acknowledgments)	Indicates that text was received without errors; also is a positive response to an ENQ on a point-to-point line
DLE (data link escape)	Allows transmission of all 256 characters of the EBCDIC code structure within text (called transparency)
RVI (reverse interrupt)	Transmitted by the receiving station instead of an ACK to stop the transmitting station from sending so that the receiving station can send data
TTD (temporary text delay)	Holds the communications link when not transmitting data
WACK (wait before transmitting)	Indicates to the transmitting station a positive acknowledgment and a temporary not ready condition
NAK (negative acknowledgment)	Indicates a not ready condition, an error has occurred, or is sent as a response to an ENQ
PAD (padding character)	Ensures that all bits of the first and last character of a message are transmitted
BCC (block check sequence)	Used to check that all bits transmitted are also received (EBCDIC only)

The following example shows how some of these characters are used to transmit a message, using BSC on a point-to-point line:



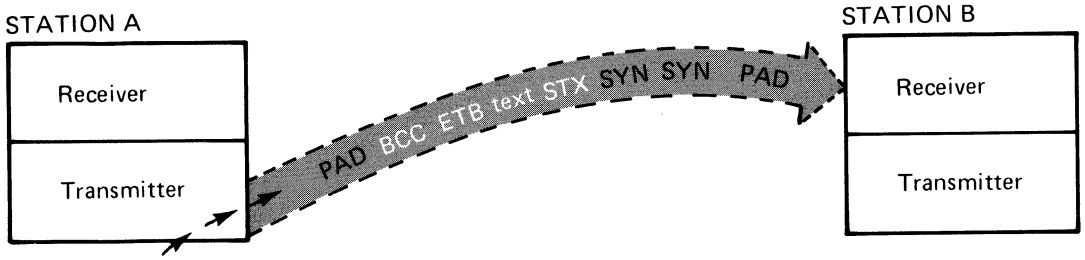
PAD
SYN
SYN
ENQ
PAD

Station A requests the status of station B.

Two SYN characters are used to ensure that the sending and receiving stations do not lose their synchronization, especially during transmission of a message.

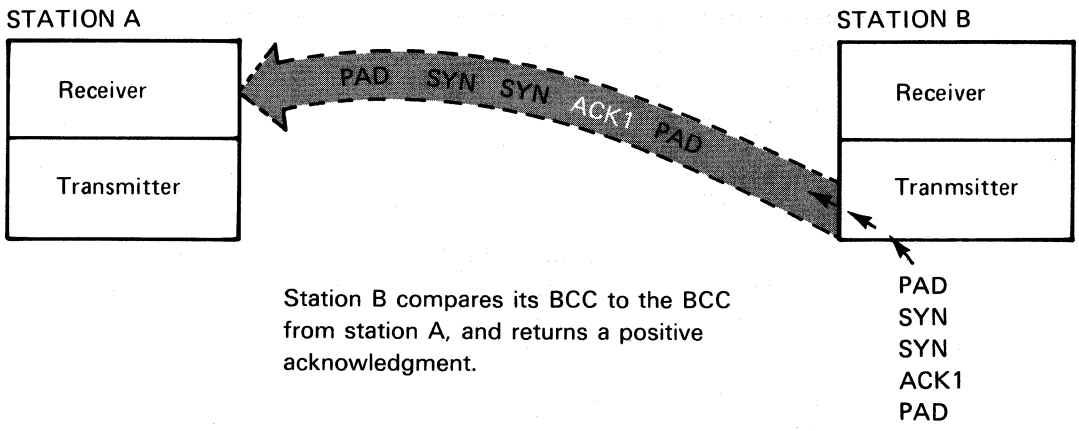
Station B is ready; therefore, it responds with a positive acknowledgment (ACK0).

PAD
SYN
SYN
ACK0
PAD

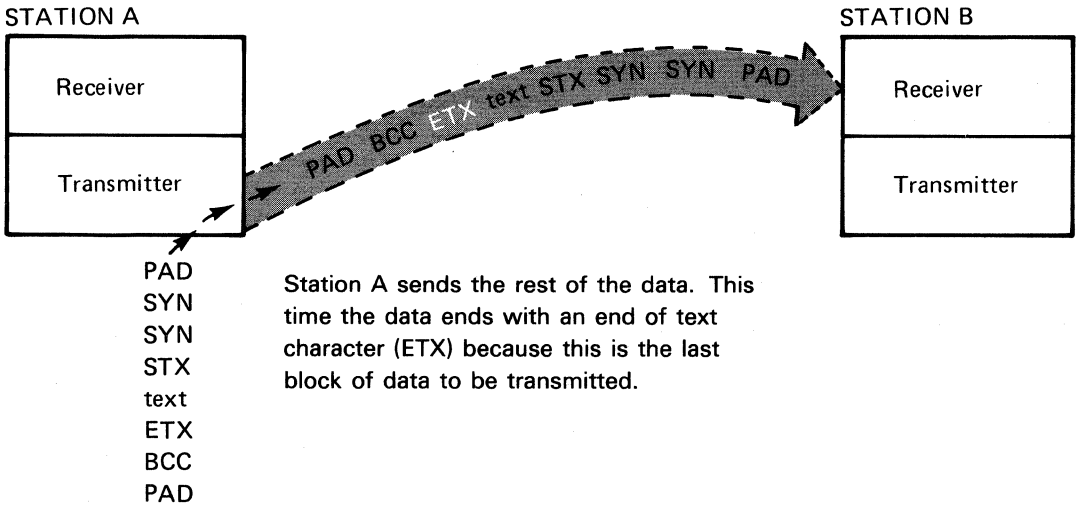


PAD
SYN
SYN
STX
text
ETB
BCC
PAD

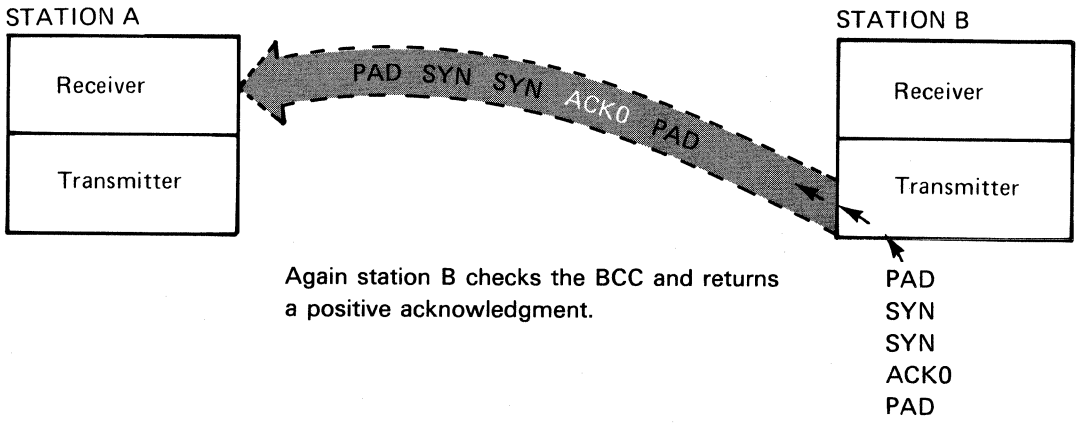
Station A sends a start of transmission character (STX), the data (text), an end of text block character (ETB), and a block check bit sequence (BCC).



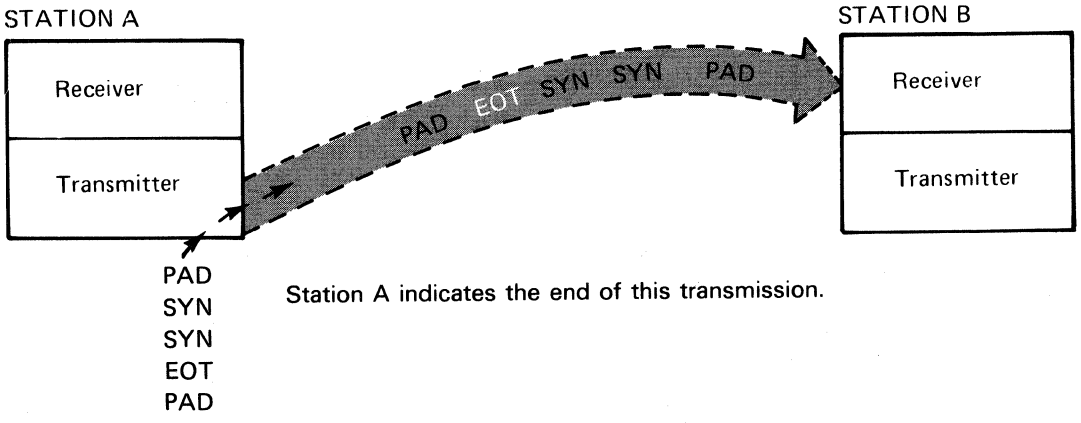
Station B compares its BCC to the BCC from station A, and returns a positive acknowledgment.



Station A sends the rest of the data. This time the data ends with an end of text character (ETX) because this is the last block of data to be transmitted.



Again station B checks the BCC and returns a positive acknowledgment.



Station A indicates the end of this transmission.

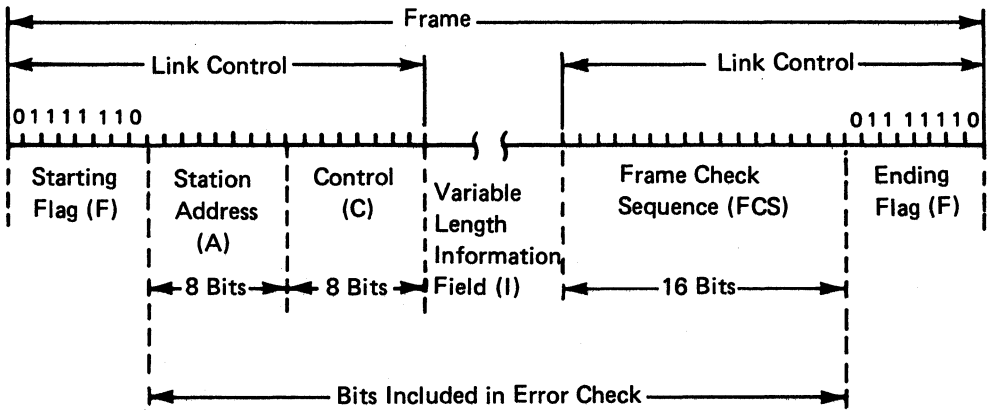
SYNCHRONOUS DATA LINK CONTROL

Synchronous data link control (SDLC) uses synchronous transmission to transfer information over a data communications line. Transmission exchanges may be duplex or half duplex. The line may be point-to-point switched, point-to-point nonswitched, or multipoint. Synchronization is maintained by self-checking modems, or by internal machine clocking at each station.

The primary station is the controlling station and the secondary station is the responding station. The primary station controls the communications link by sending commands to the secondary station, and the secondary station responds to the commands.

Some SDLC stations can communicate on more than one data link at the same time. In this case, a station might be assigned as a primary station for one data link and as a secondary for another data link.

All information, including commands and responses, is transmitted between stations in groups of bits called frames as shown in the following example:



Flag (F): The beginning and end of each frame is indicated by a series of bits (01111110) called a flag. In some machines, the ending flag of one frame can be used as the starting flag of the next frame.

Station Address (A): An address field is used to identify the secondary station that is receiving or sending the frame.

Control (C): The control field contains commands or responses to control the data link.

Information (I): The information field contains the data that is transferred between stations. Any code structure can be transmitted within this field. (This field may or may not be present depending on the content of the control field and machine type.)

Frame Check Sequence (FCS): The frame check sequence field contains the cyclic redundancy character (CRC) check sequence that is used to check data transmission validity.

Control Field Format

The control field has three formats: the unnumbered format, the supervisory format, and the information transfer format, as shown in the following example:

	Bits							
	0	1	2	3	4	5	6	7
Unnumbered Format		**		P/F	**		1	1
Supervisory Format		Nr		P/F	*		0	1
Information Transfer Format		Nr		P/F	Ns			0

Poll/Final bit

Nr = number received
Ns = number sent
*Codes for supervisory commands or responses
* *Codes for unnumbered commands or responses

The poll/final bit is used to control sending and receiving. A primary station sends the poll (P) bit to invite a secondary station to send data. In response to a frame with the poll bit on, a secondary station may send a single frame with the final bit on or multiple frames with the final bit on in the last frame to indicate the last frame transmitted. Up to seven frames can be transmitted before the poll/final bit is set on.

The Nr and Ns counts are used in sequencing frames for more efficient use of the communication link. The transmitting station sequences each information frame it sends. This count is called the Ns count. A receiving station need not acknowledge each frame as it is received. The receiving station counts each error-free frame; the receive count is called the Nr count. The Nr count is advanced each time an error-free frame is received. If the Ns count in a received sequenced frame does not match the Nr count, the frame is out of sequence.

The transmitting station must retain all frames that are not acknowledged. The frames that were not received correctly, as indicated by the Nr count returned by the receiving station, must be sent again by the transmitting station. Up to seven frames can be transmitted before the receiving station responds by sending the Nr count to the transmitting station.

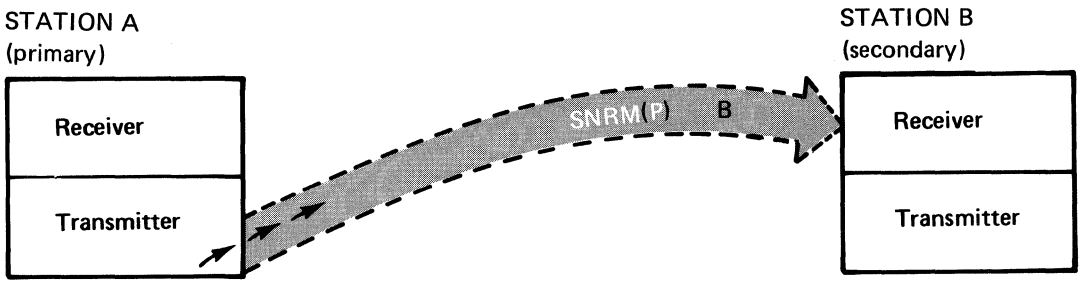
The commands and responses that are transmitted within the control field are described in the following chart:

Format	Binary Configuration	Acronym	Command	Response	I-Field Prohibited	Resets Ns and Nr	Confirms Frames Through Nr-1	Defining Characteristics
Unnumbered	000 P/F 0011	NSI	X	X				Command or response that requires nonsequenced information
	000 F 0111	RIM		X	X			Initialization needed; expect SIM
	000 P 0111	SIM	X		X	X		Set initialization mode; the using system prescribes the procedures
	100 P 0011	SNRM	X		X	X		Set normal response mode; transmit on command
	000 F 1111	DM		X	X			This station is in disconnected mode
	010 P 0011	DISC	X		X			Do not transmit or receive information
	010 F 0011	RD		X	X			Request disconnect
	011 F 0011	UA		X	X			Acknowledge unnumbered commands
	100 F 0111	FRMR		X				Non-valid command received; must receive SNRM, DISC, or SIM
	101 P/F 1111	XID	X	X				Exchange ID
	110 P/F 0111	CFGR	X	X				Configure
	111 P/F 0011	TEST	X	X				Test
	001 P/F 0011	UP	X		X			Unnumbered poll
	111 F 1111	BCN		X	X			Beacon
Supervisory	Nr P/F 0001	RR	X	X	X		X	Ready to receive
	Nr P/F 0101	RNR	X	X	X		X	Not ready to receive
	Nr P/F 1001	REJ	X	X	X		X	Transmit or retransmit starting with frame Nr
Information	Nr P/F Ns0	I	X	X			X	Sequenced I-Frame

Controlling the Communications Link

The following example shows the commands used and whether the poll or final bit is on during communications between a primary station and a secondary station.

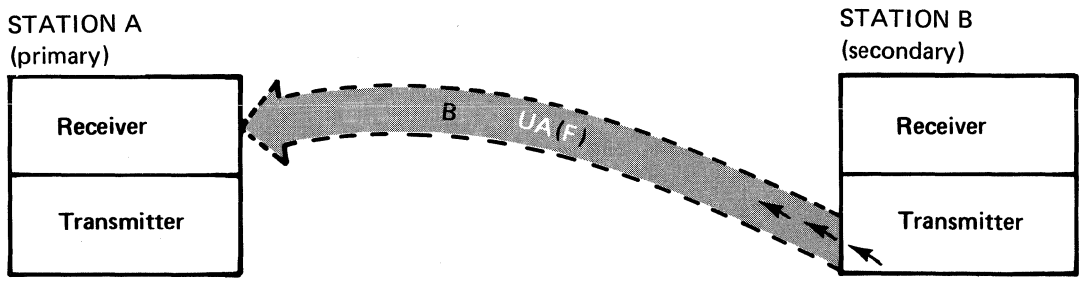
Assume that station B (the secondary station) is in normal disconnect mode. In this mode, station B cannot transmit until station A (the primary station) sets it in normal response mode. Station A does this with the set normal response mode (SNRM) command (the control field also contains the poll bit (P) to allow station B to transmit):



B Address field
SNRM(P) Control field

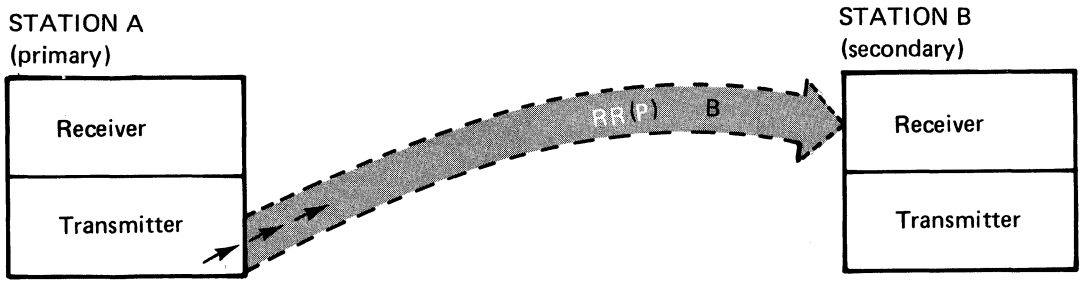
Note: The flags and check field are always transmitted with each frame, although they are not shown in the example. Also, the address field always contains the address of the secondary station.

Station B acknowledges with an unnumbered acknowledgment (UA) response (the final bit (F) is set on in response to station A):



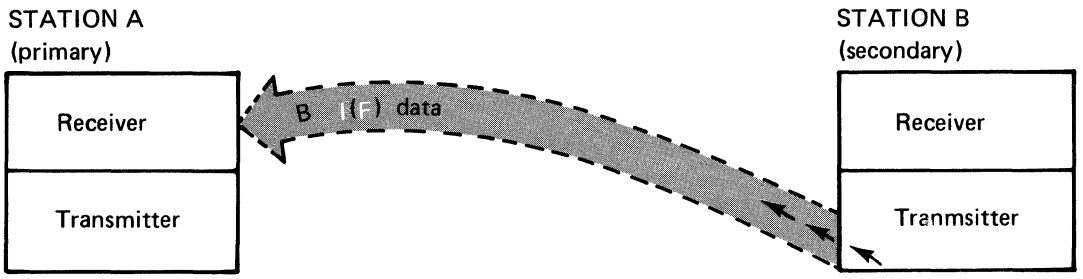
Address field B
Control field UA(F)

Station A invites (polls) station B to transmit with a receive ready (RR) command (the poll bit (P) is set on to allow station B to transmit):



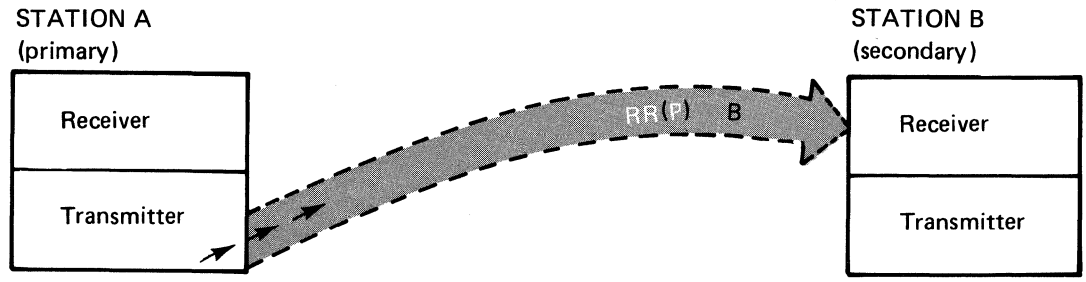
B	Address field
RR(P)	Control field

Station B sends an information frame (I) command (the final bit (F) is on to indicate that this is the last frame):



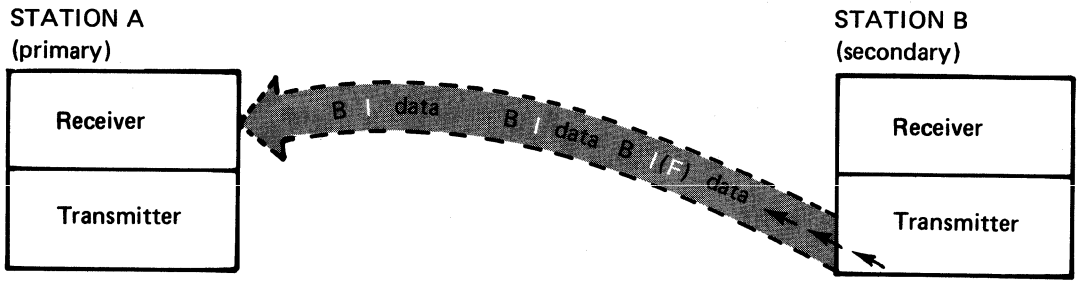
Address field	B
Control field	I(F)
Information field	data

Station A acknowledges receiving the information frame with a receive ready (RR) command (the poll bit (P) is on to allow station B to send):



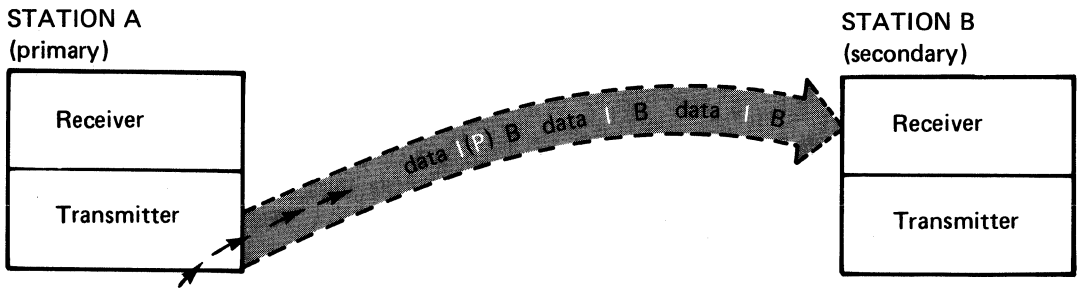
B	Address field
RR(P)	Control field

Station B responds by sending three sequenced information frames (the last frame has the final bit on to indicate that it is the last frame):



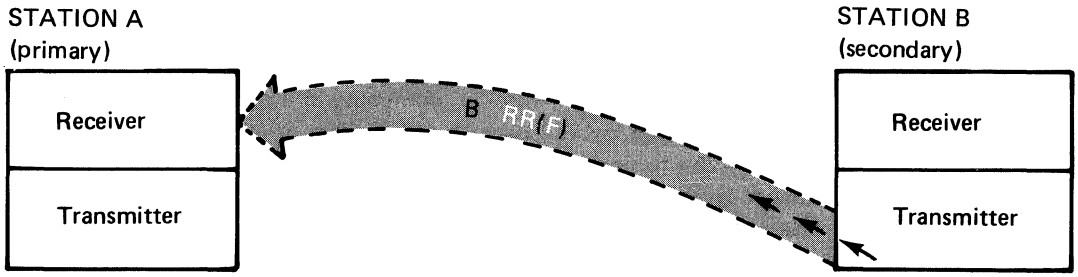
Address field	B
Control field	I
Information field	data
Address field	B
Control field	I
Information field	data
Address field	B
Control field	I(F)
Information field	data

Station A confirms the three information frames from station B and sends three information frames (the poll bit (P) is on in the last frame to indicate that it is the last frame and to allow station B to respond):



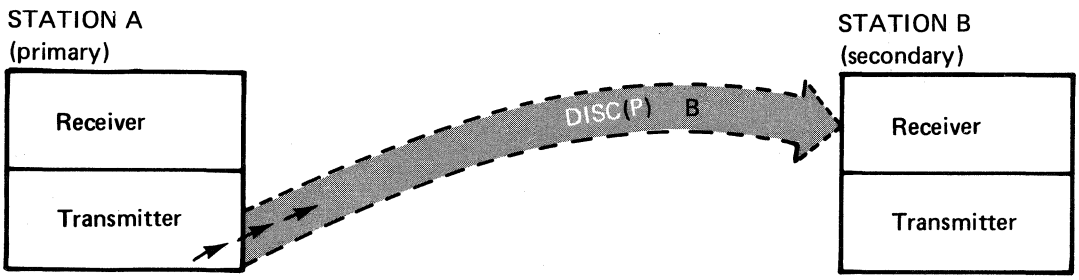
B	Address field
I	Control field
data	Information field
B	Address field
I	Control field
data	Information field
B	Address field
I(P)	Control field
data	Information field

Station B confirms the three information frames from station A with a request receive (RR) command (the final bit (F) is on in response to the poll bit from station A), indicating nothing to send:



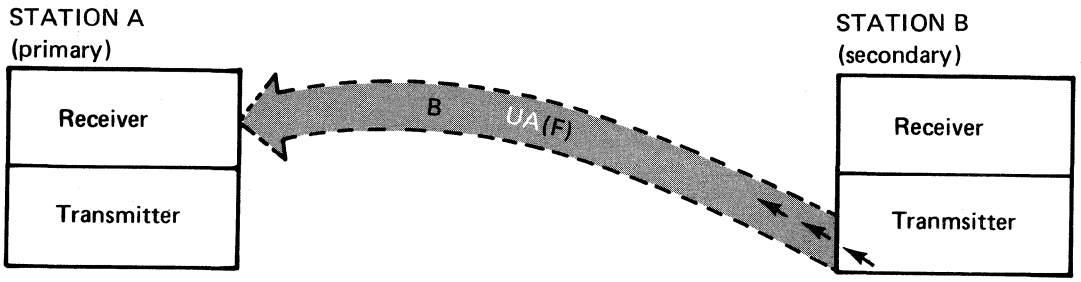
Address field	B
Control field	RR(F)

Station A sends a disconnect (DISC) command to set station B offline (the poll bit (P) is on to allow station B to respond):



B	Address field
DISC(P)	Control field

Station B acknowledges with an unnumbered aknowledgment (UA) response and assumes normal disconnect mode:

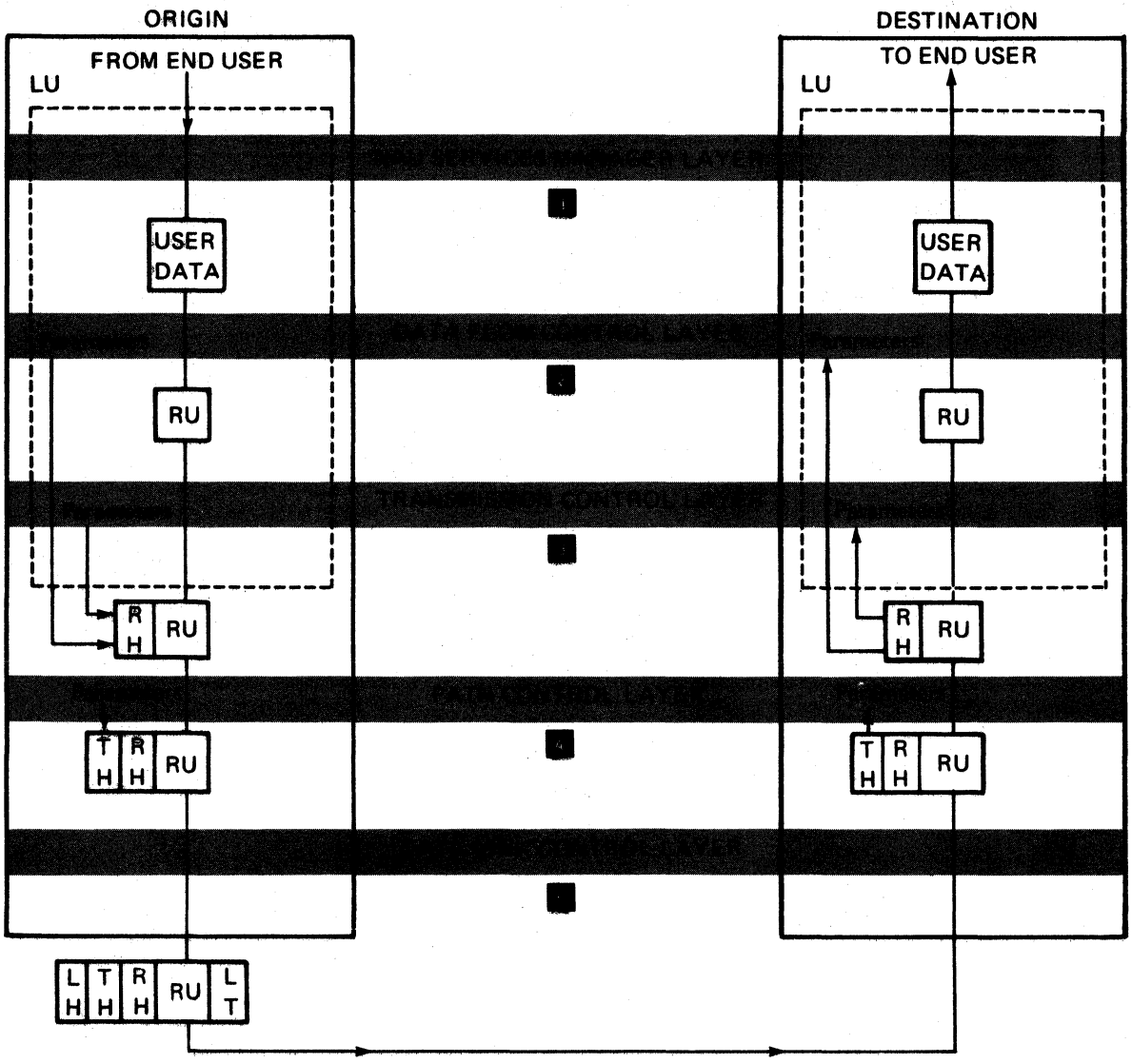


Address field	B
Control field	UA(F)

SYSTEMS NETWORK ARCHITECTURE

Systems Network Architecture (SNA) is a standard by which IBM designs and builds data communications products. SNA specifies the protocols (commands and responses) that communications products use to transmit a user's data from one location to another.

The communications control programming in a device is divided into specific functions called layers. Each layer (program or group of programs) is designed and written to perform a specific task as described by SNA. There are five major layers as follows: NAU (network addressable unit) services manager, data flow control, transmission control, path control, and data link control. (Some products do not use all of the layers. The layers used depend upon the purpose and functions performed by the product.) These layers are shown in the following illustration:



LU - Logical Unit
LH - Link Header
LT - Link Trailer
RH - Request/Response Header
RU - Request/Response Unit
TH - Transmission Header

Network Addressable Unit Services Manager

The network addressable unit (NAU) services manager 1 handles the user's data. It formats the data into units, called request/response units (RUs), for transmission on the communications line. The NAU services manager allows the user access to the communications network.

Data Flow Control

Data flow control 2 monitors and controls the flow of user requests and responses and controls the communications session between end users.

Transmission Control

Transmission control 3 adds a request/response header (RH) to the RU. This header indicates whether the RU is a request, a response, or user data. This layer also controls the pace at which the RUs are transmitted between devices.

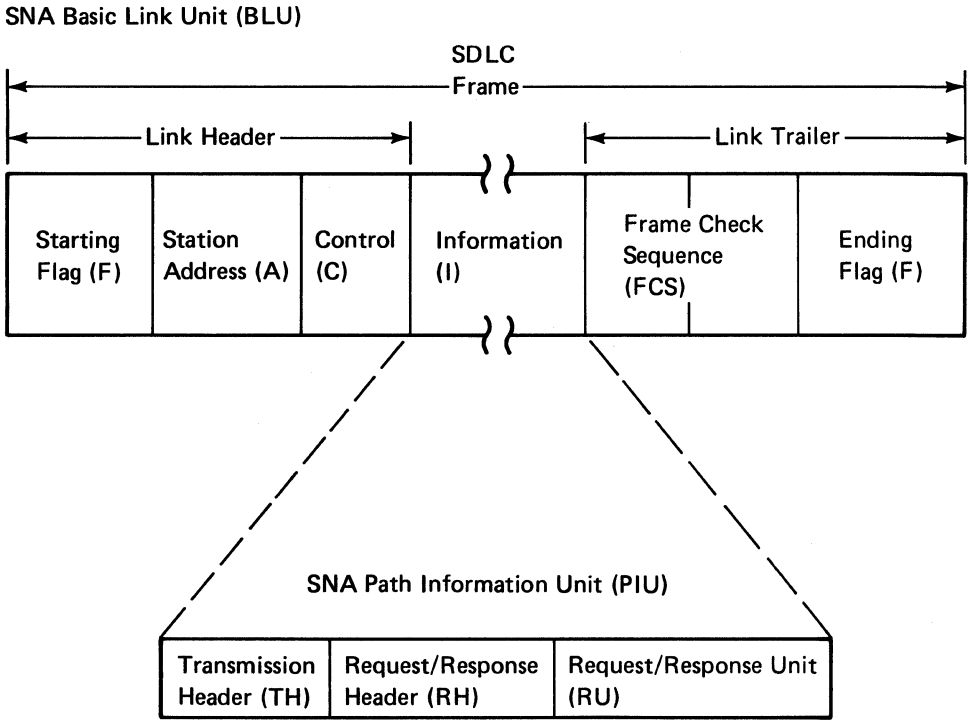
Path Control

Path control 4 handles the communications path between end users in the communications network. This layer adds a transmission header (TH) to route data from an origin to the proper destination in the network. The transmission header contains information such as the destination address and the origin address of the request/response unit.

The resulting combination of headers and user data is called a path information unit (PIU). One or more path information units are called a basic transmission unit (BTU).

Data Link Control

Data link control 5 handles the transmission of the data on the communications line. To transmit the data, data link control adds a link header (LH) and a link trailer (LT) to the basic transmission unit. The combination of the BTU and the link header and link trailer is called a basic link unit (BLU). The basic link unit is the SDLC frame transmitted on the communications line. The link header contains the SDLC leading flag, address, and control byte. The trailer contains the frame check sequence and the ending flag. The following illustration shows the basic link unit that is transmitted on the communications line:



Chapter 5. Communications Adapters

In order to transmit and receive data, a computer (a host system or terminals) must be connected to data terminal equipment by a communications line. In IBM small and intermediate systems, an adapter (enclosed in the system and often called an *integrated adapter*) is used to connect the equipment to the communications line.

CONNECTING IBM EQUIPMENT TO THE COMMUNICATIONS LINE

Data processing or word processing equipment used for communications is called data terminal equipment (DTE). Equipment used to connect the DTE to the communications line is called data circuit-terminating equipment (DCE). In this manual, data communications equipment is used to mean data circuit-terminating equipment.

An adapter or an integrated modem is used to connect the data terminal equipment to data communications equipment as discussed in the following sections.

EIA/CCITT Adapter

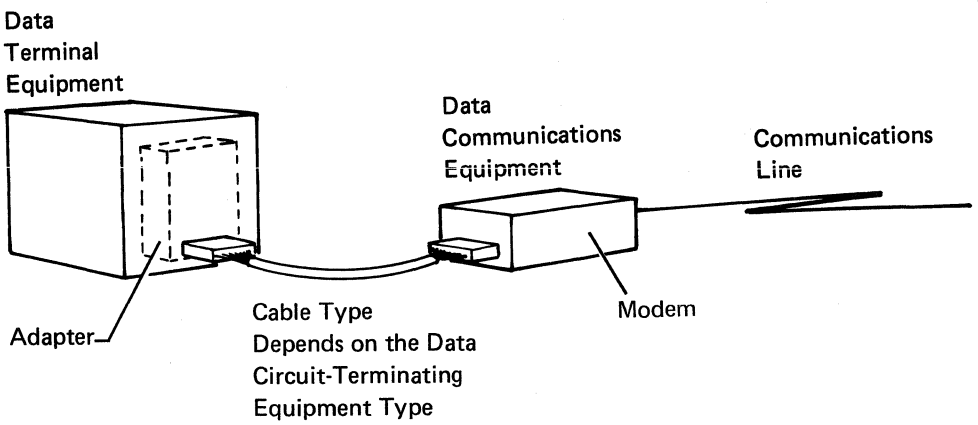
The connection (or interface) between data terminal equipment and data circuit-terminating equipment must be standardized. Otherwise, other special equipment and cables are required to connect the data terminal equipment to the data circuit-terminating equipment. When IBM equipment is connected to data circuit-terminating equipment, it is connected with cables and lines that are defined by the Electronic Industries Association (EIA) or the International Telegraph and Telephone Consultative Committee (CCITT).

The EIA RS-232C interface standard defines the connector type, pin number, line names, and signal levels used to connect data terminal equipment to data circuit-terminating equipment (an external modem in this example) for the purpose of transmitting and receiving data.

The EIA RS-366A standard defines the connections between data terminal equipment and automatic calling equipment. Automatic calling equipment automatically dials a remote location when the data terminal equipment activates the required interface lines.

Note: The CCITT V.24 interface standard is equivalent to the EIA RS-232C standard and the CCITT V.25 is equivalent to the EIA RS-366A standard; therefore, the following descriptions of the EIA standards also apply to the CCITT standards.

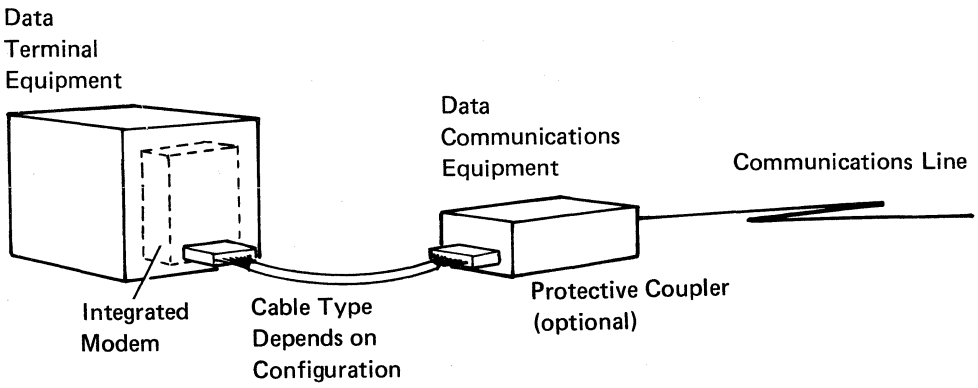
The following illustration shows how IBM terminal equipment is connected to an external modem:



Integrated Modems

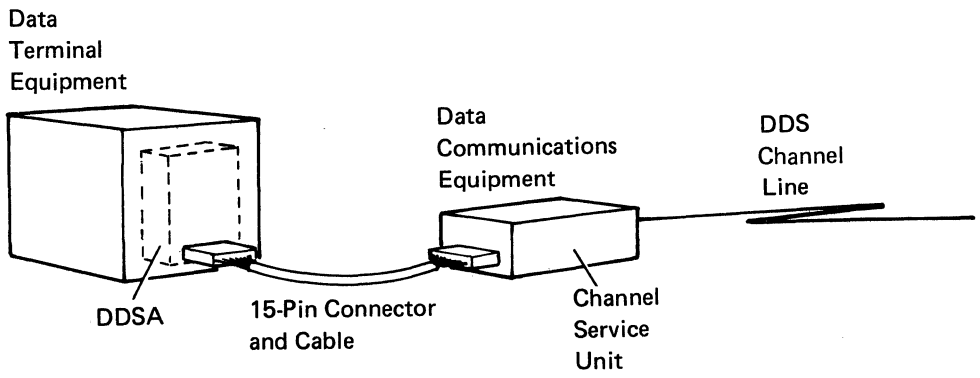
When an integrated modem is installed in the data terminal equipment, the connections between the modem and the communications line depend upon whether the line is switched or nonswitched and the type of modem and modem options used.

The following illustration shows a connection between an integrated modem and an IBM machine using a protective coupler:

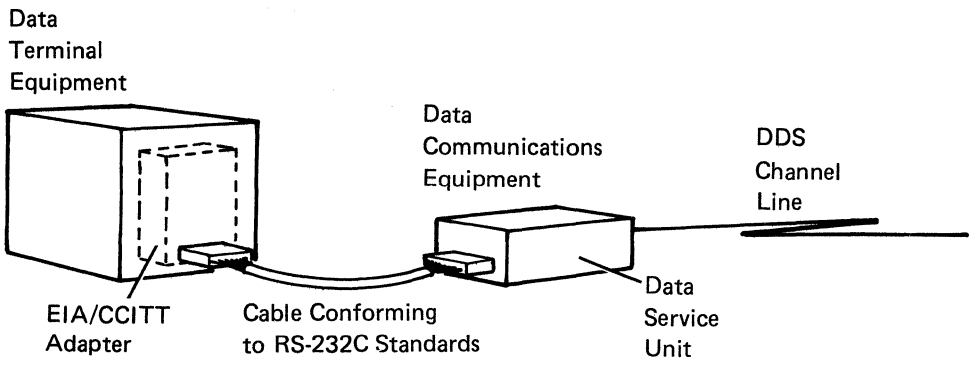


Digital Data Service Adapter

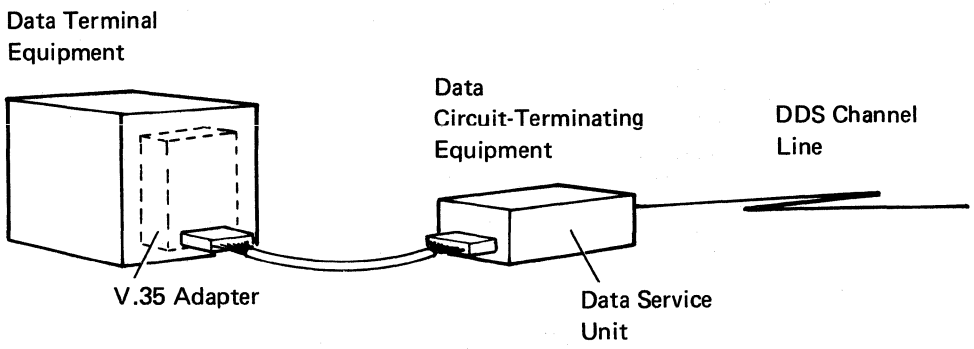
The Digital Data Service Adapter (DDSA) is used to connect IBM data terminal equipment to the digital data service (DDS) channel. The following illustration shows how the DDSA is connected to the DDS channel using a common-carrier-provided channel service unit (CSU):



The DTE can also be connected to the DDS channel using the EIA/CCITT adapter and a common-carrier-provided data service unit (DSU) as shown in the following example:

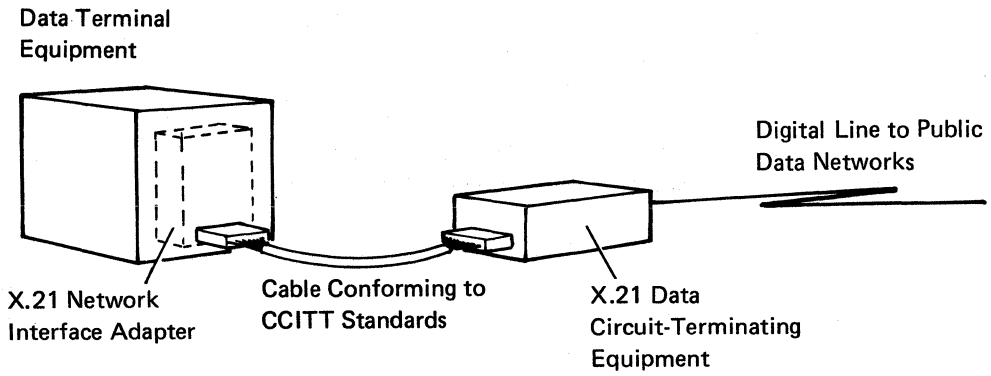


The DTE can also be connected to the DDS channel using the V.35 adapter (which is described later in this chapter), and a common-carrier-provided data service unit (DSU), as shown in the following example:



The X.21 (Network Interface) Adapter

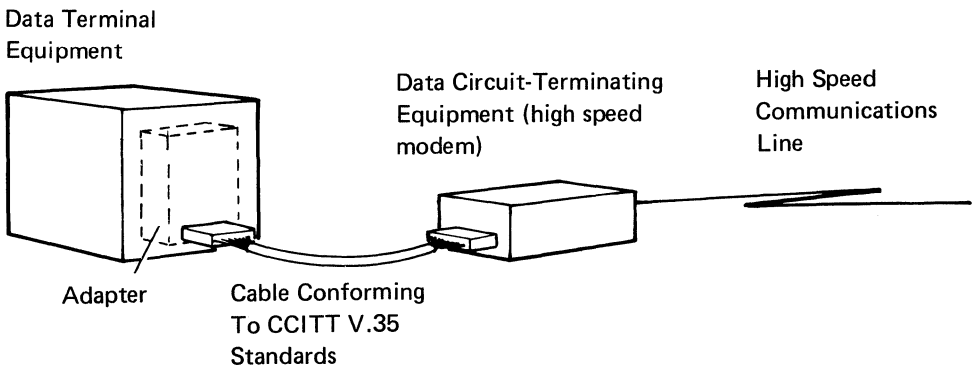
The X.21 (network interface) adapter allows the data terminal equipment to be connected to a communications line using connections and interface signals defined by the CCITT X.21 interface standard. The CCITT X.21 interface standard defines the connection of data terminal equipment to digital public data networks. The following illustration shows how IBM data terminal equipment is connected to a communications line in a digital network.



The CCITT V.35 Interface Standard

The following illustration shows how IBM data terminal equipment is connected to a high speed external modem using connections defined by the CCITT V.35 interface standard.

As shown in the illustration, the modem is connected to the DTE by a cable (with a 34-pin connector). The purpose of the interface lines is the same as that described for the EIA RS-232C interface standard described earlier in this chapter.



X.25

What is X.25?

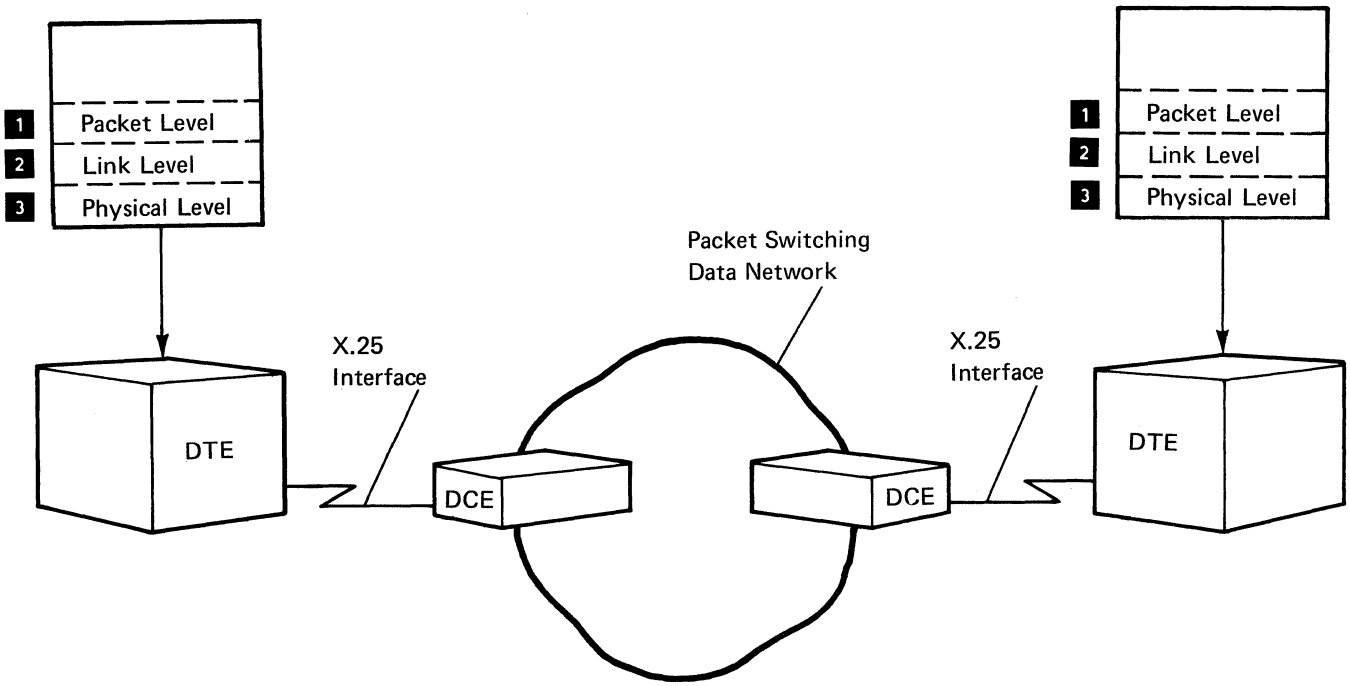
X.25 is the set of recommendations issued by the International Telegraph and Telephone Consultative Committee (CCITT). (The CCITT is a group comprised of representatives from common carriers, telephone companies, and other areas that study technical, operating, and tariff questions about communications equipment used on public packet switching networks.) X.25 defines the requirements of equipment used to connect computers to public packet switching networks. (See Chapter 3 for more information on packet switching networks.)

Because many countries now use networks for data communications, X.25 minimizes the differences between user equipment and provides a universal packet network interface.

A network that uses the X.25 standard provides the ability to connect various systems to a network, and data transport only. This means the standard provides a means for physically connecting equipment transferring data from your equipment to the data circuit-terminating equipment (DCE). A higher level of protocol is required to transfer the data across the network. In this respect, machine communications is no different from human communications: an application program needs to share a common language or set of protocols with the remote location's applications. For the X.25 network user, other layers of the communications system manage the application-to-application *language.*

X.25 defines three levels of the connection between your system (referred to as data terminal equipment, DTE) and the data circuit-terminating equipment, DCE (often referred to as a modem):

- The physical connection
- The link protocol
- The packet procedures



Data Terminal Equipment (DTE)

Data Circuit - Terminating Equipment (DCE)

The Physical Connection

The **physical connection** 1 defines the control of the electrical connection between the data terminal equipment and the data circuit-terminating equipment. The control functions include activating, maintaining, and deactivating the circuit between the communicating device and the network entry point.

This electrical connector must conform to X.21 bis (for existing DTE equipment) or X.21 (for all new equipment) standards.

The Link Protocol

The **link protocol** 2, sometimes referred to as the frame level, defines the high-level data link control (HDLC) procedures used to transfer data across the link between the DTE and the network accurately. (The HDLC procedures are similar to the synchronous data link control (SDLC) procedures used in SNA communications.) The link protocol formats data and consists of procedures for setting up calls, transferring frames, and disconnecting calls, and the first level of recovery procedures.

The Packet Procedures

The **packet procedures** 3 define how your data and control information are structured into packets, and how calls are established, maintained, and cleared.

ADAPTER FUNCTIONS

Some of the functions that communications adapters perform are:

- Receive and transmit data
- Add or remove control characters
- Convert bits into characters as they are received (assemble serial data into parallel data)
- Convert characters into bits as they are transmitted (convert the parallel data into serial data)
- Check the accuracy of data transmitted and received
- Control time-outs
- Automatically call and/or answer calls on switched lines
- Automatically poll and respond to polls on a multipoint line

IBM PERSONAL COMPUTER ADAPTERS

The IBM Personal Computer uses the following adapters to communicate with other systems:

- SDLC communications adapter
- Binary synchronous communications adapter
- Asynchronous communications adapter

The SDLC Communications Adapter

An IBM Personal Computer equipped with an SDLC communications adapter can communicate with other systems that use SDLC protocols. Communications can occur on either switched or nonswitched lines.

The SDLC adapter supports the following:

- Switched and nonswitched communications lines (including nonswitched multipoint)
- The EIA RS 232C interface
- Transmission of data in half-duplex mode
- External clocking
- Transmission of data at speeds up to 9600 bps
- Constant requests to send
- Line turnaround
- On-line problem determination with line trace, error logging, and analysis
- Program controlled data transfer
- Modem control functions (such as line synchronization and data transmission speed)

Only one SDLC adapter may be installed on the Personal Computer at one time; however a second adapter, the asynchronous communications adapter, may be installed on the Personal Computer with the SDLC adapter.

An IBM Personal Computer that communicates with other systems using the SDLC adapter requires:

- At least 128K bytes of main storage
- One diskette drive
- The IBM Communications Adapter Cable (that attaches the adapter to a modem)

Binary Synchronous Communications Adapter

The Binary Synchronous Communications Adapter allows the Personal Computer to communicate with other systems that use BSC protocols on either switched or nonswitched communications lines.

The BSC adapter supports the following:

- The EIA RS 232C interface
- Switched and nonswitched communications lines
- Transmission speeds up to 9600 bps
- An external modem with external clocking
- The Personal Computer Binary Synchronous Communications 3270 Emulation Program
- Modem control functions (such as line synchronization and data transmission speed)

A maximum of two BSC adapters can be installed on the Personal Computer at one time, or one BSC adapter and one SDLC adapter, or one BSC adapter and one asynchronous adapter can be installed at one time; however, only one BSC or one SDLC adapter can be active at any given time.

An IBM Personal Computer that communicates with other systems using the BSC adapter requires:

- A minimum of 128K bytes of main storage
- One diskette drive
- The IBM Communications Adapter Cable (that attaches the adapter to a modem)

The Asynchronous Communications Adapter

The asynchronous communications adapter and the appropriate communications support allows the IBM Personal Computer to communicate with a wide range of systems.

This adapter supports the following:

- Transmission speeds of 50 to 9600 bps
- Modem and data transfer control
- Attachment of external modems using the EIA RS 232C or current loop interface
- Characters with 5, 6, 7, or 8 bits
- Odd, even, or no parity checking and mark and space generation
- Status reporting

An IBM Personal Computer that communicates with other systems using the asynchronous adapter requires:

- At least 64K bytes of main storage
- A RS 232C cable (that attaches the adapter to a modem)
- The Asynchronous Communications Support Program (version 2.0)
- One diskette drive

The following combination of communications adapters can be installed on a Personal Computer at one time; however, only one BSC or SDLC adapter can be active at any given time:

- Two asynchronous communications adapters
- One asynchronous communications adapter and one binary synchronous communications adapter
- One asynchronous communications adapter and one SDLC adapter

SERIES/1 CONTROLS AND ADAPTERS

The Series/1 communications features provide a variety of communications options. Four types of communications controls permit the Series/1 to communicate with other systems and terminals. These controls and adapters are:

- Binary synchronous communications controls
- Synchronous data link controls
- Asynchronous communications controls
- Feature programmable control and adapter

All these features (except the binary synchronous communications single-line control/high speed control) support automatic answering on switched lines.

Additional features, available as RPQs, further enhance the communications options available to the Series/1.

Binary Synchronous Communications Single-Line Control

This control allows the Series/1 to function as a remote terminal to host systems or as a host system for remote binary synchronous terminals. Communications occur in half duplex on a cycle-stealing basis.

The number of binary synchronous controls that can be installed on a Series/1 is determined by the number of available feature positions. One feature position is required for each control.

The binary synchronous communications single-line control has the following features:

- Communications on a point-to-point switched line, a point-to-point nonswitched line, or a multipoint line
- Attachment of external modems with an EIA RS-232C/CCITT V.24 interface
- Data transmission speeds up to 9600 bps
- Internal clocking at 600 or 1200 bps
- Either EBCDIC or ASCII codes
- Text transparency when using EBCDIC
- Link connection on switched lines, completed by manual call, manual answer, automatic call, or automatic answer
- Line error checking
- Intermediate block checking (ITB) provided on TRANSMIT/RECEIVE by the adapter
- The ability to receive an initial program load (IPL) from a host system

Binary Synchronous Communications Single-Line Control/High Speed

This control allows the Series/1 to function as a remote binary synchronous terminal, or as a host system with attached binary synchronous terminals. It also allows a Series/1 to communicate with another system using binary synchronous communications protocol. Communications occur in half duplex on a cycle-stealing basis.

The number of binary synchronous control/high speed lines that can be installed on a Series/1 is determined by the number of available feature positions (up to a maximum of eight). One feature position is required for each control.

The binary synchronous communications single-line control/high speed has the following features:

- Communications on a point-to-point nonswitched line, a multipoint nonswitched line, or a point-to-point switched line
- Attachment using a Western Electric 303 data set (or an equivalent modem) or with modems that use CCITT V.35 interfaces
- Data transmission speeds up to 56 000 bps
- Either EBCDIC or ASCII transmission codes
- Text transparency when using EBCDIC
- Line error checking
- Intermediate block checking provided by a block check character (BCC)
- The ability to receive an initial program load (IPL) from a host system

Binary Synchronous Communications Eight-Line Control

The binary synchronous communications eight-line control permits the Series/1 to communicate with other systems and terminals. This control allows:

- The attachment for up to two BSC four-line adapters (or support for up to eight communications line).
- Transmission speeds up to 9600 bps. (Data transmission speeds are 9600 bps for lines one and two and up to 2400 bps for lines three through eight when two adapters are used. When a single four-line adapter is used, the data transmission speeds for each line can be up to 4800 bps.)

This control also permits the Series/1 to function as a primary or a secondary station.

Binary Synchronous Communications Four-Line Adapter

The binary synchronous communications four-line adapter supports up to four half duplex communications lines. Data transmission speeds depend on the number of lines and transmission speeds used. This adapter is controlled by the binary synchronous communications eight-line control feature.

Synchronous Data Link Single-Line Control

The Synchronous Data Link Control (SDLC) single-line control provides a cycle-stealing attachment for a single half duplex communications line.

The SDLC single-line control has the following features:

- Communications on a point-to-point switched line, a point-to-point nonswitched line, or a multipoint line
- Data transmission speeds up to 19 200 bps
- Attachment of external modems using an EIA RS-232C/CCITT V.24 interface
- Internal clocking at 600 or 1200 bps
- Use of any 8-bit code including EBCDIC and ASCII
- Link connection on switched lines completed by manual call, manual answer, or automatic answer
- Two programmable timers

Synchronous Communications Single-Line Control/High Speed

The synchronous communications single-line control/high speed control allows the Series/1 to communicate with other systems using the following binary synchronous communications features:

- Communications in half duplex with transmission speeds up to 56K bytes using V.35 interfaces (on nonswitched lines)
- Use of the ASCII and EBCDIC transmission codes and EBCDIC transparency
- Local connection using the X.21 interface with transmission speeds up to 48K bytes (on nonswitched or switched lines)
- The ability to load a Series/1 initially (IPL) from a remote system

This control also allows the Series/1 to communicate with other systems using the following synchronous data link control features:

- Communications in duplex or half duplex with transmission speeds up to 56K bytes using the V.35 interface (on nonswitched lines)
- Attachment to networks using the X.21 interface with transmission speeds of 48K or 9600 bps
- Use of any 8-bit transmission code
- Zero bit insertion/deletion
- Block check character generation/checking

Asynchronous Communications Single-Line Control

This control allows a Series/1 to function as either a host system or as a secondary station when communicating with asynchronous (start-stop) devices. Communications occur in half duplex on a cycle-stealing basis.

The asynchronous communications single-line control has the following features:

- Communications on a point-to-point switched line, on a point-to-point nonswitched line, or on a multipoint nonswitched line
- Data transmission speeds within two ranges, 37.5 to 1200 bps or 300 to 9600 bps
- Attachment of external modems using an EIA RS-232C/CCITT V.24 interface
- PTTC/EBCD, PTTC/Correspondence, or 8-bit data interchange operations under program control
- Manual call, manual answer, or automatic answer on switched lines

The asynchronous communications single-line control also has an optional local attachment feature that allows direct connection of a terminal to the control within a distance of 14.99 meters (50 feet). A communications indicator panel may be used to help in problem determination during installation of your system and/or during normal operation.

The number of asynchronous single-line controls that can be installed on a Series/1 is determined by the number of available feature positions. One feature position is required for each control.

Asynchronous Communications Eight-Line Control

The features for this control are the same as those for asynchronous communications single-line control, except that this control provides connection for four duplex or eight half duplex communications lines, and a remote host system cannot perform an IPL on the Series/1.

Asynchronous Communications Four-Line Adapter

The asynchronous communications four-line adapter provides for the attachment of up to four asynchronous half duplex or two duplex communications lines. The four-line adapter is controlled by the asynchronous communications eight-line control.

The other features for this adapter are identical to those of the asynchronous communications single-line control except that the maximum data rate on the asynchronous communications four-line adapter is 2400 bps per line.

Feature-Programmable Multiline Eight-Line Communications Control

The feature-programmable multiline eight-line communications control allows the Series/1 to communicate with other systems and devices using the following:

- Up to two programmable four-line communications adapters
- Either point-to-point or multipoint lines with a combined transmission speed up to 64 000 bps

Feature-Programmable Multiline Four-Line Communications Adapter

The feature-programmable multiline four-line communications adapter supports up to four communications lines. Each line can be programmed to select such functions as:

- Transmission speeds of 37.5 bps to 1200 bps, or 300 bps to 19 200 bps
- Either synchronous or asynchronous operation
- Program control of line control characters
- Characters with 5, 6, 7, or 8 bits
- Odd, even, or no parity checking/generation
- Block check characters reception for one character

The following RPQs are available to further enhance your Series/1 communications support:

- Local communications controller
- The Series/1 System/370 channel attachment
- The autocall originate attachment
- Series/1-to-Series/1 attachment
- Direct binary synchronous attachment
- Asynchronous terminal eight-line adapter
- Data link control adapter

Local Communications Controller

The local communications controller is an additional communications feature that allows up to 16 Series/1 processors to communicate with each other at a rate of 2 million bps. The Series/1 processors are attached by a ring data link without the need of a primary station. The maximum distance allowed between any two processors is 1524 meters (5000 feet).

System/370 Channel Attachment

The Series/1 System/370 channel attachment allows the Series/1 to communicate with other systems at a maximum rate of 300 000 bytes per second. The Series/1 appears as a 3272 type control unit to the System/370. The host systems can perform an IPL for the Series/1. Using this attachment, the Series/1 can communicate with the following:

- IBM System/370 (Models 135 through 168)
- IBM 303X
- IBM 4331 and 4341

Automatic Call Originate Attachment (RPQ D02013)

The automatic call originate attachment controls an automatic calling unit for the Series/1, and provides an EIA RS-366, CCITT V.25 interface. This interface defines the interchange between the data terminal equipment and the automatic calling unit. This attachment can control two calling units under direct program control, and can be used in any input/output slot, or in the processor modules 4952, 4954, 4955, or input/output expansion enclosure 4959.

Series/1-to-Series/1 Attachment (D02241 and D02242)

The Series/1-to-Series/1 attachment permits a Series/1 to communicate with another locally attached Series/1. Communications occur on a cycle-steal basis at a maximum rate of 55 000 bytes per second. This attachment enables a peer-to-peer relationship to exist, except that the Series/1 using RPQ D02241 has priority if contention occurs.

Direct Binary Synchronous Communications Attach (RPQ D02349)

The direct BSC attachment allows a Series/1 to use a single line to communicate with another Series/1 in half duplex mode. These Series/1's can transmit data at a maximum rate of 38 000 bps. This feature also conforms to the EIA RS-4224 standards and must be installed on both Series/1's.

Asynchronous Terminal Eight-Line Adapter (RPQ D02350)

The asynchronous terminal eight-line adapter allows a Series/1 to attach up to eight devices, such as the IBM 3101 Display Terminal, that conform to the RS-422A standard. This adapter is used with the Feature-Programmable Eight-Line Control in place of the Feature-Programmable Multiline Four-Line Communications Adapter. Using this adapter, a Series/1 can transmit data at a rate of up to 19 200 bps.

Data Link Control Adapter (RPQ 8T1067)

The data link control adapter allows a Series/1 to use a single, half duplex line and communicate with other devices that use the X.25 protocol networks. Data can be transmitted at rates up to 19 200 bps. Two of these adapters can be installed to provide duplex communications with systems that conform to either CCITT V.24 or EIA RS.232C standards.

IBM SYSTEM/23 DATAMASTER ADAPTER

The IBM System/23 Datamaster uses the Communications Adapter feature to attach one communications line. The adapter can provide a duplex, serial data transmission line for the System/23.

Other support includes:

- External interface to EIA RS 232C/CCITT V.24-V.28 interfaces
- Operation in either duplex or half duplex using asynchronous protocol
- Asynchronous data transmission speeds from 110 to 1200 bps
- User specification of the number of stop bits to use in asynchronous transmissions
- User specification of the parity bit to use in receiving and transmitting data
- Operation in half duplex synchronous mode using BSC
- BSC data transmission speeds up to 4800 bps on switched and nonswitched lines

Single-Line Communications Adapter

The System/34 Communications Adapter feature allows the System/34 to communicate with other systems or terminals using binary synchronous communications or synchronous data link control. The System/34 can have one or two single-line communications adapters operating in any combination of binary synchronous communications and synchronous data link control.

The Communications Adapter feature allows a maximum aggregate transmission rate of 9600 bps. If the system uses two adapters, the total bits per second that is transmitted can equal up to 9600 bps. The communications adapter operates in half duplex mode over point-to-point and multipoint networks (only as a tributary station with BSC), including both two-wire and four-wire communications lines. A System/34 on a switched network supports manual dialing and manual answering. System/34 supports automatic answering only when the attached modem (external or integrated) also supports it.

Other features of the communications adapter include:

- Program selection of either BSC or SDLC
- Program selection of ASCII, EBCDIC, or EBCDIC transparency (BSC only)
- If supported by the attached modem, full rate or half rate selection by a utility before execution of a program
- An EIA/CCITT Interface feature that permits attachment of modems that use the EIA RS-232C interface
- An Internal Clocking feature for transmission rates of either 600 bps or 1200 bps
- Attachment of a Digital Data Service Adapter for communicating on American Telephone & Telegraph's digital data network
- An integrated modem for 1200 bps transmission
- A 2400 bps integrated modem that includes switched network backup (this modem can be used with the IBM 3872 modem only)
- A communications display panel

The adapter allows the System/34 to:

- Function as a host system, as a remote batch entry terminal, or as an MRJE work station with the BSC feature
- Function as a host system to remote 5250 display stations, as a remote batch entry terminal or as an RJE work station using SDLC
- Function as a peer to another System/34
- Function as an interactive terminal

Multiline Communications Adapter

The multiline communications adapter (MLCA) allows the System/34 to control one to four data communications lines at the same time. Each line can operate at 600 to 9600 bps in half-duplex mode. Also, one line can operate at speeds up to 56 000 bps if the total of the remaining three lines is not more than 9600 bps. (Other line speed combinations are available with an RPQ.)

Other features of the MLCA include:

- Program selection of either BSC or SDLC
- Program selection of ASCII, EBCDIC, or EBCDIC transparency (batch BSC only)
- If supported by the modem, full rate or half rate selection before running a program

The MLCA allows attachment to:

- An EIA/CCITT Interface adapter for attaching modems that use the EIA RS-232C interface
- A Digital Data Service Adapter (DDSA) for communicating on a digital data network (U.S. only), or for local connection to another IBM small or intermediate system or terminal that has a DDSA
- An integrated modem for 1200 bps transmission
- An integrated modem for 4800 bps transmission (this modem can be used with the IBM 3864 modem)
- An analog wideband adapter for connection to a WE-303 type modem
- An interface to an external automatic calling unit
- An X.21 adapter

Single-Line Communications Adapter

The System/36 Single-Line Communications Adapter permits System/36 to communicate with other systems or terminals using binary synchronous communications or synchronous data link control.

The SLCA using BSC permits System/36 to function as a transmitting or receiving station on point-to-point or multipoint lines. This communications adapter operates in half-duplex mode over point-to-point and multipoint lines, including both two-wire and four-wire communications lines. Only one single-line communications adapter can be installed and operated at one time. The single-line communications adapter cannot be installed on the same System/36 with the multiline communications adapter (MLCA).

Other support provided by the communications adapter includes:

- Program selection of either BSC or SDLC (primary or secondary)
- Program selection of ASCII, EBCDIC, or EBCDIC transparency (BSC only)
- An EIA/CCITT Interface feature that permits attachment of modems that use the EIA RS-232C interface
- An Internal Clocking feature for transmission rates of either 600 bps or 1200 bps
- Attachment of a Digital Data Service Adapter for communicating on American Bell's digital data network
- An integrated modem for 1200 bps transmissions
- The X.21 feature for transmission rates up to 9600 bps on nonswitched lines
- A communications display panel
- System Measurement Facility (SMF) support

This attachment allows the Sytem/36 to be:

- A host system to remote 5250 work stations
- A remote job entry (RJE) batch system that can communicate with other systems using BSC
- An interactive system using the System Support Program-Interactive Communications Feature (SSP-ICF)
- A peer system to another System/36 or System/34
- A multiple session remote job entry (MSRJE) work station that can communicate with either BSC or SNA/SDLC host systems

Multiline Communications Adapter

The multiline communications adapter (MLCA) permits System/36 to communicate with other systems using up to four communications lines at the same time. Each line can operate at speeds of 600 to 9600 bps. One line can operate at speeds up to 56 000 bps if the total for the remaining three lines is not more then 9600 bps.

Other features of the MLCA include:

- Program selection of either BSC or SDLC (primary or secondary)
- Program selection of ASCII, EBCDIC, or EBCDIC transparency (BSC only)

The MLCA allows attachment to:

- An EIA/CCITT Interface adapter for attaching modems that use the EIA RS-232C interface
- A Digital Data Service Adapter (DDSA) for communicating on a digital data network (U.S. only), or for local connection to another IBM small or intermediate system or terminal that has a DDSA
- An integrated modem for 1200 bps transmission
- An X.21 adapter for switched or nonswitched lines
- The CCITT V.35 interface standard for nonswitched lines (line four only)
- An automatic calling unit

IBM SYSTEM/38 ADAPTERS

The System/38 can support up to two 4-line communications adapters that can attach up to eight communications lines. With the appropriate feature, either BSC or SDLC line protocol can be selected for any of these lines. With standard support, each line can operate at 600 to 9600 bps in half-duplex mode.

The System/38 can also support two high-speed communications lines (one per adapter). The remaining lines or adapters can be connected to a communications network but cannot be operated at the same time as the high-speed line. The high-speed lines support the following:

- Local communications with a System/34, a Series/1, or another System/38 at speeds up to 56 000 bps
- Local communications with a 3705-II at speeds up to 56 000 bps
- Remote communications to a 3705-II, a 4331 Communications Adapter, a System/34, or another System/38 at speeds up to 56 000 bps

The communications attachments allow the System/38 to function as a remote batch entry terminal, and with the RJEF programming support, as an RJEF work station for submission of jobs to a host IBM System/370, 30xx, or 43xx using either BSC or SDLC/SNA.

With these attachments, the System/38 can also be connected to communications networks that support the V.35 interface and to digital data networks.

The communications attachment feature allows attachment to:

- An EIA/CCITT Interface adapter for attaching modems that use the EIA RS-232C interface
- A CCITT V.35 interface adapter for attaching modems that use the V.35 interface standard
- A Digital Data Service Adapter (DDSA) for communicating on a digital data network (U.S. only), or for local connection to another system or terminal that has a DDSA
- An integrated modem for 1200 bps transmission
- An integrated modem for 2400 bps transmission (this modem can be used with the IBM 3863 modem)
- An integrated modem for 4800 bps transmission (this modem can be used with the IBM 3864 modem)
- An interface to an external automatic calling unit

Using BSC, the System/38 can communicate with the following systems and devices:

- IBM 6240 Communicating Magnetic Card Typewriter
- IBM Communicating Magnetic Card II (CMCII) Typewriter
- IBM 5520 Administrative System
- IBM 3741
- IBM 5110 and 5120 computers (also program-to-program)
- IBM 5230 Data Collection System
- IBM 5260 Retail System
- IBM Office System 6 Information Processors
- IBM 5280 Distributed Data System (also program-to-program)
- IBM Displaywriter
- IBM 6670 Information Distributor
- IBM 6640 Document Printer
- IBM 3776 Communications Terminals (Models 1 and 2)
- IBM 3777 Communications Terminal (Model 1)

Using BSC, the System/38 can communicate with the following systems on a program-to-program basis:

- IBM Series/1
- IBM System/3
- IBM System/23 Datamaster
- IBM System/32
- IBM System/34
- IBM System/36
- IBM System/38
- IBM System/370, 30XX, and 43XX

Using SDLC, the System/38 can function as a host system to a remote 5250 work station; as a logical unit type 1 terminal to a host System/370, a 30XX, or a 43XX; or as a peer system using program-to-program communications between two System/38s, or between a System/38 and CICS/VS that uses SNA LU6.2 and PU2.1 architecture.

Other communications support includes:

- Transmission rates of 600 to 56 000 bps using customer-owned or common carrier lines
- Point-to-point switched communications
- Point-to-point nonswitched communications
- Multipoint nonswitched communications
- Automatic calling, automatic answering, manual calling, and manual answering
- Connection to a switched line through the integrated modem or external modems (attached through the EIA/CCITT interface) at 600 to 9600 bps
- A Digital Data Service Adapter for communicating on a digital data network (U.S. only) at 2400 to 56 000 bps

IBM 5230 DATA COLLECTION SYSTEM ADAPTER

The adapter available for the 5230 system is BSCA (binary synchronous communications adapter).

The BSCA permits the 5231 (Model 2) Controller to function as a 3741 terminal communicating in binary synchronous mode.

BSCA has the following features:

- A selection of switched or nonswitched point-to-point or nonswitched multipoint lines
- Switched network versions that support manual dial and manual answer or automatic answer operations
- An EBCDIC transmission code in a nontransparent mode
- A selection of data transmission speeds (600 to 4800 bps)

In addition to the preceding features, the following optional features are available for the BSCA:

- A self-clocking feature for modems that do not provide clocking signals
- An EIA Interface feature that permits remote communications by allowing a modem that uses the EIA RS-232C interface to be attached
- An integrated modem for 1200 bps transmission over nonswitched or switched lines with an automatic answering unit

IBM 5280 DISTRIBUTED DATA SYSTEM ADAPTERS

The IBM 5communications allow the IBM 5280 to communicate with other systems and devices using either binary synchronous communications or synchronous data link control. These adapters support one communications line.

The base communications and the 3270 device emulation communications features also support:

- An EIA/CCITT Interface feature that permits attachment of modems that use the EIA RS-232C V.24 or V.28 interface
- Line speeds of 600 to 4800 bps when using the EIA/CCITT interface
- Attachment of a Digital Data Service Adapter for communicating on a digital data network (U.S. only), or for local connection to other devices which use a DDSA and support the IBM 5280 Communications Utilities
- Line speeds of 2400 and 4800 bps when using the DDSA
- An integrated modem for a line speed of 1200 bps
- An Internal Clocking feature for transmission speeds of 600 or 1200 bps
- Automatic answering of calls on switched lines
- Switched network backup on switched communications lines (the Elapsed Time Counter feature must be installed when using SNA/SDLC)

Chapter 6. Terminals

The terminal is the input and/or output station of the data communications system. Some terminals consist of a combination of devices that perform a variety of functions. Some of these functions include the ability to:

- Enter data from a keyboard
- Read cards
- Read magnetic disks and diskettes
- Read paper tape
- Read badges
- Punch cards
- Write magnetic disks and diskettes
- Punch paper tape
- Print reports
- Display data on display screens

Some terminals transmit data directly to a host system or other terminals as it is entered. Other terminals store the data for later transmission.

Some terminals can be programmed to control certain functions in order to relieve the host of having to perform them.

In some configurations, a system may be a terminal. For example, the System/34, System/36, or System/38 can be a remote job entry terminal. Such a terminal can send and receive information to and from a larger computer, such as an IBM System/370, which is referred to as the central system, central computer, or host system.

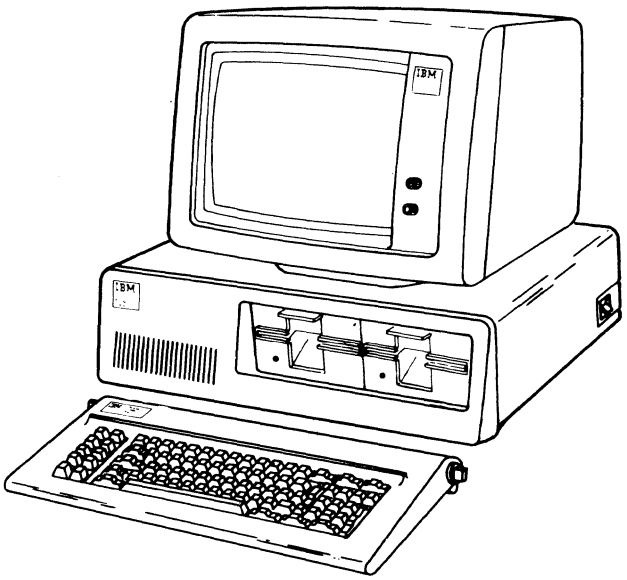
Before selecting a terminal, the following characteristics about it and the host system should be considered:

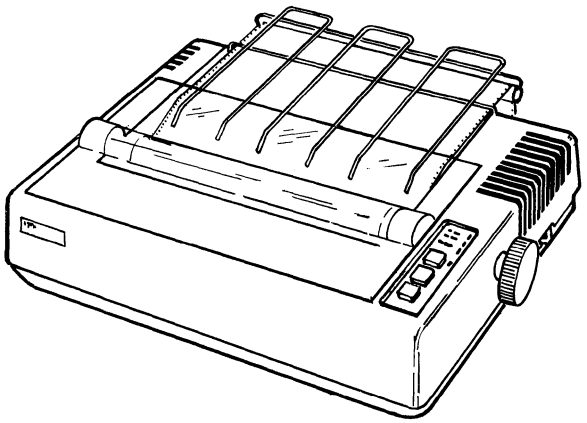
- The data link protocol
- The transmission speed
- The volume of data to be handled
- The type of line
- The use of programmable terminals
- The use of mass storage at the terminal for remote batch entry

Your IBM marketing representative can assist you in selecting the proper terminal.

The following is a brief description of the terminals that can be used with IBM small and intermediate products. For more information about a terminal, see the publications listed in the Bibliography.

THE IBM PERSONAL COMPUTER





The IBM Personal Computer is a small computer that offers a variety of options, from home entertainment to education to business applications. With the appropriate features, the Personal Computer can communicate with either host systems or other Personal Computers, and emulate other display stations, such as the 3101, and the 5253 display stations that can be attached to the 5520 Administrative System.

The Personal Computer can be attached to other systems, such as the System/34, the System/36, and the System/38 as a 5250 device.

The Personal Computer consists of the following:

- The system unit, or the system controller, that supports a monochrome display station, black and white or color televisions, and monitors for display purposes.

- Storage media that includes both disk and diskettes.

  Hard disks and diskettes enable you to store games and programs for future use. Also available is a cassette recorder adapter that permits you to use cassette tapes as storage media.

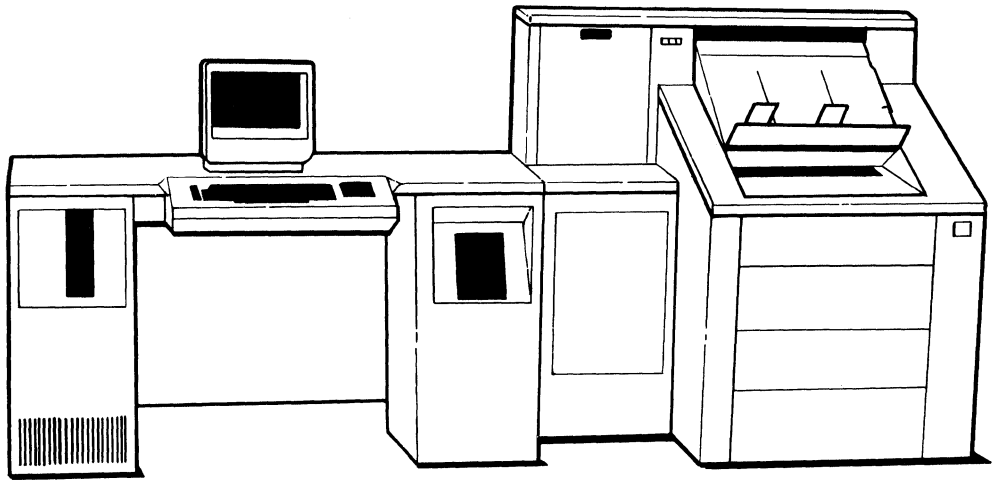
  An adjustable keyboard is attached to the system unit for input to the system.

- The optional IBM 80 CPS (characters per second) Matrix Printer prints enlarged, condensed, emphasized, and normal characters bidirectionally.

Optional support includes:

- A monochrome display
- A maximum of 256K bytes of main storage
- Application programs
- Emulation programs (3101, 5223, 5250)
- Joysticks for games
- A radio frequency (RF) modulator
- An asynchronous adapter
- A binary synchronous adapter
- An SNA/SDLC adapter
- Color graphics monitor adapter
- A parallel printer adapter
- A game control adapter
- A maximum of two 5 1/4 inch diskette drives

THE IBM OFFICE SYSTEM 6 INFORMATION PROCESSOR



The IBM Office System 6 (OS/6) is a text processing system that allows you to enter, edit, and format text, and process and maintain records.

An optional communications feature enables the OS/6 to support batch communications for terminal-to-terminal and terminal-to-host applications using BSC.

Terminal-to-terminal communications can be between two OS/6 information processors, or between an OS/6 and an IBM 6640 Document Printer, an IBM Magnetic Card II Communicating Typewriter, an IBM 6240 Magnetic Card Communicating Typewriter, or an IBM Word Processor/32 (WP/32). Also supported is terminal-to-terminal communications between the OS/6 (as a BSC device) and the System/38.

Terminal-to-host computer applications are supported by the IBM System/370 Virtual Storage (VS) Operating Systems.

The system diskette permits batch data to be transmitted. Incoming data can be stored on diskettes, magnetic cards, or printed out automatically.

Application programs that support communications with the IBM 2770 Data Communications System supports communications with the IBM OS/6 information processors. When attached to a System/370, the OS/6 appears as a 2770 and uses the Network Control Program (NCP) and the BTAM, TCAM, and VTAM access methods.

Other functions of the OS/6 include the ability to function as a remote job entry terminal, or as an interactive or batch terminal when attached to a System/370. The OS/6 also communicates with the following systems:

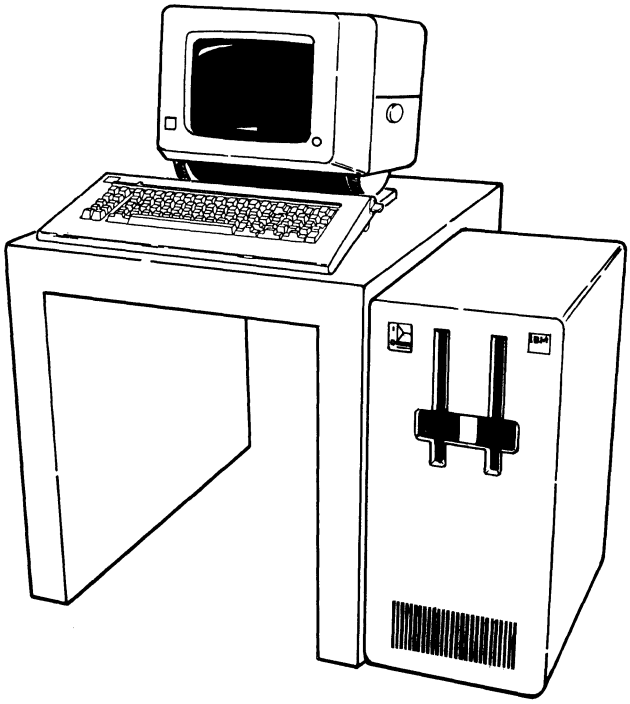
- POWER/VS (DOS/VS)
- RES (OS/VS1)
- JES II (OS/VS2)
- JES III (OS/VS2)
- RSCS (Remote Spooling Communications Subsystem) (VM/370)
- CICS/VS (DOS/VS, OS/VS1, OS/VS2)

Remote job entry programs such as JES II, JES III, and POWER/VS enable the OS/6 to appear as a local card reader and printer to a System/370 application program.

Other communications support includes:

- An optional internal modem that transmits data at 1200 bps and at half speed
- An internal modem that uses switched network backup (SNBU)
- An EIA/CCITT adapter that can be connected to an external modem meeting the RS-232C characteristics
- Data transmission speeds of 600 to 2400 bps using an external modem
- An internal or external modem that can be connected to switched or nonswitched lines
- A device that can call and answer calls automatically
- Three operator-selectable transmission code sets: EBCDIC, EBCDIC/WP, and 7-BIT/DP
- The ability to appear as a 2770 when attached to the IBM Series/1

IBM SYSTEM/23 DATAMASTER

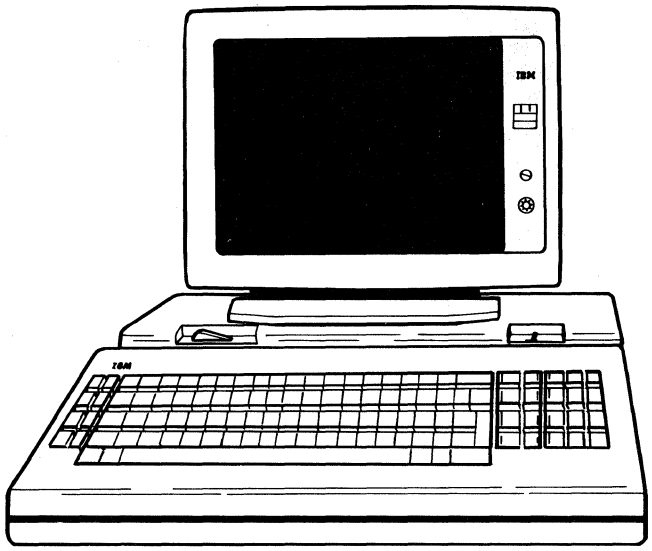


The IBM System/23 Datamaster is a small general purpose computer that uses a communications feature to communicate with other systems at other locations, or with other System/23s. The System/23 consists of the following:

- Two models of the System/23 Datamaster with main storage capacities from 64K bytes to 128K bytes
  - The 5322 desk-top computer
  - The 5324 floor model computer with floor standing processor and diskette unit
- A nonglare display screen that can display 24 lines of data with 80 characters in each line
- A typewriter-like keyboard with a 10-key numeric keypad in calculator arrangement
- Up to two diskette drives
- An optional 5247 Disk Unit that provides 15 or 30 megabytes of disk storage
- A choice of two printers:
  - The 5242 Printer (Model 2) that prints 160 characters per second in standard density, or 40 characters per second in high density
  - The 5217 Printer

The Communications Feature allows the System/23 to communicate with other systems at other locations, or with other System/23s.

THE IBM 3101 DISPLAY TERMINAL

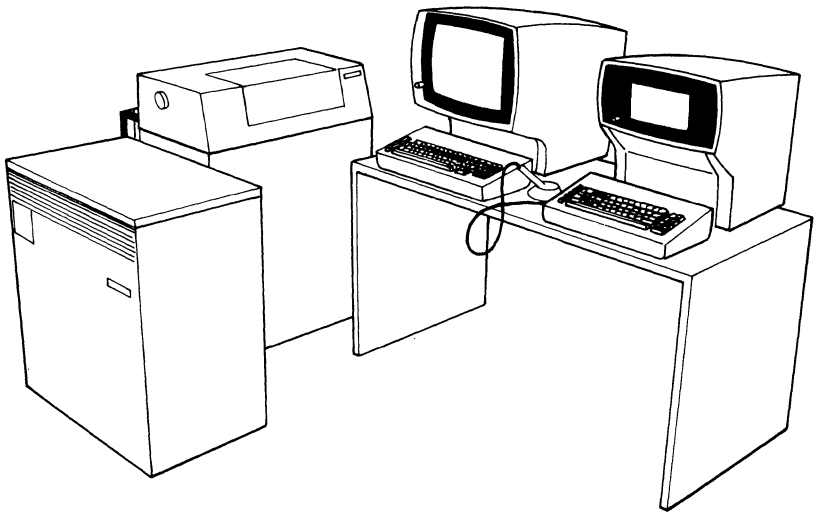


The IBM 3101 Display Terminal is an adjustable display station that allows interactive communications using ASCII. The 3101 is a keyboard display with a screen format of 1920 characters. Characters are presented in a 7 x 14 dot matrix within a 9 x 16 dot matrix.

Communications support includes:

- Asynchronous communications interfaces
- Data transmission speeds of 110 to 9600 bps
- EIA RS-232C or 422A interfaces
- Operation in either half duplex or duplex mode
- Operation in character or block mode

THE IBM 3270 INFORMATION DISPLAY SYSTEM



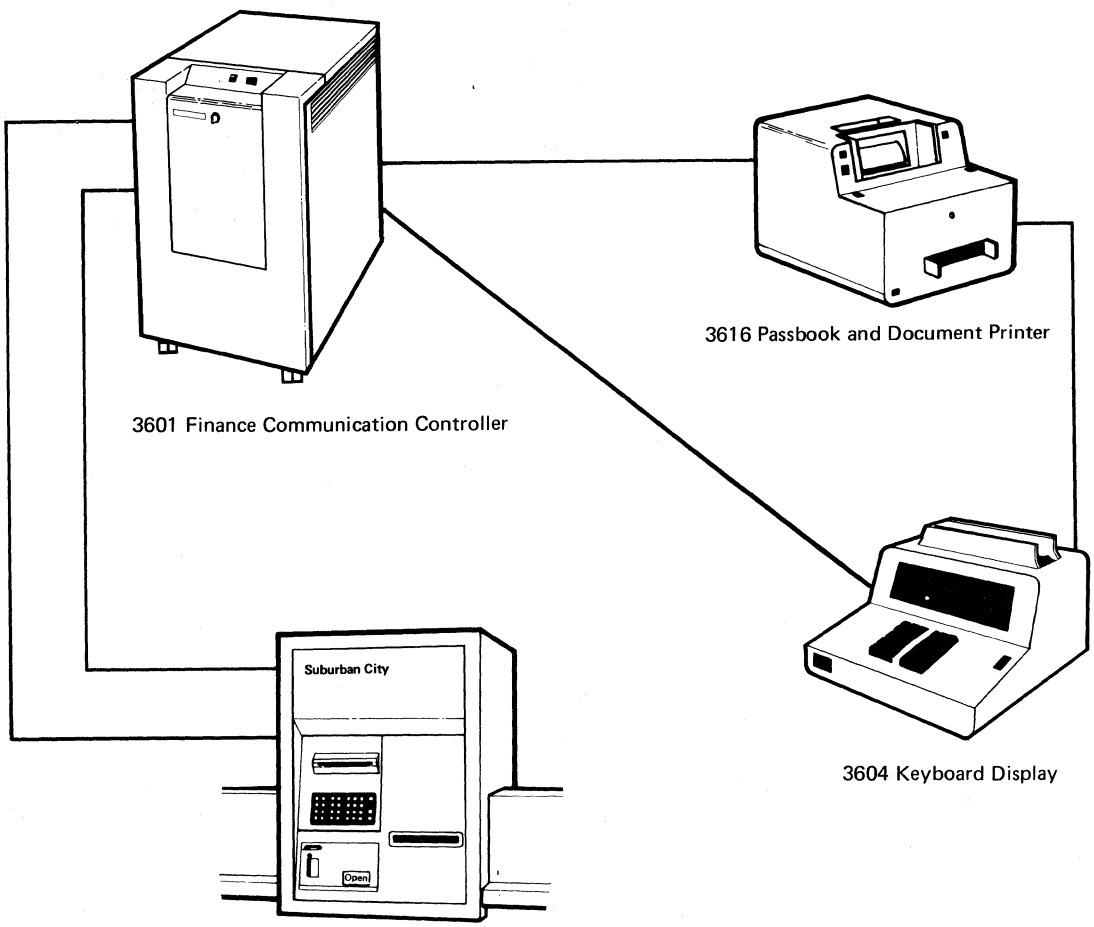
The IBM 3270 Information Display System consists of a display station (display screen and keyboard), a printer, and a control unit. The display system offers a choice of display sizes (with or without color), keyboard layouts, and printer speeds.

The 3290 information panel, with a distortion-free screen, provides access to applications or data bases in one or more systems. Nearly 10 000 characters can be displayed on its screen.

The components of the 3270 are designed for many different data communications system configurations, including attachment to the IBM Personal Computer (using the 3270 Personal Computer attachment).

The 3270 uses binary synchronous communications with either the ASCII or EBCDIC code and transmits data at speeds up to 9600 bps on remote lines; 1200 bps with an internal modem. The 3270 can be used on switched point-to-point or nonswitched multipoint lines.

THE IBM 3600 FINANCE COMMUNICATION SYSTEM



3624 Consumer Transaction Facility

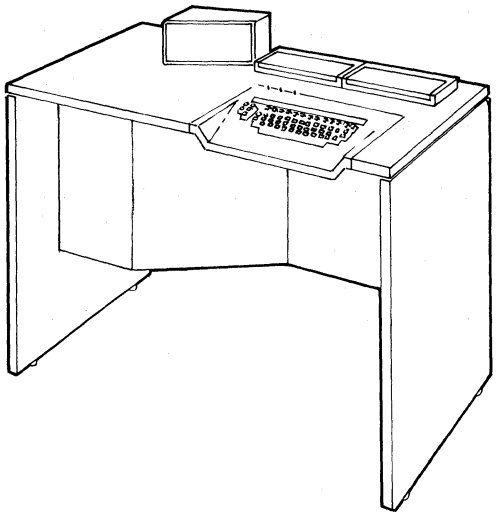
The IBM 3600 Finance Communication System (and the 4700 finance system) are groups of data communications products that are used by financial institutions and their branches. A typical 3600 system provides distributed data processing rather than concentrated processing at a central office.

The 3600 system offers a choice of several programmable controllers and various terminals. Therefore, a variety of configurations with the keyboards, displays, and printers are available. The IBM 3603 Terminal Attachment Unit allows the 3600 devices to be connected to communications devices on other 3600s or other systems with the appropriate communications equipment.

Some communications functions include the ability to:

- Communicate with a System/34 using SDLC and the SSP-ICF Finance subsystem
- Communicate with the System/3 Model 15D (as the host system) with CCP using BSC
- Transmit data at speeds of 1200 to 9600 bps
- Support the EIA/CCITT interface for attaching an external modem
- Communicate with other systems using an integrated modem
- Communicate with other systems using point-to-point, half duplex communications lines
- Communicate with a System/36 using the SSP-ICF Finance subsystem

THE IBM 3741 DATA STATION AND THE IBM 3741 PROGRAMMABLE WORK STATION

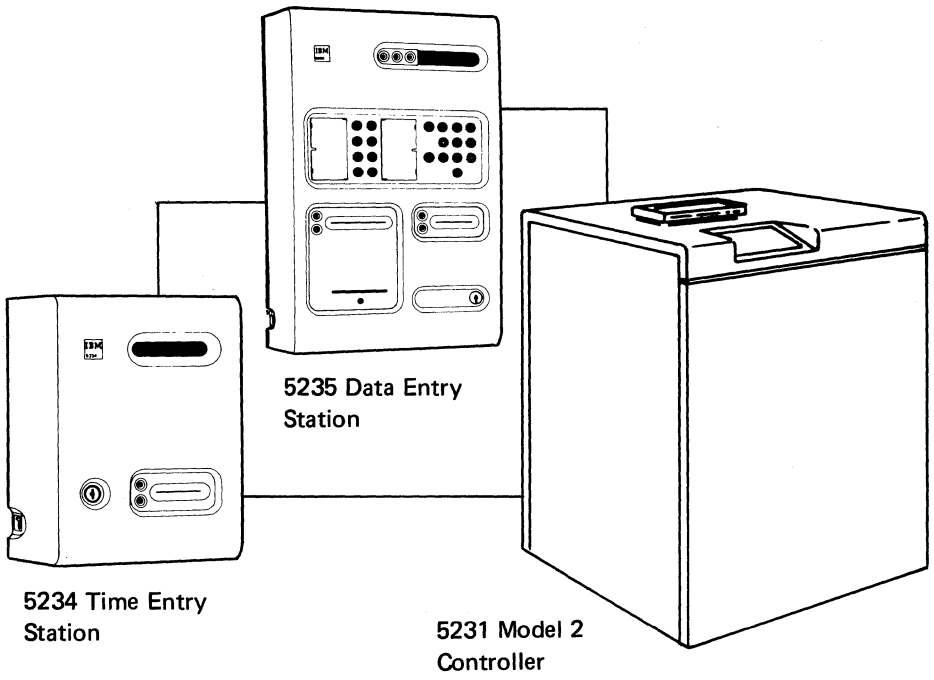


The IBM 3741 Data Station or 3741 Programmable Work Station can be used to enter and store data on diskettes for later transmission to a host system.

The 3741 is a binary synchronous terminal that transmits and receives data at speeds of 1200 bps using an internal modem; up to 2400 bps using an external modem and EBCDIC. It can communicate on a switched point-to-point line or on a nonswitched point-to-point line with another 3741, a 3747, or a host system. Expanded communications is available for transmitting blocked data.

An optional multipoint feature allows the 3741 to become a tributary or secondary station on a multipoint line.

THE IBM 5230 DATA COLLECTION SYSTEM

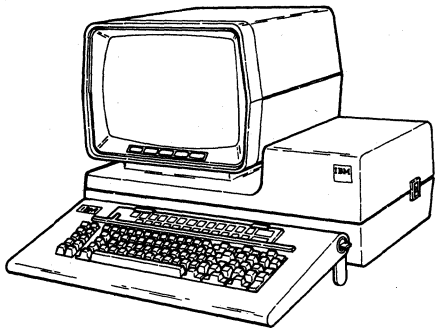


The IBM 5230 Data Collection System can be used to enter data at entry stations located in work areas. The 5234 Time Entry Station is for badge entry only; the 5235 Data Entry Station accepts data from cards, keyboards, and badges. The entry stations are attached to the 5231 controller.

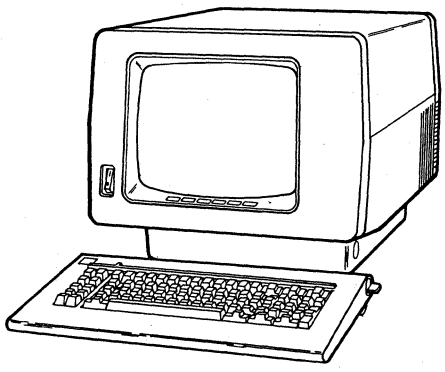
The 5231 Model 2 Controller communicates with a host system as a binary synchronous terminal. It uses EBCDIC in nontransparent mode and can transmit data at speeds up to 4800 bps. The 5230 Data Collection System can be used on switched point-to-point lines, nonswitched point-to-point lines, or multipoint lines.

Data can be transmitted to the host when received from the entry stations or can be stored on diskette for later transmission to the host.

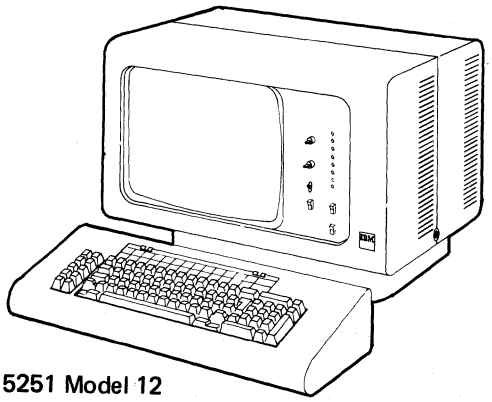
THE IBM 5250 INFORMATION DISPLAY SYSTEM



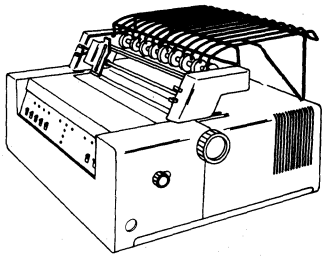
5291
Display Station



5292
Display Station



5251 Model 12
Display Station



5256 Printer

The IBM 5250 Information Display System is a family of keyboard/display and printer work stations.

The 5250 consists of the following devices and features:

- 5291 Display Station

  The 5291 has a 1920-character display screen that can be adjusted for viewing and keying preference.

- 5292 Display Station

  The 5292 can display up to seven colors at once on a 1920-character display screen. The display unit and low profile keyboard can be adjusted for viewing and keying preference.

- 5219 Printer that prints bidirectionally and comes in these models:
  - Model D01 prints at a maximum rate of 40 characters per second.
  - Model D02 prints at a maximum rate of 60 characters per second.

The 5251 Model 12 Display Station serves as the work station controller for attached 5251 Model 11, the 5224 Printer, the 5225 Printer, or the 5256 Printer when the Cluster feature is installed. The 5250 Information Display Station can use the 5256 Printer, the 5224 Printer, or the 5225 Printer to print information that is displayed at the 5251, or output that comes from a system program. The printer attaches directly to a System/34, System/36, System/38, or a 5251 Model 12 Display Station with a Cluster feature or a host system.

- 5251 Display Station in these models:
  - Model 11 is a directly attached work station controller with a 1920-character display.
  - Model 12 is a remote communicating controller with a 1920-character display.

- 5224 Printer in these models:
  - Model 1 prints at a maximum rate of 140 lines per minute.
  - Model 2 prints at a maximum rate of 240 lines per minute.

- 5225 Printer in these models:
  - Model 1 prints at a maximum rate of 280 lines per minute.
  - Model 2 prints at a maximum rate of 400 lines per minute.
  - Model 3 prints at a maximum rate of 490 lines per minute.
  - Model 4 prints at a maximum rate of 560 lines per minute.

- 5256 Printer in these models:
  - Model 1 prints at a maximum rate of 40 characters per second.
  - Model 2 prints at a maximum rate of 80 characters per second.
  - Model 3 prints at a maximum rate of 120 characters per second.

Other features provided by the 5250 Information Display System are:

- Cluster feature

  The Cluster feature allows direct attachment of a 5256 Printer and a 5251 Model 11 Display Station to the 5251 Model 12. The Cluster feature provides four cable connections and allows the attachment of up to four work stations.

- Dual Cluster feature

  The Dual Cluster feature allows the same attachment as the Cluster feature; however, the Dual Cluster feature provides eight cable connections and up to eight work stations to be attached.

- Internal Clock Communications feature

  The Internal Clock Communications feature provides clocking of the data onto and off the communications line at 1200 bps. This feature is required only when the attached modem does not provide its own clocking.

- Digital data service adapter (DDSA)

  The DDSA allows the 5251 Model 12 to be connected to the American Telephone and Telegraph's Digital Data Service. This digital network allows the Model 12 to communicate at data rates of 2400, 4800 or 9600 bps.

- Remote communications with the host system using the SNA/SDLC line protocol

- EIA Interface feature

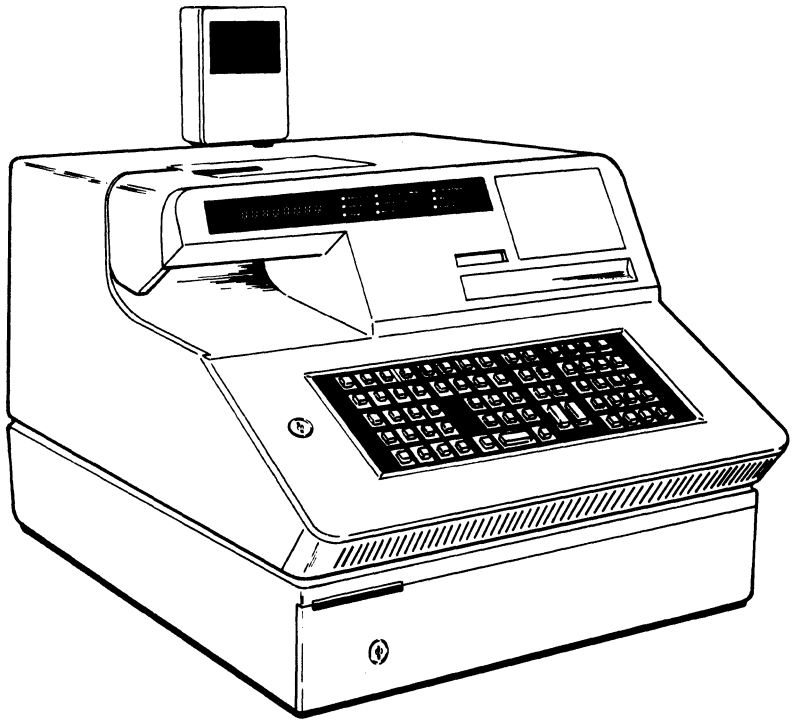
  The EIA interface allows the 5251 Model 12 to be attached to an external modem and meets the EIA standard RS-232C characteristics.

- Integrated modems

  The 5251 Model 12 offers a 2400 bps, a 4800 bps, or a 1200 bps integrated modem:
  - Nonswitched (with 1200 bps, 2400 bps, or 4800 bps).
  - Switched with manual answer (and 1200 bps, 2400 bps, or 4800 bps).

  The modems connect the Model 12 to either a customer-owned communications line or to a common-carrier-provided switched or nonswitched communications line. When operating on a switched common carrier line, the 1200 bps integrated modem is connected to an FCC-registered protective coupler. Attachment to a nonswitched line is with an IBM-supplied cable directly to the line. The 1200 bps integrated modem requires the Internal Clock Communications feature.

THE IBM 5260 RETAIL SYSTEM



The IBM 5260 Retail System is used to record and store sales and nonsales information about the retail business. This system includes the IBM 5265 (shown in the illustration) and the IBM 5266 Point-of-Sale Terminals.

The 5265 can operate as a single unit system, or as a terminal that contains a shared diskette drive and a controller. The 5266 terminal, called a satellite terminal, must be connected to a controlling 5265 terminal before it is operational.

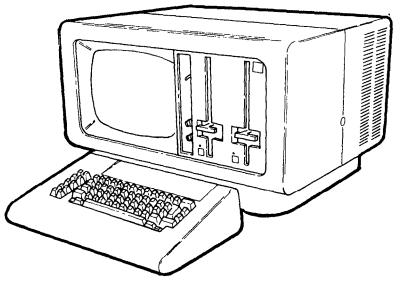
Data entered at the terminals is stored on the 5265 diskette and can be hand-carried, mailed, or transmitted using communications lines to a host system for processing.

Certain models of the 5260 can communicate with a host system using BSC protocol. The 5265 transmits only nontransparent EBCDIC data and can receive nontransparent or transparent EBCDIC data in 128-byte records.

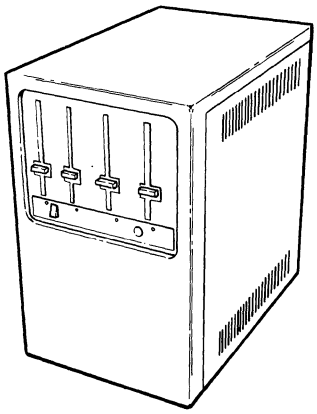
The 5260 Retail System supports:

- Point-to-point communications
- Transmission speeds of from 1200 to 2400 bps
- Half duplex mode of operation
- Switched or nonswitched communications lines
- Automatic answering, manual calling, and manual answering
- An integrated or external modem
- EIA/CCITT Interface feature

THE IBM 5280 DISTRIBUTED DATA SYSTEM



5285 Programmable Data Station



5288 Programmable Control Unit

The IBM 5280 Distributed Data System is a diskette-based data processing system that can be used to:

- Perform data entry
- Send and receive data from a host processing system using BSC and SNA/SDLC communications
- Process user programs
- Perform sorts, merges, and other utility functions

The following devices are part of the 5280 system:

- IBM 5288 Programmable Control Unit

  The 5288 is a floor-standing programmable control unit that can support up to four 5281 and/or 5282 keyboards, eight printers, eight diskette drives, and one communications line.

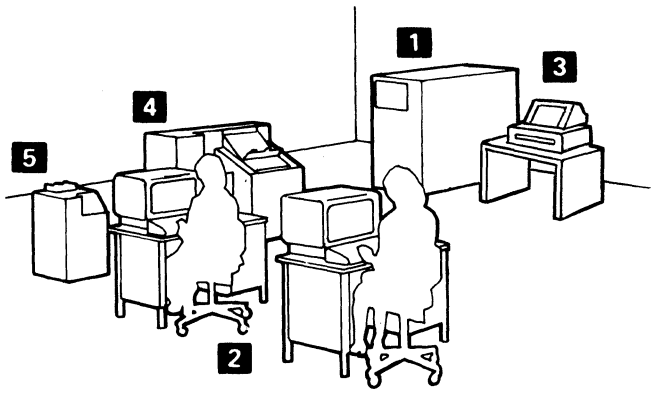
- IBM 5285 Programmable Data Station

  The 5285 is a single, tabletop, programmable, keyboard/display station with support for up to two diskette drives (four drives with optional auxiliary display stations). Special features provide for the attachment of an auxiliary display station (5281 or 5282), a printer (5222, 5224, 5225, or 5256), and a communications adapter.

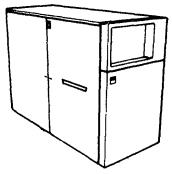
Other attributes of the 5280 system include:

- Communications support for BSC and SNA/SDLC
- Editing for data entry in support of a host processing system
- Data security through the Keylock feature and the logon communications security function
- Communications for remote batch jobs, inquiry, and remote job entry processing
- Point-to-point switched, point-to-point nonswitched, or multipoint network support (in a multipoint network, the 5280 functions as a tributary station)
- Line speeds from 600 to 4800 bps
- Use of ASCII or EBCDIC transmission codes
- Half duplex mode of operation
- EIA/CCITT Interface feature, a 1200 bps integrated modem, or a Digital Data Service Adapter
- Automatic Answering feature
- Communications using 3270 emulation

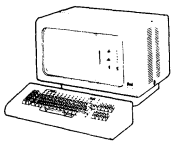
THE IBM 5520 ADMINISTRATIVE SYSTEM



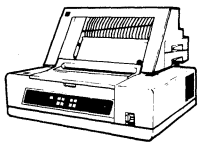
1 IBM 5525 System Unit



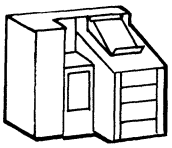
2 IBM 5253 Display Station



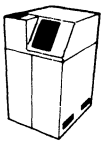
3 IBM 5219 Printer



4 IBM 5258 Printer



5 IBM 5321 Mag Card Unit



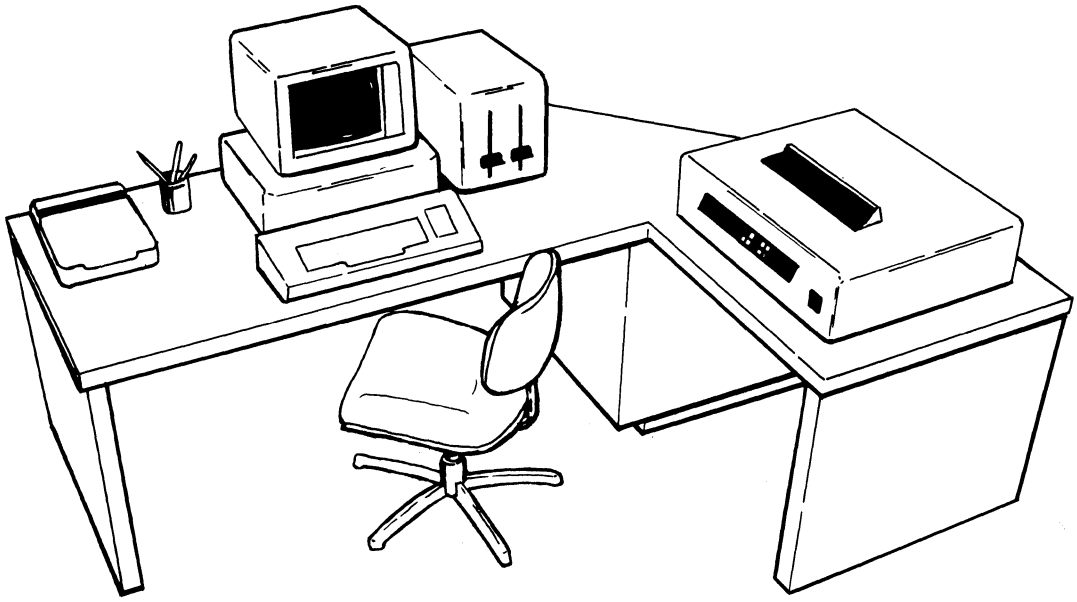
The IBM 5520 is an Administrative System that is used for text and file processing, stored procedures, document distribution, and other document management. For example, a document can be created at an IBM 5253 Display Station at one location, then distributed to one or more local or remote locations using communications lines. The document can be stored and/or reviewed at the remote location, or printed on an attached printer such as the IBM 5258 Printer, or the IBM 5219 Printer.

Other features of the IBM 5520 Administrative System include:

- Attachment of three different types of communications lines
  - Switched lines
  - Nonswitched lines
  - Local device controller (LDC) lines
- Support for up to 16 communications lines attached to an IBM 5525 System Unit (Models 50 and 51)
- Communications using both BSC and SDLC
- Line speeds from 1200 to 9600 bps for customer-owned lines
- Line speeds from 1200 to 4800 bps for switched lines
- Manual calling, manual answering, automatic calling, and automatic answering
- Both point-to-point and multipoint lines (multipoint possible only on SDLC lines)

The 5520 is easy to install and requires no programming. You can tailor the system to fit your needs, using interactive menus and displays.

THE IBM DISPLAYWRITER SYSTEM



The IBM Displaywriter System is a diskette-based text processor that allows you to create and edit text, create, revise, display, and print charts, and send and receive information over communications lines from other office equipment and computers.

The Displaywriter system can consist of at least one IBM 6580 Display Station and an IBM 6360 Diskette Unit. An IBM 5215 Selectric Element Printer, or an IBM 5218 Printwheel Printer can also be attached.

The Displaywriter can communicate in two modes:

- Interactive asynchronous communications mode
- Batch binary synchronous communications mode

Asynchronous communications supports the following:

- EIA RS-232C interface for external modems
- Communications on switched or nonswitched point-to-point lines
- An automatic answering device
- Data transmission speeds of 300, 600, or 1200 bps

Using asynchronous communications, the IBM Displaywriter System can appear as the IBM Magnetic Card II Typewriter–Communicating or a teletypewriter.

Binary synchronous communications supports the following:

- EIA RS-232C interface for external modems
- Integrated modem interface for internal modems
- Communications using switched or nonswitched lines
- Communications using point-to-point, half duplex lines
- Data transmission speeds of 1200 or 2400 bps
- Use of the EBCDIC transmission code
- Line error checking with vertical redundancy (VRC), longitudinal redundancy (LRC), and cyclic redundancy (CRC)
- An automatic answering device

The binary synchronous communications support allows the Displaywriter to appear as the 2770, 2780, and the 3780. The Displaywriter can also communicate with the following devices and systems:

- IBM 5520 Administrative System
- IBM 6640 Document Printer
- IBM 6240 Magnetic Card Typewriter–Communicating
- IBM 6670 Information Distributor
- IBM Office System 6
- IBM Magnetic Card II Typewriter–Communicating
- Another IBM Displaywriter System
- IBM System/23 Datamaster
- IBM System/34*
- IBM System/36
- IBM System/38*
- IBM System/370
- IBM Series/1*

Using the 3277 Device Emulation RPQ, the Displaywriter can appear to the host as a 3277 Display Station Model 2 when attached to the appropriate controller.

With the 3270 attached work station program, the Displaywriter can emulate the 3270 Display Station and the 3287 Printer when directly attached to the 3270 or 3276 control units, the 43XX processors, or the 4700 finance communications system.

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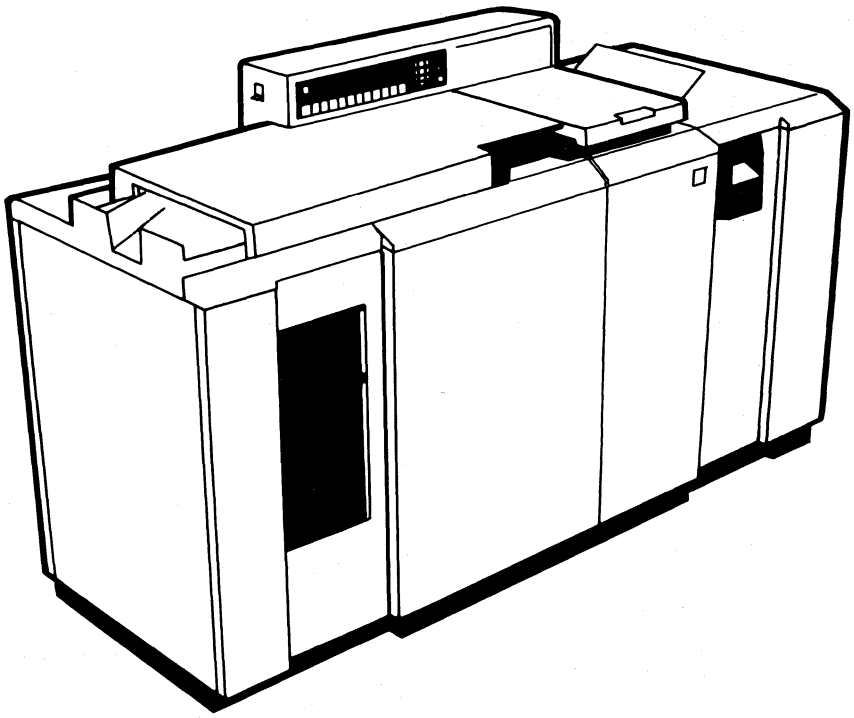
*These systems must be appropriately programmed.

THE IBM 6670 INFORMATION DISTRIBUTOR



The IBM 6670 Information Distributor is a laser printer/copier that prints, records, sends, and receives information using communications lines. Documents are automatically formatted during printing.

Using BSC or SDLC, the IBM 6670 can send information to other office products and suitably programmed computers on magnetic cards or diskettes. The IBM 6670 can receive documents and print them or store the data in the Card Record File for later recording onto magnetic cards.

The IBM 6670 can communicate with host systems that support the following subset of SNA:

- Logical unit type 4
- Transmission services profile 7
- Function management profile 7

All the text processing functions, paper selection, duplex printing, and collating functions are available during online printing.

As a transmitting station, the IBM 6670 can process text locally and then send the formatted page to the host system, or it can send the page as entered and let the host system format it.

As a receiving station, the IBM 6670 honors the OCL that it receives.

More than one job can be sent during a communications session.

Other communications support includes:

- An optional internal modem that transmits data at a line speed of 1200 bps
- Support of switched or nonswitched communications lines and half speed transmission
- Switched network backup (SNBU)
- An optional external modem that transmits data at speeds of 600 to 4800 bps
- An optional external modem that can be connected to a switched or nonswitched communications line
- Automatic answering
- Data transmission, using EBCDIC/WP (Word Processing), EBCDIC/DP (Data Processing), or ASCII code structures

EBCDIC/WP is an expansion of EBCDIC/DP. EBCDIC/WP includes special word processing codes like required carrier returns, and required tabs. This code set is used when sending information where word processing codes must be retained.

The 6670 can communicate with the following products, using BSC:

- IBM Office System 6 Information Processors
- IBM Magnetic Card II Typewriter–Communicating
- IBM 6240 Magnetic Card Typewriter–Communicating
- IBM Series/1
- IBM System/36
- IBM System/360
- IBM System/370
- IBM System/34 (RPQ)
- IBM System/38
- IBM 5520 Administrative System
- IBM 6640 Document Printer
- IBM 3031, 3032, and 3033 Processors
- IBM 4300 Processors
- Another 6670 Information Distributor
- IBM Displaywriter
- Other products that are programmed for IBM 2770 Data Communications

Chapter 7. Using IBM Small and Intermediate Systems with Communications

This chapter describes how some of the IBM small and intermediate systems and other related IBM products are used with data communications. Communications programs provided for these systems are described briefly followed by sample configurations showing how devices, programming, and data communications lines and equipment are related in a total system.

IBM PERSONAL COMPUTER

With its communications support, the IBM Personal Computer allows you to access and interact with a wide range of information networks, host systems and other data network resources, including other Personal Computers.

A Personal Computer can be equipped to emulate asynchronous or binary synchronous terminals, synchronous terminals, and to communicate over switched or nonswitched lines.

- The SNA 3270 Emulation and Remote Job Entry Support Program
- The 3101 Emulation Program
- The BSC 3270 Emulation Program
- The Asynchronous Communications Support Program

With the appropriate attachments, the Personal Computer can appear as an IBM 5250 Display Station.

The SNA 3270 Emulation and Remote Job Entry Program

The IBM SNA 3270 Emulation and Remote Job Entry (RJE) Support Program, which was designed for high-speed synchronous communications, permits the Personal Computer to function as an intelligent terminal that can communicate with host systems as either:

- 3270 devices
- 3770 RJE terminal

The communications interface supports:

- Switched and nonswitched lines (including nonswitched multipoint lines)
- Half duplex transmission
- The EIA RS-232C interface
- Constant request to send and line turnaround
- Online diagnostics with line trace, error logging and analysis

The Personal Computer as a 3270 Emulator

When the Personal Computer functions as a 3270 device, it appears to host systems as an IBM 3274 Model 51C Logical Unit Type 2 Control Unit. (The 3274 directs the operations of attached 3278 Display Stations and Printers.) As a 3270 device, the Personal Computer supports the following 3278 features:

- Line transmission support for EBCDIC
- The same display formats, substituting status line messages for status line
- 24 program function keys and the local print key
- 3279 base color (which supports 4 colors)
- User-definable 3270 keys

The Personal Computer printers can emulate the IBM 3287 Models 1 and 2 Printers for local copy and host-initiated display screen print.

The Personal Computer as a Remote Job Entry Terminal

As an RJE terminal, the Personal Computer can enter batch processing jobs into host systems. The Personal Computer can also interact with the host system as an IBM 3770 communications terminal with the following features:

- Transmission support for ASCII and EBCDIC
- Logical Unit Type 1 (LU1)
- Compression of data sent from host
- Blank compression of data sent to host
- Transmission Subsystem (TS) Profile 3 and FM Profile 3
- Transparency (text is transmitted as it appears in files)
- Support of console, card/punch, and printer

You can send and receive data in a format used by the Personal Computer Disk Operating System (DOS), and control printing format by channel control, page size, tab setting, and line density.

A configuration utility program is provided with the SNA program to help you tailor the communications programs to meet your needs. For ease of use, the utility has menus that prompt you for the available options.

3101 Emulation

The 3101 Emulation Program Support enables the IBM Personal Computer to function similar to an IBM 3101 Display Terminal Model 20. As a 3101 terminal, the Personal Computer can do the following:

- Access and transmit ASCII files from host system to local storage on the Personal Computer and vice versa (The ASCII files can be converted to and from binary format.)
- Access external information networks
- Communicate with other Personal Computers
- Provide specification files for popular 3101 configurations

  The 3101 program includes several specification files that support popular uses of a 3101 terminal (such as creating specification files). You can select specification options such as line characteristics and keyboard mapping.

The specification files allow you to communicate with the following systems and services:

- VM/370
- MVS/TSO
- IBM 8100 using the 7426 Terminal Interface Unit (TIU)
- Series/1 using the Yale IUP
- 3101 Pass-through (PVM)
- The Dow Jones News Service[1]
- THE SOURCE[2]
- Another Personal Computer
- IBM Information Network

The 3101 emulation program enables the Personal Computer to appear as a 3270 terminal that can access the IBM 3270 Information Display System. (The Personal Computer requires installation of the Asynchronous Communications Adapter with the 3101 Emulation Program.)

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[1]Trademark of Dow Jones & Co., Inc.
[2]THE SOURCE is a service mark of SOURCE Telecomputing Corporation, a subsidiary of The Reader's Digest Association, Inc.

The Binary Synchronous Communications 3270 Emulation Program

The Binary Synchronous Communications 3270 Emulation Program allows the Personal Computer to access BSC networks and to interact with BSC host systems as one of the following:

- 3271 Model 2 or 3277 Model 2 (over nonswitched lines)
- 3274 Model 51C and 3278 Model 2 (over nonswitched lines)
- 3275 Model 2 (over switched and nonswitched lines)
- 3276 Model 2 (over nonswitched lines)

The communications interface supports:

- Switched and nonswitched lines (including multipoint lines)
- Half duplex transmission
- Data transmission rates up to 9600 bps
- The EIA RS-232C interface
- Online diagnostics with line trace, error logging and analysis

Other functions supported by the BSC 3270 Emulation Program include:

- Transmission of data using EBCDIC
- Program function keys (12)
- Local print key
- Keyboard Numeric Lock feature
- Status line messages
- Audible alarm
- IBM 3279 base color
- Nonbuffered or separately addressable buffered printers

The Configuration Utility program is provided with the BSC 3270 Emulation Program to help you tailor your communications program to meet your needs. For ease of use, the utility has menus to prompt you for the various options available.

The Asynchronous Communications Support Program

The Asynchronous Communications Support Program permits the Personal Computer to do the following:

- Operate as a teletypewriter with automatic send and receive ability (a teletype[1] (TTY) ASR 33/35)
- Function as an interactive terminal
- Communicate with host systems that use ASCII
- Communicate with another PC that uses ASCII
- Communicate with the VM/370 system
- Communicate with the MVS/TSO system
- Access the Dow Jones News Service
- Access THE SOURCE
- Transfer files to and from host systems
- Convert binary files to ASCII and back to binary

The following support is user-defined:

- Transmission bit rate
- Parity
- Number of stop bits
- Line turnaround characters
- ECHO or no ECHO

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[1]Trademark of the Teletype Corp.

THE IBM SERIES/1

With data communications, the Series/1 can be used as a host system, a remote job entry terminal, or a remote batch entry terminal. With its associated disk storage, attached devices, integrated communications features, programmable communications subsystem, and broad range of programming support, the Series/1 can perform such functions as:

- Data concentration (combining several messages into a single message for transmission)
- Communications controller (often called front-end processor)
- Message switching (receiving a complete message, storing it, and then forwarding it unchanged to its destination)
- Distributed host support (data entry)
- Distributed processing (stand-alone or host dependent)
- Inquiry to multiple systems
- Remote job entry
- Provide interface of non-SNA terminals to SNA networks
- Remote IPL

The following chart provides a list of systems with which the Series/1 can communicate and the data link controls used:

IBM System	Binary Synchronous Communications	Asynchronous Communications	SNA/SDLC Communications	Channel Attachment	Local Communications Controller	High Speed Data Link Control
Another Series/1	X	X			X	X
System/23	X	X				
System/34	X					
System/38	X					
System/370	X		X	X		
System/370 with 327X Emulation	X		X			
Office System 6	X					
IBM 3101		X				
IBM 3271	X					
IBM 3600	X					
IBM 3741	X					
IBM 5230	X					
IBM 5260	X					
IBM 5280	X					
IBM 5520	X					
IBM Displaywriter	X	X				
IBM 6640	X					
IBM 6670	X					
IBM Personal Computer		X				

The Series/1 can communicate with terminals, other systems, or both, by using the following communications programs. These programs fall into four categories:

- Realtime Programming System
- Event Driven Executive
- Control Programs Support
- Other Series/1 Communications Products

THE REALTIME PROGRAMMING SYSTEM

The Realtime Programming System permits you to send or receive data using asynchronous, binary synchronous or synchronous data link control protocols between the Series/1 and remote stations. A remote station can be either a terminal or another computer. The Realtime Programming System allows a Series/1 to communicate with other systems or terminals using multipoint or point-to-point switched and point-to-point nonswitched communications lines as well as multipoint communications lines. The communications portion of this programming system has the ability to:

- Establish, terminate, and control communications between user programs and remote stations
- Transfer data between user programs and remote stations
- Provide message routing either to attached Series/1's or host systems
- Translate one transmission code to another
- Provide error recovery and diagnostic support (including input and output tracing, logging, and online terminal testing)

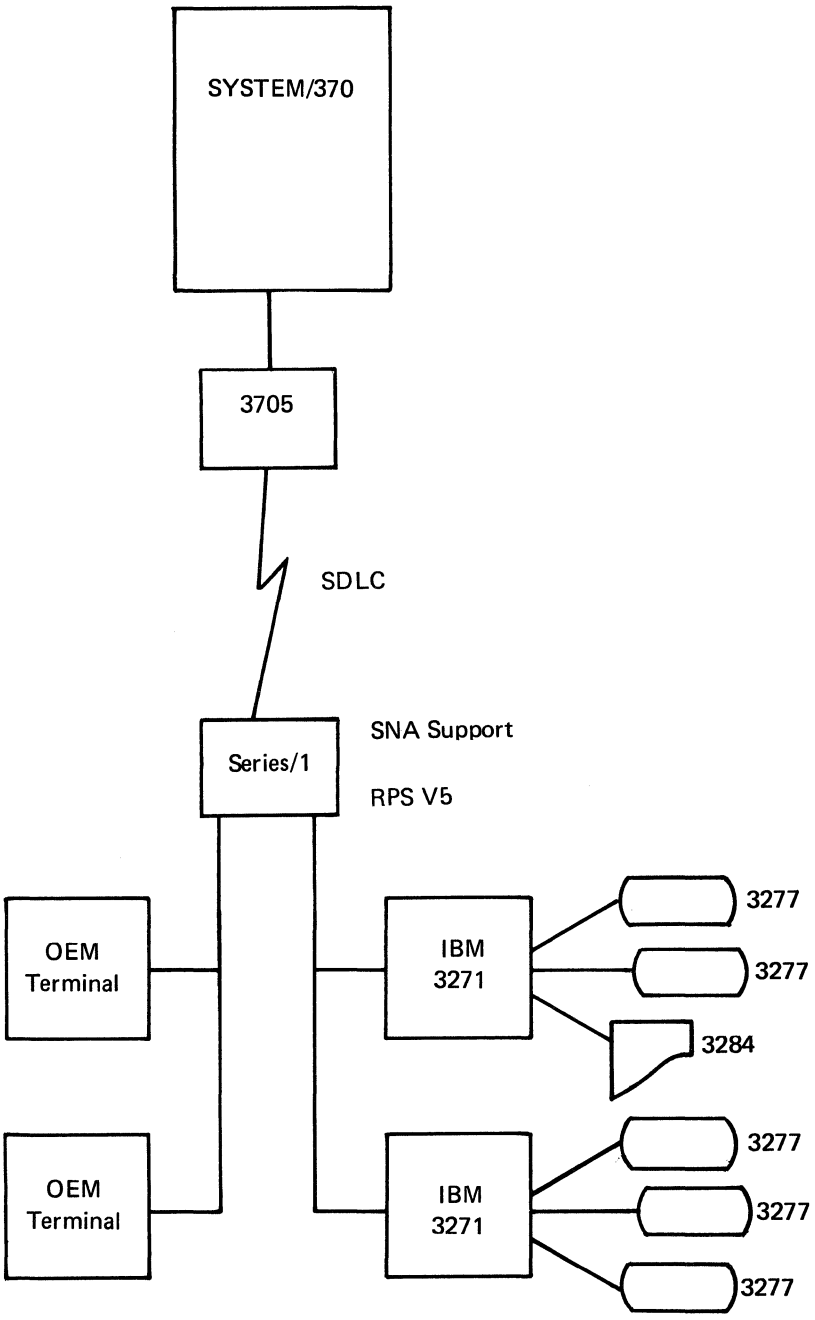
The following communications input/output operations are supported (as appropriate to the protocol being used):

- Receive only
- Transmit only
- Transmit mixed with receive
- Transmit with conversational reply
- Receive with conversational reply
- Transmit delay
- Transmit end of transmission (EOT)
- Transmit acknowledgment
- Transmit interrupt
- Transmit IPL
- Receive with automatic polling

The Realtime Programming System SNA support controls the management of sessions, and the flow of data in an SNA network between a user program in the SNA host and a user program in the Series/1. This support provides the following:

- System definition services
- Network attachment activation/deactivation services
- Session and message exchange services
- Activation of a Series/1 task from the host
- SDLC secondary station support
- SNA physical unit type 2 support
- SNA function management profile 3 and 4 support
- SNA transmission services profile 3 and 4 support

The Realtime Programming System provides a data flow control level interface on an SNA network and provides for support as a multiple logical unit cluster controller. A System/370 using ACF/VTAM or ACF/TCAM controls the network. The Realtime Programming System allows multiple Series/1 user programs to be in session with multiple host user programs.



This configuration shows a Series/1 using SNA/SDLC to communicate with a System/370 and support IBM and OEM terminals at the same time.

Communications Manager

The IBM Communications Manager for Series/1 supports line concentration, message routing, terminal control, and distributed data processing.

One or more Series/1 using the program can be installed to manage the flow of information through a network. The support allows you to perform the following functions:

- Line concentration

  The program can receive messages, batch them, and transmit them efficiently over a high-speed line.

- Message delivery

  The program can receive a message from a computer, a device, or an application program and transmit it to any destination in the network.

- Message priority

  The Communications Manager can receive a message from a system, a device, or an application program, and transmit it to another system, device, or application program. Messages are delivered in the order of priority assigned to each originator.

- Message queue

  The program creates priority queues of messages for each destination. The user can specify that queues of messages above a certain priority be in processor storage. Queues for messages of lower priorities are in disk storage.

Communications Manager supports a variety of terminals and other input/output devices. Support for non-IBM devices can be had by using the 4987 Programmable Communications Subsystem.

In addition to providing a choice of the preceding functions, Communications Manager allows users to add applications of their own to the network control base support. The following are examples:

- Store-and-forward applications collect messages as they arrive at a destination, hold them, and then forward them to another destination.

  The messages might be forwarded, for example, when a certain number has been collected, at a certain time of day, or when usage of the line is low.

- Data-entry applications solicit or accept messages from input devices, such as terminals.

  An application program can process the messages and produce an output report, or it can collect the data and pass it along to another computer. The application program can be at the same processor as the terminal, or at a remote processor. The application can be split among many processors; In which case, the Communications Manager will manage the communications among the processors.

- Host backup applications permit a Series/1 to serve as a backup for a host computer when the host or the line to the host is down.

Using the Communications Manager program, two or more Series/1's can communicate in one of the following ways:

- Over a point-to-point, nonswitched line using BSC
- Using high-level data link control (HDLC)
- Using the Series/1 Local Communications Controller (which enables up to 16 Series/1's to be connected to each other in a local configuration)

The Communications Manager program allows a Series/1 to communicate with a host computer, such as a System/370, in one of these four ways:

- Using binary synchronous communications
- Using 3271 emulation
- Using the Series/1 System/370 Channel Attachment feature
- Using SDLC and appearing as an SNA logical unit 0

BSC Communications

The Communications Manager allows a Series/1 to communicate with a host computer using BSC and the following (see configuration B):

- Point-to-point nonswitched communications line
- Both transparent and nontransparent EBCDIC transmission

3271 Emulation

A Series/1 using the Communications Manager program can communicate with a host as a 3271 Control Unit over a multipoint nonswitched line. Each Series/1 that is attached to the host through one or more 4987 Programmable Communications Subsystem lines appears to the host as a 3271 Control Unit. (See configuration B.) Communications occurs over lines that use binary synchronous communications.

By using 3271 emulation, an application program in a host system can manage communications between the Series/1 and a variety of input/output devices such as a Series/1 and 3270 displays and printers. The devices can be 3277 Display Stations and 3284 and 3286 Printers attached to a 3271; 3278 Display Stations, 3279 Color Display Stations, and 3287 and 3289 Printers attached to a 3276 Control Unit; and 3277 and 3278 Display Stations, 3279 Color Display Stations, and 3284, 3286, 3287, 3288, and 3289 Printers attached to a 3274 Control Unit.

You can define multiple lines with up to 32 control units on each line and up to 32 displays and printers attached through each control unit.

Channel Attachment Feature

The Communications Manager allows the Series/1 to communicate with a host computer using the Series/1 System/370 Channel Attachment feature. With this feature, the Series/1 appears to the host system as a 3272 Control Unit with up to 32 devices attached. When the channel attachment feature is used with 3270 control, the host system can support remote 3270 and other devices as if they were local devices.

The host application program can also control a group of 3277 Display Stations and 3284 and 3286 Printers that are attached to a Series/1. This support can be used with 3278 Display Stations, 3279 Color Display Stations, and 3287 and 3289 Printers attached through a 3276 Control Unit; and 3277, 3278, and 3279 Display Stations and 3284, 3286, 3287, 3288, and 3289 Printers attached through a 3274 Control Unit. (See configuration C.)

SNA

Using the Communications Manager, the Series/1 can be connected to an SNA network and communicate with IMS/VS and CICS/VS application programs running in a System/370. This connection is provided by the IBM 2090 Synchronous Data Link Control Single-Line Control feature.

One or more lines to the System/370 can be active with any number of sessions established on each line. (See configuration C.)

Other devices with which the Series/1 Communications Manager can communicate include the (see configuration A):

- IBM 5280 (as a 3270)
- IBM System/3
- IBM 4973, 4974, and 4975 Printers
- IBM 4978 and 4979 Display Stations
- IBM 4962 Disk Storage Unit and IBM 4963 Disk Subsystem
- IBM 4964 Diskette Unit and the IBM Diskette Magazine Unit in the IBM 4962 (Model 2, 2F, and 4) Disk Storage Unit
- IBM 4969 Magnetic Tape Subsystem
- Teletype[1] Models 33 and 35 (or ASCII equivalent) Teletypewriters attached through 7850 Teletypewriter Adapters
- IBM 5520 Administrative System (using BSC)

Other systems with which the Communications Manager can communicate using either asynchronous or binary synchronous communications protocols include:

- IBM System/23 Datamaster
- IBM Displaywriter
- IBM 6670 Information Distributor

The Series/1 can also use the Communications Manager to communicate with the IBM Personal Computer and the IBM 3101 Display Terminal.

The Series/1 Communications Manager runs under the control of the Realtime Programming System, Version 5.

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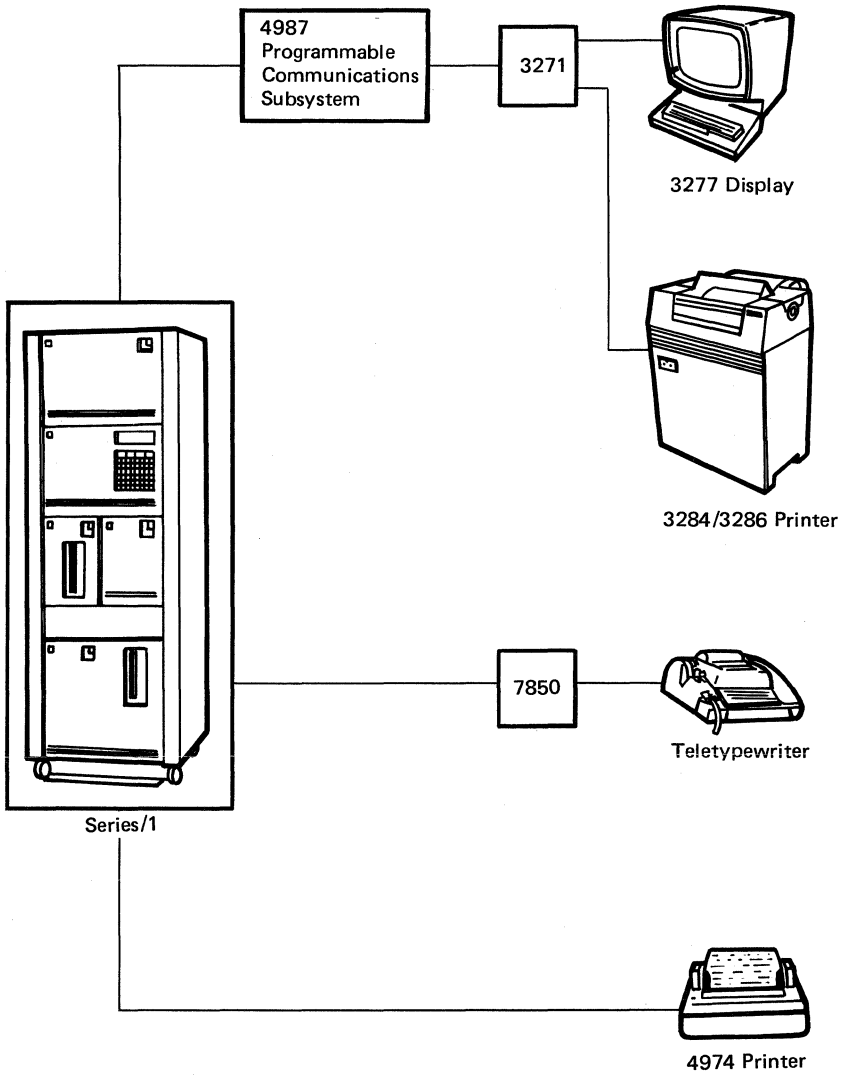
[1]Trademark of the Teletype Corp.

The following illustration (configuration A) shows a configuration with a Communications Manager, a single Series/1, including a disk and two diskettes, and these devices:

- A 3277 Display Station for input and output from applications
- A 3284 and 3286 Printer for output from applications
- A 7850 Teletypewriter Adapter, with a teletypewriter device for input and output from applications
- A 4974 Printer (matrix) for output from applications and for printing system messages

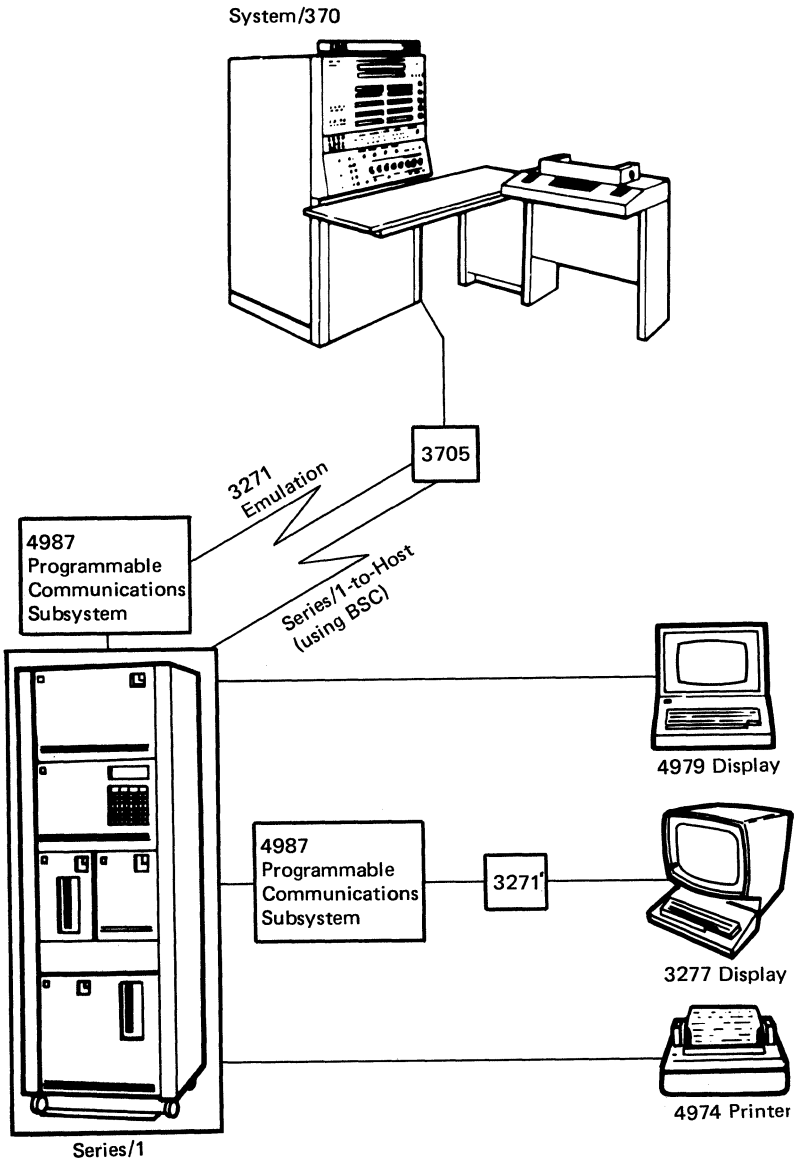


Configuration A

The following illustration (configuration B) shows a Series/1 communicating with a host IBM System/370, in two ways: using 3271 emulation and the Series/1-to-host BSC program.

The 3271 emulation path communicates through the Programmable Communications Subsystem, while Series/1-to-host uses an integrated BSC adapter. The Series/1 has a 4979 Display Station that is used to send and receive messages and a 4974 Printer (matrix) used to receive messages. The Series/1 also has a disk and two diskettes. The 3277 Display Station attached to the Series/1 is controlled by an application program running in the System/370.

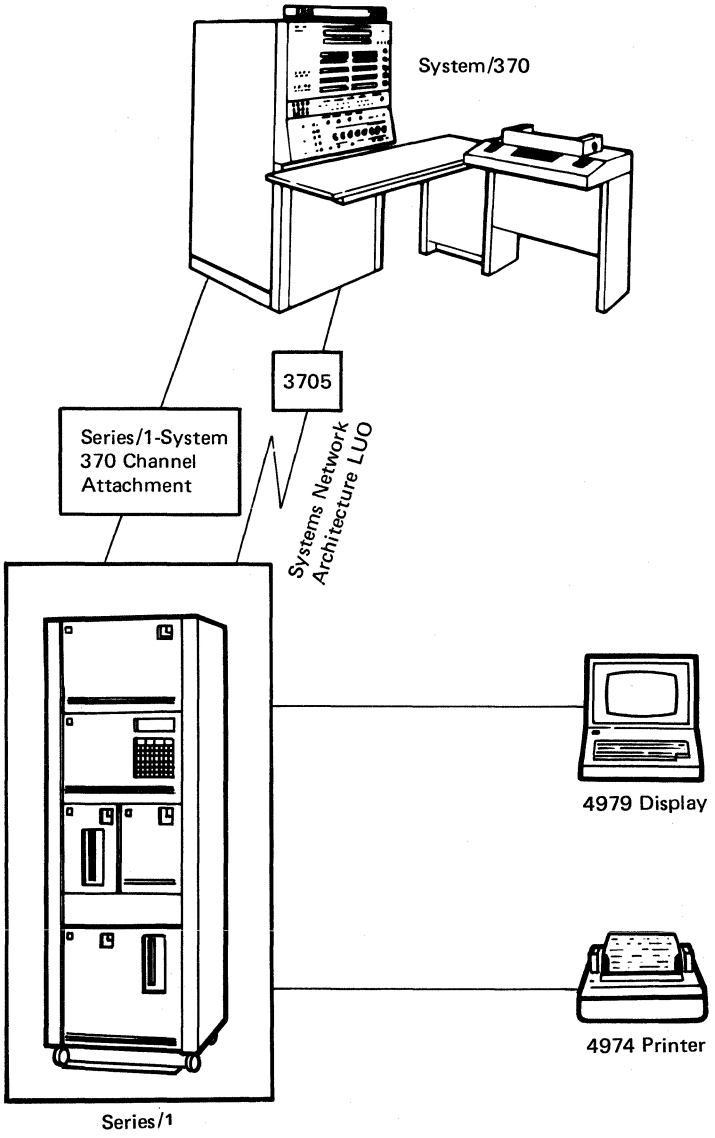
A 3705 Communications Controller is attached to the System/370. Other devices can be attached to the 3705 without affecting the communications link between the Series/1 and the System/370.



Configuration B

The following illustration (configuration C) shows a Series/1 connected to the System/370 through the Channel Attachment feature and the SNA LU0 interface. (Notice that the Programmable Communications Subsystem unit is not needed in either case.)

In this example, an IMS application running in the System/370 can communicate with the display and printer attached to the Series/1.



Configuration C

Systems Network Architecture Extended Support

The Systems Network Architecture (SNA) extended support is available with the Realtime Programming System Communications support. The SNA extended support provides a higher GET/PUT level of support than the base SNA support for the Series/1. The SNA extended support allows application programs to communicate with IMS/VS or CICS/VS application programs in a host system. The Series/1 appears to the host system as a Logical Unit Type P by IMS, or a 3790 Full Function Logical Unit by CICS, or a 3650 Logical Unit by CICS.

This support relieves the application programmer of having to work at the data flow control level and does the following:

- Establishes communications with the host subsystem
- Transmits data to and from the host subsystem
- Ends communications with the host subsystem

Remote Management Utility

The Realtime Programming System SNA remote management utility allows a remote Series/1 to operate as a distributed data processing system and permits a host system to manage a network of Series/1's. This utility program resides in a Series/1. As a network management tool, this program can do the following:

- Be accessed from a System/370 or another Series/1 and issue Realtime Programming System operator commands
- Transmit, receive, create, revise, or delete a data set on the Series/1
- Schedule programs on a Series/1 for processing
- Shut itself down

The Realtime Programming System SNA remote management utility uses SDLC to communicate with the host system. A virtual telecommunications access method (VTAM) application program provides the control in the host system.

Programmable Communications Subsystem Preparation Facility

The IBM Series/1 Programmable Communications Subsystem Preparation Facility is a macroinstruction library that supports the generation of controller storage image programs for the Series/1 Programmable Communications Subsystem. This macroinstruction library is used with either the Series/1 Base Program Preparation Facility or the Series/1 Program Preparation Subsystem.

This macroinstruction library provides the following macroinstructions for defining and tailoring the protocol for the subsystems:

- You use *communications macroinstructions* to code your communications programs for each communications line used by the 4987 Programmable Communications Subsystem.

- You use *communications definition macroinstructions* to define tables and parameters used by the communications programs.

Realtime Programming System Advanced Remote Job Entry

The Realtime Programming System Advanced Remote Job Entry program product allows a Series/1 with the Realtime Programming System operating system to send jobs to and receive printed or punched output from one of the following host operating systems:

- OS/VS2 MVS JES/2 (and SP versions)
- OS/VS2 MVS JES/3 (and SP versions)
- OS DOS/VSE (SNA only)
- VM/370 RSCS (BSC only)

This program product also supports the following:

- Binary synchronous communications MRJE mode
- Systems network architecture LU SRJE mode
- Operation without operator intervention
- Forms support
- A system console
- Journaling of messages at the system console
- Chaining of data sets sent to the host
- Automatic allocation of punch files

4987 Programmable Communications Subsystem

The IBM 4987 Programmable Communications Subsystem is a communications hardware unit that you can program for use with the Series/1 in a wide range of applications. This subsystem provides the following:

- Support for asynchronous and binary synchronous communications
- The ability to attach up to 32 communications lines per subsystem
- Transmission rates of from 45 bps (for teletypewriters) to 9600 bps
- Support for point-to-point nonswitched lines, point-to-point switched lines, and multipoint lines
- The ability to perform programming functions (such as polling) without interrupting Series/1 processing

The programmable communications subsystem instruction set allows the subsystem to perform such functions as:

- Controlling line discipline
- Control character generation and execution
- Chaining of input/output operations
- Automatic calling and answering of calls
- Automatic polling on multipoint lines
- Timer functions

Other functions that are program selectable include:

- Asynchronous/synchronous line type
- Switched/nonswitched line
- Bit characters 5, 6, 7, or 8 or 1, 1.5, or 2
- Internal or external clocking
- Data transmission rates
- Even, odd, or no parity
- Longitudinal redundancy check
- Cyclic redundancy check

The 4987 can be directly attached to the Series/1.

Programmable Communications Subsystem Extended Execution Support

The IBM Series/1 Programmable Communications Subsystem Execution Support is controlled by the Series/1 Realtime Programming System and provides support for the IBM Series/1 Programmable Communications Subsystem. The support consists of a loader and macros that enhance the EXIO commands in the Realtime Programming System for operation with a 4987.

This support permits the controller storage image load module (created by the IBM Programmable Communications Subsystem Preparation Facility Support) to be loaded into the subsystem controller storage online. The loader can be started from the console or your program, and processed in a partition as a user task set. Many functions are provided by this feature, including:

- Verifying that the subsystem can be loaded (by processing internal diagnostics)
- Reading the controller storage image program from disk or diskette
- Performing line traces to locate a problem area

The 4987 can perform program-controlled internal diagnostics for tracing data or tracing operations of the 4987, and send the contents of the 4987 to the Series/1 for program debugging or problem determination. An optional 4990 Communications Console might be useful in problem determination of the 4987 during installation or normal operation.

System/370 Channel Attach Support

The System/370 Channel Attach Support program is an input/output interface that allows user programs on the Series/1 to communicate with application programs on the System/370. This attachment allows a Series/1 to appear as a 3272 Control Unit to the System/370.

Other systems with which the Series/1 can communicate include the:

- IBM System/370 (Models 135 through 168)
- IBM 303X
- IBM 4331 and 4342

The Series/1 can also use this support and communicate with other systems using one of the following operating systems:

- DOS/VS
- OS/VS1
- OS/VS2 (SVS or MVS)
- DOS/VSE with BTAM-ES

Two versions of the System/370 Channel Attach Support program are available. One version (5719-CA1) can be used with the Realtime Programming System. This version provides READ/WRITE macroinstructions that allow you to write your own communications programs.

The other version (5719-CX1) is available if you do not need to write your own communications programs. If you do not use many of the functions provided by the Communications Manager 1 program, then you should use the Realtime Programming System macros.

Multiple Terminal Manager

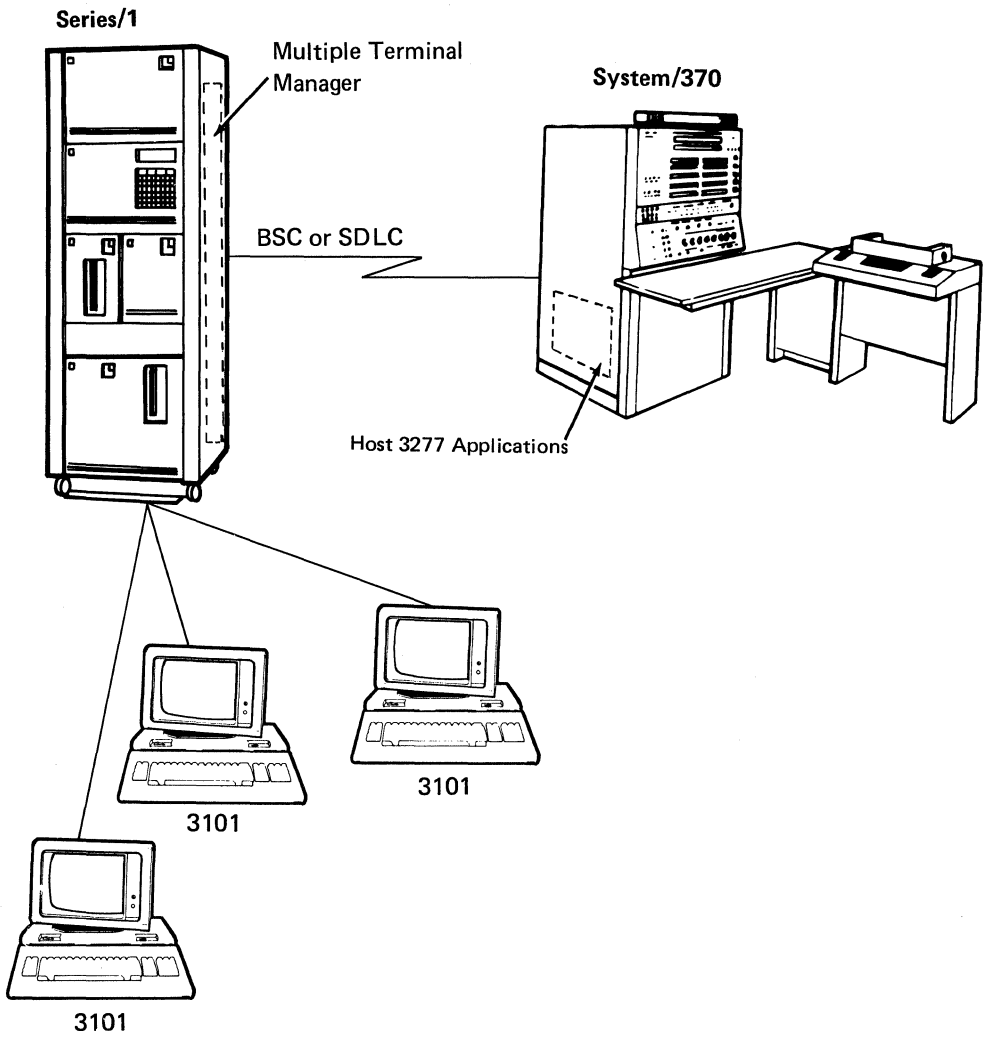
The IBM Series/1 Realtime Programming System Multiple Terminal Manager provides a set of high-level functions designed to simplify the design and implementation of transaction-oriented applications. Your application programs written in Series/1 Assembler and another language (COBOL, FORTRAN, Pascal, or PL/1) can execute in an interactive environment where one or more applications run concurrently.

The highlights of the program are:

- Screen design for transaction-oriented programs designed through a utility at program design time
- Matching of the proper application code and response screen handled by Multiple Terminal Manager at execution time
- Multiple terminal transaction processing and file access that is controlled by the Multiple Terminal Manager
- Options, including the ability of a 3101 Display Station (by emulating a 3270 display station) to communicate with a host system (using either BSC or SDLC/SNA protocols)

User-written transaction programs using predetermined screen formats can be used for order entry, inventory file update, and inquiry-type applications. Full screen support is provided for the 3101, 3270, 4978, and 4979 display terminals.

The following illustration shows a Series/1 using the multiple terminal manager to communicate with a System/370.



Packet Network Support

The Series/1 Realtime Programming System X.25 Multiple Data Link Control (MDLC) Communications Support Program enables the Series/1 to appear as packet mode data terminal equipment (DTE), or data circuit-terminating equipment (DCE).

When the Series/1 is used as DTE, it can be connected to an X.25 packet switching network. When the Series/1 is used as DCE, it will communicate with data terminal equipment whose protocol conforms to the X.25 interface standard.

This communications program does the following:

- Assembles and disassembles packets of data
- Connects and disconnects virtual circuits or logical channels
- Controls and manages the flow of data packets based on parameters you supply

The Series/1 Communications Manager provides a message path interface to the X.25 MDLC Communications Support Program.

This support provides entry into TELENET, DATAPAC, TRANSPAC, and other packet switched networks and requires installation of the data link control adapter on the Series/1.

Advanced Remote Job Entry

The IBM Series/1 Realtime Programming System Advanced Remote Job Entry program provides an improved RJE facility for users of the Realtime Programming System.

Highlights of this program are:

- Full function RJE console on Series/1
- Logging of console activity to a journal file
- Support for unattended operation
- Status reporting

The Series/1 appears as a remote job entry work station to a host System/370, 303X, or 4300. The RJE program in the Series/1 can operate concurrently with other applications. Host connection is made using either BSC or SNA/SDLC.

The BSC connection provides a standard point-to-point multileaving technique (MRJE) where the Series/1 can transmit and receive data concurrently. Host connection is supported by OS/VS2 (MVS), using either JES2 or JES3, and to VM/370 RSCS. The Series/1 is viewed by the host as a System/3 with console support.

The SNA/SDLC connection uses a logical unit type 1 protocol. The Series/1 appears to the host as multiple logical units, allowing an intermixing of input and output data streams on a communications line. Host connection is supported by OS/VS2 (MVS), using either JES2 or JES3, and DOS/VSE/POWER.

MULTI-LEAVING Remote Job Entry

The MULTI-LEAVING Remote Job Entry (MRJE) program allows a Series/1 to use the Realtime Programming System and communicate with host systems in a remote Houston automatic spooling program (HASP) work station environment. The Series/1 appears to the host system as a System/3 that is using BSC.

Other systems with which the Series/1 can communicate include:

- HASP II (Version 3.1 or 4.0)
- OS/VS2 JES2 or JES3
- VM/CMS RSCS

EVENT DRIVEN EXECUTIVE

The Series/1 Event Driven Executive (EDX) is an operating system that is easy to use in entry level application environments. The Event Driven Executive allows two or more application programs to communicate with each other while executing on a single Series/1. EDX also supports binary synchronous communications, asynchronous communications, and communications using synchronous data link control.

Other features include the following:

- Communications Facility II
- Series/1 Systems Network Architecture
- Systems Network Architecture remote job entry
- System/370 Channel Attach program
- Data collection interactive
- Yale ASCII Terminal Communications System
- Remote management utility
- Series/1 communications controller for System/38

Up to eight BSC lines are supported. Each line can be point-to-point switched, point-to-point nonswitched, or multipoint. On a multipoint line, the Series/1 can operate as either a control station or a tributary station. The Series/1 can communicate over a duplex or half duplex line, but it operates only in half duplex mode. The EBCDIC transmission code is used.

The following BSC adapters and controllers support Series/1 EDX:

- Multifunction attachment with transmission speeds up to 9600 bps
- BSC single-line control with transmission speeds up to 9600 bps
- BSC single-line control/high speed
- The synchronous communications single-line control/high speed
- BSC eight-line adapter with transmission speeds up to 9600 bps
- BSC four-line adapter

Communications Facility II

This facility also allows terminals to appear as a 3270 to a host system and allows users to inquire into multiple data bases on host systems such as the System/370, 303X, 4330, and the System/3.

Other functions provided by this facility include:

- Communications between two Series/1's over a point-to-point BSC line
- Management of remote Series/1's by a centrally located Series/1 through a host management utility program in the Series/1
- Management and routing of messages between programs and terminals on two or more Series/1's
- Device control for a variety of remote terminal devices such as:
  - The 3271 Control Unit (Model 2) with attached 3277 Display Stations (Model 2), and 3286 Printers (Model 2) on a multipoint line; the 3276 and 3279-2A Displays; and 3287-2 Printers
  - A 4978 or 3101 terminal that appears as a 3277 Display Station (Model 2)
  - 4973/4974 Printers that appear as 3286 Printers (Model 2)
- Communications with an IBM 6640 Ink-Jet Printer and associated Magnetic Card Reader over a point-to-point line using 2770-like BSC line discipline
- Communications with two or more host systems
- Online system configuration

Series/1 Systems Network Architecture

The Series/1 SNA support enables the EDX SNA application programs to communicate with a System/370 Data Base/Data Communications (DB/DC) subsystem (IMS/VS, CICS/VS) application program. In an Information Management System/Virtual Storage (IMS/VS) and a CICS/VS environment, this support allows the Series/1 to function as a 3790 cluster controller.

The EDX SNA support provides services to establish, control, and terminate sessions between Series/1 applications and System/370 subsystems or between Series/1 applications and host applications within an SNA environment. The EDX SNA support also provides services to transfer data and control information between the applications.

The network consists of the following:

- A Series/1 defined as a cluster controller with one or more logical units (the Series/1 contains the EDX, Version 3, SNA support, and user programs).
- A System/370 defined as a host containing a virtual operating system, VTAM or TCAM access method, and Data Base/Data Communications (DB/DC) subsystem (IMS/VS, CICS/VS) application programs.
- An IBM 3705 Communications Controller connecting the Series/1 with the System/370. The network control program (NCP) resides in and controls the communications controller.
- SDLC provides the communications line discipline between the Series/1 and the 3705.

Advanced Remote Job Entry

The Series/1 Event Driven Executive Advanced Remote Job Entry (ARJE) program supports both BSC and SNA/SDLC host systems, and allows the Series/1 to use the protocol required by the host system. The line protocol is selected when the Series/1 program is installed. All ARJE commands you supply are independent of line protocol.

The BSC option provides MULTI-LEAVING RJE (MRJE) work station support over a point-to-point (switched or nonswitched) connection, appearing to the host as an IBM System/3 with console support.

The SDLC option provides an SNA RJE work station over a point-to-point (switched or nonswitched) or multipoint connection.

The Series/1 appears to the host as a PU type 2 with up to four LU type 1's.

The advanced RJE program provides the following support:

MRJE: MULTI-LEAVING Remote Job Entry (MRJE) support for binary synchronous communications.

SNA RJE: Multiple Logical Unit Systems Network Architecture (SNA) support for Synchronous Data Link Control (SDLC).

Unattended operation: ARJE allows unattended operation by having ARJE commands on disk/diskette, and support for dynamic punch file allocation and delayed activation.

Full function RJE: Console support with status reporting and journaling, data decompression, and printer form support, in addition to standard RJE support.

ARJE commands: Are designed for ease of use and are identical for MRJE or SNA RJE operation.

Host Remote Job Entry Subsystems: ARJE supports the following:

BSC	SDLC
OS/VS2 JES2	OS/VS2 JES2
OS/VS2 JES3	OS/VS2 JES3
VM/370 RSCS	DOS/VSE VSE/POWER

System/370 Channel Attach Program

The Series/1 Event Driven Executive System/370 Channel Attach program allows the Series/1 to communicate with an IBM System/370 (Models 135-168), the 30XX, or the IBM 43XX Processor over a selector or block multiplexer channel (except 2870). This program runs under the control of the Event Driven Executive (EDX) (Version 3.1).

The Channel Attach program can transfer data between application programs in the Series/1 and application programs on a System/370. The System/370 must be using DOS/VS, OS/VS1, or OS/VS2 (SVS or MVS) and BTAM, or DOS/VSE and BTAM ES. The Series/1 appears to the System/370 as a local 3272 Control Unit with up to 32 devices attached.

5230 Entry Station Direct Attach Support

The IBM 5230 Entry Station Direct Attach Support is a program that interfaces with the Event Driven Executive to allow the direct attachment of up to thirty-one 5234 Time Entry Stations or a combination of 5235 and 5236 Data Entry Stations.

This support allows a Series/1 to communicate with some 5230 units that do the following:

- Read badges (punched hole or magnetic stripe badges)
- Read punched cards
- Record values such as counts, weights, and temperatures registered by an external device through a 5230 unit
- Accept keyed input

Yale ASCII Terminal Communications System

The IBM Series/1 Yale ASCII Terminal Communications System permits ASCII display terminals attached to a Series/1 to communicate with the System/370 TSO, Virtual Machine/Conversational Monitor System (VM/CMS), and other IBM interactive systems as emulated 3270 terminals. This program also provides the following:

- A duplex ASCII terminal interface for use by ASCII terminals
- Emulation of 3270 terminals by ASCII terminals for communications with IBM host systems (the ASCII terminals appear to the host system as 3277 terminals attached to a 3272 controller)
- Data transmission speeds up to 19 200 bps
- Emulation of the 4978 Display Station to allow ASCII terminals to use EDX programs

A total of fifty-six 3101 Display Terminals and/or non-IBM ASCII display terminals can be supported.

Remote Manager

The Series/1 Event Driven Executive Remote Manager allows Series/1 networks to be managed and operated through the communications network management programs available on IBM host processors (System/370, 30XX, and 43XX). Effective network management is made possible with the Network Communications Control Facility licensed program and related communications network management programs.

The Remote Manager communicates with host programs and provides these major functions:

- *Alert Processing*:

  The routing of Series/1 hardware and software error indications to the Network Problem Determination Application (NPDA) at the host.

  These error indications alert network operators of real or potential problems with Series/1 network operation.

- *Host Operator Facility*:

  A host System/370 terminal operator can act as a local Series/1 operator. The host operator can issue commands, invoke system utilities, and run application programs. This operator can also communicate with any Event Driven Executive program which communicates with a local Series/1 terminal (4979).

  The host 3270 terminal operator, using the Host Command Facility licensed program and the Remote Manager, is able to:
  - Display system status, examine error logs, run utilities, start and stop applications as a part of problem determination.
  - Act as the console operator on an unattended Series/1.

- *Relay and Node Data Services*: These services allow user and system data and programs to flow between a host system and a Series/1 in either direction. Thus, new or changed data or programs may be sent to a Series/1 in a controlled way. Data which originates at the host, or is destined to be processed at the host, may also be transmitted.

Remote Job Entry for Control Program Support

The Series/1 Remote Job Entry for Control Program Support field-developed program (FDP) allows the Series/1 to communicate with host systems using a subset of the IBM 3780 BSC line protocol. The Series/1 appears as a 3780 on a switched or nonswitched point-to-point line. This program also allows the Series/1 to communicate with host systems that use DOS/VS POWER, HASP IV, and JES2.

Series/1 Communications Controller for System/38

The Communications Controller for System/38 provides a Series/1 resident program that allows a System/38 to communicate to a variety of systems and devices through a Series/1. Highlights are:

- SDLC link from System/38 to Series/1
- BSC links from Series/1 to other devices and systems
- Support provided for System/38 to communicate with:
  - IBM System/3
  - IBM System/34
  - Another IBM System/38
  - IBM System/370 (3780 Emulation)
  - IBM 3741 Data Entry Station
  - IBM 3780 (System/34 Emulation)
  - IBM 5260/5280 (3741 Emulation)

The Series/1 program is used with a companion program the **IBM System/38 Series/1 Communication Utility** (a field-developed program). The Series/1 program can receive data from the System/38 and transmit it to the selected system or device. It can also receive data from the selected system or device and transmit it to the System/38. Initiation of communications is from the System/38. The Series/1 program can run concurrently with other Series/1 programs.

Control Program Support

A Series/1 that is operating under the Control Program Support can communicate with other systems and terminals, using the following:

- Remote job entry
- (Intelligent) programmable terminal subsystem
- Automatic call support
- Binary synchronous communications support

THE IBM SYSTEM/23 DATAMASTER

The IBM System/23 Datamaster can communicate with other systems using one of the following:

- Asynchronous communications line protocol
- Binary synchronous communications line protocol

Both batch communications (using BSC protocol) and interactive communications (using asynchronous protocol) are possible.

You can either use communications programs supplied by IBM or create your own using the BASIC language.

IBM supplies a Communications Access Method (CAM) and a set of Customer Support Functions. The CAM (which is a program on the communications diskette), sets aside main storage to be used for communications, and activates the communications feature. The communications programs use the communications access method (CAM) to access the communications line.

Included in the Customer Support Functions are setup programs that enable you to define your communications environment, programs that enable you to send and receive data, and programs to help you find and solve problems you might encounter while using communications on the System/23.

Binary Synchronous Communications

The IBM System/23 binary synchronous communications uses the line protocol of the IBM 3741 to communicate with the following systems:

- IBM System/3 Model 15D
- Another IBM System/23 Datamaster
- IBM System/34
- IBM System/36
- IBM System/38
- IBM 5280 Distributed Data System
- IBM 5265 Point-of-Sale Terminal
- IBM 5110/5120 Computing Systems
- IBM Series/1 (EDX, RPS)

The System/23 can also be attached to the System/370 Models 115-168, the 30xx, and the 43xx through CICS/VS using BTAM under VSE, VS1, or MVS. The 3741 BSC protocol is provided for communications using point-to-point switched or nonswitched lines using Integrated Communications Adapter (ICA) or the Communications Adapter (CA), or 3704/3705 EP.

Data can be transmitted:

- In blocked or unblocked records
- At transmission speeds up to 4800 bps
- Using IBM supplied EBCDIC or user-supplied translation tables with or without transparency

Using BSC, the System/23 can communicate using a point-to-point switched line, or a point-to-point nonswitched line. When using a switched line, the System/23 allows manual dialing and manual or automatic answering of calls (the modem must support automatic answer). The System/23 also automatically disconnects on switched lines.

Interactive Communications

The Binary Synchronous Communications Customer Support Functions provide the System/23 with an interactive interface to perform inquiry functions. The send and receive files functions are batch functions.

Asynchronous Communications

The System/23 asynchronous communications uses ASCII to communicate with the following systems:

- System/370 (Models 135-168), the 30xx and the 43xx using 3704/3705 EP (release 3.0) to VM/370 (in duplex, switched lines at transmission speeds up to 300 bps)
- Series/1 EDX, RPS (using half duplex, switched lines at transmission speeds up to 300 bps)
- System/23 (duplex and half duplex, switched and nonswitched lines at transmission speeds up to 1200 bps)

The System/23 becomes a teletype (TTY)-like system by using asynchronous (start-stop) communications on a point-to-point line.

Interactive Communications

The Asynchronous Customer Support Functions provide the System/23 with an interactive interface to perform asynchronous communications that are terminal (TTY)-like in ASCII mode.

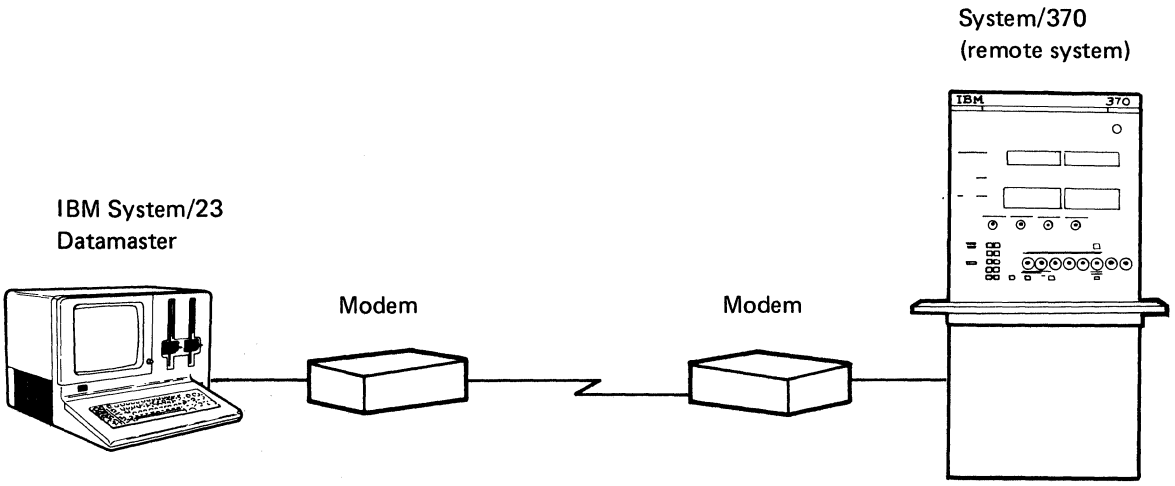
Programmable Interface

You can also write your own programs (using the BASIC language) for either asynchronous or binary synchronous communications.

With data communications, the System/23 can communicate with the following systems:

IBM Systems	BSC	Asynchronous
System/3 Model 15D	X	
System/23 Datamaster	X	X
System/34	X	
System/38	X	
IBM 5280	X	
IBM 5265	X	
IBM 5110/5120	X	
Series/1 (EDX, RPS)	X	X
VM/370		X
CICS/VS using BTAM	X	

The following example shows an IBM System/23 Datamaster communicating with an IBM System/370 host system.



THE IBM SYSTEM/34 AND IBM SYSTEM/36

With data communications, the System/34 or System/36 can be a host system, a peer-to-peer system, a remote batch entry terminal, and/or an RJE work station. The System/34 or System/36 and their program products provide the following data communications support:

- Batch BSC support in RPG II and the assembler language (the Interactive Communications feature can also be used to perform batch communications using RPG II, COBOL, BASIC, and assembler)
- MULTI-LEAVING (BSC) remote job entry (MSRJE) utility (System/34 only)
- SNA remote job entry (SRJE) utility (System/34 only)
- Multiple Session Remote Job Entry (MSRJE) (System/36 only)
- Remote work station (5250 terminals) support
- Interactive Communications feature (SSP-ICF)
- SNA 3270 Device Emulation program
- BSC 3270 Device Emulation program
- Distributed Disk File Facility (only target is supported on System/36)

Other communications support includes:

- From one to four communications lines
- A maximum line speed up to 56 000 bps
- An automatic calling feature
- The X.21 feature
- An interface for the Digital Data Service Adapter
- Remote service (System/36 only)
- The V.35 interface (System/36 only)

Batch Binary Synchronous Communications

System/34 or System/36 support batch BSC communications, using RPG II and assembler language programs. Interactive communications is supported by COBOL, BASIC, RPG II, and assembler programs through the SSP-Interactive Communications feature (SSP-ICF). The support performs all functions necessary to establish a line connection, exchange identification sequences, send and receive data, and perform correct termination procedures.

The batch BSC support permits System/34 or System/36 to function in any of the following modes:

- Receive only (receive data from a remote station).
- Transmit only (transmit data to a remote station).
- Transmit and receive (no conversational reply). The following modes of operation are possible:
  - Transmit a file, then receive a file.
  - Receive a file, then transmit a file.
  - Transmitting records of one file, while at the same time receiving records of another file.

Systems supported by System/34 or System/36 batch BSC include:

- Another System/34 or System/36 with either RPG II or assembler
- System/38
- System/32 with either RPG II or basic assembler
- System/3 with RPG II, CCP, or MLMP
- System/7 with MSP/7
- Operating System or Disk Operating System Basic Telecommunications Access Method (OS, OS/VS, DOS/VS, or DOS BTAM)
- System/360 Model 20 Input/Output Control System for the binary synchronous communications adapter (BSCA)
- Operating System Telecommunications Access Method (OS or OS/VS TCAM) (System/34 only)
- Operating System or Disk Operating System Virtual Telecommunications Access Method (DOS/VS or OS/VS VTAM)
- Customer Information Control System (CICS/DOS/VS or CICS/VS)
- Information Management System (IMS/VS)
- IBM 3741 Model 2 Data Station or Model 4 Programmable Work Station
- IBM 3747 Data Converter

- IBM 5231 Data Collection Controller Model 2 (as a 3741 in transmit mode only)
- IBM 3750 Switching System (World Trade only)
- IBM 5110 (in 3741 mode)
- IBM Series 1 (in System/3 mode)
- IBM 5260 Point of Sale Terminal (in 3740 mode)
- IBM 5280 Distributed Data System (in 3740 mode)
- IBM 5520 Administrative System

Binary synchronous communications between these devices and the System/34 is available with a request for price quotation (RPQ); communications between the following products and the System/36 requires a field-developed program (FDP):

- IBM 6640 Document Printer
- IBM Office System 6 Information Processor
- IBM Mag Card II Typewriter–Communicating
- IBM 6670 Information Distributor
- IBM 6240 Magnetic Card Typewriter–Communicating
- IBM Displaywriter System

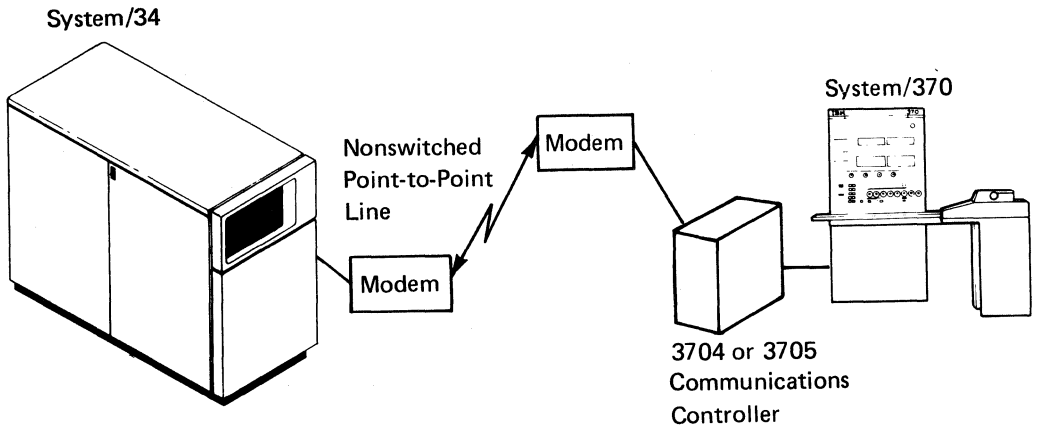
SYSTEM/34 MULTI-LEAVING (BSC) Remote Job Entry Utility

The MULTI-LEAVING (BSC) remote job entry (MRJE) utility allows a System/34 to submit jobs to a System/370 using BSC. Output from these jobs can be returned to the System/34, to another work station, or to the host system input/output devices. A System/34 with MRJE can communicate with many of the System/370 remote job entry subsystems (such as, ASP, HASP II, JES2, or JES3, under OS/VS2; RES under OS/VS1, or VM/370 RSCS). System/34 MRJE can run in automatic mode (without System/34 operator assistance), and can also accept input from up to three System/34 display stations (two as readers) and one as a combined RJE console and reader.

SYSTEM/34 SNA Remote Job Entry Utility

The SNA remote job entry (SRJE) utility allows a System/34 to submit jobs to a System/370 using SDLC and SNA. Output from these jobs can be returned to the System/34, to another work station, or to the host system I/O devices. System/34 SRJE can communicate with the RES, JES2, JES3, and POWER/VSE subsystems at the host System/370, 303X, 3081, and 43XX.

In the following configuration, one System/34 is attached to a host 370 using a nonswitched point-to-point line.



SYSTEM/36 MULTIPLE SESSION REMOTE JOB ENTRY

The System/36 Multiple Session Remote Job Entry (MSRJE) feature allows you to submit jobs from System/36 to a host system for processing and to obtain the output of those jobs from the host system. MSRJE allows you to use the processing power of a host system, and yet maintain your own local applications on System/36. With MSRJE, System/36 can communicate with either BSC or SNA/SDLC host systems.

System/36 as a Remote Job Entry Work Station

With the MSRJE feature, you can use System/36 as an RJE work station. Because System/36 does not support cards, the card reader input stream comes from disk or a display station keyboard. Before sending data to the host system, MSRJE ensures that it will be acceptable to the host system as reader input.

The System/36 stores entered data in a disk file (that file can then become reader input to MSRJE) or submits the data directly to MSRJE, which then sends the data to the host system.

When a punch data stream is received from the host system, MSRJE stores that data in a disk file. The disk file can then be used as input to another job (either a local System/36 job or an RJE job).

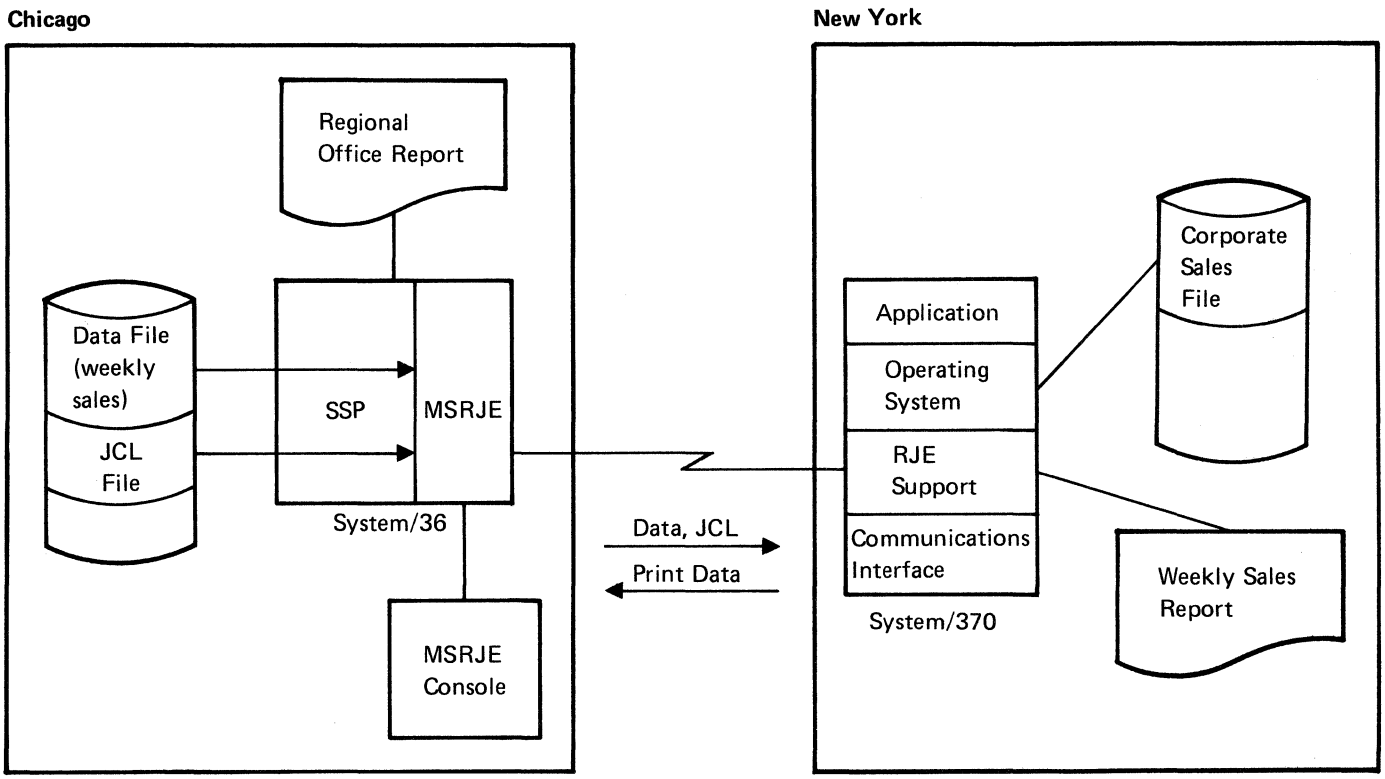
When data to be printed is received from the host system, MSRJE either prints it as it is received or writes it to a disk file for later printing by the MSRJE disk file utility.

In addition to transmitting data, MSRJE can also send Job Control Language (JCL) statements and commands to the host system. JCL and host system commands are not checked by MSRJE; they are simply sent. You must ensure the accuracy of JCL and host system commands before using them with MSRJE. JCL is the host system's version of the System/36 Operation Control Language (OCL) statements. Other statements, utility control statements, control the operation of MSRJE. These statements are processed by MSRJE and are not sent to the host system.

Example of How You Can Use MSRJE

In the following illustration of an MSRJE application, a System/36 located at a regional office in Chicago is communicating with a host system located at corporate headquarters in New York. The regional office sends weekly sales totals to the host system, which processes the data and returns printed data to the System/36 in Chicago. This data is then printed at the System/36. In addition to processing the reports for the Chicago office, the host system also updates the corporate sales files and generates weekly sales reports for corporate management, giving sales figures for the entire corporation.

The System/36 in this example has communications and the MSRJE feature. An application program has been written to allow operators to enter sales invoices directly into a System/36 data file. A file has also been created that contains the JCL statements and commands needed by the host system to process the data and the utility control statements used to control the operation of MSRJE.



From Monday through Friday, the operators in Chicago enter the sales invoices into the data file on System/36. On Friday afternoon, MSRJE is started to send the collected data to the host system for processing. Once the data link is established, MSRJE reads the file that contains the MSRJE utility control statements and the host system JCL. The JCL is sent to the host system and the appropriate application is started to process the sales data. The data file is then read by MSRJE and sent to the host system. Once the host application has processed the data, data to be printed is returned to the System/36 and printed. When all data has been sent, processed, and received, the System/36 operator ends MSRJE.

Utilities Provided with MSRJE

In addition to the communications support provided by MSRJE, utilities are provided with the MSRJE feature to aid you in using MSRJE:

- MSRJE disk file utility
- MSRJE control table utility

MSRJE Disk File Utility

You can use the MSRJE disk file utility (RJFILE) to convert disk files that contain 256-character records. Print data that was written to a disk file as 256-character unprocessed records can be printed. Punch data that was written to a disk file as 256-character unprocessed records can be converted to files you define, and those files can be used as input to your application programs or used as input to MSRJE.

MSRJE Control Table Utility

You can use the MSRJE control table utility (RJTABLE) to define how output received from the host system will be handled during an MSRJE session. The control table allows you to specify whether print data received is to be written to a disk file containing 256-character unprocessed records, sent directly to the printer, or spooled.

Host Subsystems Supported By MSRJE

BSC Host Subsystems Supported By MSRJE

Using MSRJE, System/36 can operate as an RJE work station when attached, through a data link on a single System/36 line, to the following BSC host subsystems:

- Job Entry Subsystem 2 (JES2) running under MVS
- Job Entry Subsystem 3 (JES3) running under MVS
- Remote Entry Service (RES) running under OS/VS1
- Remote Spooling Communications Subsystem (RSCS) running under VM/370

SNA/SDLC Host Subsystems Supported By MSRJE

Using MSRJE, System/36 can operate as an RJE work station when attached, through a data link, to the following SNA/SDLC host subsystems:

- Job Entry Subsystem 2 (JES2) running under MVS
- Job Entry Subsystem 3 (JES3) running under MVS
- Priority Output Writers, Execution Processors, and Input Readers/Virtual Storage Extended (POWER/VSE) running under DOS/VSE
- Remote Entry Service (RES) running under OS/VS1

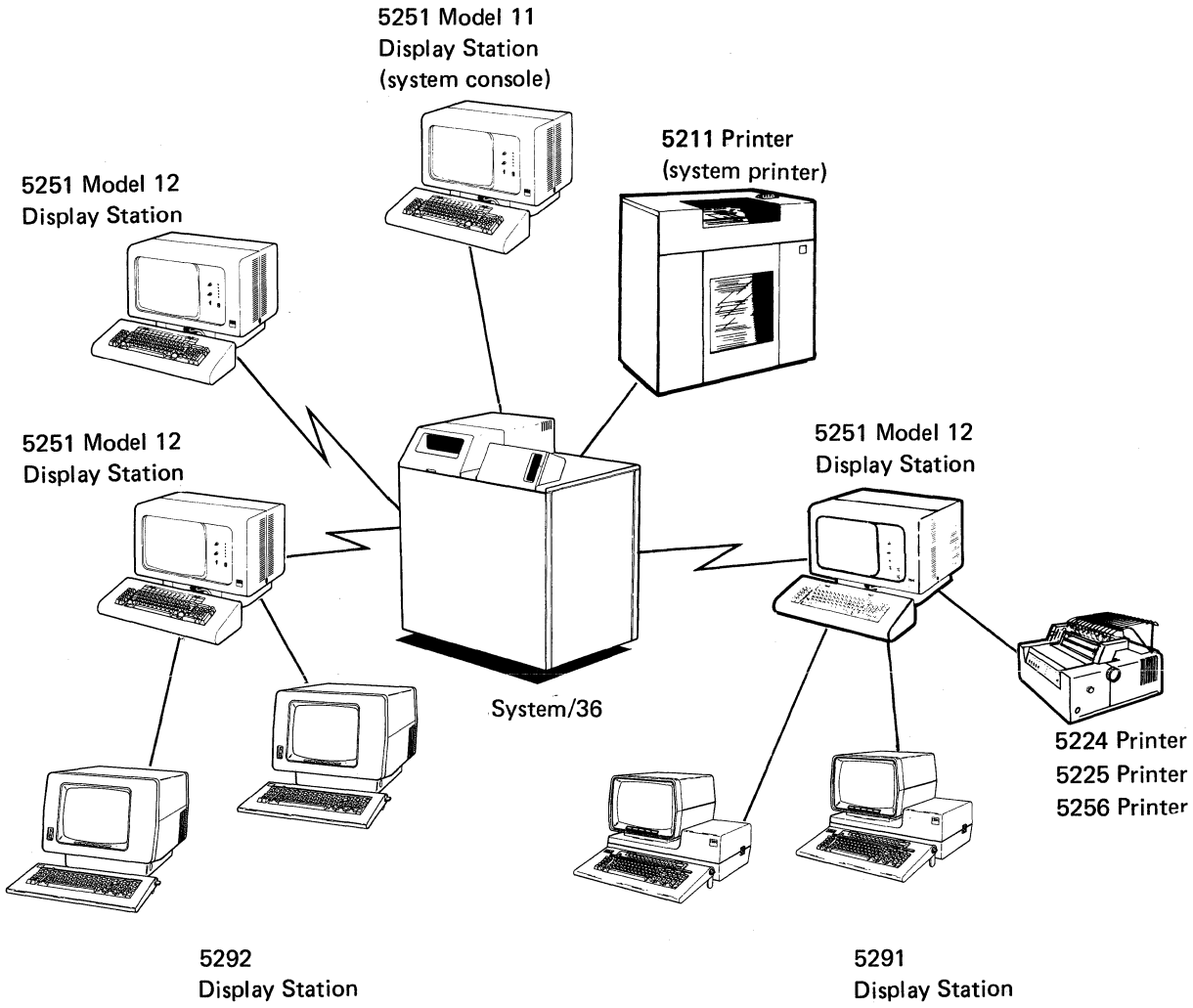
When MSRJE is used to communicate with an SNA/SDLC host system, MSRJE can share a System/36 communications line with the SSP-ICF SNA Upline Facility (SNUF) subsystem and with SNA 3270 device emulation. SSP-ICF and 3270 device emulation are separate features for System/36. (The SSP-ICF subsystems are described later in this chapter.)

System/36 allows BSC MSRJE and SNA MSRJE to be running simultaneously on two separate communications lines. Only one line can be used at a time for BSC MSRJE and one line can be used for SNA MSRJE.

System/34 and System/36 Remote Work Station Support

System/34 and System/36 support the attachment of remote 5250 work stations using synchronous data link control (SDLC) protocol. The functions performed at the remote display stations and printers are identical to those performed on locally attached work stations with no user application programming changes required. The System/34 and System/36 can also run remote work station support and some other communications support at the same time, thereby allowing the System/34 and System/36 to function as a subhost system.

The following example configuration shows a System/36 with eight remote work stations. Three of the remote display stations (Model 12) attach to the communications line; the other work stations attach to the Model 12 Display Stations.



System/34 and System/36 System Support Program Interactive Communications Feature

The System Support Program Interactive Communications feature (SSP-ICF) allows System/34 and System/36 programs to communicate with programs at remote locations using BSC or SDLC. The SSP-ICF also allows programs within the same System/34 or System/36 to communicate. The SSP-ICF also allows programs on other systems to start System/34 or System/36 procedures and allows System/34 or System/36 programs to start procedures or programs on other systems without operator action. The other systems include System/3, System/370, System/38, another System/34, or another System/36.

The communications programs can be written in the RPG II, COBOL, assembler, or BASIC language.

The System/34 and System/36 SSP-ICF provides the following subsystems:

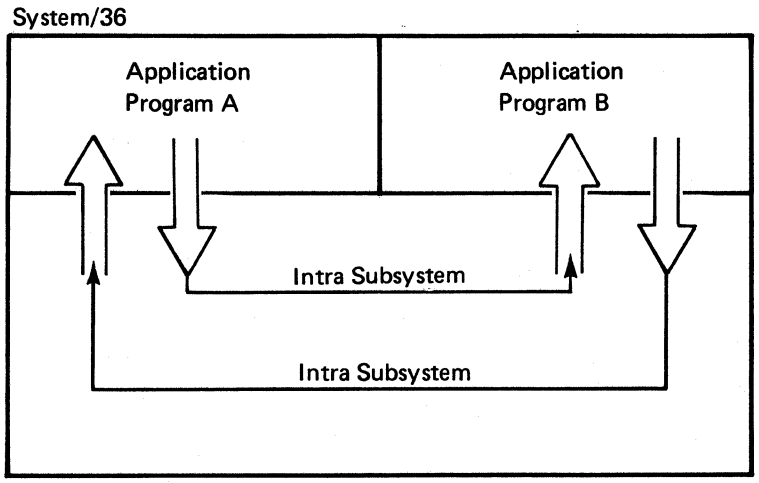
SSP-ICF Subsystem	Communicating System or Program(s) or Subsystem(s) Communicates with
Intra	Other programs in the same System/34
BSC Equivalence Link (BSCEL)	System/34, System/36, System/32, System/38, and those using batch BSC
BSC CCP	System/3 Model 15 CCP
BSC CICS	CICS/VS (BTAM) (using BSC)
BSC IMS	IMS/VS with IRSS (BTAM) (using BSC)
BSC 3270 Program Interface	IMS/VS, CICS/VS, TSO, and System/3 CCP (using BSC)
Finance Subsystem	3601 and 4701 Controllers (using SDLC), and the 3694 Document Processor
SNA Peer	System/34 or System/36 (using SDLC)
SNA Upline Facility (SNUF)	CICS/VS or IMS/VS (using SDLC)

The Intra Subsystem

The Intra subsystem allows two or more application programs on the same System/34 or System/36 to communicate with each other. Also, System/34 and System/36 application programs can start procedures on the same System/34 or System/36.

The Intra subsystem can be used for other applications, including applications that allow the same program to make inquiries into other programs on the System/34 or System/36 (using the Intra subsystem) and remote systems (using one of the other subsystems).

The following is an example of a System/36 using the Intra subsystem.



BSC Equivalence Link Subsystem

The binary synchronous communications equivalence link (BSCEL) subsystem allows communications between a System/34 or System/36 and the following systems:

- System/38 with BSC support
- Another System/34 or System/36 with batch BSC or the BSCEL SSP-ICF subsystem
- System/32 with batch BSC
- System/3 with batch BSC (RPG II or MLMP)
- System/7 with MSP/7 (as a System/3)
- System/370, 30XX, or 43XX with OS, OS/VS, DOS/VS, DOS BTAM, or OS/VS TCAM
- IBM 3741 Model 2 Data Station or Model 4 Programmable Work Station
- IBM 3747 Data Converter
- IBM 5231 Data Collection Controller Model 2 (as a 3741 in transmit mode)
- IBM 3750 Switching System (World Trade only)
- IBM 5110 (as a 3741)
- IBM Series/1 (as a System/3)
- IBM 5260 Retail System (as a 3741)
- IBM 5280 Distributed Data System (as a 3741)

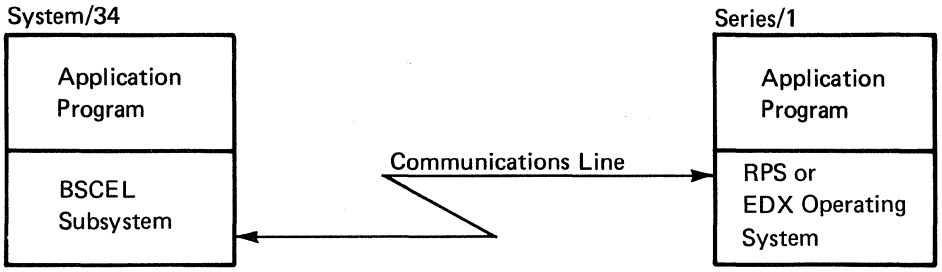
Systems supported only by the System/36 include:

- IBM Displaywriter System
- IBM 5520 Administrative System
- IBM Office System/6 (including the 4XX Information Processors)
- IBM 6640 Document Printer
- IBM 6670 Information Distributor

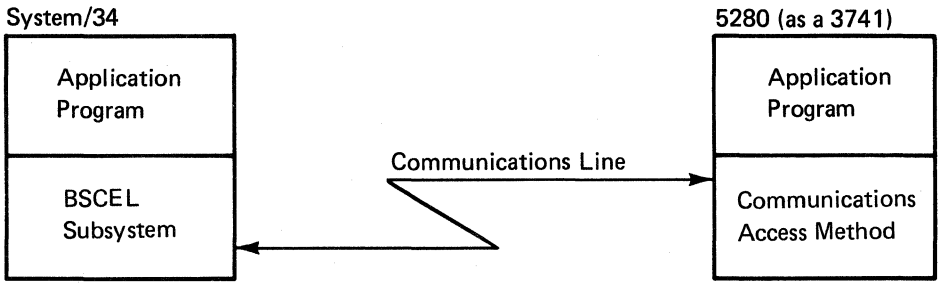
The BSCEL subsystem supports up to four lines. Each line must be one of three types:

- Point-to-point nonswitched
- Point-to-point switched (automatic call, automatic answer, manual call, or manual answer)
- Multipoint with the System/34 or System/36 as a tributary station

The following illustration shows a System/34 using the BSCEL subsystem to communicate with a Series/1.



The following illustration shows a System/34 using the BSCEL subsystem to communicate with a 5280.



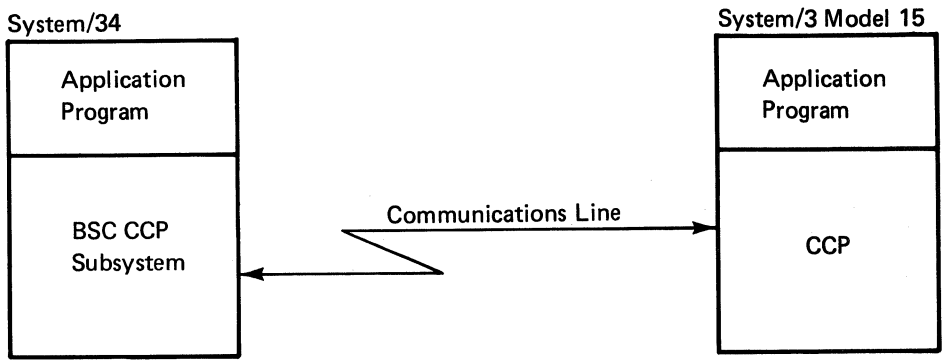
BSC CCP Subsystem

The binary synchronous communications communications control program (BSC CCP) subsystem provides communications support between System/34 or System/36 application programs and System/3 Model 15 CCP application programs. The subsystem can use:

- A point-to-point nonswitched line
- A point-to-point switched line (a System/34 or a System/36 must be the caller unless the BSC CCP application starts a procedure on a System/34 or a System/36)
- A multipoint line (with a System/34 or a System/36 as a tributary station)

The BSC CCP subsystem can send and receive transparent or nontransparent EBCDIC data, or nontransparent ASCII data.

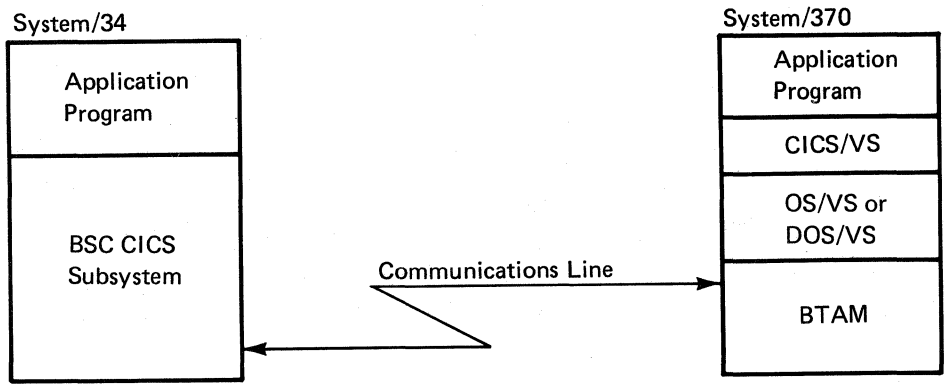
The following illustration shows a System/34 or a System/36 communicating with a System/3 using CCP.



BSC CICS Subsystem

The binary synchronous communications customer information control system (BSC CICS) subsystem provides communications support for a System/34 and a System/36 and a System/370 using CICS/VS (Customer Information Control System/Virtual Storage). This subsystem provides communications between System/34 and System/36 application programs and programs on a CICS/VS OS/VS (Operating System/Virtual Storage) or DOS/VS (Disk Operating System/Virtual Storage) system with BTAM (basic telecommunications access method). Using the BSC CICS subsystem, one or more System/34s or System/36s can communicate with CICS/VS on a System/370. On a multipoint line, each System/34 or System/36 session appears to the System/370 as a System/370. Each System/34 or System/36 on a multipoint line should be defined as one or more System/3 terminals. Up to 16 System/3 terminals can be defined in the CICS/VS network.

The following illustration shows a System/34 or System/36 communicating with a System/370 using BTAM, OS/VS or DOS/VS, AND CICS/VS.



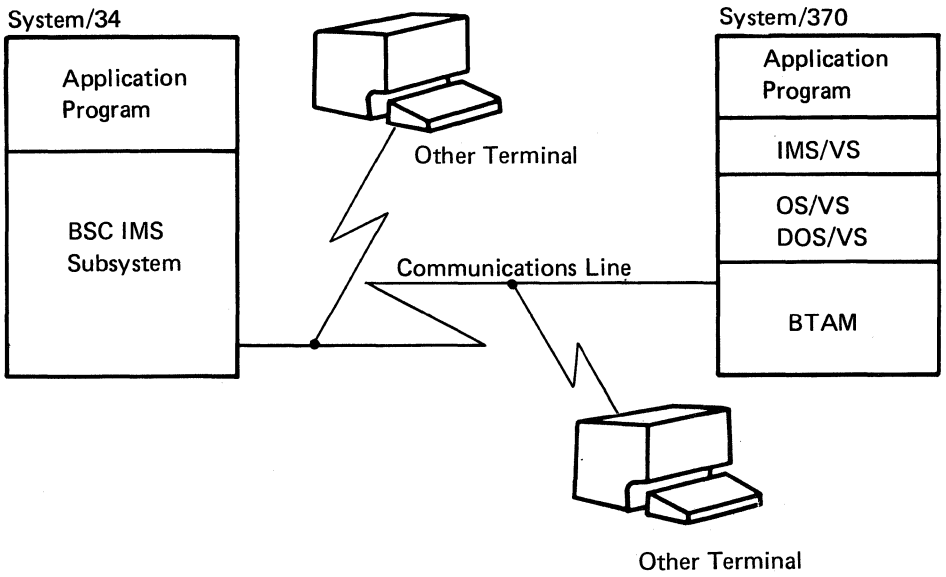
Other communications functions of the BSC CICS subsystem include:

- The ability to communicate with CICS/VS over a point-to-point line (on a point-to-point line, the System/34 or the System/36 function like a single System/3 terminal)
- The ability to transmit data in transparent EBCDIC or nontransparent EBCDIC or ASCII mode
- The use of switched or nonswitched lines for point-to-point communications
- The use of switched or nonswitched point-to-point, or multipoint lines for batch communications

BSC IMS Subsystem

The binary synchronous communications information management system (BSC IMS) subsystem allows a System/34 or System/36 to communicate with a System/370 using IMS/VS (Information Management System/Virtual Storage) with IRSS (Intelligent Remote Station Support). This subsystem communicates with IMS/VS over a multipoint line only. Up to 16 sessions are allowed between the System/34 or System/36 and IMS/VS at one time over a single multipoint line.

The following illustration shows a System/34 using the BSC IMS subsystem to communicate with a System/370.



BSC 3270 Support Subsystem

The BSC 3270 subsystem allows a System/34 or a System/36 to appear as a remote 3277 display station. Using this subsystem, the System/34 or the System/36 can communicate with the following host operating systems:

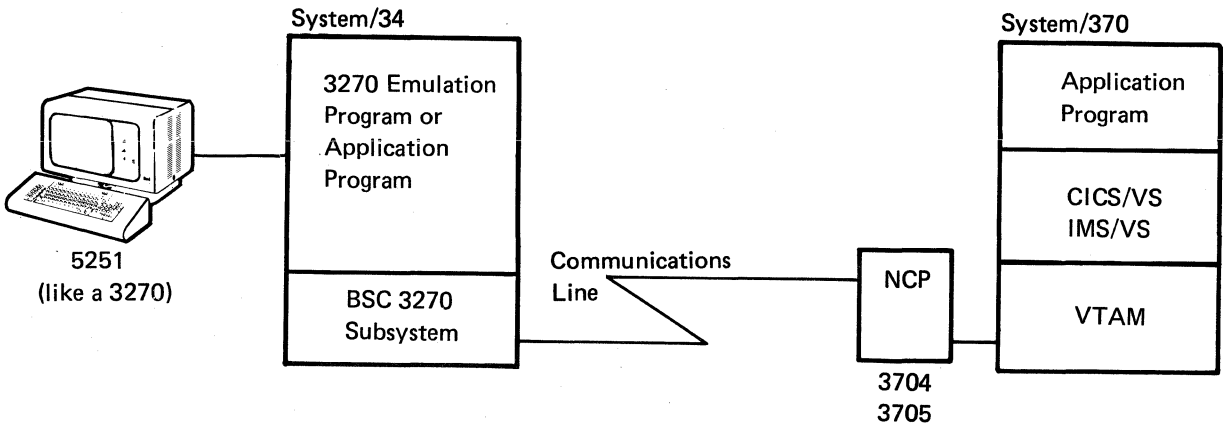
- CICS/VS
- IMS/VS
- Model 15 CCP

Also, when you use the BSC 3270 subsystem and the 3270 Device Emulation program interface, a System/34 or a System/36 appears as a 3271 Model 1 Cluster Control Unit with attached devices. In this environment, a System/34 or a System/36 can communicate with both the time sharing option (TSO) and the preceding operating systems.

This subsystem allows certain communications sessions to occur at the same time. These sessions include communications between host systems and the following:

- Remote 3270 terminals
- System/34 or System/36 using RPG II, COBOL, BASIC, and assembler language programs
- System/34 or System/36 display stations and printers operating as terminals (this function requires use of 3270 Device Emulation)

The following illustration shows the System/34 using the BSC 3270 subsystem to communicate with a System/370.



Because a System/34 or a System/36 appears as a remote 3277 Display Station, data sent by the host system that would have been displayed on a 3277 display screen is used instead to satisfy a System/34 or a System/36 application program input operation. Conversely, data from a System/34 or a System/36 application program output operation appears to the remote system as if entered from a 3277 Display Station.

The subsystem isolates a System/34 or a System/36 application program from 3270 device control information, or allows a System/34 or a System/36 application to send and receive data streams complete with all 3270 device control information. The 3270 subsystem supports up to 32 program or device sessions on one multipoint line at one time. On the System/34, up to 16 local display sessions are supported. Additional remote sessions can be added to the System/34 when PRPQ 5799-BEZ is installed.

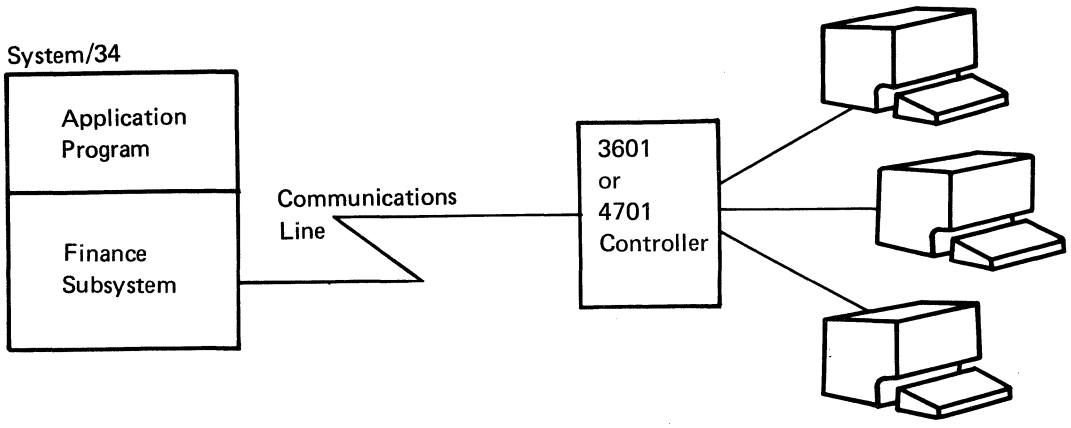
Finance Subsystem

The Finance subsystem allows System/34 or System/36 application programs to communicate with the 3601/4701 Finance Controller, its attached devices, and the 3694 Document Processor. Programs on the System/34 or System/36 communicate with programs on the 3601/4701 or 3694, and the IBM 3600 Online Terminal Support (with program number 5798-RAA) for System/34 or System/36 field-developed programs (FDP).

The Finance subsystem allows communications on switched or nonswitched lines. Remote 5251 Display Stations, other System/34s or System/36s using the SNA Peer subsystem, and 3601/4701 Finance Controllers or 3694 Document Processors can be connected on the same nonswitched communications line.

Up to sixteen devices (3601s, 3694s, and so on) can be attached to a multipoint line and up to 30 logical work station jobs are allowed with each controller at one time.

The following illustration shows a System/34 using the Finance subsystem to communicate with a 3601 or 4701 controller.



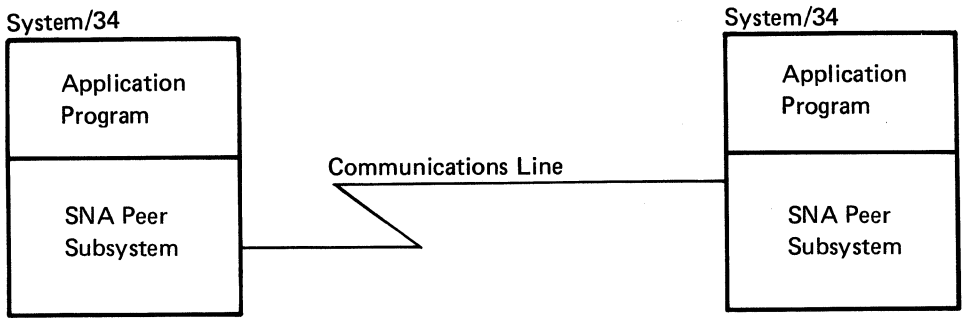
SNA Peer Subsystem

The SNA Peer subsystem allows communications between users of one System/34 or System/36 and other System/34s or System/36s. Both batch and interactive communications can occur between these application programs.

The SNA Peer subsystem can communicate with another System/34 or a System/36 on a point-to-point switched or nonswitched line, or a multipoint line. Because the communications occur as peer communications, neither location is considered to be the host system.

The SNA Peer subsystem allows up to 64 communications sessions at a time between a primary SDLC and a secondary SDLC system. Up to 32 remote locations can be defined for each multipoint or switched line.

The following illustration shows two System/34s communicating using the SNA Peer subsystem.

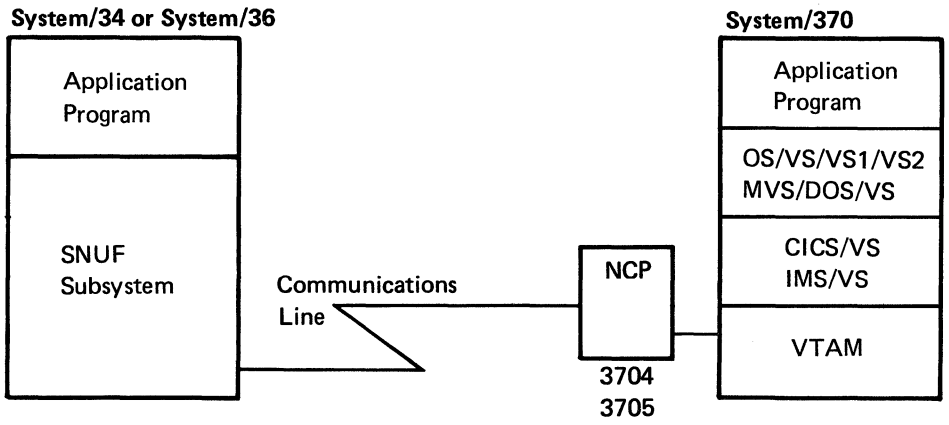


SNA Upline Facility Subsystem

The SNA Upline Facility (SNUF) subsystem permits a System/34 or a System/36 to communicate with a System/370 using CICS/VS or IMS/VS. This subsystem provides both interactive or batch communications between System/34 or System/36 application programs and application programs on a CICS/VS system or an IMS/VS system.

The SNUF subsystem supports up to 32 communications sessions at one time.

The following illustration shows a System/34 or a System/36 application program communicating with a System/370 using VTAM, CICS/VS, or IMS/VS.



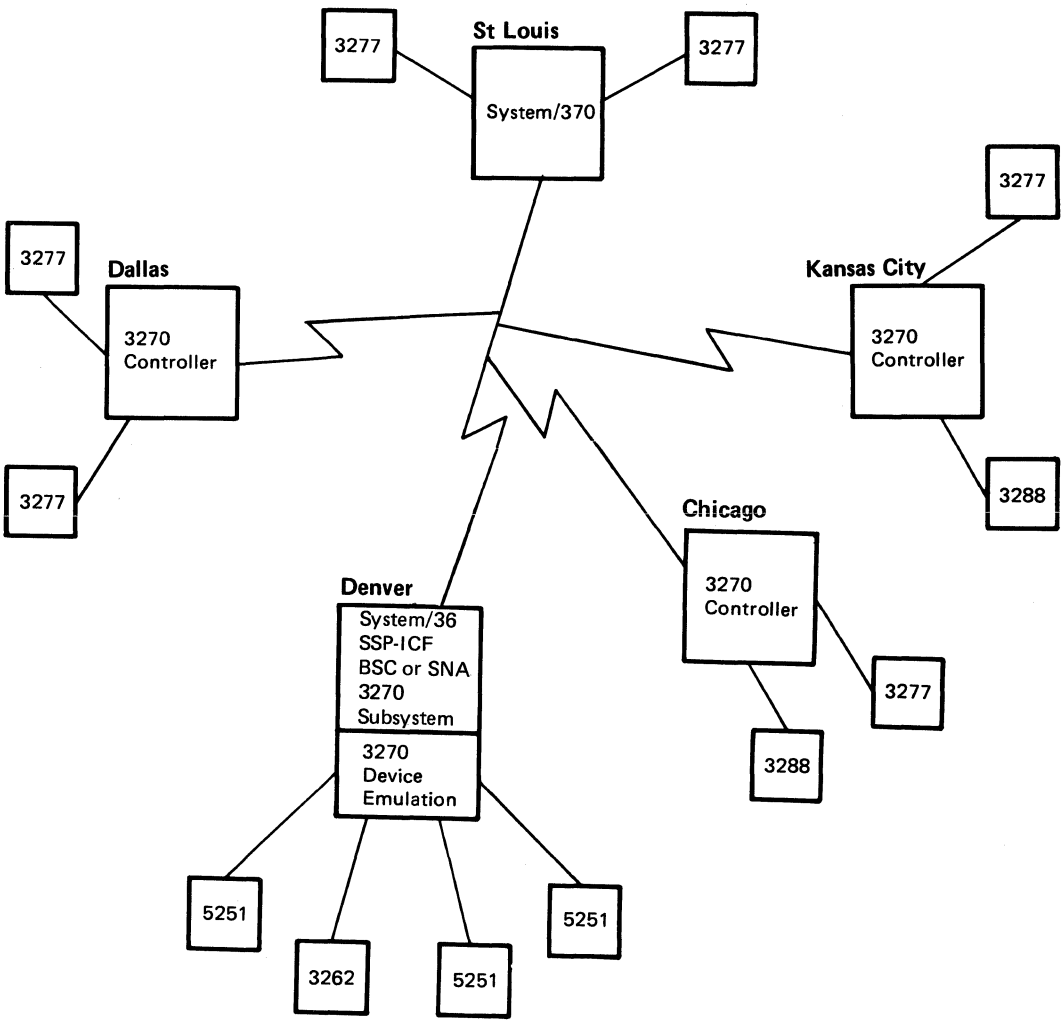
System/34 and System/36 3270 Device Emulation

The 3270 Device Emulation program allows the System/34 and System/36 and locally attached devices and remote 5251 Model 12 Display Stations (via an RPQ on the System/34 only) to execute the same application programs as a 3270 Control Unit with attached devices. Both BSC and SNA/SDLC attachments are available.

The 3270 Device Emulation program provides the status information required by the host system and the 3270 error recovery features of the 3270.

All models of System/34 and System/36 can execute this program product if they have at least one communications adapter and the Work Station Control Expansion feature (A for System/36, A or B for System/34[1]).

The following illustrates a host system located in St. Louis, and remote locations in Dallas, Chicago, Kansas City, and Denver that communicate with the host system. The systems at all the locations can use 3270 devices to access the same (common) programs on the host system. Besides the common programs, the system at the Denver location uses certain programs and data not used by other locations. Denver can store and execute the programs on a System/36, and can use 3270 Device Emulation to access the common programs and data at the host system in St. Louis.



[1]The Work Station Control Expansion feature is only required when the System/34 emulates display stations. The feature is not required when emulating printers.

BSC 3270 Device Emulation

When the System/34 or System/36 is attached to a BSC 3270 network, it appears as a 3271 Model 2 Cluster Control Unit with attached devices. The System/34 and System/36 devices appear as 3270 devices as follows:

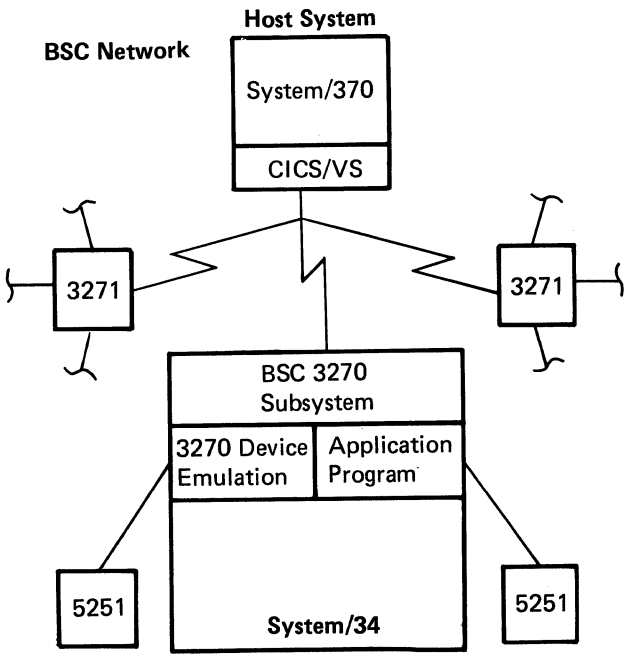
System/34 or System/36 Device	3270 Device
5291 Display Station 5292 Display Station 5251 Model 11 Display Station	3277 Model 2 Display Station
5211 Printer (all models) 5256 Printer (all models) 3262 Printer (all models) 5225 Printer (all models except 11 and 12) 5219 Printer	3284, 3286, or 3288 Model 2 Printers

The System/34 with 3270 Device Emulation can exist on the same multipoint network as the 3271 Model 2 Control Unit. The host system can be a System/370 with IMS/VS, CICS/VS, TSO, and a System/3 Model 15 CCP.

The System/34 can use the same communications line and run both the 3270 Device Emulation program and the BSC 3270 subsystem at the same time.

Up to 32 sessions (device emulation and program-to-program sessions) can be active at the same time on one communications line.

The following illustrates a BSC 3270 line-sharing configuration.



The SNA 3270 Device Emulation program product allows a System/34 or a System/36 to appear as a 3274 Model 1C Control Unit with attached devices. System/34 and System/36 devices appear as 3270 devices as follows:

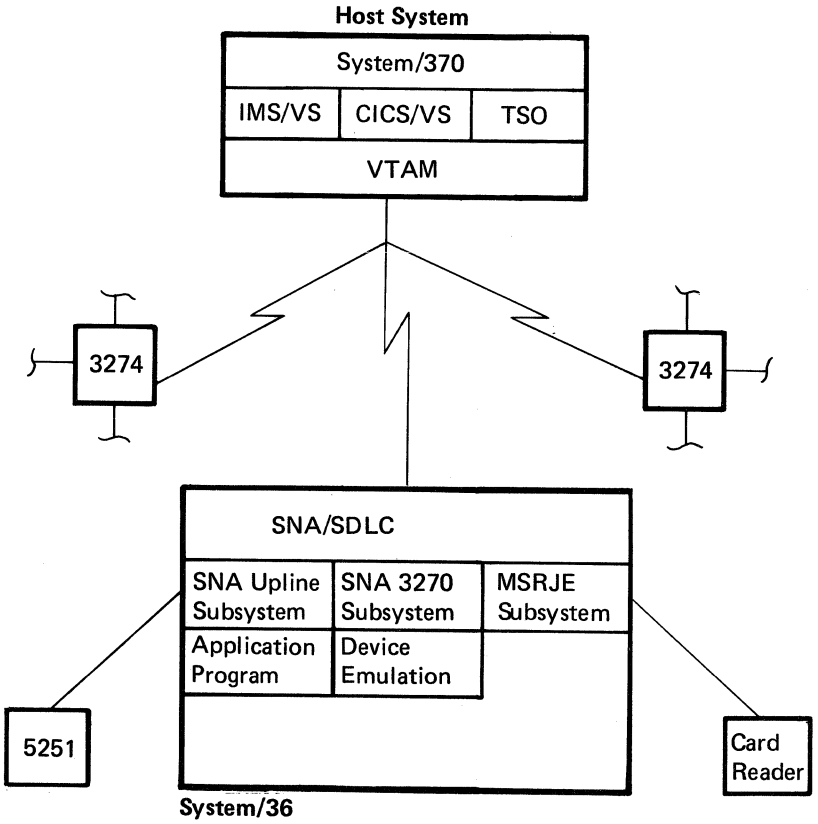
System/34 or System/36 Device	3270 Device
5291 Display Station 5292 Display Station 5251 Model 11 Display Station	3277 Model 2 Display Station
5211 Printer (all models) 5256 Printer (all models) 3262 Printer (all models) 5225 Printer (all models except 11 and 12) 5219 Printer	3284, 3286, 3287, or 3288 Model 2 Printers

System/34 or System/36 with 3270 Device Emulation can run on switched or nonswitched lines. The host system can be using IMS/VS, CICS/VS, or TSO.

SNA 3270 Device Emulation supports the emulation of sixteen 3270 devices by locally attached work stations and up to four lines at one time. On a System/34, remotely attached work stations can use SNA device emulation when PRPQ 5799-BGH is installed.

In the following illustration, the communications lines use SDLC. The MSRJE subsystem and application programs using the SNA Upline Facility subsystem can share the communications line with SNA 3270 Device Emulation.

SNA/SDLC Network

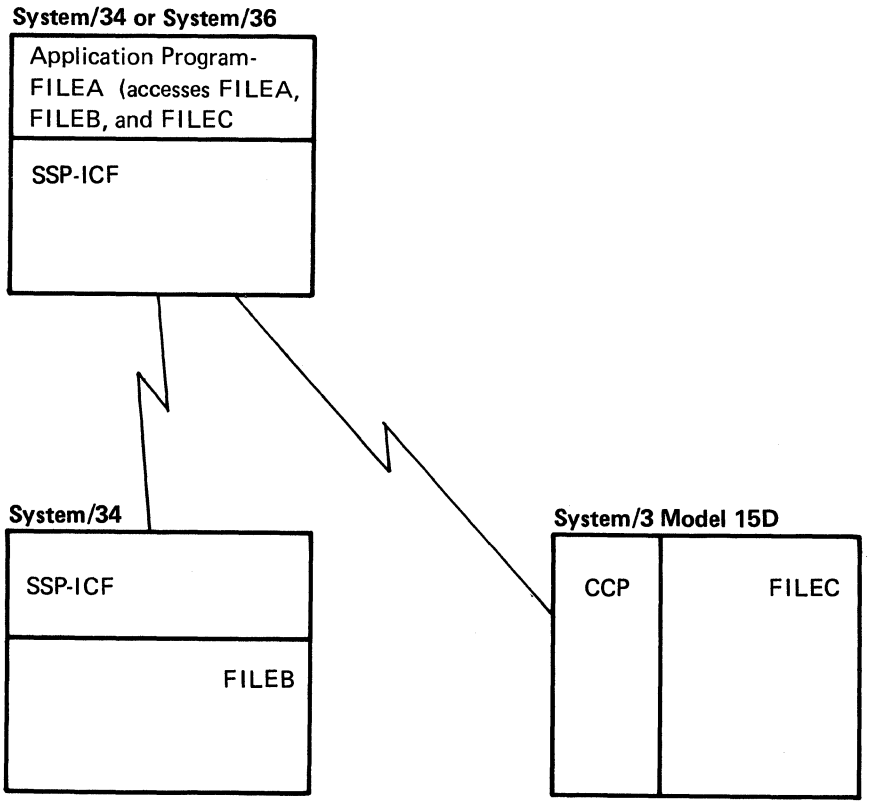


System/34 and System/36 Distributed Disk File Facility

The Distributed Disk File Facility (DDFF) permits a System/34 application program to access files stored on a System/3, a System/36, or another System/34. This facility makes it easier to distribute data between two or more systems because it allows a system to access remote data files. (On the System/34, the Distributed Disk File Facility is a program request for price quotation, a PRPQ; on the System/36, DDFF is a program product.)

When a remote file is located on a System/34, the communications between the local System/34 or a System/36 and the remote System/34 or a System/36 is with SDLC, and the SSP-ICF SNA Peer subsystem is used. When a remote file is located on a System/3, the communications between the local System/34 and the remote System/3 is with BSC, and the SSP-ICF BSC CCP subsystem is used.

The following illustration shows a System/34 running an application program that needs to access FILEA, FILEB, and FILEC. FILEA is located on the System/34 running the application program; FILEA is accessed without using communications. FILEB is stored on a remote System/34 or a System/36, and FILEC is stored on a remote System/3 Model 15D. However, the System/34 accesses the files as if they were stored in its processor. Changes to the application program are not required.



With data communications, the System/38 can function on a program-to-program basis with other systems, be a host system, a terminal with a host system or an RJE work station. The System/38 communicates with other systems or another System/38 in the following ways:

- As a host to remote work station using SNA/SDLC
- As a terminal to a remote SNA host
- Using advanced program-to-program communications
- As a host to remote BSC devices
- As a terminal to a BSC host
- On a system-to-system basis using BSC application programs
- As a remote job entry facility using BSC and SNA/SDLC
- As a 3270 device using BSC
- As a terminal that alerts a host system of certain hardware and software conditions

Other communications support includes:

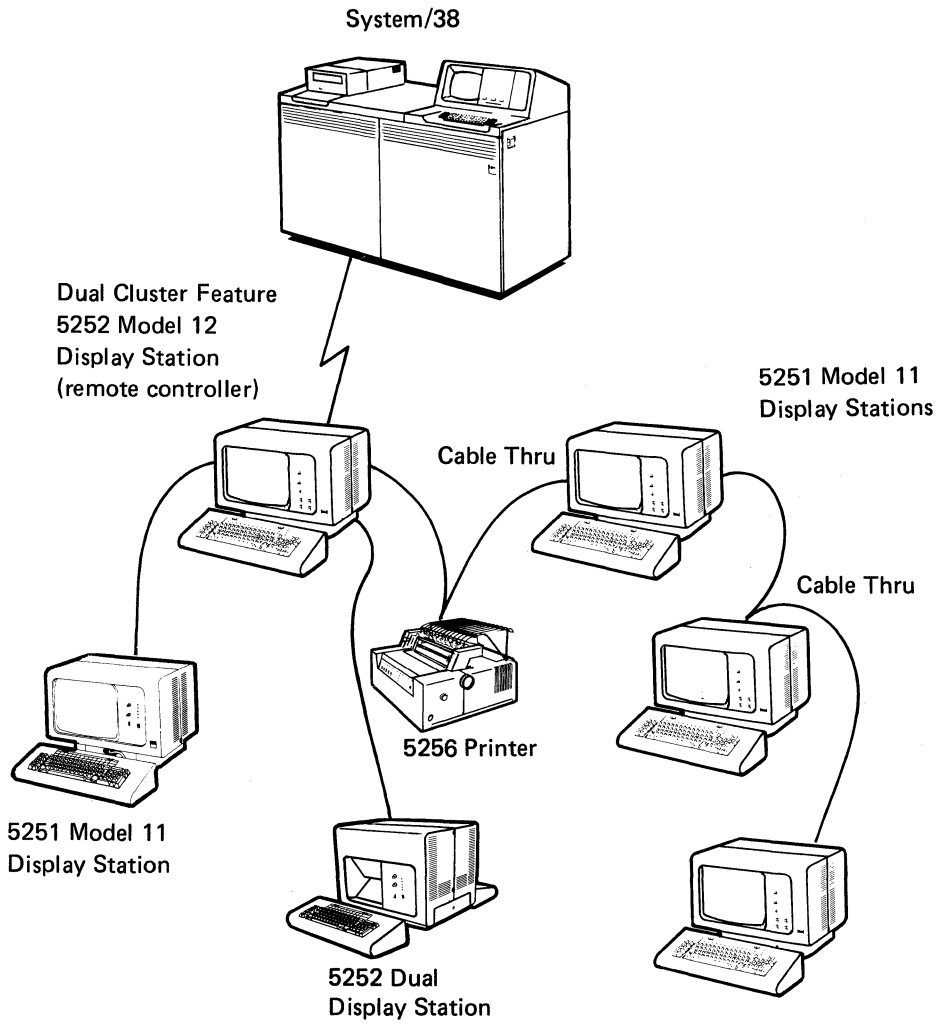
- Up to eight communications lines
- A maximum line speed up to 56 000 bytes per second

Host to Remote Work Stations Using SNA/SDLC

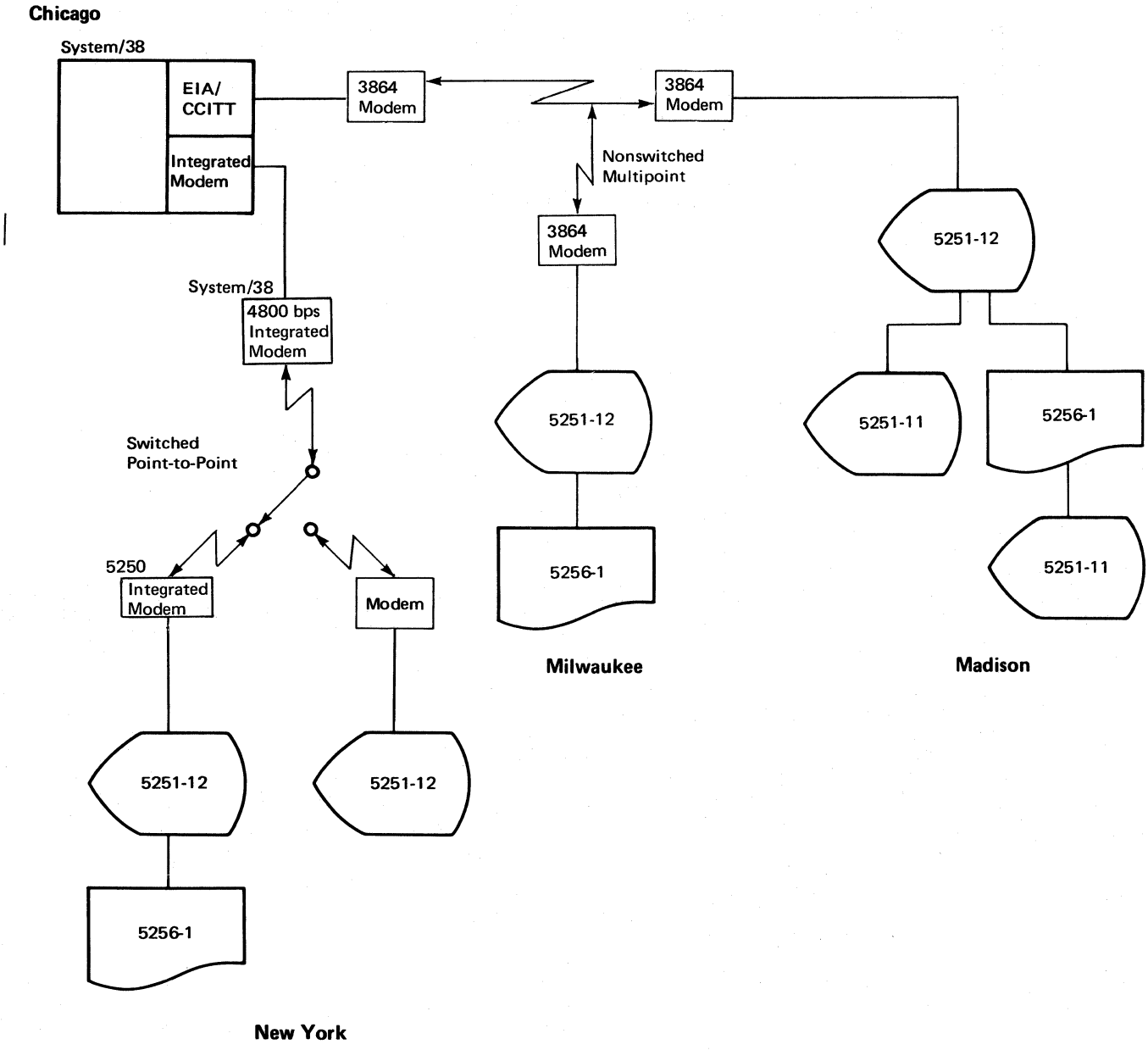
As an SNA host system, the System/38 can communicate with remote 5250 Information Display System terminals and devices that use SDLC line protocol. The 5250 devices that can communicate with the System/38 as remote work stations are the 5291 Color Display Station; the 5292 Display Station; the 5251 (Models 11 and 12) Display Stations; the 5252 Dual Display Station; and the 5219, 5224, 5225, and the 5256 Printers.

The IBM Person Computer can be attached to a System/38 as a 5250 Display Station when the 5250 emulation program is installed on the Personal Computer.

The following illustration shows a typical 5250-to-System/38 communications configuration.



The following shows a typical System/38 configuration with remote work stations. In this illustration, the System/38 is installed at a company's main office and plant in Chicago. The company also has sales offices in New York, Milwaukee, and Madison.



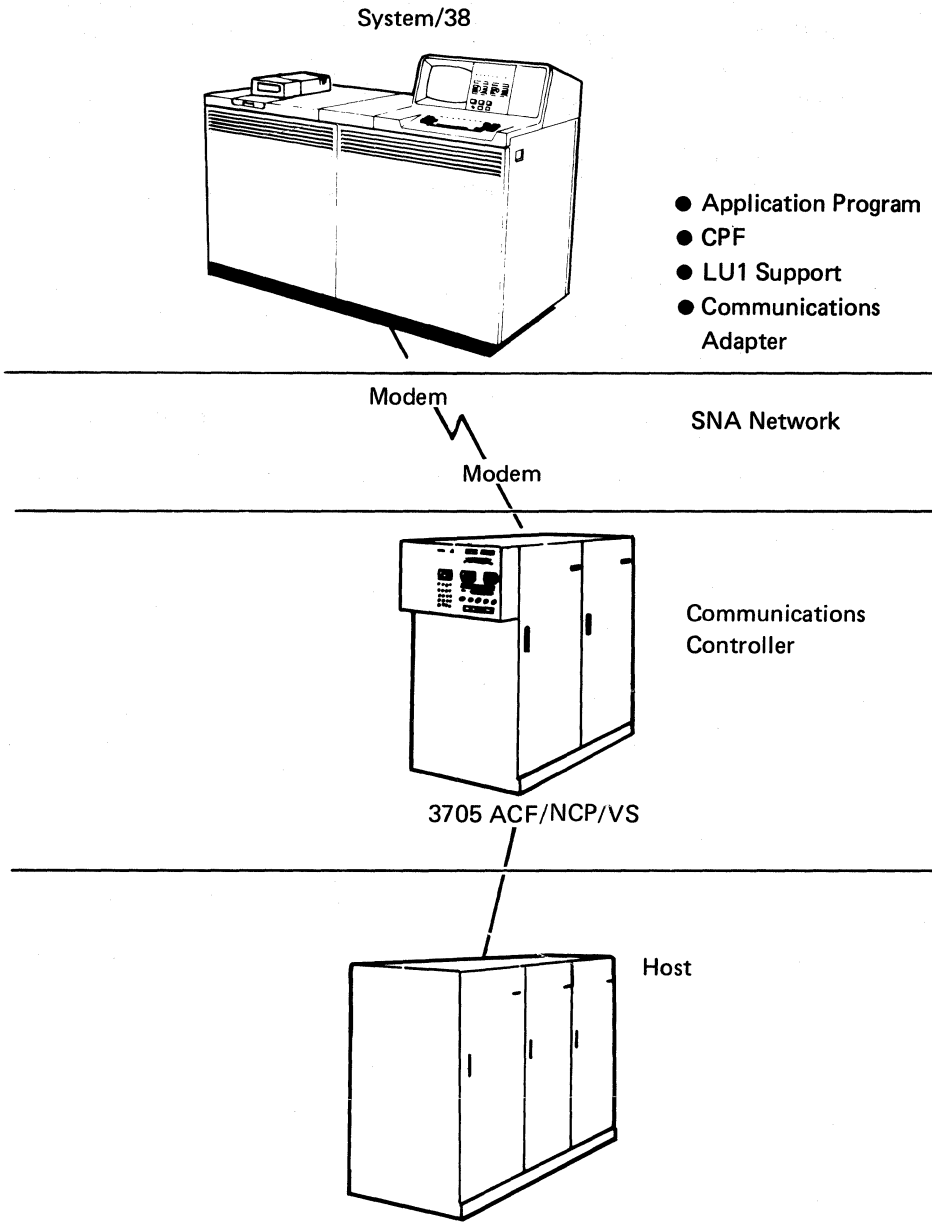
System/38 as an SNA Terminal

As an SNA terminal, the System/38 can communicate on an application-program-to-application-program basis with an IBM System/370, 30XX, or 43XX host system that uses IMS/VS or CICS/VS. The access method used in the host system can be ACF/VTAM (Virtual Telecommunications Access Method) or ACF/TCAM (Telecommunications Access Method). The host system must also be using ACF/NCP/VS (Advanced Communications Function/Network Control Program for Virtual Storage). For communications with a host system, the System/38 is considered to be a Logical Unit Type 1 (LU1).

When the System/38 communicates with a host system as an LU1 device, ACF/NCP/VTAM and the interface system (CICS/VS or IMS/VS) must be configured to communicate with the System/38.

The communications lines can be point-to-point switched, point-to-point nonswitched, or multipoint nonswitched common carrier provided or customer-owned. System/38 supports automatic calling, automatic answering, manual calling, and manual answering.

The following illustrates a System/38-to-host communications configuration using SNA.



System/38 Advanced Program-to-Program Communications

Advanced Program-to-Program Communications (APPC) allows a System/38 to communicate with other IBM systems that support the logical unit (LU6.2) SNA protocol. Using APPC, the System/38 communicates with other systems as a peer device. APPC allows the System/38 to communicate with:

- Another System/38 with APPC
- An SNA system running CICS/VS (Version 1.6 or above)

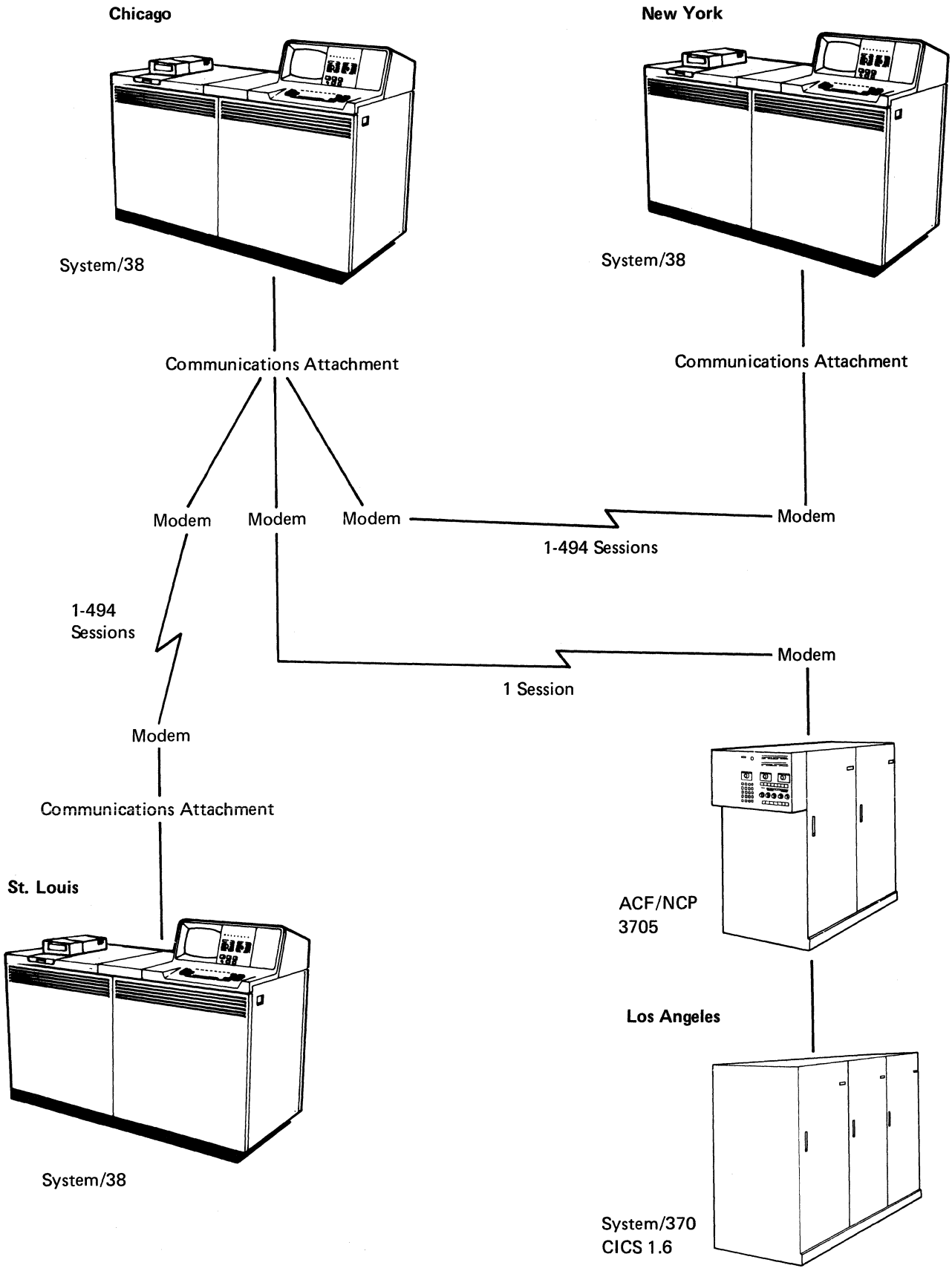
Using APPC, no host system controls all the sessions. Instead, peer communications occurs where control of the sessions is distributed among all the systems in the network. For example, when two System/38s use APPC to communicate, each system is responsible for starting and ending some communications sessions.

Also, System/38 application programs can initiate programs on other systems and other systems can initiate programs on the System/38 without any operator action.

Although there is no host system in an APPC network, one of the systems must use primary SDLC and the other systems must use secondary SDLC support. The System/38 can communicate over point-to-point switched or nonswitched lines using SDLC, or multipoint nonswitched lines using SDLC.

APPC allows the System/38 to engage in up to 494 sessions (per device) at a time when communicating with another System/38 over a single communications line.

The following is an example of a System/38 using APPC to communicate with a System/370 and other System/38s. Up to 494 sessions can be conducted at a time:

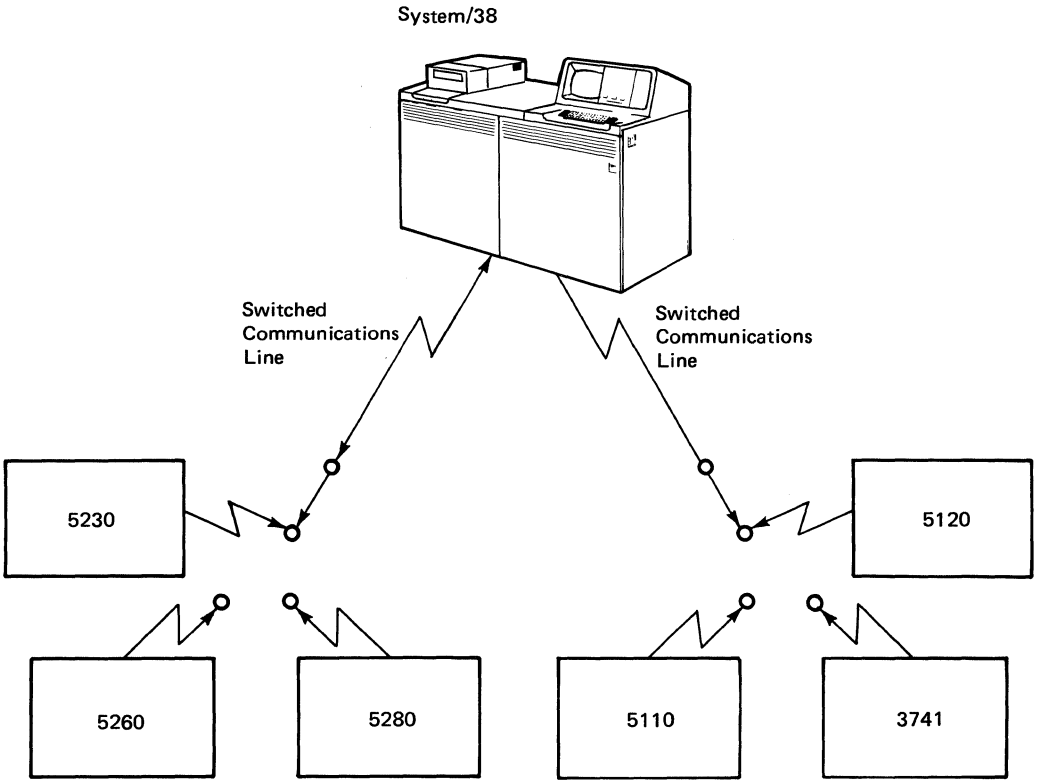


System/38 as a BSC Host

As a BSC host, the System/38 can communicate on point-to-point lines with remote BSC devices, as follows:

- IBM System/23 Datamaster
- IBM 6240 Magnetic Card Typewriter–Communicating
- IBM Magnetic Card II (CMC II) Typewriter–Communicating
- IBM 5520 Administrative System
- IBM 3741 Data Station
- IBM 5110 and 5120 computers (also program-to-program)
- IBM 5230 Data Collection System
- IBM 5260 Retail System
- IBM Office System 6 Information Processors
- IBM 5280 Distributed Data System (also program-to-program)
- IBM Displaywriter
- IBM 6670 Information Distributor
- IBM 6640 Document Printer
- IBM 3776 Communications Terminals (Models 1 and 2)
- IBM 3777 Communications Terminal (Model 1)

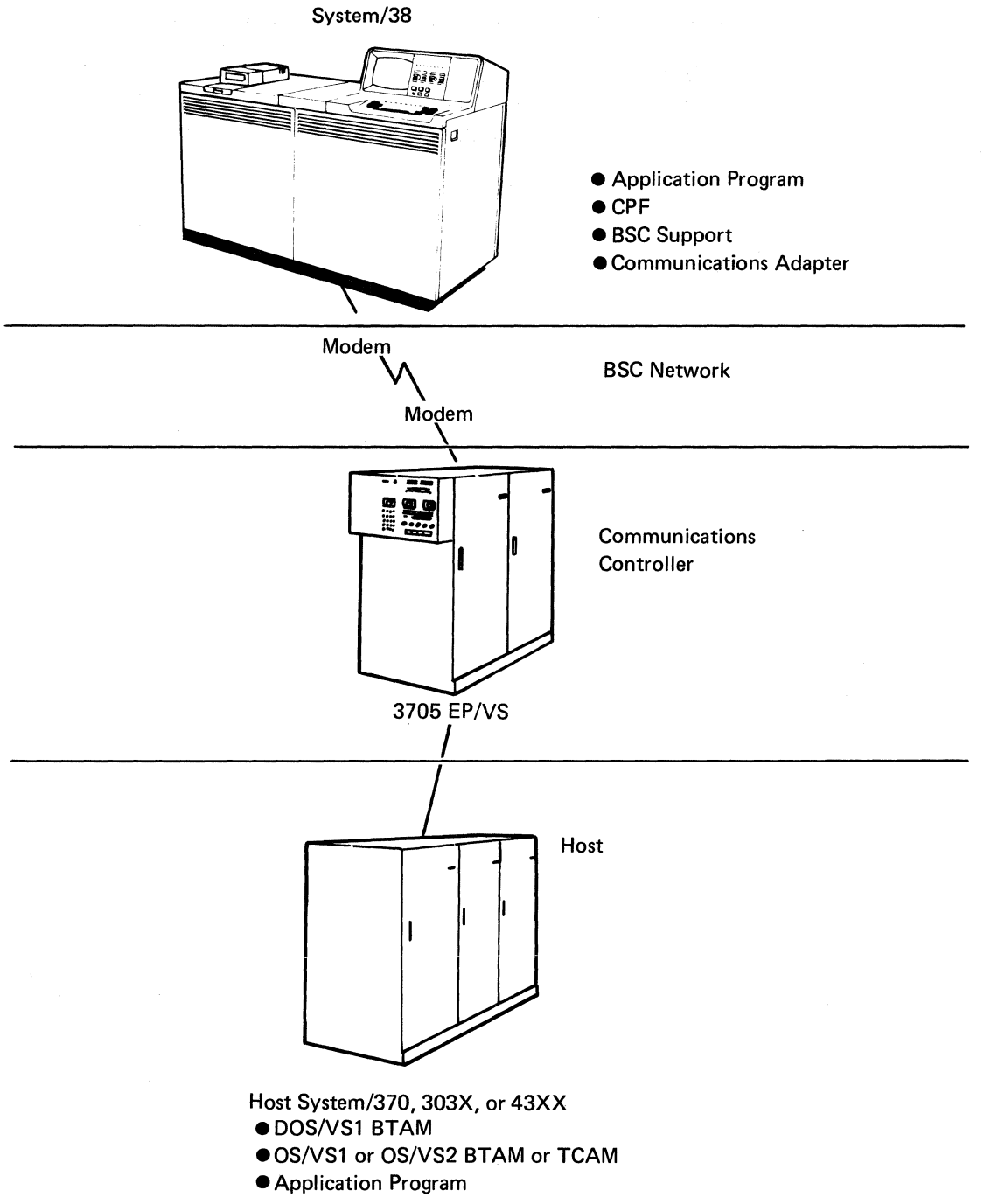
The following illustrates a BSC configuration with the System/38 as a host to remote BSC devices.



System/38 as a Terminal to BSC Host System

As a BSC terminal, the System/38 can communicate with an IBM System/370, 303X, or 43XX host system using Basic Telecommunications Access Method (BTAM) or Telecommunications Access Method (TCAM) or CICS/VS with BTAM. The communications network can be over a point-to-point switched or point-to-point nonswitched common carrier or private line or a multipoint nonswitched line. System/38 supports automatic calling, automatic answering, manual calling, and manual answering.

The following illustrates a System/38-to-host communications configuration using BSC.



System/38 to BSC Systems-Application-Program-to-Application-Program

Also using BSC, the System/38 can communicate with the following systems on an application-program-to-application-program basis:

- IBM Series/1*
- IBM System/3*
- IBM System/23 Datamaster
- IBM System/32
- IBM System/34
- IBM System/36
- IBM System/38
- IBM 30XX*
- IBM 43XX*
- IBM 5110 Model 2 Computer
- IBM 5120 Computer
- IBM System/370*
- IBM 5280 Distributed Data System
- IBM 5520 Administrative System (also uses SDLC to communicate with the System/38)

The System/38 also provides support for user-written application programs that communicate with other systems and devices that use 3780 BSC programs.

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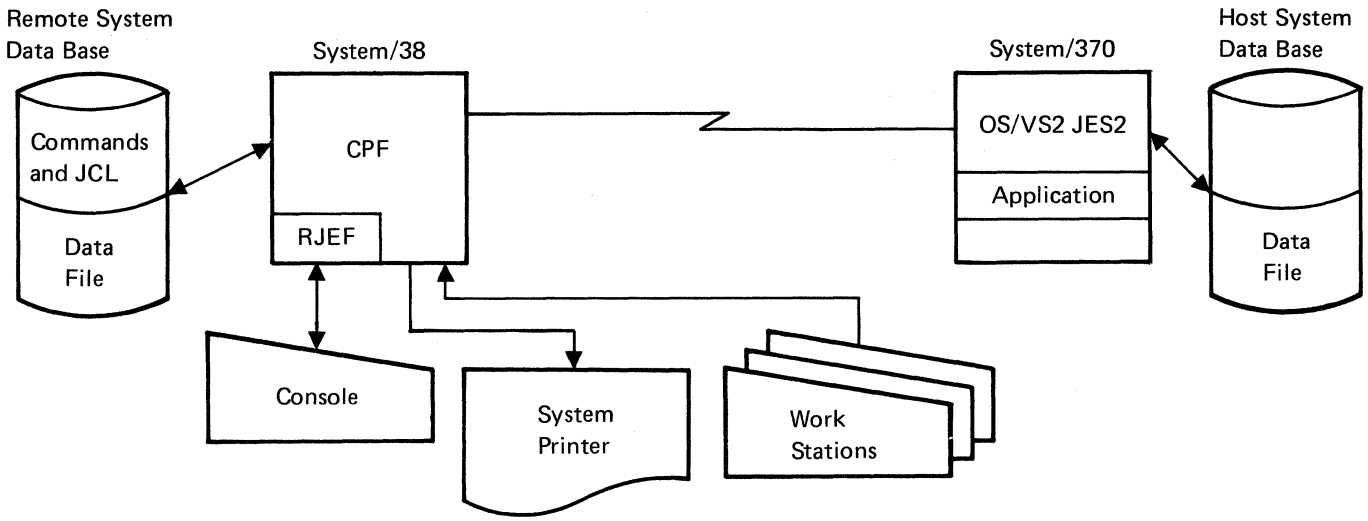
*The System/38 appears to these systems as a tributary station on a multipoint line.

SYSTEM/38 REMOTE JOB ENTRY FACILITY

The System/38 Remote Job Entry Facility (RJEF) is a licensed program that runs under the control of the Control Program Facility (CPF) program.

RJEF is designed to be used with host systems that process applications requiring the collection of data at the System/38, the processing of that data at a host system, and the return of any output back to the System/38.

The following is an example of the System/38 using RJEF:



RJEF uses the BSC or SNA/SDLC support provided by the System/38 Control Program Facility (CPF) to transmit data and maintain line control. The Remote Terminal Access Method (RTAM) is used to communicate with host systems using BSC while the Virtual Telecommunications Access Method (VTAM) is used to communicate with host systems using SNA. All data is transmitted using the EBCDIC transmission code.

With RJEF, the System/38 acts as a remote job entry work station that submits jobs to a host System/370, 303x, or 43xx using one of the following:

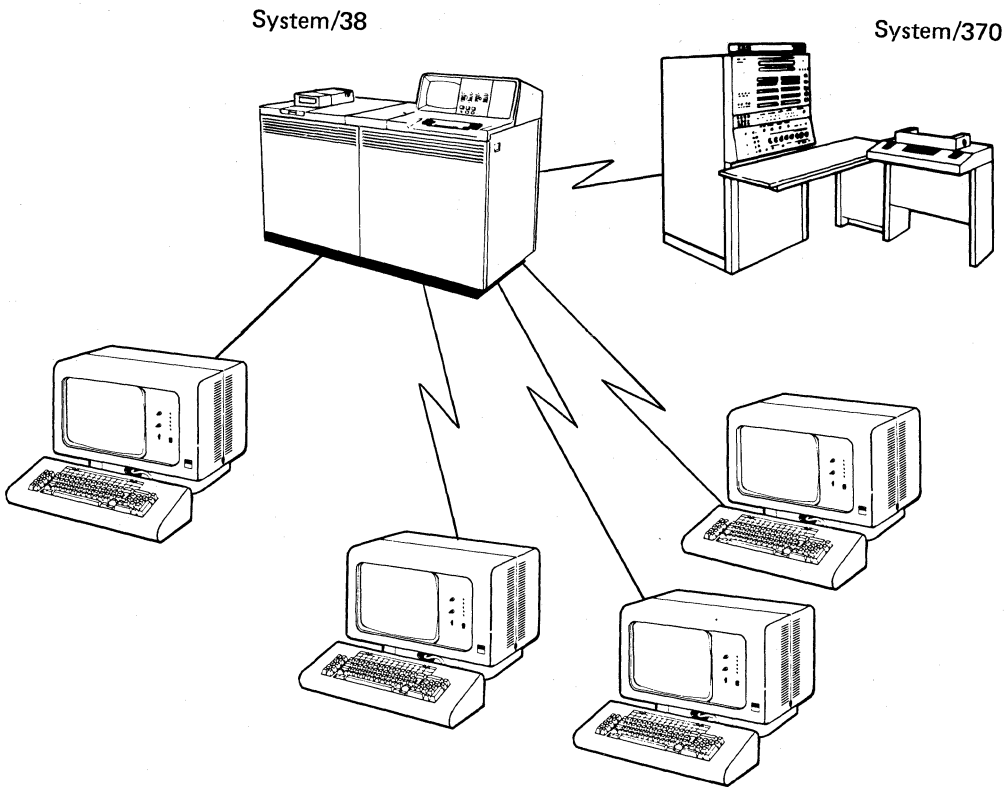
- OS/VS1 RES (Operating System/Virtual Storage 1 Remote Entry Services)
- OS/VS2 JES2 or OS/VS2 JES3 (Operating System/Virtual Storage 2 Job Entry Subsystem 2 or 3)
- VM/370 RSCS (Virtual Machine Facility/370 Remote Spooling Communications Subsystem Networking) as a System/3 RJE work station (only when using BSC)
- DOS/VSE POWER/VSE as a 3770 RJE work station (only when using SNA/SDLC)

Some highlights of the System/38 RJEF follow:

- MULTI-LEAVING remote job entry (MRJE) support that runs at the same time as other System/38 program and device operations.
- The ability to use several consoles with RJEF to enter host system commands and display host system and System/38 messages.
- Up to seven RJEF readers for BSC and 15 for SNA/SDLC that can run at the same time.
- UP to seven RJEF printers for BSC and 15 for SNA/SDLC that can run at the same time.
- Up to seven RJEF punches for BSC and 15 for SNA/SDLC that can run at the same time.
- Selection of default for messages issued by RJEF to permit unattended mode.
- Data security provided by the CPF security function.
- Automatic reblocking of data for the reader and writer data.
- The ability to run RJEF SNA and other SNA operations on the same line at the same time.

RJEF communicates with one host system for the duration of a remote job entry session.

The following illustrates a System/38 using terminals that can initiate remote job entry, using binary synchronous communications or SNA/SDLC communications.



Using BSC, RJEF communicates with host systems over a point-to-point switched or nonswitched communications line.

Using SNA/SDLC, RJEF communicates with host systems over a point-to-point switched or nonswitched, or a multipoint communications line. With SNA/SDLC, the System/38 functions as a tributary station in an SNA network and as a RJE work station that submits jobs to the host system.

The RJEF program runs on all models of the System/38 with:

- The Control Program Facility licensed program
- 512K bytes of main storage and 64.5 megabytes of auxiliary storage
- One communications attachment feature
- One remote communications line adapter (the communications control feature) for BSC or SDLC
- One line base feature per line
- An EIA external modem interface, Digital Data Service (DDS), or an IBM integrated modem

SYSTEM/38 3270 DEVICE EMULATION

The System/38 3270 device emulation program allows a System/38 to communicate with applications on System/370 type host systems with little or no change to application programs. With this program, the System/38 and its devices can be connected to existing 3270 networks and appear as 3270 control units with attached devices.

Using 3270 device emulation, the System/38 can communicate with the following hosts and operating systems:

- System/370, System 303x, System 43xx, Series/1
- CICS/VS, IMS/VS, TSO/VS, VM-/SP-CMS
- VTAM, BTAM, TCAM

System/38 3270 device emulation can be used with any host system that supports 3271 Model 2 Control Units. The 3271 Control Units use BSC line protocol on a nonswitched line in a multipoint tributary network. Both the System/38 and the 3270 devices can be connected to the same network; however, the 3270 devices cannot be directly connected to the System/38.

The 3270 device emulation support is provided by two interfaces:

- The device emulation interface
- The program interface

Both interfaces are included in the Control Program Facility.

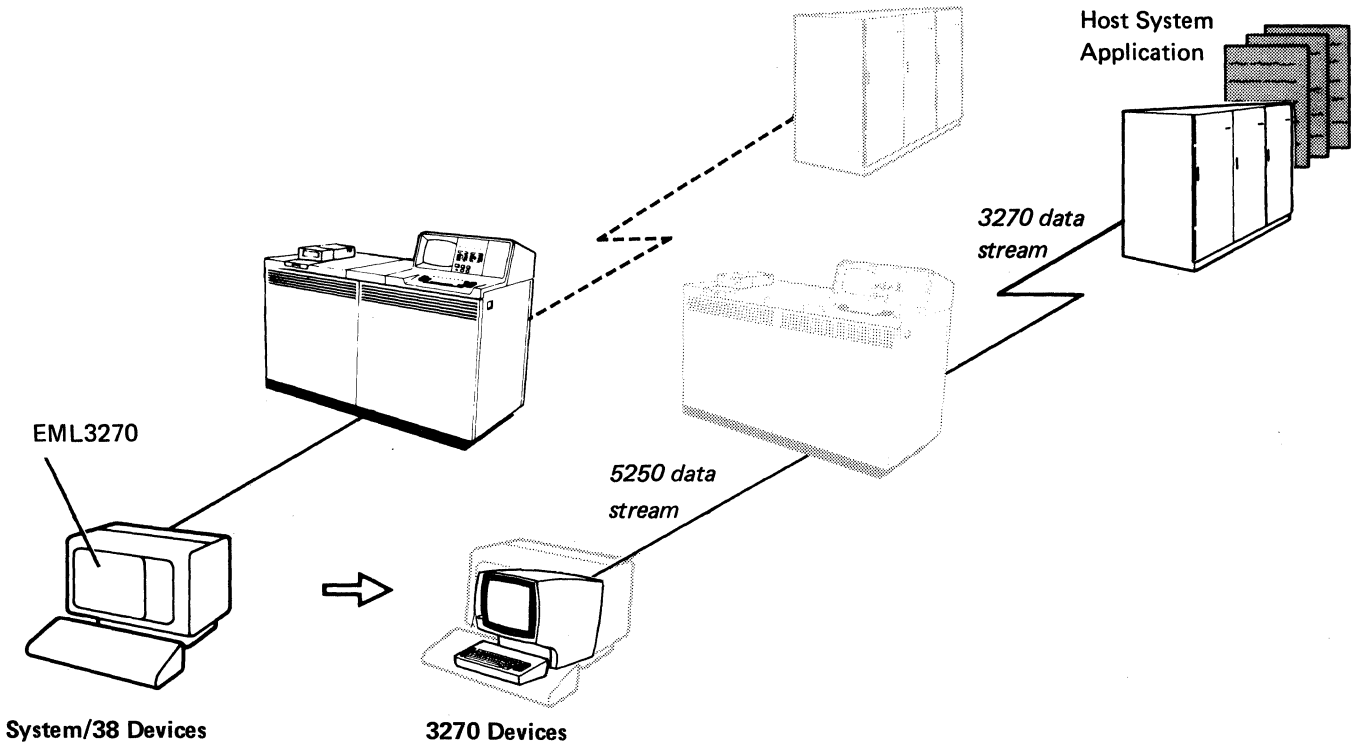
Device Emulation Interface

The device emulation interface allows System/38 devices to appear as 3277 Display Stations and 328x printers.

A user at a 5250 display station (5251, 5291, and 5292) that is attached to a System/38 can interact directly with a host system application as though the user is communicating with the application from a 3277 Display Station. The host system responds to the 5250 display station as though the 5250 user is communicating from a 3277 Model 2 Display Station (that is connected to a host system through a 3271 Model 2 Control Unit). The 3270 device emulation support translates 3270 data streams from and to 5250 data streams.

During printer emulation, the host responds as though it is sending data to a 3284, 3286, or a 3288 Printer that is connected to the host system through a 3271 Model 2 Control Unit.

The following illustrates how the device emulation interface works:



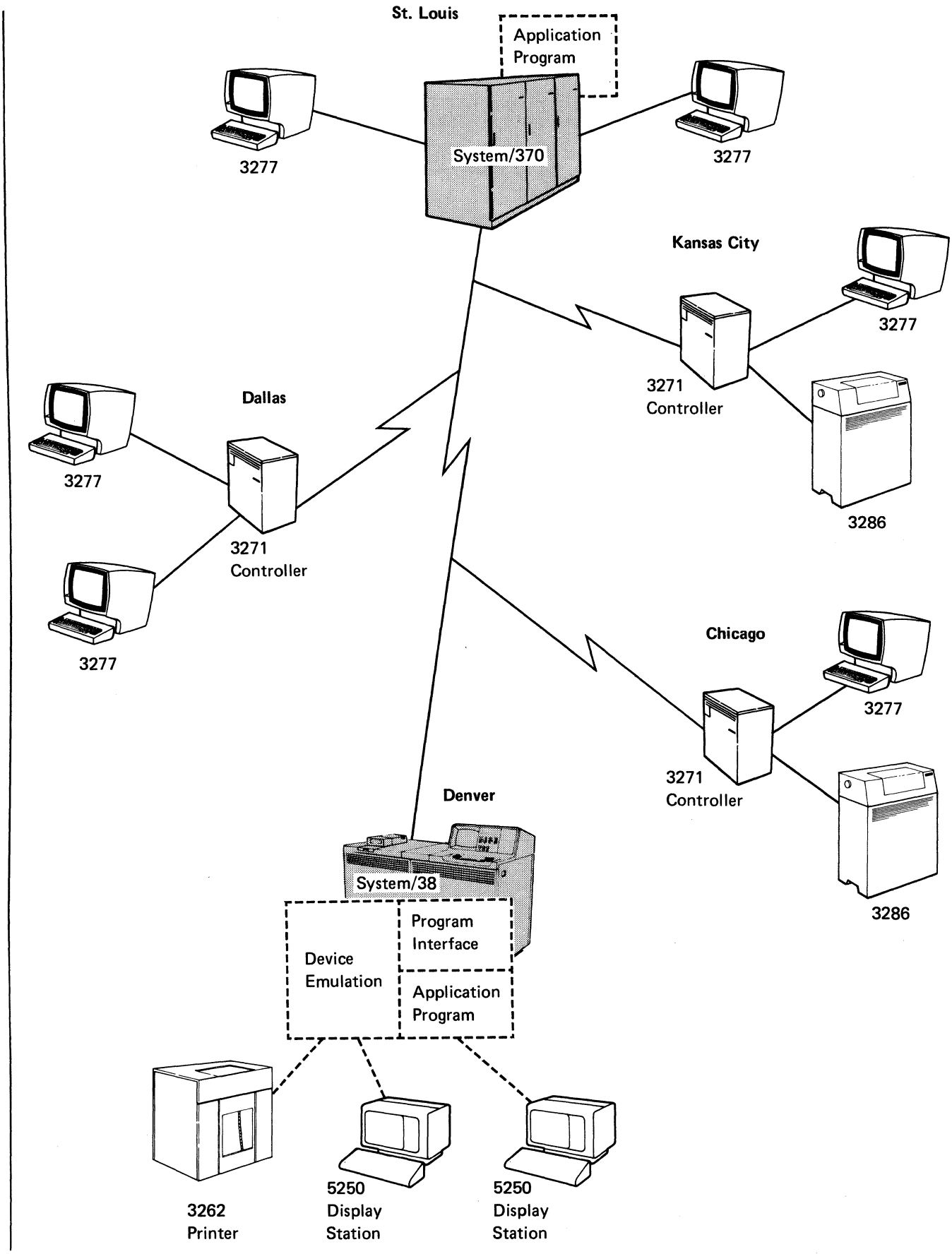
Program Interface

The 3270 program interface allows you to create application programs that communicate with host system application programs. Any data sent by the host system that would have been displayed at a 3277 Display Station is instead presented as input to the System/38 program. Data sent by the System/38 application program as input to the host system is presented to the host as though it had been entered from a 3277 Display Station.

Example of System/38 3270 Device Emulation

The following example shows a 3270 network, consisting of a host system in St. Louis and remote locations that communicate with the host system from Dallas, Kansas City, Chicago, and Denver. All locations use a common set of application programs at the host system. Also, the Denver location uses programs and data that are not used by the other locations. These special programs and data are stored and executed on a System/38 at Denver.

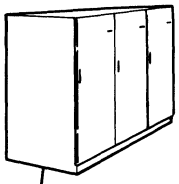
By using System/38 device emulation, Denver users communicate with the host system from 5250 Display Stations in the same way that users at other locations communicate from 3277 Display Stations. Sometimes, Denver users who are not familiar with the host application need to make inquiries to the host system. These inquiries are handled by a System/38 application program that interacts with a host system application program through the program interface.


St. Louis
Application Program
System/370
3277
3277
Kansas City
3277
3271 Controller
3286
Dallas
3277
3271 Controller
3277
Chicago
3277
3271 Controller
3286
Denver
System/38
Program Interface
Device Emulation
Application Program
3262 Printer
5250 Display Station
5250 Display Station

Summary of 3270 Emulation Requirements and Capabilities

Host Systems Supported
- System/370
- 30xx
- 43xx (4331 with communications adapter)
- Series/1

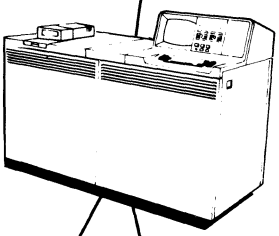
Applications Supported for Device Emulation
- CICS/VS
- IMS/VS
- TSO
- VM/SP-CMS
- CM1/CF



Access Methods Supported
- VTAM
- BTAM
- TCAM

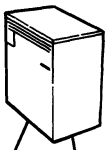
Communications
- BSC protocol
- Multipoint tributary configuration
- Nonswitched line
- Up to 8 lines with one control unit per line
- Up to 32 devices per control unit
- EBCDIC code

Any Model System/38 with
- Communications Adapter
- Support for BSC protocol
- CPF Release 5 or later

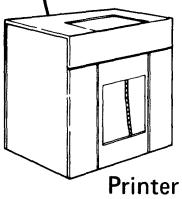


Device Emulation

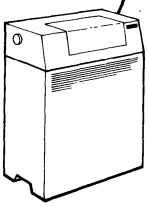
Emulates



3271 Model 2 Controller

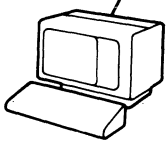


Emulates



Printer file (any System/38 printer)

3284, 3286, or 3288 Printer



Emulates

5251 Model 11 or 12, 5291, or 5292 Display Station with
- 1920-character screen
- Either typewriter or data entry keyboard
- Either local or remote connection to System/38

3277 Model 2 Display Station with
- 1920-character screen
- Either typewriter or data entry keyboard
- PA1–PA3, PF1–PF24

SYSTEM/38 SNA ALERTS

The alert function permits the System/38 to notify a remote System/370, 30XX, or 43XX host about conditions detected by the System/38. When the System/38 detects certain hardware or software conditions, the system will send an alert message to the host system.

The System/38 sends the alert to the system services control point (SSCP) at the host system. The SSCP at the host system then sends the message to the Network Problem Determination Application (NPDA). The problem determination application displays the message and saves it for future reference by the host system operator. The Network Problem Determination Application uses alerts to perform centralized network problem determination.

Alerts supported by the System/38 may be associated with local devices and controllers, with remote lines, controllers and devices, with software errors, with application programs, and with user (operator) actions on the System/38. The alert function may be turned on or off by a System/38 command. The host programs which support the alert and associated information are Network Communications Control Facility (NCCF) and Network Problem Determination Application (NPDA).

These programs provide a set of command processors which enable you to centralize network problem determination.

The host receives the alert and places it into the NPDA data base for subsequent use in problem determination by the NPDA terminal operator. A copy of the alert may also be displayed dynamically on the NCCF operator terminal.

SNA alerts are supported when the System/38 communicates as a terminal to an SNA host (LI1) or to CICS/VS using APPC (LU6.2).

THE IBM 5230 DATA COLLECTION SYSTEM

The 5230 Data Collection System can transmit data to the host system in one of three modes of operation:

- Batch mode: the transmission of data currently on diskette to the host system.
- Online mode: the transmission of data directly from the entry stations to the host system.
- Interleaved mode: the transmission of data currently on diskette and the interleaving of online data as it is entered from the entry stations to the host system.

The 5230 Data Collection System uses binary synchronous communications over switched or nonswitched point-to-point or multipoint (nonswitched) lines to communicate with:

- IBM System/370 models operating under DOS/VS, OS/VS1, or OS/VS2 BTAM. The BSCA attachment is supported by CICS/VS operating under DDS/VS and OS/VS.
- IBM System/32 with BSCA (point-to-point only).
- IBM System/34 with BSCA (point-to-point only).
- IBM System/34 with BSCEL.
- IBM System/38 with BSC support.
- IBM System/3 Models 12 or 15 with BSCA, LCA, ICA, or EIA.
- IBM 3741 restricted to single diskette transfer (point-to-point only).
- IBM Series/1.
- IBM 5280 Distributed Data System.

Data Collection System Support

The Data Collection System Support (DCSS) program edits and reformats data collected from the plant floor. Jobs such as payroll, inventory management and production status are performed before the data is submitted to the application program. The DCSS can operate on a System/3, a System/32, and a System/34.

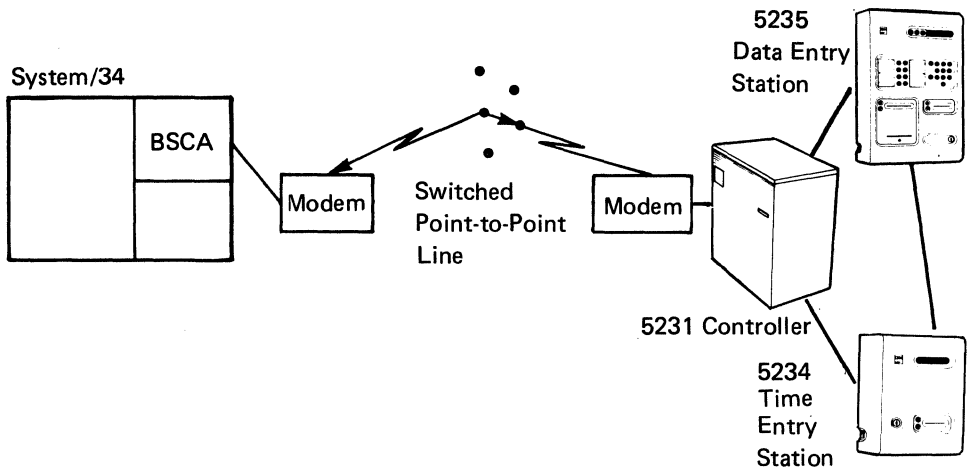
Online Data Collection and Inquiry

Other programs allow the 5230 transactions to be sent to the System/32 or System/34 by the 5231-2 Controller. The programs provide the following functions:

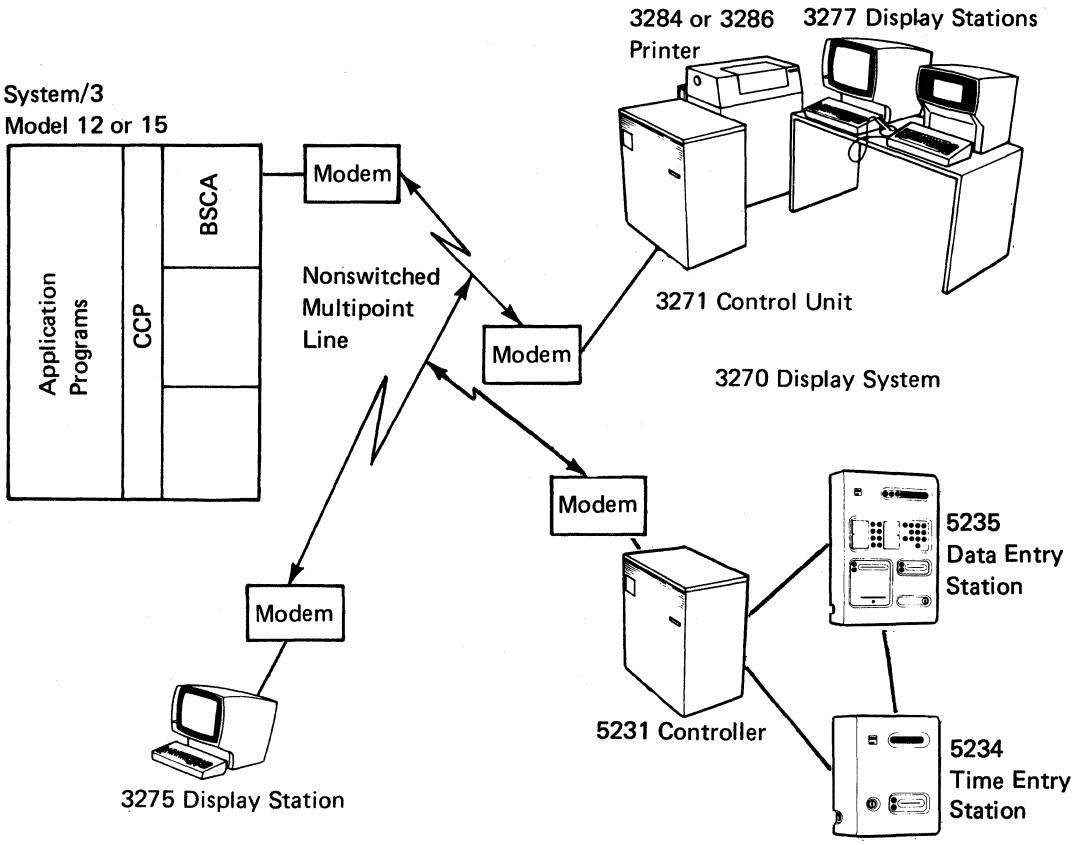
- Online transaction sequence control
- Online transaction editing and error reporting
- System/32 control center transaction error resolution or error resolution using IBM 5251 Display Stations connected to a System/34
- Production data base control
- Inquiry directly through the System/32 console or through 5251 Display Stations connected to a System/34
- Spooling of edited, approved transactions from a disk file to a remote host system using common carrier equipment

The following configurations show the 5230 Data Collection System communicating with other systems.

With the following configuration, the user can collect data from the plant floor, transmit the data to a System/34 using a switched point-to-point line, and process the data in a host system for subsequent query by devices attached locally to the host system.



The following configuration shows the System/3 as a host to a remote 5230 Data Collection System using the BSCA. The communications network is attached to the 5231 Model 2 Controller of the 5230 system using a nonswitched multipoint line.

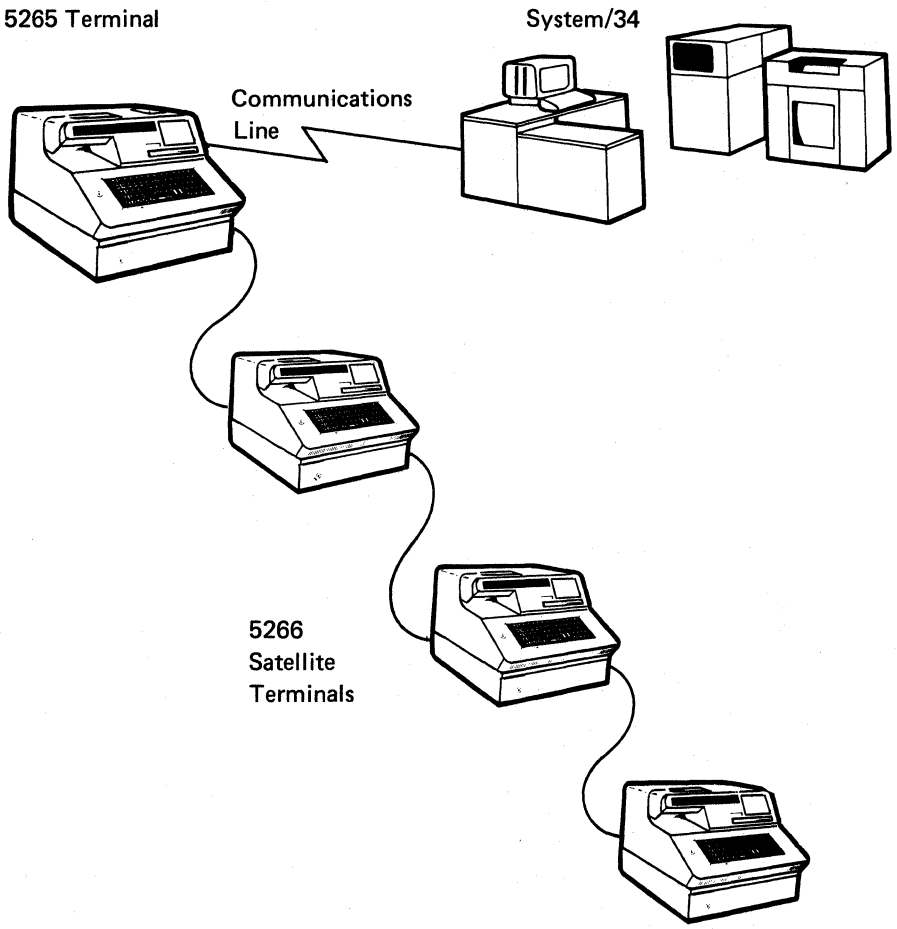


THE IBM 5260 RETAIL SYSTEM

Using BSC, the 5260 Retail System performs remote batch entry and communicates with the following systems:

- IBM Series/1
- IBM System/3
- IBM System/32
- IBM System/34 (ICF BSCEL subsystem or batch BSC)
- IBM System/38
- IBM System/370
- IBM 3741
- IBM 3747
- IBM 30XX
- IBM 43XX
- IBM 5110 and 5120
- IBM 5280

The following illustration shows a typical 5260 communications configuration. Both the 5265 terminal and the 5266 satellite terminals record and store data on the 5265 diskette. At the end of the day, the 5265 is used to transmit the data to the host processing system, using the communications line.



THE IBM 5280 DISTRIBUTED DATA SYSTEM

The IBM 5280 Distributed Data System communicates with other terminals and host systems, using utilities. These utilities allow the 5280 to perform the following functions:

- Send data to a terminal or host system
- Receive data from a terminal or host system
- Inquire into and receive replies about host system files
- Send job instructions and/or data to a host remote job entry system and receive the results

The communications utilities include:

- BSC batch transfer utility
- BSC data communications utility
- SNA data communications utility
- MULTI-LEAVING remote job entry (MRJE) utility
- SNA remote job entry (SRJE) utility
- BSC online test utility
- 5280-3270 emulation (BSC or SNA/SDLC)

In addition to the communications support provided by the 5280 communications utilities, the 5280 can also communicate with other terminals and host systems using application programs written with DE/RPG, COBOL, and the 5280 assembler language. Both BSC and SNA/SDLC communications are available to these user-written programs.

BSC Batch Transfer Utility

The BSC batch transfer utility allows the 5280 to transmit data to and receive data from a diskette data set while appearing to be a 3741. Multiple transmit and receive handled as a single job. The diskette drive is the only input/output device supported.

BSC Data Communications Utility

This utility can be used for 3741 inquiry or batch communications. Multiple transmit, receive, and inquiry functions can be handled as a single job. When you use this program, the 5280 appears to be a 3741 or a 3780 (DOS/VSE/POWER) to the network.

SNA Data Communications Utility

The SNA data communications utility allows the 5280 to send and receive batch data and to send and receive inquiries from other systems. Up to four SNA data communications programs using the same SNA data base/data communications (DB/DC) subsystem (either IMS or CICS) can run at the same time. Multiple transmit, receive, and inquiry functions can be processed as a single job.

MULTI-LEAVING Remote Job Entry (MRJE) Utility

The MRJE utility allows the 5280 to function as a remote job entry work station to an IBM host processor. When using MRJE, the 5280 is always the remote station and must start communications with the subsystem in the host system.

SNA Remote Job Entry (SRJE) Utility

The SRJE utility allows the IBM 5280 to function as a remote job entry station in an SNA/SDLC network. The IBM 5280 uses this utility to communicate with the RJE subsystem in the host system.

This utility allows data stored on diskette or directly entered through the keyboard to be sent to the host system. Utility control statements are used to control the SRJE session. Output from the host system can be sent to output devices at the host system, to a diskette, display, or printer at the remote IBM 5280, or to another station in the network.

BSC Online Test Utility

The BSC online test utility permits you to test the communications line and modems your system will use for communications to determine whether they are properly prepared to run a communications job. This utility can be run when you suspect a problem exists in the communications line. This utility can also be run with any BSC system or host with which the IBM 5280 can communicate if it supports one of the IBM 5280 tests.

Each utility can be used in only one type of network, either BSC or SNA/SDLC and communicates with certain IBM systems and host subsystems. Also, because of the kind of support provided by the CAMs, user-written programs can communicate with certain systems and host subsystems as shown in the following chart.

Network Type	IBM 5280 Communications Programs	IBM S/3, S/32, S/34, 3741, Series/1, 5260, 5280	IBM S/370, 303X and 4300 Subsystems					
			CICS/VS	IMS/VS	RJE	DOS/VSE/POWER CICS/VS	DOS/VSE/POWER RES and JES2	DOS/VSE/POWER JES3
BSC to S/370 115 to 168, 3031, 3032, 3033, and 4300 attached through a 3704 or 3705 S/370 115, 125, 138, and 4331 through ICA, access methods BTAM and ACF/TCAM	BSC Batch Transfer Utility	3741	3741	3741				
	BSC Data Communications Utility	3741	3741	3741	3780	3741		
	MULTI-LEAVING Remote Job Entry Utility						S/3 (MRJE) WS	S/3 (MRJE) WS
	User-written Program	3741	3741	3741		3741		
SNA LU1, PU2, FMP3, TSP3 (see note)	SNA Data Communications Utility (Multiple LU)		LU1	LU1		LU1		
	SNA Remote Job Entry Utility (Single LU)				LU1		LU1	LU1
	User-written Program		LU1	LU1				

Note: SNA to S/370 138 to 168 for CICS/VS, S/370 145 to 168 for IMS/VS, and 3031, 3032, 3033, 4331, and 4341 through a 3704 or 3705. Access methods are ACF/TCAM and ACF/VTAM.

5280-3270 Emulation

The 5280-3270 Emulation program allows the 5280 to appear as selected 3270 Control Units and devices to the host systems. The following support is available:

- 3270 BSC program interface
- Batch data transmission over a BSC line
- 3270 Device Emulation using BSC and SDLC communications

The 5280-3270 BSC program interface permits you to communicate with 3270 devices using programs written in DE/RPG and COBOL. A 1920-character device (image buffer), data and attributes, and a 4096-character or less data stream buffer (consisting of commands, orders, link control, and data) are available to the application programmer.

The 3270 BSC batch transfer utility allows the 5280 to send or receive diskette data sets using 3270 link protocol.

The 3270 device emulation utility allows a 1920-character 5280 Display Station to appear to a host system as an IBM 3277 Model 2 Display Station.

The 3270 printer emulation utility allows the 5222, 5224, 5225, and the 5256 Printers to appear as the 3284-2, 3286-2, or the 3288-2 Printer with BSC, or the 3287 Model 1 or 2 Printer with SNA.

3270 Binary Synchronous Communications

You can use the following utilities with the IBM 5280-3270 binary synchronous communications support:

- IBM 3270 batch transfer emulation utility allows the user to interactively transmit records to or receive records from a host system using IBM 3270 protocols in a BSC network. A user-written program must be provided on the host system.

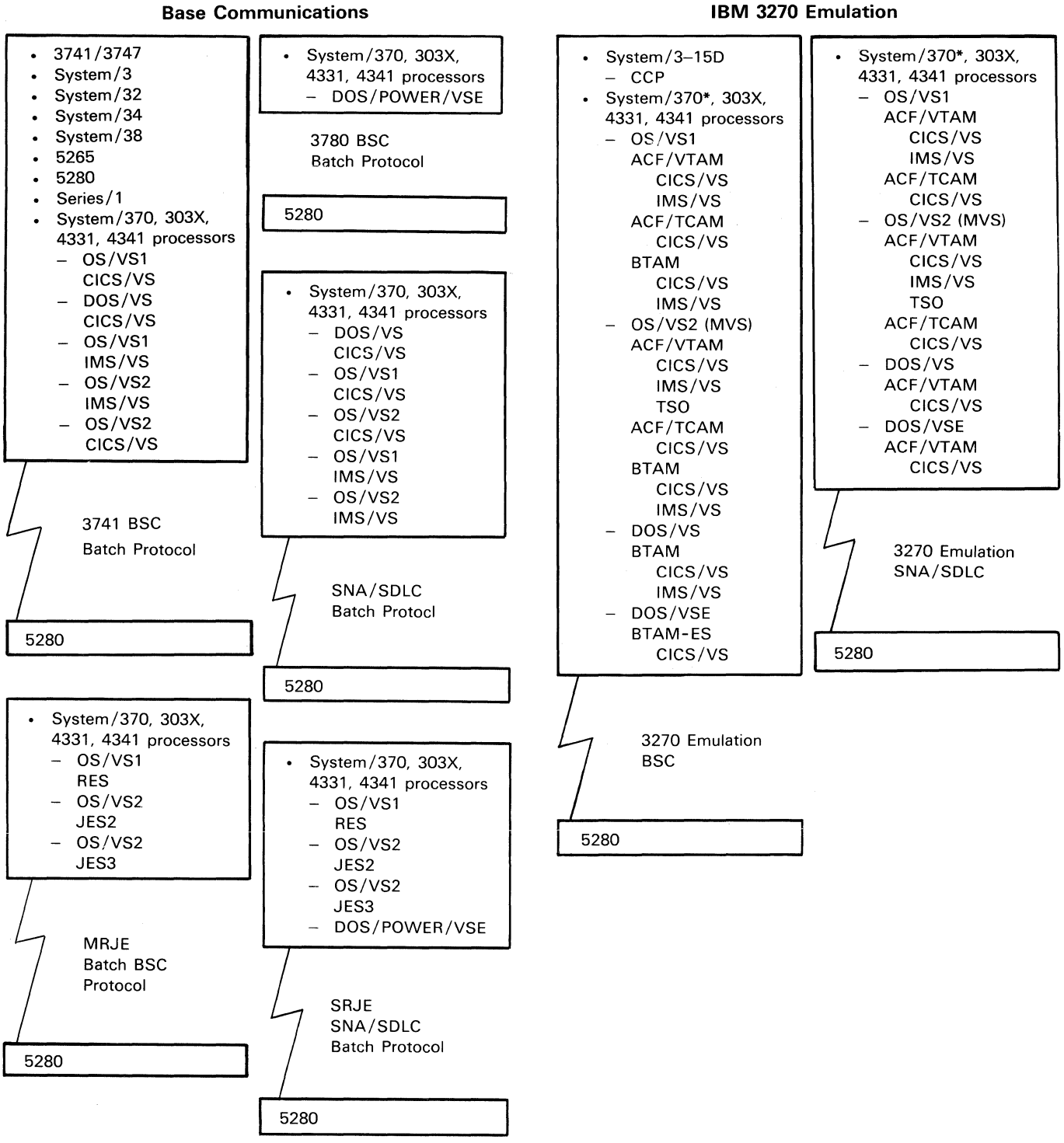
- IBM 3270 BSC display emulation utility allows the IBM 5280 to appear to the host system as an IBM 3277 Model 2 Display Station. Typewriter, data entry, and data entry with proof arrangement keyboards are supported. IBM 3270 program function keys are supported. The local print key function is supported.

- IBM 3270 SNA display emulation utility allows the IBM 5280 to appear to the host system as an IBM 3277 Model 2 Display Station. Typewriter, data entry, and data entry with proof arrangement keyboards are supported. IBM 3270 program function keys are supported. The local print key function is supported.

- IBM 3270 BSC print emulation utility allows the IBM 5222, 5224, 5225, and 5256 Printers to appear to the host system as the IBM 3284 Model 2 Printer, the IBM 3286 Model 2 Printer, or the IBM 3288 Model 2 Printer.

- IBM 3270 SNA print emulation utility allows the IBM 5222, 5224, 5225, and 5256 Printers to appear to the host system as the IBM 3287 Model 1 or 2 Printer.

The following charts show the host processing systems with which the BSC and SNA support on the IBM 5280 can communicate. The charts also indicate how the IBM 5280 appears to the host system with which it communicates.



The SNA support shown in the previous charts uses the following:

- Logical Unit Type 1 (LU1) for base communications
- Logical Unit Types 1, 2, 3 (LU1, 2, 3) for IBM 3270 Device Emulation
- Physical Unit Type 2 (PU2)
- Function Management Profile 3 (FMP3)
- Transmission Subsystem Profile 3 (TSP3)

It offers multiple logical-unit-to-logical-unit (LU-LU) sessions on one physical unit for IMS/VS or CICS/VS subsystems and a single LU-LU session for the remote job entry (RJE) subsystems.

THE IBM 5520 ADMINISTRATIVE SYSTEM

The IBM 5520 Administrative System provides the following communications support:

- BSC communications using a point-to-point nonswitched line
- SDLC communications using a nonswitched multipoint line
- Communications on a switched line using either BSC or SDLC
- Attachment of up to 16 communications lines (using the Models 50 and 51)
- Use of a distribution controller to manage the communications connection and the line protocol
- Use of local device controller (LDC) lines (using SDLC) to communicate with IBM 5520 Printers or another IBM 5520 system
- The ability to transmit and/or receive data at rates of 1200 to 9600 bps
- Manual call, manual answer, automatic call, and automatic answer

Using BSC, the IBM 5520 can communicate with these systems:

- IBM Series/1*
- IBM System/370
- IBM Office System 6 Information Processor
- IBM System/32 (with word processing feature 6002)
- IBM 6640 Document Printer
- IBM Communicating Magnetic Card II Typewriter
- IBM 6240 Communicating Magnetic Card Typewriter
- IBM System/34*
- IBM System/36
- IBM System/38*
- IBM Displaywriter System
- IBM 6670 Information Distributor

Using SDLC, the IBM 5520 can communicate with the following systems:

- IBM System/370
- Another IBM 5520
- IBM System/34*
- IBM System/36
- IBM System/38*

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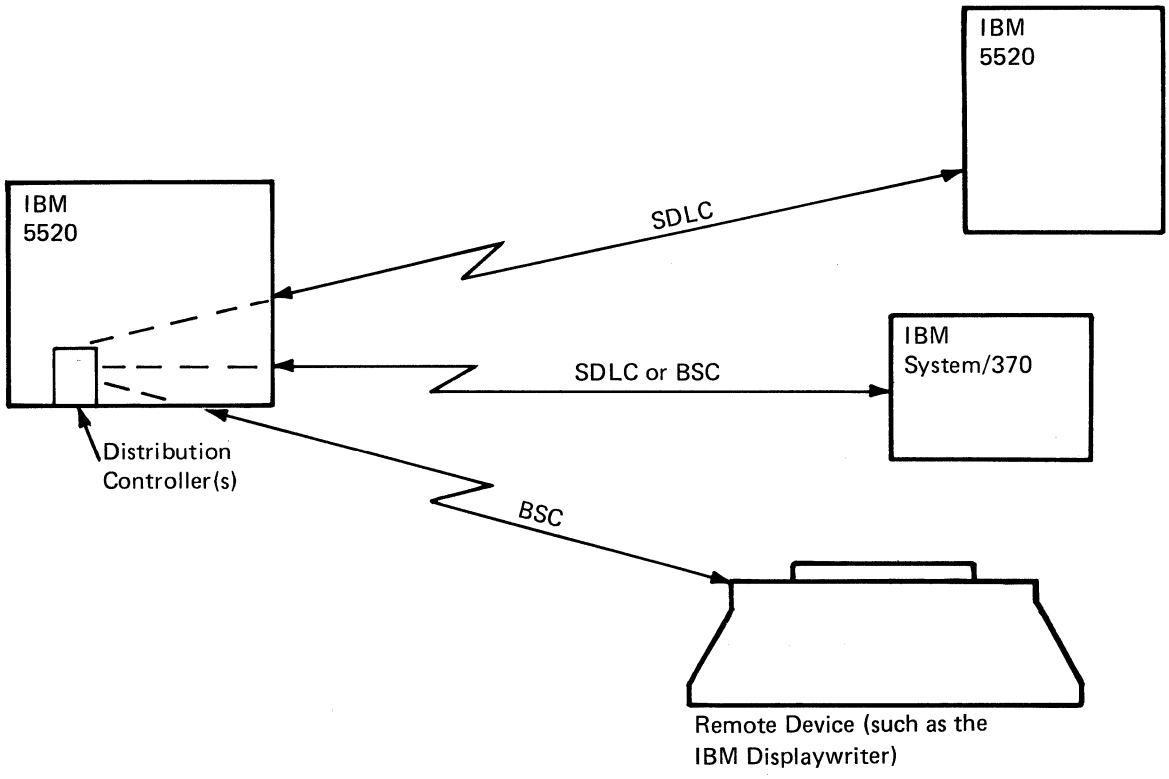
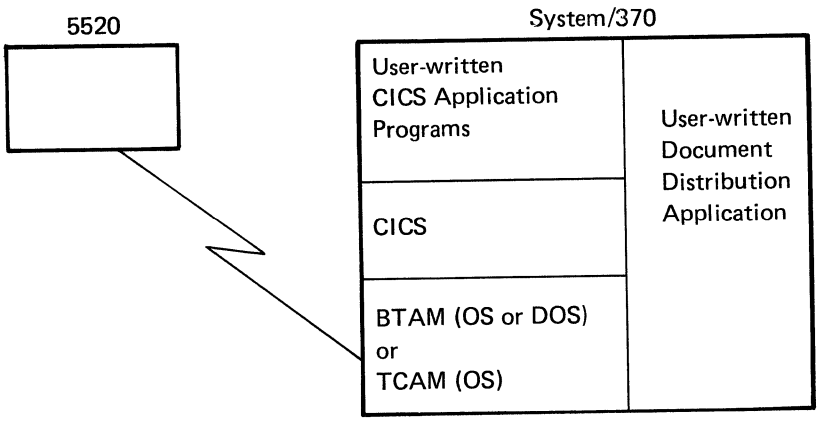
*These systems must be appropriately programmed.

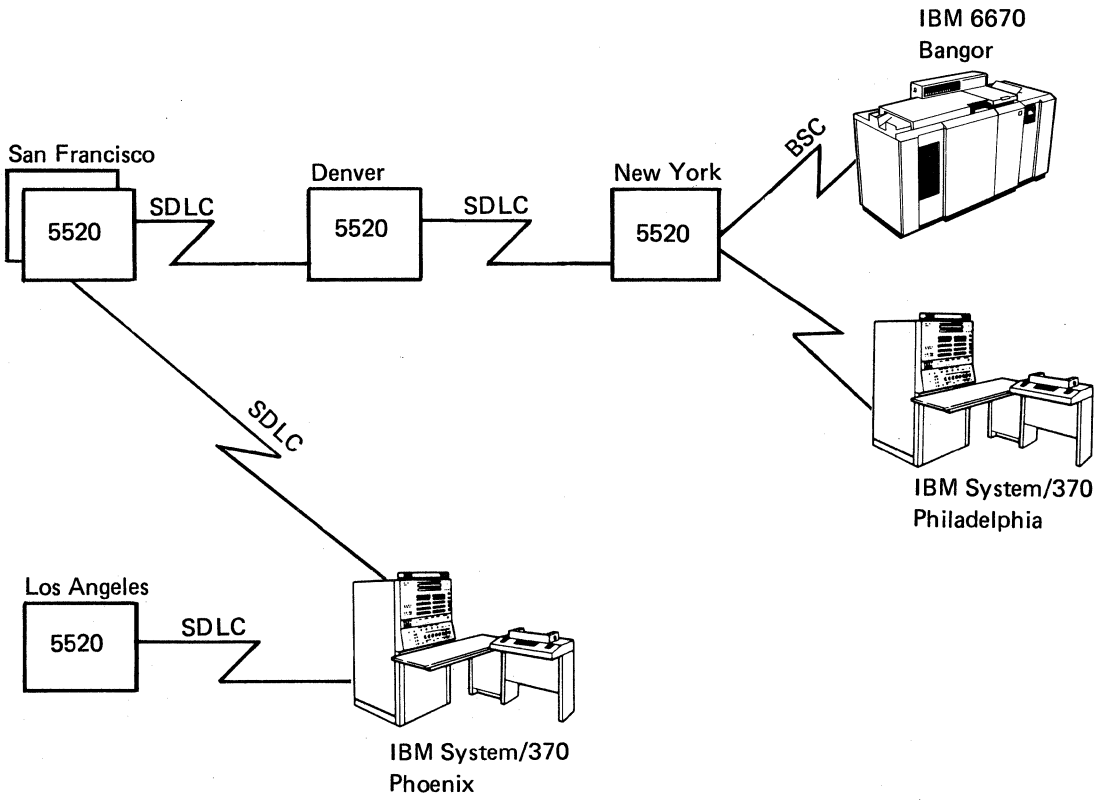
The following illustration shows a 5520 using SDLC to communicate with a System/370 and another 5520, and BSC to communicate with remote devices.



The following illustration shows an IBM 5520 communicating with application programs on a System/370, using BTAM or TCAM.



In a large organization, the following configuration can be used to distribute written documents. Anyone in any location can send documents to anyone else in the network.



Glossary

This glossary contains a list of some of the common terms that you may read or hear when working with data communications. The terms are described only as they relate to data communications.

access: The manner in which files or data sets are referred to by the computer.

access method: The way that records in files are referred to by the system. The reference can be consecutive (records are referred to on after another in the order in which they appear in the file), or it can be random (the individual records can be referred to in any order).

access mode: See *access method*.

acknowledge: Answer. To respond to a poll, address, or message.

acknowledgment character (ACK): In binary synchronous communications, a transmission control character sent as a positive response to a data transmission.

ACK0: In binary synchronous communications, the even-numbered positive acknowledgment character. See *acknowledgment character*.

ACK1: In binary synchronous communications, the odd-numbered positive acknowledgment character. See *acknowledgment character*.

adapter: See *communications adapter*.

addressing: (1) The way the sending or control station selects the station to which it is sending data. (2) A means of identifying storage locations.

allocate: To assign a resource, such as a disk file or a diskette file, to perform a specific task.

alphabetic character: Any one of the letters A through Z. Some program products extend the alphabet to include the special characters #, $, and @.

alphameric: Consisting of both letters and numbers and often other symbols, such as punctuation marks and mathematical symbols.

alphanumeric: See *alphameric*.

alternate routing: Using an alternate path to transmit data when the usual path is not available.

American National Standard Code for Information Interchange (ASCII): The code developed by ANSI for information interchange among data processing systems, data communications systems, and associated equipment. The ASCII character set consists of 7-bit control characters and symbolic characters.

American National Standards Institute: An organization sponsored by the Computer and Business Equipment Manufacturers Association for establishining voluntary industry standards.

amplifier: A device that amplifies signals to allow data transmission over long distances.

amplitude modulation: A method of modifying the amplitude of a carrier signal so it can carry data.

analog signals: Continuously variable data signals, such as voice signals or a sine wave.

ANSI: See *American National Standards Institute*.

answering station: The station responding to a dialed call on a switched channel.

application program: A program used to perform an application or part of an application.

ASCII: See *American National Standard Code for Information Interchange*.

assembler language: A symbolic programming language in which the set of instructions includes the instructions of the machine and whose data structures correspond directly to the storage and registers of the machine.

asterisk: The symbol (*).

asynchronous transmission: A method of transmission in which the bits included in a character or block of characters occur during a specific time interval. However, the start of each character or block of characters can occur at any time during this interval. Contrast with *synchronous transmission.*

attended operation: Some equipment requires a person at each station to establish the data channel. For example, one person dials a location, waits for the other person to answer, then both persons push a button to switch from voice to data communications.

attenuation: A decrease in signal strength of a data signal on a communication channel.

auto: Automatic.

autoanswer: The ability of a station to receive a call over a switched line without operator action. Contrast with *manual answer.*

autocall: The ability of a station to place a call over a switched line without operator action. Contrast with *manual call.*

automatic calling unit (ACU): A device that allows a host to automatically dial the number of a remote device.

bandwidth: The difference, in hertz, between the two limiting frequencies of a band.

BASIC (beginner's all-purpose symbolic instruction code): A programming language designed primarily for numerical applications.

batch processing: A method of running jobs without the continuing attention of an operator, usually distinguished by processing large amounts of data. Contrast with *interactive processing.*

baud: The number of changes in signal levels, frequency, or phase per second on a communication channel. If each change represents one bit of data, baud is the same as bits per second. However, it is possible for one signal change (one baud) to equal more than one bit of data.

Baudot code: A 5-bit transmission code structure that is used to represent data.

BCC: Block check character.

bel: Ten decibels.

bid: An attempt to gain control of the channel to transmit data.

binary: (1) Pertaining to a system of numbers to the base two; the binary digits are 0 and 1. (2) Involving a choice of two conditions, such as on-off or yes-no.

binary synchronous communications (BSC): A form of communications line control that uses transmission control characters to control data transferring over a communications line. Compare with *synchronous data link control.*

binary synchronous communications equivalence link (BSCEL): The SSP-ICF subsystem that provides BSC communications with another System/34 or System/36 and many other BSC computers and devices.

bit: Either of the binary digits 0 or 1. See also *byte.*

bit rate: The speed at which serialized data is transmitted, usually expressed in bits per second.

block: (1) A group of records that is recorded or processed as a unit. Same as *physical record.* (2) Ten sectors (2560 bytes) of disk storage. (3) In data communications, a group of records that is recorded, processed, or sent as a unit.

block check character (BCC): The character used in BSC to check that all of the bits transmitted were received.

bps: Bits per second.

BSC: See *binary synchronous communications.*

BSCEL subsystem: See *binary synchronous communications equivalence link.*

buffer: (1) A temporary storage unit, especially one that accepts information at one rate and delivers it at another rate. (2) An area of storage, temporarily reserved for performing input or output, into which data is read or from which data is written.

byte: The amount of storage required to represent one character.

call: (1) To activate a program or procedure at its entry point. Compare with *load*. (2) In data communications, the action necessary in making a connection between two stations on a switched line.

cancel: To end a task or job before it is completed.

carrier signal: A signal with a constant frequency that can be modulated to carry a data signal.

CBS coupler: A coupler that answers automatically.

CCITT: The International Telegraph and Telephone Consultative Committee.

central office: Location of common carrier switching equipment that routes data; also called exchange offices.

channel: The electrical path between data communications equipment.

character: A letter, digit, or other symbol.

CICS subsystem: The SSP-ICF subsystem that allows binary synchronous communications with CICS/VS.

circuit switching: A process that, on demand, connects two or more data terminal equipments (DTEs) and permits the exclusive use of a data circuit between them until the connection is released. Synonymous with line switching.

clock: A device that generates periodic signals used for synchronization.

clocking: A method of controlling the number of data bits sent on a communications line in a given time.

COBOL (common business oriented language): A high-level programming language, similar to English, that is used primarily for commercial data processing.

code: (1) Instructions for the computer. Same as *program*. (2) To write instructions for the computer. (3) A representation of a condition, such as an error code.

command: A request to perform an operation or a procedure.

common carrier: Any company that provides communications services to the general public.

communications adapter: A hardware feature that enables a computer or device to become a part of a data communications network.

communications line: Any physical link (such as a wire or a telephone circuit) that connects one or more work stations to a communications control unit, or connects one communications control unit with another.

conditioning: Adding equipment to a communication channel to improve the data transmission qualities of the channel.

configuration: The group of machines, devices, and programs that make up a data processing system. See also *system configuration*.

console: A part of a computer used for communications between the operator or maintenance engineer and the computer.

contention: A condition on a communications channel when two stations attempt to use the same channel simultaneously.

control block: A storage area used by a program to hold control information.

control character: A character that is transmitted to control a function of the device that receives the character. For example, a control character indicates the end or beginning of data to a station.

control station: The primary or controlling computer on a multipoint line. The control station controls the sending and receiving of data.

control storage: Storage in the computer that contains the programs used to control input and output operations as well as controlling the use of main storage. Contrast with *main storage*.

coupler: A device that connects a modem to a telephone network.

cradle: The part of a telephone that holds the handset.

CRC: Cyclic redundancy check (character).

cross talk: Undesired signals, such as voice signals, transferred to a data channel.

CRQ: Call request.

cycle sharing: The process by which a device uses machine cycles of another device or processing unit.

cycle steal (CS): The process by which a device uses cycles of another machine or device. If, for example, the processing unit is performing an ALU operation when the disk needs service, the ALU operation is stopped while a byte of data is moved to or from the disk.

cycle stealing: Synonym for cycle sharing.

cyclic redundancy check character (CRC): A character code used for error sensing and correction.

data access arrangement (DAA): Circuitry that allows communications equipment to be connected to the public switched telephone network.

data circuit: Associated transmit and receive lines that provide a means of two-way data communications. See also *physical circuit* and *virtual circuit*.

data communications: The transmission of data between computers and/or remote devices over a communications line.

data file: In System/34 MRJE, a disk file, procedure member, or source member that can contain only records to be transmitted to the host system.

data item: A unit of information to be processed.

data link: The equipment and rules (protocols) used for sending and receiving data.

data link escape (DLE) character: In BSC, a transmission control character usually used in transparent text mode to indicate that the next character is a transmission control character.

data management: The SSP support that processes a request to read or write data.

data mode: (1) A mode in which a display station can be used only for data entry. (2) In data communications, a time during which BSC is transmitting or receiving characters on the communications line. (3) In BASIC, a way to enter source statements without having them checked for accuracy.

data phone[1]: A telephone device designed for data communications.

[1]Trademark of the Bell System.

data set: See *modem*.

data stream: All information (data and control information) transmitted over a data link.

data terminal equipment (DTE): The data processing unit that uses communications lines.

DCE: Data circuit-terminating equipment, commonly called data communications equipment.

DDSA: See *Digital Data Service Adapter*.

deactivate: To make ineffective.

decibel: A unit of signal strength, such as the signal on a data communications channel.

delete: To remove.

deletion: See *zero bit insertion/deletion*.

demodulate: To set a modulated signal to its original state.

diagnostic: Pertaining to the detection and isolation of a malfunction or error.

digital data: Data represented by on and off conditions called bits.

Digital Data Service Adapter (DDSA): In data communications, a device used when transmitting data using the digital data service. Compare with *modem*.

direct addressing: An addressing method that uses an expression as an operand entry to represent an instruction address.

DISC: See *disconnect character*.

disconnect (DISC) character: The BSC transmission control sequence for ending the connection.

disconnect signal: A signal transmitted to a receiving station to indicate that the channel is to be disconnected.

disconnect time-out: An indication that the BSC station you were communicating with has been inactive for a specified length of time and, therefore, has been disconnected.

disconnected mode: In SDLC, a response from a secondary station indicating that it is disconnected and wants to be online.

disk: A storage device made of one or more flat, circular plates with a magnetic surface on which data can be stored.

disk file: A set of related records on disk that are treated as a unit.

diskette: A thin, flexible magnetic plate that is permanently sealed in a protective cover. It is used to store information copied from the disk.

display: (1) (ANSI) A visual presentation of data. (2) To show information on the display screen.

display station: An input/output device that includes a display screen on which data is displayed, and an attached keyboard from which data is entered.

distortion: An undesirable change in a data communications signal.

DLE: See *data link escape character.*

DLO: Data line occupied.

DM: Disconnected mode.

DSR: Data set ready.

DTE: See *data terminal equipment.*

DTR: Data terminal ready.

dump: (1) To copy the contents of all or part of storage, usually to an output device. (2) (ANSI) Data that has been dumped.

duplex: Pertains to communications in which data can be transmitted and received at the same time. Same as full duplex. Contrast with *half duplex.*

EBCD (extended binary coded decimal): A 7-bit code (6 data bits and one parity bit) used to represent data.

EBCDIC: See *extended binary-coded decimal interchange code.*

EBCDIC character: Any one of the symbols included in the 8-bit EBCDIC set.

ECC: (1) Error checking and correction. (2) Error correction code.

echo: A reflected signal on a communications channel.

edit: (1) To modify the form or format of data; for example, to insert or remove characters such as for dates or decimal points. (2) To check the accuracy of information that has been entered, and to indicate if an error is found.

EIA: Electronic Industries Association.

emulation: The imitation of a computer or device.

enable: In interactive communications, to start a subsystem.

end-of-text (ETX) character: The transmission control character used to end a logical set of records that began with the start-of-text character.

end-of-transmission (EOT) character: In binary synchronous communications, the transmission control character usually used to end communications.

end-of-transmission-block (ETB) character: In binary synchronous communications, the transmission control character used to end a block of records.

ENQ: See *enquiry character.*

enquiry (ENQ) character: In binary synchronous communications, the transmission control character usually used to request a response from the remote computer or device.

EON: In data communications with the autocall feature, the end-of-number (telephone number) character.

EOT: See *end-of-transmission character.*

ETB: See *end-of-transmission-block character.*

ETX: See *end-of-text character.*

even positive acknowledgment: See *ACK0.*

exchange: See *central office.*

extended binary-coded decimal interchange code (EBCDIC): A set of 256 eight-bit characters.

FD or FDX: Full duplex. See *duplex.*

feature: A programming or hardware option, usually available at an extra cost.

field: One or more characters of related information (such as a name or amount) in a record.

figure shift: Shifting a typewriter from letters to numbers and special characters. The term is used with the Baudot code.

file: (ANSI) A set of related records treated as a unit.

file name: The name used by a program to identify a file.

filter: An electronic component of group of components that is designed to allow only specified signal frequencies to pass through the filter.

FM: Frequency modulation.

format: (1) A defined arrangement of such things as characters, fields, and lines, usually used for displays, printouts, or files. (2) To arrange such things as characters, fields, and lines.

four wire circuit: A circuit that uses four wires (two for transmitting data and two for receiving data) for data transmission. Four wire is used at times for duplex transmission; however, duplex transmission in some systems does not use four wire circuits.

frequency modulation: Modifying the frequency of a carrier signal so it can carry data signals.

full duplex: Same as *duplex.*

half duplex: Pertains to communications in which data can be transmitted in only one direction at a time. Contrast with *duplex.*

handset: The part of a telephone used for talking and listening.

handshaking: Before transmitting data, modems and equipment must establish an electrical path and synchronization. The process used to establish the path and synchronization is called handshaking.

hardware: The equipment, as opposed to the program, of a computer system.

HD or HDX: See *half duplex.*

hex: See *hexadecimal.*

hexadecimal: Pertaining to a system of numbers to the base sixteen; hexadecimal digits range from 0 (zero) through 9 (nine) and A (ten) through F (fifteen).

host system: The primary or controlling computer in the communications network. See also *control station.*

host system: Information management system.

IMS: Information management system.

I/O: See *input/output.*

initial: Pertaining to something that is at the beginning.

initial program load (IPL): The process of loading the system programs and preparing the system to run jobs.

inplant systems: A data communications system in which all components of the system are located in the same building or on adjacent locations.

input: Data to be processed.

input stream: The sequence of operation control statements and data given to the system from an input device.

input/output (I/O): (ANSI) Pertaining to either input or output, or both.

input/output block (IOB): A data area that can be used to move, from the calling program to the input/output supervisor, the information necessary for data operations.

inquiry: (1) A request for information in storage. (2) A request that puts a display station into inquiry mode.

inquiry program: (1) A program that allows the operator to get information from a disk file. (2) A program that runs while the system is in inquiry mode.

insertion: To put into.

interface: A common boundary, but not of internal connections.

instruction: A statement that specifies an operation to be performed by the computer and the locations in storage of all data involved in that operation.

interactive: Pertains to activity involving requests and replies as, for example, between an operator and a program or between two programs.

Interactive Communications feature (SSP-ICF): A feature of the System/34 and the System/36 SSP that allows a program to interactively communicate with another program or system using BSC and SNA communications as well as communications between programs within the same computer.

interactive processing: A method of processing in which each operator action causes a response from the system or a program, as in an inquiry system or an airline reservation system. Contrast with *batch processing*.

intermediate block check: In binary synchronous communications, an option that permits checking each record, instead of checking the contents of the total buffer, when large buffers of data are received.

intermediate-text-block (ITB) character: In binary synchronous communications, the transmission control character used to indicate the end of a section of data to be checked. See *intermediate block check*.

interrupt: (1) To temporarily stop a process. (2) In data communications, to take an action at a receiving station that causes the sending station to end a transmission.

Intra: An SSP-ICF subsystem (for System/34 and System/36) that enables programs to communicate with other programs on the same system without the use of communications lines.

IOB: Input/output block.

IPL: See *initial program load*.

ITB: See *intermediate-text-block character*.

job: (1) A unit of work to be done by a computer. (2) One or more related procedures or programs grouped into a first-level procedure.

K-byte: 1024 bytes.

leased facility: See *nonswitched line*.

letters shift: Used with the Baudot code to indicate shifting a typewriter to print letters (lowercase characters).

library: (1) A named area on disk that can contain programs and related information (not files). A library can contain load members, procedure members, source members, and subroutine members. See also *system library*. (2) The set of publications for a system.

line: See *communications line*.

line adapter: A modem that is a feature of a particular device.

load: (1) To move data or programs into storage. (2) To place a diskette into a diskette drive or a magazine into a diskette magazine drive. (3) To insert paper into a printer.

local: Pertaining to a device that is directly connected to a computer without using a communications line. Contrast with *remote*.

LRC: Longitudinal redundancy check.

main storage: General-purpose storage of a computer, where all user programs are run. Contrast with *control storage*.

main storage processor: Hardware that performs the machine language instructions in main storage.

manual answer: The operator actions required to receive a call over a switched line. Contrast with *autoanswer*.

manual call: The operator actions required to place a call over a switched line. Contrast with *autocall*.

mark: Indicates the presence of a data signal on a communication channel.

mark hold: Condition of the channel when no data is being transmitted; the channel is held at a steady mark level.

megahertz: A unit of measure of frequency. 1 megahertz equals one million hertz.

microwave: A high frequency radio wave (above 890 megahertz) used to transmit data.

MLCA: See *multiline communications adapter*.

modem: See *modulator-demodulator*.

modulation: Changing the frequency or size of one signal by using the frequency or size of another signal.

modulator-demodulator (modem): A device that converts data from the computer to a signal that can be transmitted on a communications line, and converts the signal received to data for the computer.

monitor: Software or hardware that observes, supervises, controls, or verifies the operation of a system.

MRJE: See *MULTI-LEAVING remote job entry*.

MSRJE: See *multiple session remote job entry*.

multidrop: Stations connected to a multipoint channel at one location.

multiline: More than one communications line.

multiline communications adapter (MLCA): A feature that allows up to four communications lines. It allows a total speed of 65 600 bits per second.

MULTI-LEAVING remote job entry: A System/34 SSP function that allows the user to communicate with a system over a communications line using BSC.

multiple: More than one.

multiple session remote job entry (MSRJE): A feature of the System Support Program Product that allows one or more remote job entry sessions at the same time.

multipoint: Pertains to a network that allows two or more stations to communicate with a single system on one line.

NAK: See *negative acknowledgment character*.

negative acknowledgment character (NAK): In binary synchronous communications, a transmission control character transmitted as a negative response to data received.

negative response: A reply indicating that data was not received correctly or that a command was incorrect or unacceptable.

network: A collection of data processing products connected by communications lines for data processing or information exchange.

noise: Undesirable electrical signals on the communication channel that can interfere or distort data signals.

nonswitched line: A connection between computers or devices that does not have to be established by dialing. Contrast with *switched line*.

nonswitched network: A connection, between computers or devices on a network, that does not have to be established by dialing.

NRZI: Non-return-to-zero inverted.

OCL: See *operation control language*.

odd positive acknowledgment: See *ACK1*.

off hook: Indicates the data connection is active. For example, if you remove the telephone from the hook or cradle, it is active.

offline: Not controlled directly by or not communicating with the computer.

on hook: Indicates the data connection is not active. For example, if you hang up the telephone (on hook), it is not being used.

online: Being controlled directly by or directly communicating with a computer.

online system: A system in which input data enters the host directly from the point of origin and/or output data is transmitted directly to where it is used.

operation control language (OCL): A language used to identify a job and its processing requirements to the SSP.

output: Data that has been processed.

parallel transmission: Transmitting all bits of a character simultaneously.

parameter: A value passed to a procedure or program either for evaluation or to control the actions of the procedure or program.

parity: The state of being either even-numbered or odd-numbered.

phase modulation: Altering the phase of a carrier signal to convey data signals.

physical circuit: A circuit created with hardware rather than by multiplexing. See also *data circuit*. Contrast with *virtual circuit*.

point-to-point line: A communications line that connects a single remote station to a computer.

poll: To execute a polling sequence.

polling: A method for determining whether each of the stations sharing a communications line has data to send.

poll list: A list of terminal addresses in computer storage; the addresses are used to poll the terminals.

primary station: On a point-to-point channel, the station that gains control of the channel first, on a multipoint channel, the station controlling communications.

priority: The relative ranking of items. For example, a job with high priority in the job queue will be run before one with medium or low priority.

procedure: A set of related OCL statements (and, possibly, utility control statements) that cause a specific program or set of programs to be performed.

processing batch: Accumulating and grouping related data for processing.

processing unit: The parts of a computer that perform the processing for the system, perform operations on data, and control output.

processor: Pertaining to the control storage processor (CSP) or the main storage processor (MSP).

processor terminal: A programmable terminal or computer that can process data offline and can also be used as a terminal online.

program: (1) A sequence of instructions for a computer. (2) To write a sequence of instructions for a computer.

program product: An IBM-written, licensed program for which a monthly charge is made. A program product performs functions related to processing user data.

programmable terminal: A terminal that can perform some of the functions of a computer.

programmer: One who designs, writes, and tests programs.

programming: To design, write, and test programs.

protocol: The rules for transferring data.

PRPQ: Programming Request for Price Quotation.

PSN: Public switched network.

public switched network: A communications service through which users can be connected by dialing specific service address numbers.

pulse modulation: Transmitting data by altering (modulating) a pulsed or intermittent carrier.

realtime system: A system that receives and processes data so the data or result is available for immediate use.

RB: Request block.

receive initial command: In binary synchronous communications, a command that permits the communications adapter to receive synchronization characters.

receive time-out: The result of no data being received in a given period of time.

record: A collection of fields that is treated as a unit and is part of a file.

redundancy: See *cyclic redundancy check character*.

remote: Pertaining to a computer or device that is connected to another computer or device over a communications line. Contrast with *local*.

response time: The time it takes for a data communications system to respond to a request. For example, if you enter a customer number on a terminal keyboard, response time begins when you press the last key and ends when the first character of your answer is displayed at the terminal.

reverse-interrupt character (RVI): In binary synchronous communications, a request by the receiving station to the sending station to stop transmitting and receive a message.

RPG: A programming language specifically designed for writing application programs that meet common business data processing requirements.

RVI: See *reverse-interrupt character.*

SDLC: See *synchronous data link control.*

secondary station: The station that receives control from a primary station.

selection: See *addressing.*

sequence: An order of succession.

sequenced: Put in an order of succession.

serial transmission: Transmitting each bit of a data character separately over the same electrical path.

session: (1) The logical connection by which programs or devices can communicate with each other. (2) The length of time that starts when an operator signs on the system and ends when the operator signs off the system.

simplex channel: A channel that can transmit data in only one direction.

SNA: See *systems network architecture.*

SNA peer subsystem: An interactive communications feature subsystem that supports program-to-program communications with another System/34 or a System/36 on an SDLC line.

SNA remote job entry: Submission of jobs through an input unit that has access to a computer through an SNA data link.

SNA upline facility (SNUF): An interactive communications feature (for the System/34 and System/36) subsystem that supports program-to-program communications with CICS/VS and IMS/VS application programs using SNA.

SNUF: See *SNA upline facility.*

SOH: See *start-of-heading character.*

source: A system, a program within a system, or a device that makes a request to a target. Contrast with *target.*

space: Indicates the absence of a data signal on a communication channel.

SRJE: See *SNA remote job entry.*

SSP: See *System Support Program Product.*

SSP-ICF: See *Interactive Communications feature.*

start-of-heading (SOH) character: In binary synchronous communications, the transmission control character indicating that the information that follows is a heading.

standby display: A display that allows an operator to enter data only. When a standby display appears, the display station can be acquired by a program. Contrast with *command display.*

standby mode: See *standby display.*

start-of-text (STX) character: In binary synchronous communications, a transmission control character used to begin a logical set of records that will be ended by the end-of-text character.

start-stop: See *asynchronous transmission.*

station: A computer or device that can send or receive data.

STX character: See *start-of-text character.*

subhost: A communication system that controls attached terminals in addition to communicating with another (usually higher level) system.

subsystem: A part of the interactive communications feature that handles the requirements of the remote system, isolating most system-dependent considerations from the application program.

subvoice: Indicates a channel with a lower bandwidth than a voice grade channel.

switched line: A connection between computers or devices that is established by dialing. Contrast with *nonswitched line.*

switched network backup: A technique that provides a switched line connection when a nonswitched line fails.

SYN: See *synchronization character*.

sync: synchronous.

sync byte: A byte of synchronization characters.

synchronization character (SYN): In binary synchronous communications, the transmission control character that provides a signal to the receiving station for timing when other characters are not being sent.

synchronous: Occurring with a regular or predictable time relationship.

synchronous data link control (SDLC): A form of communications line control that uses commands to control data transfer over a communications line. Compare with *binary synchronous communications*.

synchronous transmission: A method of transmission in which the sending and receiving of characters is controlled by timing signals. Contrast with *asynchronous transmission*.

system: The computer and its associated devices and progams.

system configuration: A process that specifies the machines, devices, and programs that form a particular data processing system.

system console: A display station designated to activate certain system actions and to control and observe system operation.

system library: The library, provided with the system, that contains the System Support Program Product and is named #LIBRARY.

System Support Program Product (SSP): An IBM licensed program that provides data management and job control support for the system.

systems network architecture (SNA): A set of rules for controlling the transfer of information in a data communications network.

target: A system, a program within a system, or a device that interprets, rejects or satisfies, and replies to requests received from a source. contrast with *source*.

tariff: The established rates for data communications services.

telecommunications: Transmitting signals over long distance.

teleprocessing: Processing data that is received from or transmitted to a remote location via communication channels.

temporary-text-delay (TTD) character: A BSC transmission control character that indicates to the receiving station that there is a temporary delay in the transmission of data.

terminal: A device, uaually equipped with a keyboard and a display device, capable of sending and receiving information over a link.

transfer: To send data to one place and to receive data at another place.

translation table: A table that provides replacement characters for characters that cannot be printed by the line printer.

transmission control characters: Special characters that are included in a message to control communication over a data link. For example, the sending station and the receiving station use transmission control characters to exchange information; the receiving station uses transmission control characters to indicate errors in data it receives.

transparent data: Data that can contain any hexadecimal value.

transparent text mode: A mode that allows BSC to send and receive messages containing any of the 256 character combinations in hexadecimal, including transmission control characters.

tributary station: A secondary device on a multipoint line.

TTD character: See *temporary-text-delay character*.

turnaround: Changing a communications line from transmit mode to receive mode or from receive mode to transmit mode.

turnaround time: The time interval required to reverse the direction of transmission over a communication line.

utility program: An SSP program designed to perform a common task, such as copying data from diskette to disk.

version: A separate program product, based on an existing program product, that usually has important new code or new function. Numbering of versions starts with 1.

virtual circuit: In packet switching, those facilities provided by a network that give the appearance to the user of an actual connection. Contrast with *physical circuit*.

voice-grade telephone line: A telephone line that is normally used for transmission of voice communications. The line requires a modem for data communications.

VRC: Vertical redundancy check.

WACK: See *wait-before-transmitting-acknowledgment character*.

wait before transmitting acknowledgment character (WACK): In BSC, the transmission control character indicating that the station is temporarily not ready to receive data.

wide band channel: A communication channel that has a greater bandwidth than a voice channel; therefore, it is capable of transmitting data at high speeds.

work station: A device that lets a people transmit information to or receive information from a computer, or both, as needed to perform their job; for example, a display station or printer.

work station data management: The part of the SSP that enables a program to present data on a display screen by providing a string of data fields and a format name.

zero bit insertion/deletion: A function of inserting a zero after every four 1-bits and then removing the zeros to return the data to normal.

zero suppression: The substitution of blanks for leading zeros in a number. For example, 00057 becomes ␣␣␣57 when using zero suppression.

3270 BSC Support Subsystem: The subsystem that provides program-to-program communications with IMS/VS, CICS/VS, TSO, or System/3 CCP application programs using 3270 BSC protocols, and provides support for the BSC portion of the 3270 Device Emulation feature.

3270 SNA Support Subsystem: The subsystem that provides support for the SNA portion of the 3270 Device Emulation feature.

Bibliography

This bibliography lists publications containing more detailed information on the subjects and/or products that are discussed in this manual. You can order these publications from your IBM representative or your local IBM branch office.

The IBM Personal Computer

The IBM 5250 Emulation Program User's Guide, explains how to use the IBM Personal Computer as a 5250 device when it is attached to a host system that supports the IBM 5250 Information Display System family of display stations.

The IBM Asynchronous Communications Support, 6025218, explains how to use the IBM Personal Computer Asynchronous Communications Support Program. This manual provides information on program requirements. It also describes procedures for selecting and running terminals, communicating with host systems, and communicating with other personal computers or an IBM Personal Computer.

The IBM Series/1

The *IBM Series/1 Binary Synchronous Communication Control Program Support PRPQ 82516 User's Guide*, SC34-1553 contains information on the function provided by the IBM Series/1 Binary Synchronous Communication Control Program Support. It contains the procedures required to install and use the support provided. This guide also contains detailed information about the following:

- Hardware supported
- Programming considerations
- Interface modules
- Error messages and codes
- Trace facility

The *IBM Series/1 Remote Job Entry PRPQ P82575 User's Guide*, SC34-1589 describes the functions and installation procedures for the IBM Series/1 remote job entry support. It contains information on the devices supported, the command procedures used to communicate with RJE, and information on the host support. This publication also includes the following:

- Messages and codes
- Operator procedures
- Execution time options

The *IBM Series/1 Digest*, GX360-0061 contains information about the Series/1 devices and programs currently available.

The *IBM Series/1 Programming Systems Summary*, GC34-0285 describes licensed programs and programming RPQs available for use with the Series/1.

The IBM System/3

The *IBM System/3 Communications Control Program General Information Manual,* GC21-7578 provides a general description of the Communications Control Program.

The *IBM System/3 Communication Control Program System Design Guide,* GC21-5165 is a guide to designing a System/3 that uses the communications control program. This manual includes information on:

- Application design concepts
- The use of direct files
- File sharing
- 3270 screen design
- The use of printers under CCP
- System security and integrity
- Queuing theory
- Performance tips

The *IBM System/3 Communications Control Program Terminal Operator's Guide,* GC21-7580 contains both introductory and reference information necessary to use the System/3 communications control program from a terminal. It also includes consideration for terminals supported by CCP and a description of the commands used by terminal operators to request CCP services related to loading and executing application programs.

The *IBM System/3 Communications Control Program Messages Manual,* GC21-5170 helps identify the IBM System/3 CCP messages and how to respond to them. This manual contains all the operational messages, termination codes, terminal messages, and halts associated with System/3 CCP operations for all System/3 models.

The *IBM System/3 RPG II Telecommunications Programming Reference Manual,* SC21-7507 contains information needed to write an RPG II communications program. It also includes a description of each of the specifications required and sample programs that illustrate programming techniques and possible applications for System/3 RPG II communications programming.

The *IBM System/3 Model 15 Communications Control Program System Operator's Guide*, GC21-7619 contains information about using the IBM System/3 Communications Control Program (CCP). It also includes information on:

- The role of the system operator
- Startup and shutdown
- Controlling the CCP after startup
- Entering terminal operator commands and program requests from the console
- Operational stage message formats
- The disk file recovery program
- The glossary
- Sample commands
- The main storage dump to printer program
- Online tests
- Program errors

The *IBM System/3 Model 15D Channel Connected Systems Program Reference and Logic Manual*, GC21-5199 contains information on channel-connected Model 15Ds that use the modified SIOC (serial input/output channel).

The *IBM System/3 Multiline/Multipoint Binary Synchronous Reference Manual*, GC21-7573 provides information required to use the multiline/multipoint, (MLMP) feature with the System/3. The manual describes MLMP functions, MLMP macro instructions, diagnostics, diagnostic aids, system requirements, and considerations.

The *IBM System/3 Multiple Line Terminal Adapter RPQ Program Reference and Component Description Manual*, GC21-7560 contains information concerning MLTA features, describes the instruction set and the procedures to use the MLTA features, and the appendixes contain control block formats, tables, installation procedures, and other information about the MLTA and program analysis.

The IBM Office System 6

The *IBM Office System 6 Programmer's Guide for Communicating with*:

- *IBM 6/450 Information Processor*
- *IBM 6/440 Information Processor*
- *IBM 6/430 Information Processor*, G544-1003 contains information about how to develop a distributed word processing/record processing system which includes the communications attachment of an IBM Office System 6 Information processor to a host system.

The IBM System/23 Datamaster

The *IBM System/23 Communications Guide*, SA34-0111 consists of two parts.

- *Part 1* (Chapters 1-11) explains how to operate the System/23, using Binary Synchronous Communications. It explains how to use the communications Customer Support Functions to set up the communications environment, transmit data across the communications line, and find and correct problems with the communications system. It also explains how to write your own application program for Binary Synchronous Communications.
- *Part 2* (Chapters 12-21) explains how to operate the System/23, using Asynchronous Communications. It also explains how to use the communications Customer Support Functions to set up the communications environment, transmit data across the communications line, and find and correct problems with the communications system. It also includes information on how to write your own application program for Asynchronous Communications.

The appendixes contain information about installing and testing the communications equipment, the communications messages and codes, and a glossary of communication terms.

The IBM System/32

The *IBM System/32 Data Communications Reference Manual*, GC21-7691 contains information on work station input and output, MRJE/WS commands, MRJE/WS program operations, and the DCSUP print utility for MRJE/WS output. The appendixes include MRJE/WS line protocols, altering the BSC environment, data link control summary, and EBCDIC and ASCII code charts.

This manual describes System/32 SNA/SDLC communications concepts; batch work station system utility program input, output, commands, and program operation; and System/32 statements required to operate the system utility program for RJE and DB/DC.

Also provided is information needed to write System/32 RPG II communications programs. It contains a definition of basic communications terms, a description of the communications capabilities of the System/32, the RPG II communications specifications required to write a communications program for the System/32, sample programs, programming techniques, and possible applications for System/32 RPG II communications programming.

The *IBM System/32 Remote Job Entry PRPQ Information Manual*, GC21-7653 provides reference information for operators and programmers using the System/32 remote job entry program with HASP and POWER/VS. It also includes operating instructions, installation instructions, and program listings.

The IBM System/34

The *IBM System/34 Data Communications Reference Manual*, SC21-7703 contains information about how to write BSC programs that use assembler and RPG II programming languages. Sample programs are included to illustrate programming techniques and possible applications. It also explains how to use the MRJE (MULTI-LEAVING Remote Job Entry) and SRJE (SNA Remote Job Entry) utilities.

The *IBM System/34 Interactive Communications Feature Reference Manual*, SC21-7751 contains information about how to configure, write programs for, and use subsystems on the System/34. The subsystems can communicate with the same or different systems. Communications programs can be written using assembler, BASIC, COBOL, and RPG II for use with subsystems such as the BSCEL subsystem, BSC 3270 Support subsystem, and the SNA Upline Facility subsystem.

The *IBM System/34 3270 Device Emulation Program Product User's Guide*, SC21-7868 contains operating information about device emulation and information about setting up and running the 3270 Device Emulation program product. This manual contains information about both BSC and SNA 3270 Device Emulation.

The *IBM System/36, IBM System/34, and System/3 Model 15D Distributed Disk Facility Reference Manual*, SC21-7869 contains information about installing, setting up, and operating the Distributed Disk File Facility (DDFF). The DDFF extends System/34 disk data management and the Interactive Communications feature (SSP-ICF) support to permit a System/34 application program to access files stored on a System/3 or on another System/34.

The IBM System/36

IBM System/36 Interactive Communications Feature: Guide and Examples, SC21-7911, contains general information about the SSP-ICF, including:

- How to install and use SSP-ICF
- How SSP-ICF works
- How to write programs that use SSP-ICF
- Programming examples
- Problem determination information

IBM System/36 Interactive Communications Feature: Reference, SC21-7910, contains detailed information about the Interactive Communications feature.

Multiple Session Remote Job Entry, SC21-7909, describes the Multiple Session Remote Job Entry feature and contains information about configuring both BSC and SNA/SDLC. This manual also contains information about how to use this feature.

3270 Device Emulation Guide, SC21-7912, describes the 3270 Device Emulation feature for both BSC and SNA/SDLC. This manual also describes how to use the BSC program interface, contains reference information for using the program interface, and host systems considerations.

The IBM System/38

The *IBM System/38 Data Communications Programmer's Guide*, SC21-7825 contains communications configuration information, information about how to write communications programs (using languages such as RPG III and COBOL), and information about how to use the programs to communicate with other terminals and systems in environments such as an SNA environment using SDLC and a BSC environment.

The *IBM System/38 Remote Job Entry Facility User's Guide*, SC21-7914 provides the information needed to use the System/38 as a remote job entry work station to a host system. This manual also provides information required to define the System/38 resources and operations for a remote job entry station.

The *IBM System/38 Remote Job Entry Facility Installation Planning Guide*, GC21-7924 contains information for planning and installing the System/38 Remote Job Entry Facility. Also included is an example of how to install the RJEF.

The *IBM System/38 3270 Emulation Reference and User's Guide*, SC21-7961 contains configuration information and operating information about BSC 3270 device emulation. This manual also contains information about the BSC 3270 emulation program interface, programming considerations, files, coding, and host considerations.

The IBM 3270

The *Introduction to the IBM 3270 Information Display System Manual,* GA27-2739 contains planning information about the 3270 and local and remote display stations and printers. The publication:

- Describes the 3270 hardware (units, features, functional capabilities) and its programming support
- Outlines applications for alphameric displays and guidelines for conversion
- Gives data on human factors, installation planning, reliability, and performance

The *IBM RPG II 3270 Display Control Feature Reference and Logic Manual,* SC21-5161 describes how to write communications application programs to run under the RPG II 3270 display control feature and provides information to aid the RPG II application programmer and IBM systems engineer.

The introductory chapter of the manual summarizes the requirements of the display control feature. Subsequent chapters describe the application program interface, the operations and their codes, how to write RPG II application programs, and internal logic of the display control feature.

The IBM 3741

The *IBM 3741 Data Station Reference Manual,* GA21-9183 describes the basic and special features, application, and capabilities of the 3741.

The IBM 3747

The *IBM 3747 Data Converter Reference Manual and Operator's Guide,* GA21-9170 explains how to use the 3747. The manual contains information on programming considerations, disk and tape operations, the binary synchronous communications feature, operating considerations, and error recovery.

The IBM 5100, 5110, and 5120

The *IBM 5100 Computer Communications Adapter Feature User's Manual*, SA21-9215 describes how to operate the feature, lists the error codes applicable to the 5100 communications feature, and how to use the communications adapter self test to check the 5100 communications feature. The appendixes contain setup instructions, sample programs, and translation code charts.

The *IBM 5110 Binary Synchronous Communications Feature User's Manual*, SA21-9316 describes how to use the 5110 with binary synchronous feature, and information needed to plan, set up, and check out the feature.

The *IBM 5110 Asynchronous Communications Feature User's Manual*, SA21-9314 describes how to operate the feature, lists the error codes applicable to the 5110 communications feature, and how to use the communications adapter self test to check the 5110 communications feature. The appendixes include setup instructions, sample programs, and translation code charts.

The IBM 5250 Information Display System

The *IBM 5250 Information Display System*, GA21-9246 describes each machine in the 5250 family, their special features, and how you can use them. This manual also discusses how a display system can be used in data processing applications.

The IBM 5260

The *IBM 5260 Retail System—Systems Planning Guide*, GA21-9390 contains operating information about the 5260 system.

The IBM 5280

The *IBM 5280 Distributed Data System Communications Reference Manual*, SC34-0384 contains information about the communications utilities and how to write communications programs using DE/RPG, COBOL, and the assembler languages.

The IBM 5520

The *IBM 5520 Administrative System Document Distribution Concepts and Facilities*, GC23-0707 describes document distribution and explains the communications functions that are available.

The IBM Displaywriter

The *IBM Displaywriter System*, G544-0851 contains information about the Displaywriter system functions, such as text processing and communications. Also described is the equipment available that supports this system.

Other Related Manuals

The *X.25 Interface for Attaching SNA Nodes to Packet Switched Data Networks General Information Manual*, GA27-3345 describes the elements, including optional user facilities, of CCITT Recommendation X.25—interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode on public data networks that are applicable to IBM SNA network nodes that can attach to X.25-based Packet-Switched Data Networks.

The *IBM Systems Reference Library—General Information—Binary Synchronous Communications*, GA27-3004 contains information on binary synchronous communication concepts, transmission codes, data link operation, message formats, additional data link capabilities, and planning considerations.

The *IBM Synchronous Data Link Control General Information Manual*, GA27-3093 contains a brief background and basic description of SDLC terminology and concepts. It also includes a catalog of SDLC components and some representative examples of their uses.

The *IBM Systems Network Architecture General Information Manual*, GA27-3102 describes the basic terminology, concepts, and scope of systems network architecture (SNA).

The *IBM Systems Network Architecture Reference Summary*, GA27-3136 contains summary information about the structure of SNA and SDLC, format and profile descriptions, and other information.

The *IBM Communicating Magnetic Card Selectric Typewriter Reference Manual*, G543-0608 describes the functional characteristics of the Communicating Magnetic Card Selectric Typewriter.

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