Systems

An Introduction to the IBM 3270 Information Display System

IBM

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Preface

This publication provides customer executives and data processing management, system analysts, programmers, and IBM marketing representatives and systems engineers with introductory information about the IBM 3270 Information Display System, which comprises the following units:

- 3271 Control Unit Models 1 and 2 (BSC protocol)
- 3271 Control Unit Models 11 and 12 (SDLC protocol)
- 3272 Control Unit Models 1 and 2 (Local)
- 3274 Control Unit Models 1A, 1B, 1D, 21A, 21B, 21D, 31A, and 31D (Local)
- 3274 Control Unit Models 1C, 21C, 31C, and 51C (BSC or SDLC protocol)
- 3275 Display Station Models 1 and 2 (BSC protocol)
- 3275 Display Station Models 11 and 12 (SDLC protocol)
- 3276 Control Unit Display Station Models 1, 2, 3, and 4 (BSC or SDLC protocol)
- 3276 Control Unit Display Station Models 11, 12, 13, and 14 (SDLC protocol)
- 3277 Display Station Models 1 and 2
- 3278 Display Station Models 1, 2, 3, 4, and 5
- 3279 Color Display Station Models 2A, 2B, 3A, and 3B
- 3262 Line Printer Models 3 and 13
- 3284 Printer Models 1, 2, and 3
- 3286 Printer Models 1 and 2
- 3287 Printer Models 1, 1C, 2, and 2C
- 3288 Line Printer Model 2
- 3289 Line Printer Models 1 and 2

Check with your IBM marketing representative for details about the IBM programming support that is applicable for your configuration.

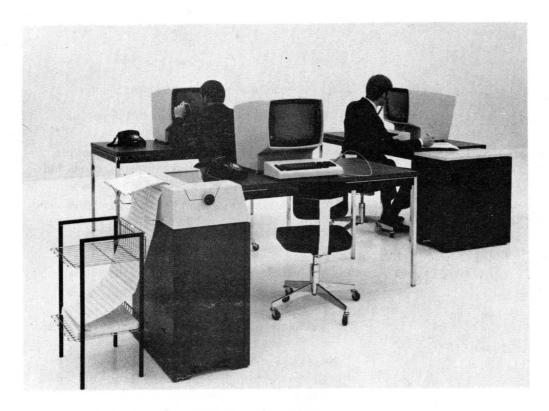This publication is divided into seven chapters:

- Chapter 1, Introduction, highlights important aspects of the 3270 display products.
- Chapter 2, Display System Units, describes the various control units and the display stations and printers to which they attach.
- Chapter 3, Input/Output Functions, outlines some of the functional capabilities of the 3270 display system.
- Chapter 4, Applications, discusses types of applications that can be served by the 3270 display system.
- Chapter 5, Programming Support, lists access methods program products, interactive subsystems, and program facilities that support the use of the 3270.
- Chapter 6, Installation Planning and Setup, briefly describes installation planning and setup requirements and lists literature available.
- Chapter 7, Problem Determination, lists software products that help provide effective problem determination.

A list of abbreviations and a glossary precede the index.

This publication assumes that the reader has a basic understanding of display systems and of their relation to a host computer. Someone reading those chapters related to programming is expected to have an understanding of an operating system and of applications-related display system programming support.

For details on color and programmed symbols, including programming support, refer to *IBM 3270 Information Display System: Color and Programmed Symbols*, GA33-3056.

See *IBM 3270 Information Display System Library User's Guide,* GA23-0058, for a listing of publications pertinent to the 3270 display system.

Frontispiece. IBM 3270 Information Display System — Line Printer, Display Terminals, and Control Unit (Design Models)

Frontispiece. IBM 3270 Information Display System — Control Unit Display Station, Matrix Printer, and Display Terminals (Design Models)

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Chapter 1. Introduction

The IBM 3270 Information Display System is a family of display products consisting of control units and of monochrome and color display stations and printers. When equipped with a variety of available features, the 3270 display system units can be configured in various combinations. This flexibility of configuration permits the user to tailor the system to the needs of his alphameric and business graphic-display applications.

The control unit directs the operation of its attached display stations and printers and provides the attachment of the 3270 display system to a data processing system. Configurations range from a single control unit display station to a configuration in which the control unit directs the operation of up to 32 display stations and printers (called a *cluster*).

Permissible control unit attachments to a data processing system are:

- Local attachment directly to a host system channel.
- Remote attachment to a host system via binary synchronous communications (BSC) protocol or synchronous data link control (SDLC) protocol either through communication facilities or through direct connection via an Electronic Industries Association (EIA) interface.
- Loop attachment either to a data-link-attached or to a direct-attached loop of the IBM 8100 Information System and IBM 4331 Processor.
- Direct attachment to the IBM 3790 Communication System and to the IBM 8100 Information System.
- Direct attachment to the IBM 3704 and 3705 Communications Controllers.

Highlights

Features of the 3270 Information Display System include:

- Various keyboards, such as typewriter, data entry, APL, text, attribute select, overlay, and operator console keyboards.
- Selector light pen and Cursor Select key, which allow a display operator to select fields of data from the display screen for input to the host system.
- Magnetic slot reader and magnetic hand scanner, which permit entry of magnetically encoded data.
- Screen formatting and editing capability.
- Control of field and character attributes.
- Display stations and printers with color capabilities.
- Extended highlighting, which provides reverse video, blinking, and underscore on monochrome and color displays.
- Underscore on monochrome and color printers.
- Programmed symbols to permit user-designed symbols and presentation graphics to be displayed or printed in monochrome and color.
- Data security features, such as a security keylock, an operator identification card reader, and a magnetic slot reader to permit entry of data without its being displayed.

- Encryption/decryption capability, which allows the user to encipher and decipher data between the host system and the control unit.
- APL and Text capabilities.

Note: *Not all features are available on all units and models. For details about configurations and features, see* IBM 3270 Information Display System: Configurator, *GA27-2849, or consult your IBM marketing representative.*

Applications and Programming Support

The 3270 display system is designed for alphanumeric display applications, including simple, interactive, or complex inquiry applications, data or order entry applications, and system console applications. Display stations provide end users with access to their data in a quick and convenient form. With the proper use of color, graphics, and extended highlighting, end-user comprehension of displayed data or printed data can be improved. Chapter 4 contains a survey of applications and a description of highlights of the 3270 display system in relation to these applications.

Chapter 5 lists the access methods, program products, interactive subsystems, and program facilities that support the 3270 display system.

Problem Determination

- Problem determination aids to be used by the operator include Unit Problem Determination Guides.
- Problem determination software facilities at the host include: Network Problem Determination Application, Display Exception Monitoring Facility, Facility Error Recognition System, and Network Error Management Facility.

Human Factors and Installation Planning

The 3270 display system has been designed with human factors and installation-planning considerations in mind:

- The display image is clear, stable, and bright. The 3276, 3278, and 3279 display stations have a filter bonded to the face of the cathode-ray tube to reduce glare on the display screen.
- The 3279 Color Display Station is a high-quality color display for alphanumeric and presentation graphics use. It has an adjustable, tilted screen to provide a more comfortable viewing position.
- Color convergence (the superimposing of primary colors to produce secondary colors on the 3279 display screen) can be performed by the operator. The procedure can be called out by the operator using the keyboard and a special pattern that is displayed on the screen.
- Features are available such as movable keyboards with layouts familiar to typists, data entry operators, or system operators.
- Operators of the 3276, 3278, and 3279 display stations are assisted by an operator information area on the bottom of the screen, below and outside the data area, which displays messages and status.

For more information on human factors, see *Human Factors of Workstations with Display Terminals*, G320-6102. For details about installation planning, see *IBM 3270 Information Display System: Installation Manual–Physical Planning*, GA27-2787.

Customer Setup

The IBM 3274 Control Unit Models 1C, 21C, 31C, and 51C, 3276 Control Unit Display Station, 3278 Display Station, 3279 Color Display Station, 3262 Line Printer, 3287 Printer, and 3289 Line Printer are designated customer setup (CSU) machines. This offers the customer early availability and terminal-relocation flexibility. For detailed information, see *IBM 3270 Information Display System: IBM 3274 Control Unit Planning, Setup, and Customizing Guide*, GA27-2827, and *IBM 3270 Information Display System: IBM 3276 Control Unit Display Station Planning and Setup Guide*, GA18-2041. Other publications pertinent to customer setup are listed in *IBM 3270 Information Display System Library User's Guide*, GA23-0058.

System Attachment (Figure 1-1)

Host systems that can operate with 3270 display systems when locally attached or when remotely attached and using BSC protocol are:

- System/360 Models 30, 40, 50, 65, 75, and 195
- All System/370 Processors
- All 4300 Processors
- System/3 Models 4, 8, 10, 12, and 15[1]

Host systems that can operate with the 3270 display system when remotely attached and using SDLC protocol are:

- All System/370 Processors
- All 4300 Processors
- 8100 Information System

Local Attachment

Local attachment of a control unit to a System/360 or System/370 processor is through a selector, multiplexer, or block multiplexer channel. The control unit attaches to one of the eight control unit positions on the channel interface. The channel provides the control unit with data that is to be displayed and printed and with control information needed by the control unit to direct the operation of its attached display stations and printers. Buffer storage in the devices (display station or printer) stores digitally coded data from the control unit for display or printing. The buffer permits simultaneous display image presentation and message composition from a keyboard at each display station.

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[1] For System/3 support, refer to the appropriate System/3 manuals.

SCP
TP/AM
DB/DC

Host Interactive

Distributed

3275

3704/3705 NCP

Channel
Attachment

3277

Channel
Attachment

Channel
Attachment

3791

3276 only

3284
3286
3287
3288

3274 Model 51C

or
3276

3271
3272

3274²

3277²

3274-51C
only

3284

3287

S/8100

(A)

(A)

(A)

Clusters

Large   Small

3287
• 4-Color
• PS³

3289

3277
3284
3286
3287
3288

3284²
3286²
3288²

3278⁴

3262⁵

Loops: Directly attached or data-link-attached

3279
• (4-Color)
• (7-Color)²
• PS²

—— Directly Attached

⟋ Communication
Facility

¹ Models 1A, B, C, D; 21A, B, C, D; 31A, C, D
² Not supported by S/8100 attachments of 3274 Model 51C.
³ 3274 except for Models 1B and 21B.
⁴ Models 1 through 4 for 3274 Model 1B and 3276; Models 1 through 5
  for 3274 Models 1A, C, D; 21A, C, D; 31A, C, D; and 51C.
⁵ 3274 attaches Models 3 and 13; 3276 attaches Model 13.

Figure 1-1. IBM 3270 Information Display System Attachment Overview

1-4

Locally attached control units can be positioned up to 61 meters (200 ft) from the system channel, depending upon system and channel configuration. Control units that can be locally attached are:

- 3272 Control Unit Models 1 and 2
- 3274 Control Unit Models 1A, 1B, 1D, 21A, 21B, 21D, 31A, and 31D

Remote Attachment – General

Remote attachment differs from local attachment in the medium through which the control unit and the system channel communicate. In a local configuration, the control unit is cabled directly to the system channel. In a remote configuration, on the other hand, communication between the system channel and the control unit is via a channel-connected transmission control unit or an integrated communication adapter (using BSC protocol), or via a communication controller (using BSC or SDLC protocol). [The communication controller can be remotely connected to the channel if operating with the network control program (NCP).] The control unit is connected to these intermediate devices by means of communication facilities (data links) consisting of modems and common-carrier switched (SDLC) or nonswitched (BSC or SDLC) voice-grade channels, or the customer's own equivalent facilities (telephone lines or microwave).

Remote Attachment Using BSC Protocol

Control units that can be remotely attached are:

- 3271 Control Unit Models 1 and 2
- 3274 Control Unit Models 1C, 21C, 31C, and 51C
- 3275 Display Station Model 2
- 3276 Control Unit Display Station Models 1, 2, 3, and 4

Depending upon the host system and channel selected, an IBM 2701 Data Adapter Unit, an IBM 2703 Transmission Control Unit, or an IBM 3704 or 3705 Communications Controller connects the teleprocessing network to the host system channel.

Remote Attachment Using SDLC Protocol

Control units that can be remotely attached are:

- 3271 Control Unit Models 11 and 12
- 3274 Control Unit Models 1C, 21C, 31C, and 51C
- 3275 Display Station Model 12
- 3276 Control Unit Display Station Models 11, 12, 13, and 14
- 3276 Control Unit Display Station Models 1, 2, 3, and 4 (equipped with the SDLC/BSC Switch feature)

Loop Attachment Using SDLC Protocol

Loops can be attached to the 8100 Information System and 4331 Processor directly and through a data link. Directly attached loops operate at 9,600 or 38,400 bits per second (bps); data-link-attached loops operate at 1,200 or 2,400 bps. Both directly attached and data-link-attached loops can be used with the 8130 and 8140 Processors and the 8101 Storage and I/O Unit. The 3274 Control Unit Model 51C and the 3276 Control Unit Display Station Models 11, 12, 13, and 14 can attach to both the directly attached and data-link-attached loops.

Communication Networks and Modems

Remotely attached 3270 display systems that use BSC or SDLC protocol operate in data half-duplex transmission mode on half-duplex or duplex communication facilities.

The 3271 Models 1 and 2, the 3274 Models 1C, 21C, 31C, and 51C, and the 3276 Models 1, 2, 3, and 4 can attach to a multipoint nonswitched network. The 3275 Model 2 can operate in multipoint mode on nonswitched lines or on switched network when the Dial feature is installed.

The 3271 and 3275 Model 12, the 3274 Models 1C, 21C, 31C, and 51C, and the 3276 Models 11, 12, 13, and 14 can attach to multipoint nonswitched line networks. The 3276 Models 11, 12, 13, and 14, and the 3274 Model 51C can also attach to switched lines. When two or more SDLC devices are multidropped and attached to a 3704 or 3705 Communications Controller, messages may be simultaneously transmitted and received by the 3704 or 3705 units on duplex facilities (multi-point operation). The 3704 or 3705 Communications Controller can operate in data full-duplex mode; however, the 3270 units operate only in data half-duplex mode.

The 3274 Models 31C and 51C can be featured with 2,400-, 4,800-, and 9,600-bps integrated modems to provide nonswitched modem capability. These integrated modems are microprocessor-based and are compatible with the IBM 3863, 3864, and the 3865 Models 1 and 2 Modems.

The 3276 Models 1, 2, 3, and 4 can communicate with a host system via a data link using BSC or SDLC protocol if the SDLC/BSC Switch feature is installed.

The following external IBM modems can be used in remote systems that use BSC or SDLC protocol:

- 3863 Model 1 (2,400/1,200 bps)
- 3864 Model 1 (4,800/1,200 bps)
- 3865 Models 1 and 2 (9,600/4,800 bps)
- 3872 Model 1 (2,400/1,200 bps)
- 3874 Model 1 (4,800/2,400 bps)
- 3875 Model 1 (7,200/3,600 bps)
- 3976 Model 3 (1,200/600 bps) (World Trade countries only)
- 5979-L41 (9,600 bps) (World Trade countries only)

Switched-network backup (SNBU) with manual call and manual or auto answer is available on the 3872, 3874, and 3875 modems. Four-wire SNBU operation with manual call and auto answer is available on the 3863, 3864, and 3865.

Switched-network backup operation is initiated by the terminal operator. When, for example, a problem is experienced with a nonswitched line, the terminal operator can call the host system to reestablish a connection for operation.

A Digital Data Service (DDS) Adapter installed in the 3274 Models 1C, 21C, 31C, and 51C or in the 3276 interfaces with American Telephone and Telegraph's nonswitched Dataphone[2] digital data service network.

In the 3274, the DDS Adapter can operate in BSC or SDLC data transmission at speeds of 2,400, 4,800, and 9,600 bps and, in SDLC only, at speeds up to 56 kilobits per second. In all models of the 3276, the DDS Adapter can operate at speeds of 2,400 and 4,800 bps; and in Models 11, 12, 13, and 14, the DDS Adapter can also operate at a speed of 9,600 bps.

A CCITT V.35 Interface feature, for attachment to an external modem or other data circuit-terminating equipment (DTE), provides for speeds up to 57.6 kilobits per second for SDLC or 9,600 bps for BSC on the 3274 Models 1C, 21C, 31C, and 51C.

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[2] Trademark of American Telephone and Telegraph Company.

Chapter 2. Display Units

The 3270 family of display system products includes display stations and printers. These terminals, both monochrome and color, can be attached to various control units in configurations that are flexible to a user's needs. This includes the ability to configure a variety of display systems from the following basic groups of IBM units.

Control Units

3271 Control Unit

- This floor-standing control unit can control up to 32 display stations and printers, in any combination, in half-duplex mode on duplex or half-duplex communication facilities.
- Models 1 and 11 have 480-character buffer capacity.
- Models 2 and 12 have 1,920-character buffer capacity.
- Models 1 and 2 communicate with a System/360 Models 25, 30, 40, 50, 65, 67 (in 65 mode), 75, 85, and 195 or any System/370 Processor via a 2701 Data Adapter Unit, 2703 Transmission Control, or, except for S/360 Models 25 and 85, a 3704 or 3705 Communications Controller using binary synchronous communication (BSC) protocol. Both models also communicate with the 4300 Processors via a 2701, 3704, or 3705, and with the 4331 Processor via the Communications Adapter feature.
- Models 1 and 2 attach to System/3 Model 10 via a System/3 Binary Synchronous Communications Adapter or to System/3 Model 15 via the Local Communications Adapter.
- Models 11 and 12 communicate with any S/370 or 4300 Processor via a 3704 or 3705 Communications Controller (or via the Communications Adapter feature on the 4331 Processor) using synchronous data link control (SDLC) protocol.
- The 3271 can operate at line speeds of up to 7,200 bps for BSC and 9,600 bps for SDLC.
- One type of device adapter is used to attach terminals to the 3271. The attachable terminals and their associated control unit models are as follows.

  - Models 1 and 11 can attach up to 32:
    - 3277 Display Stations Model 1 (at least one, with keyboard, is required)
    - 3284 Printers Model 1
    - 3286 Printers Model 1
    - 3287 Printers Model 1 or 2
  - Models 2 and 12 can attach up to 32:
    - 3277 Display Stations Model 1 or 2 (at least one, with keyboard, is required)
    - 3284 Printers Model 1 or 2
    - 3286 Printers Model 1 or 2

. 3287 Printers Model 1 or 2

. 3288 Line Printers Model 2

- The maximum cable length from an attached terminal to the 3271 is 610 meters (2,000 ft).

3272 Control Unit

- This floor-standing control unit can control up to 32 display stations and printers, in any combination, for local channel attachment to a data processing system.
- Model 1 has 480-character buffer capacity.
- Model 2 has 1,920-character buffer capacity.
- The unit attaches to System/360 Models 25, 30, 40, 50, 65, 67 (in 65 mode), 75, 85, and 195; to any System/370 Processor via a selector, multiplexer, or block multiplexer channel;[1] or to any 4300 Processor via a byte multiplexer or block multiplexer channel.
- The data-to-channel rate is up to 650, 000 bps.
- Model 1 can attach up to 32:
  - 3277 Display Stations Model 1 (at least one, with keyboard, is required)
  - 3284 Printers Model 1
  - 3286 Printers Model 1
  - 3287 Printers Model 1 or 2
- Model 2 can attach up to 32:
  - 3277 Display Stations Model 1 or 2 (at least one, with keyboard, is required)
  - 3284 Printers Model 1 or 2
  - 3286 Printers Model 1 or 2
  - 3287 Printers Model 1 or 2
  - 3288 Line Printers Model 2
- The maximum cable length from an attached terminal to the 3272 is 610 meters (2,000 ft).

3274 Control Unit Models 1A, 1B, 1D, 21A, 21B, 21D, 31A, and 31D

Models 21A and 31A, Model 21B, and Models 31A and 31D are functionally compatible with the Models 1A, 1B, and 1D, respectively. Models 21A, B, and D have 64K bytes of storage; Models 31A and D have 128K bytes of storage.

- These floor-standing control units (Figure 2-1) can control up to 32 display stations and printers, in any combination, for local channel attachment to a data processing system.

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[1]Because of performance considerations, which may yield less than maximum throughput, attachment to a non-disconnect-chain-command (DCC) subchannel of a block multiplexer channel or to a selector channel is not recommended.

Figure 2-1. IBM 3274 Control Unit Models 1A, 21A, and 31A

- Models 1A, 21A, and 31A: For local [systems network architecture (SNA) version] attachment, via a byte multiplexer, selector, or block multiplexer channel,[2] to a System/370 Processor, or to any 4300 Processor via a byte multiplexer or block multiplexer channel.

- Models 1B and 21B: For local (3272 version, non-SNA) attachment, via a byte multiplexer, selector, or block multiplexer channel,[2] to a System/370 Processor or to a System/360 Models 30, 40, 50, 65, 75, and 195, or to any 4300 Processor via a byte multiplexer or block multiplexer channel.

- Models 1D, 21D, and 31D: For local (3272 version, non-SNA) attachment, via a byte multiplexer, selector, or block multiplexer channel,[2] to a System/370 processor, or to any 4300 Processor via a byte multiplexer or block multiplexer channel.

- Two types of terminal adapters (Type A and Type B) are used to attach terminals to the 3274:

  - Type A terminal adapters attach the following Category A terminals:

    . 3278 Display Station Models 1, 2, 3, 4 (3274 Models 1A, 1B, 21A, 21B, 21D, 31A, 31D)

    . 3278 Display Station Model 5 (3274 Models 1A, 1D, 21A, 21D, 31A, 31D)

    . 3262 Line Printer Models 3 and 13

    . 3279 Color Display Station Models 2A, 2B, 3A, and 3B

    . 3287 Printer Models 1, 1C, 2, and 2C

    . 3289 Line Printer Models 1 and 2

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[2]Because of performance considerations, which may yield less than maximum throughput, attachment to a non-DCC subchannel of a block multiplexer channel or to a selector channel is not recommended.

-   Type B terminal adapters attach the following Category B terminals:
    .   3277 Display Station Models 1 and 2
    .   3284/3286 Printers Models 1 and 2
    .   3287 Printer Models 1 and 2
    .   3288 Line Printer Model 2

-   A maximum number of 32 terminals attach to these models of the 3274; only 16 (maximum), however, can be attached to the Type B terminal adapters of the 3274.

-   At least one 3278 or 3279 Display Station with a keyboard must be attached to each 3274 Control Unit.

-   The maximum cable length from an attached terminal to a Type A terminal adapter is 1 500 meters (4,920 ft); maximum cable length from an attached terminal to a Type B terminal adapter is 610 meters (2,000 ft).

3274 Control Unit Models 1C, 21C, and 31C

Models 1C, 21C, and 31C are functionally compatible. Model 21C has 64K bytes of storage; Model 31C has 128K bytes of storage. In addition, the 31C has nonswitched integrated modem capability of 2,400, 4,800, and 9,600 bps.

These floor-standing control units can:

-   Control up to 32 display stations and printers. Up to 16 of these may attach to the 3274 via a Type B terminal adapter.

-   Communicate with a System/370 or 4300 Processor using SDLC protocol via a 3704 or 3705 Communications Controller or via the Communications Adapter of the 4331.

-   Communicate with a System/360, System/370, or 4300 Processor using BSC protocol via (where applicable) a 2701 Data Adapter Unit, 2703 Transmission Control, a 3704 or 3705 Communications Controller, or the Communications Adapter of the 4331.

-   Communicate with System/370 Models 115, 125, 135, and 138, using BSC, via an Integrated Communications Adapter.

-   Operate in half-duplex point-to-point or multipoint mode on half-duplex or duplex facilities, using SDLC or BSC, at transmission speeds of 2,000, 2,400, 4,800, 7,200, and 9,600 bps on nonswitched facilities. Multipoint and point-to-point communications at speeds up to 19.2 kilobits per second and point-to-point communications at speeds up to 56 kilobits per second are also possible where facilities are available. In addition, communications through a 3705 Communications Controller, or to the Communications Adapter of the 4331, can be via direct connection (that is, without modems or communications facilities) at speeds up to 57.6 kilobits per second. All communications at speeds greater than 9,600 bps must use SDLC protocol.

-   Can also attach to System/3 Models 4, 8, 10, 12, and 15 via a System/3 Binary Synchronous Communications Adapter; to Models 8 and 12 via an Integrated Communications Adapter; to Models 8, 10, 12, and 15 via an EIA local attachment; or to Models 10 and 15 via a Local Communications Adapter.

- Two types of terminal adapters (Type A and Type B) are used to attach terminals to the 3274:
  - Type A terminal adapters attach the following Category A terminals:
    - 3278 Display Station Models 1, 2, 3, 4, and 5
    - 3279 Color Display Station Models 2A, 2B, 3A, and 3B
    - 3262 Line Printer Models 3 and 13
    - 3287 Printer Models 1, 1C, 2, and 2C
    - 3289 Line Printer Models 1 and 2
  - Type B terminal adapters attach the following Category B terminals:
    - 3277 Display Station Models 1 and 2
    - 3284/3286 Printers Models 1 and 2
    - 3287 Printer Models 1 and 2
    - 3288 Line Printer Model 2

- At least one 3278 or 3279 display station with a keyboard must be attached to each 3274 Model 1C, 21C, and 31C.

- The maximum cable length from an attached terminal to a Type A terminal adapter is 1 500 meters (4,920 ft); maximum code length from an attached terminal to a Type B terminal adapter is 610 meters (2,000 ft).

3274 Control Unit Model 51C

- This table-top model of the 3274 (Figure 2-2) communicates remotely in the same manner as Models 1C, 21C, and 31C. With the appropriate configuration support, it provides all the functions supported by those models. It can control up to 12 display stations and printers. In addition, Model 51C has the following capabilities not available on the Models 1C, 21C, and 31C:
  - Communicates with a 4331 Processor or the 8100 Information System via a direct or data-link-attached loop using SDLC.

  - Operates in half-duplex mode at 9,600 or 38,400 bps over a direct-attached loop, and at 2,400, 4,800, or 9,600 bps over a data-link-attached loop.

  - Operates in half-duplex point-to-point or multipoint mode on half-duplex or duplex facilities, using SDLC or BSC, at a transmission speed of 1,200 bps via an integrated modem. (Like the Model 31C, Model 51C also has the 2,400-, 4,800-, 7,200-, and 9,600-bps integrated modems.)

  - Operates in half-duplex point-to-point mode using SDLC at transmission speeds of 1,200, 2,400, 4,800, and 9,600 bps on switched facilities.

  - Communicates with the 8100 Information System via direct connection (that is, without modems or communications facilities) at speeds up to 57.6 kilobits per second using SDLC protocol.

- Except for the 3276 printer default matrix, the Model 51C supports the functions and features on attached terminals that are supported on those same terminals attached to the 3276 Control Unit Display Station. Two types of terminal adapters (Type A and Type B) attach terminals to the Model 51C. The base 3274 Model 51C permits attachment of eight Category A terminals via the Type A terminal adapter. Four additional Category B terminals can be attached via the Type B terminal adapter.

Figure 2-2. IBM 3274 Control Unit Model 51C

      – Category A terminals are:

         . 3278 Display Station Models 1, 2, 3, 4, and 5

         . 3279 Color Display Station Models 2A, 2B, 3A, and 3B

         . 3262 Line Printer Models 3 and 13

         . 3287 Printer Models 1, 1C, 2, and 2C

         . 3289 Line Printer Models 1 and 2

      – Category B terminals are:

         . 3277 Display Station Models 1 and 2

         . 3284 Printer Models 1 and 2

         . 3286 Printer Models 1 and 2

         . 3287 Printer Models 1 and 2

         . 3288 Line Printer Model 2

- At least one 3278 or 3279 display station with a keyboard must be attached to each 3274 Model 51C.

- The maximum cable length from an attached terminal to a Type A terminal adapter is 1 500 meters (4,920 ft); maximum cable length from an attached terminal to a Type B terminal adapter is 610 meters (2,000 ft).

3274 Control Unit (All Models)

As part of the installation procedure for all 3274 models, a customized system diskette is generated. The generation process is accomplished by the customer's inserting diskettes in the 3274 and keying in system configuration parameters at a 3278 or a 3279 display station attached to the 3274. (The display station attaches to port 0 of Model 51C and to port A0 on all other models.) A duplicate, or

backup, system diskette can be generated at the 3274 using a similar procedure. Also, the customized diskette can be recustomized to modify the configuration data.

Control Unit Display Stations

3275 Display Station

- This table-top display station with integrated control unit attaches to a communication network. One 3284 Printer Model 3 can be attached to provide a paper copy.
- Models 2 and 12 have 1,920-character buffer capacity.
- Model 2 provides controls and display of alphanumeric information from a System/360 Models 25, 30, 40, 50, 65, 67 (in 65 mode), 75, 85, and 195 or any System/370 Processor via a 2701 Data Adapter Unit, 2703 Transmission Control, or, except for System/360 Models 25 and 85, a 3704 or 3705 Communications Controller on half-duplex or duplex communication facilities using BSC protocol. It also provides controls and display of alphanumeric information from any 4300 Processor via a 2701, 3704, or 3705 on half-duplex or duplex communication facilities using BSC. Communication is also possible via a Communications Adapter feature on the 4331 Processor.
- Model 2 attaches to System/3 Models 4, 8, 10, 12, and 15 via a BSC Adapter or System/3 Models 8 and 12 via an Integrated Local Communications Adapter.
- Model 12 provides controls and display of alphanumeric information from any System/370 or 4300 Processor via a 3704 or 3705 Communications Controller on half-duplex or duplex commmunication facilities using SDLC protocol. Communication is also possible via a Communications Adapter feature on the 4331 Processor.
- Model 2 operates at transmission speeds on a public switched network of up to 1,200 bps and on leased line facilities of up to 7,200 bps.
- Model 12 operates at transmission speeds on leased line facilities of up to 9,600 bps.

3276 Control Unit Display Station

- This table-top control unit (Figure 2-3) with integrated display station can control up to seven additional 3278 Display Stations, 3279 Color Display Stations, 3262 Line Printers, 3287 Printers, and 3289 Line Printers in half-duplex mode on duplex or half-duplex communication facilities. Thus, a maximum cluster of eight displays and/or printers, including the 3276 display, is possible. A keyboard is required on each 3276.
- Models 1, 2, 3, and 4 communicate with a System/360, System/370, or 4300 Processor using BSC protocol over communication facilities, via (where applicable) a 2701 Data Adapter Unit, a 2703 Transmission Control, a 3704 or 3705 Communications Controller, an Integrated Communications Adapter (System/370 Models 115, 125, 135, and 138), or a Communications Adapter feature installed in the 4331.
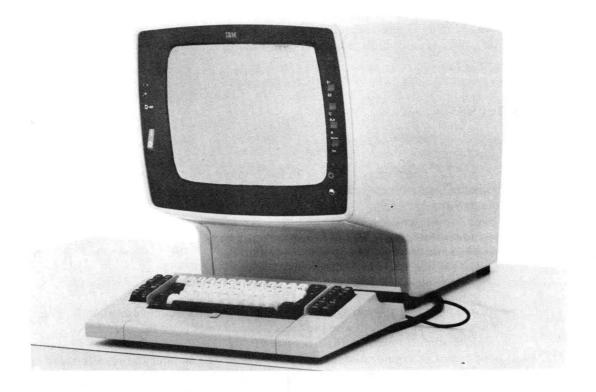
Figure 2-3. IBM 3276 Control Unit Display Station

- Models 11, 12, 13, and 14, and Models 1, 2, 3, and 4 with the SDLC/BSC Switch feature, communicate with a System/370 or 4300 Processor, using SDLC protocol over communication facilities, via a 3704 or 3705 Communications Controller, or via a Communications Adapter feature installed in the 4331.

- All models of the 3276 can communicate with a 3704 or 3705 Communications Controller or a Communications Adapter feature installed in the 4331 processor at 1,200 bps (SDLC or BSC) without need for communication facilities or a modem (direct connection).

- Model 2 attaches to System/3 Models 4, 8, 10, 12, and 15 via a System/3 BSC Adapter, to Models 8 and 12 via an Integrated Communications Adapter, to Models 8, 10, 12, and 15 via an EIA local attachment, or to Models 10 and 15 via a Local Communications Adapter.

- Models 2, 3, and 4 (with the SDLC/BSC switch set to SDLC) and Models 12, 13, and 14 attach to the 3790 Communication System via modems and an SDLC data link. Models 3, 4, 13, and 14 must operate in 1920-character mode.

- Models 11, 12, 13, and 14 communicate with the 8100 Information System via a modem or direct connection on an SDLC data link, a directly attached loop, or a data-link-attached loop. Models 1, 2, 3, and 4 (with the SDLC/BSC switch set to SDLC) can communicate with the 8100 system via a modem or direct connection on an SDLC data link. The 3278 Display Station Models 1, 2, 3, and 4, 3262 Line Printer Model 13, 3287 Printer Models 1 and 2, and 3289 Line Printer Models 1 and 2 are directly attachable to the 3276.

- Models 1, 2, 3, and 4 can attach up to seven terminals in the following combinations:
  - Model 1, displaying up to 960 characters in 12 rows of 80 characters each, can attach to 3278 Model 1, to 3262 Model 13, to 3287 Models 1, 1C, 2, and 2C, and to 3289 Models 1 and 2.

  - Model 2, displaying up to 1,920 characters in 24 rows of 80 characters each, can attach to 3278 Models 1 and 2, to 3279 Models 2A and 2B, to 3262 Model 13, to 3287 Models 1, 1C, 2, and 2C, and to 3289 Models 1 and 2.

  - Model 3, displaying up to 2,560 characters in 32 rows of 80 characters each, can attach to 3278 Models 1, 2, and 3, to 3279 Models 2A, 2B, 3A, and 3B, to 3262 Model 13, to 3287 Models 1, 1C, 2, and 2C, and to 3289 Models 1 and 2.

  - Model 4, displaying up to 3,440 characters in 43 rows of 80 characters each, can attach to 3278 Models 1, 2, 3, and 4, to 3279 Models 2A, 2B, 3A, and 3B, to 3262 Model 13, to 3287 Models 1, 1C, 2, and 2C, and to 3289 Models 1 and 2.

- Models 11, 12, 13, and 14 are comparable in their display capabilities to Models 1, 2, 3, and 4, respectively.

- When operating in 3277-compatible format, the 3276 Model 1 will display 480 characters (40 characters per line), and Models 2, 3, and 4 will display 1,920 characters (80 characters per line).

- Models 1, 2, 3, and 4 operate using BSC protocol at 1,200, 2,000, 2,400, 4,800, and 7,200 bps. When the models are directly connected to a 3704 or 3705 Communications Controller, commmunication speed is limited to 1,200 bps.

- Models 11, 12, 13, and 14 operate using SNA/SDLC protocol at 1,200, 2,000, 2,400, 4,800, 7,200, and 9,600 bps. When the models are directly connected to the 3704 or 3705 Communications Controller, communication speed is limited to 1,200 bps.

  Notes:

  1. *The 3276 Models 1, 2, 3, and 4 with the SDLC/BSC Switch feature installed can also operate via SDLC protocol at the same communication line speeds as Models 11, 12, 13, and 14.*

  2. *The 3279 Color Display Station cannot be attached to a 3276 on which the SDLC/BSC Switch feature is installed.*

  3. *The 3276 supports 3279 Models 2B and 3B in base color mode only.*

Display Stations

3277 Display Station

- This table-top display station can display up to 1,920 characters per screen.
  - Model 1 displays 480 characters (12 rows of 40 characters).

  - Model 2 displays 1,920 characters (24 rows of 80 characters).

- Model 1 attaches to a 3271 or a 3272 Control Unit (all models) or to the Type B terminal adapter of the 3274 Control Unit (all models).

- Model 2 attaches to a 3271 Control Unit Model 2 or 12, to a 3272 Control Unit Model 2, or to the Type B terminal adapter of the 3274 Control Unit (all models).

- The maximum cable length from an attached termial to the 3276 is 610 meters (2,000 ft).

- Both models attach to the 3790 Communication System.

- Both models attach to the 8100 Information System.

3278 Display Station

- This table-top display station (Figures 2-4 through 2-6) can display characters per screen.
    - Model 1 displays 960 characters (12 rows of 80 characters).
    - Model 2 displays 1,920 characters (24 rows of 80 characters).
    - Model 3 displays 2,560 characters (32 rows of 80 characters).
    - Model 4 displays 3,440 characters (43 rows of 80 characters).
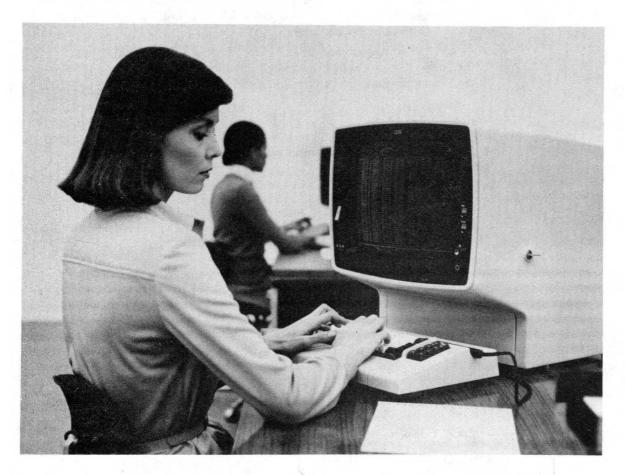   - Model 5 displays 3,564 characters (27 rows of 132 characters).

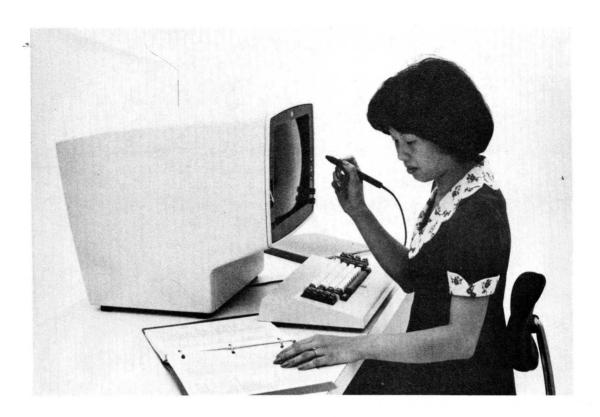Figure 2-4. IBM 3278 Display Station Model 4

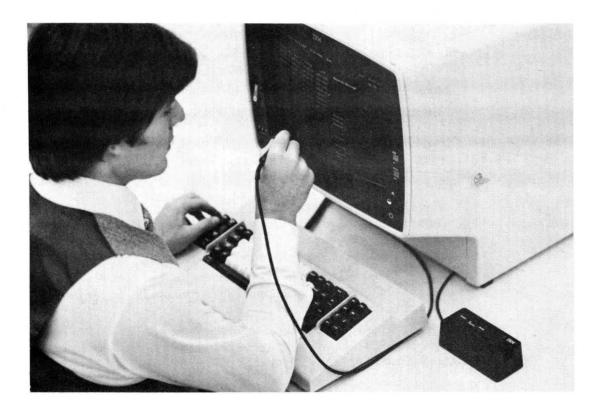Figure 2-5. Operator Using Selector Light Pen at 3278 Display Station

Figure 2-6. IBM 3278 Display Station with Keyboard, Selector Light Pen, Magnetic Slot Reader,
and Security Keylock

- When operating in 3277-compatible format, the 3278 Model 1 will display 480 characters (40 characters per row), and Models 2, 3, 4, and 5 will display 1,920 characters (80 characters per row).
- Only Models 1, 2, 3, and 4 can attach to Type A terminal adapters on all models of the 3274 Control Unit. Model 5 can attach only to Type A terminal adapters of the 3274 Models 1A, 1C, 21A, 21C, 31A, 31C, 31D, and 51C.
- Only Models 1, 2, 3, and 4 can attach to any 3276 model operating in SDLC protocol (either 3276 Models 11, 12, 13, and 14 or 3276 Models 1, 2, 3, and 4 with the BSC/SDLC feature installed and operating in SDLC protocol).
- Only Models 1, 2, 3, and 4 can attach to a 3276 operating in BSC protocol. The following restrictions apply:

  - A 3278 Model 1 can attach to any 3276 model.

  - A 3278 Model 2 can attach only to a 3276 Model 2, 3, or 4.

  - A 3278 Model 3 can attach only to a 3276 Model 3 or 4.

  - A 3278 Model 4 can attach only to a 3276 Model 4.

- The maximum cable between the 3278 and an attached 3274 or 3276 is 1 500 meters (4,920 ft).

3279 Color Display Station

- This table-top display station (Figure 2-7) is offered in four models:
  - Models 2A and 3A offer base color only. Extended color, extended highlighting, and APL/Text are not available on these models.
    - Model 2A – 1,920 characters in 24 rows of 80 characters.
    - Model 3A – 2,560 characters in 32 rows of 80 characters.
  - Models 2B and 3B offer both base color and extended color. These models also offer extended highlighting and APL/Text capability.
    - Model 2B – 1,920 characters in 24 rows of 80 characters.
    - Model 3B – 2,560 characters in 32 rows of 80 characters.

  When operating in 3277-compatible format, the 3279 Models 3A and 3B will display 1,920 characters in 24 rows of 80 characters.

- Two modes of color are available:
  - On all models, base color provides the four colors of white, red, blue, and green according to the protection and intensity attributes of the 3270 field attribute byte. On all models, a base color switch allows an operator to select an alternative monochrome mode.
  - On Models 2B and 3B, extended color provides the seven colors of white, red, blue, green, pink, yellow, and turquoise when specific extended color attributes are used to define the field *or* character.
- Models 2B and 3B provide, in addition to extended color, APL/Text capability, enabling the 3279 to display the 222-character APL/Text Character Set, including the 94-character EBCDIC Set.

Figure 2-7. IBM 3279 Color Display Station

- Models 2B and 3B support the extended highlighting attributes of underscore. reverse video, and blinking when specific extended attributes are used to define a field or character.

- On the 3279, an audible alarm is provided as standard. The alarm sounds whenever a character is entered into the next-to-last position on the display screen. The alarm can also be activated under program control to alert the operator to a special condition. The volume of the alarm can be controlled by the operator.

- On all models of the 3279, in conjunction with the control unit to which it is attached, a single procedure is provided for setting up and maintaining color convergence. The procedure can be carried out by an operator using only the keyboard and referring to a special pattern that is displayed on the screen.

- For base color only: All models of the 3279 can be attached to any model of the 3274 Control Unit; 3279 Models 2A and 2B can be attached to all models of the 3276 Control Unit Display Station except Model 1; and 3279 Models 3A and 3B can be attached to all models of the 3276 except Models 1 and 2. The 3274 must be properly configured *and* customized; the 3276 must be properly configured.

- For extended color: The 3279 Models 2B and 3B can be attached only to a properly customized and configured 3274 Control Unit (except Models 1B and 21B). To use the APL/Text capability of the 3279 Models 2B and 3B, the 3279 must be attached either to a properly configured *and* customized 3274 Control Unit or to a properly configured 3276 Control Unit Display Station.

- For both base color and extended color, attachment to the Type A terminal adapter of the 3274 Control Unit. The maximum cable length from the terminal to the control unit is 1 500 meters (4,920 ft).

Printers

Note: *In regard to print rates for the following printers, factors such as control unit configuration and line transmission speed, output format, colors printed per line, and programming application processing must all be considered in determining actual throughput. Throughput will be reduced when printing in multicolor as a function of the number of color changes on the page. In addition, using the Programmed Symbols special feature for dense printing or for printing in other than the standard character format will reduce printer throughput.*

3262 Line Printer Models 3 and 13

- The 3262 is a floor-standing printer (Figure 2-8) with an integral forms stand/stacker.
- Model 3 prints up to 650 lines per minute.
- Model 13 prints up to 325 lines per minute.
- Models 3 and 13 have 8K bytes of buffer capacity.
- Models 3 and 13 attach to the Type A terminal adapter of the 3274 (all models).
- Model 3 attaches to the 3276 Control Unit Display Station (all models).
- The maximum cable length between the 3262 and an attached 3274 or 3276 is 1 500 meters (4,920 ft).

Figure 2-8. IBM 3262 Line Printer, Models 3 and 13

3284 Printer

- The 3284 is a floor-standing serial matrix printer.
- Model 1 has a 480-character buffer, a 40-character-per-second (cps) print rate, and 132 print positions.
- Model 1 attaches to a 3271 or a 3272 Control Unit (all models) or to the Type B terminal Adapter of the 3274 Control Unit (all models).
- Model 2 has a 1,920-character buffer, a 40-cps print rate, and 132 print positions.
- Model 2 attaches to a 3271 Model 2 or 12, to a 3272 Control Unit Model 2, or to the Type B terminal adapter of the 3274 Control Unit (all models).
- Model 3 has no character buffer. The print rate is 40 cps, with 132 print positions.
- Model 3 attaches to a 3275 Display Station (all models).
- Models 1 and 2 attach to the 3790 Communication System and to the 8100 Information System.
- The maximum cable length between the 3284 and an attached control unit, 3790, or 8100 is 610 meters (2,000 ft).

3286 Printer

- The 3286 is a floor-standing serial matrix printer.
- Model 1 has a 480-character buffer, a 66-cps print rate, and 132 print positions.
- Model 1 attaches to a 3271 Model 1, 2, 11, or 12, to a 3272 Control Unit (all models), or to the Type A terminal adapter of the 3274 Control Unit (all models).
- Model 2 has a 1,920-character buffer, a 66-cps print rate, and 132 print positions.
- Model 2 attaches to a 3271 Model 2 or 12, to a 3272 Model 2, or to a 3274 (all models).
- Both models attach to the 3790 Communication System and to the 8100 Information System.
- The maximum cable length between the 3286 and an attached control unit, 3790, or 8100 is 610 meters (2,000 ft).

3287 Printer Models 1 and 2

- Both models are table-top matrix printers with bidirectional printing capability.
- Both models print in monochrome only.
- Model 1 has an 80-cps maximum print rate and 132 print positions.
- Model 2 has a 120-cps maximum print rate and 132 print positions.
- Both models have a 480-, 960-, or 1,920-character buffer. An Extended Print Buffer feature is available for 2,560-, 3,440-, and 3,564-character printouts.
- The 3287 attaches either to the 3271, 3272, or 3274 Control Unit or to the 3276 Control Unit Display Station.
- The 3287 attaches to either the Type A or Type B terminal adapter of the 3274 Control Unit, depending upon the 3287 attachment feature selected.

- The maximum cable length between the 3287 and an attached 3274 Type A terminal adapter or 3276 is 1 500 meters (4,920 ft). The maximum cable length between the 3287 and a 3271 or 3272, or a 3274 Type B terminal adapter, is 610 meters (2,000 ft).

3287 Printer Models 1C and 2C

- Both models are table-top matrix printers (Figure 2-9) with bidirectional printing capability.

- Both models can print in four colors. (Print positions 1–120 can print in four colors; print positions 121–132 print in the bottom color of the multicolor ribbon.)

- Model 1C has an 80-cps maximum print rate (when printing in one color).

- Model 2C has a 120-cps maximum print rate (when printing in one color).

   Note: *The printer prints fields in one of four colors as determined by the existing field-protect and field-intensify attribute characters. When the printer is equipped with the Extended Character Set Adapter, and the 3270 Structured Field and Attribute Processing option is being used, color attributes can be applied to individual characters as well as to entire fields.*

- Except for a 480-character buffer, buffer capacities are the same as for Models 1 and 2.

- Both models attach only to the 3276 and to the Type A terminal adapter of the 3274. (Only base color can be printed when the printer is attached to a 3276.)

- The maximum cable length between the 3287 and an attached 3274 Type A terminal adapter or 3276 is 1 500 meters (4,920 ft). See *IBM 3287 Printer Models 1C and 2C Component Description,* GA27-3229, for details on color printing.
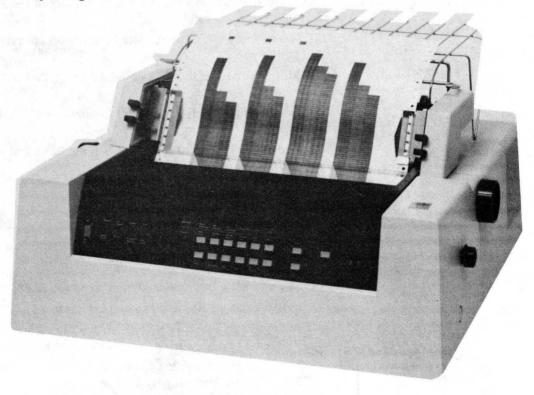

Figure 2-9. IBM 3287 Printer Models 1C and 2C

3288 Line Printer Model 2

- The 3288 is a floor-standing line printer.
- Model 2 has 1,920-character buffer capacity. The print rate is up to 120 lines per minute. The print rate when the Text Print feature is installed is up to 80 lines per minute (data-dependent).
- Model 2 attaches to a 3271 Control Unit Model 2 or 12, to a 3272 Control Unit Model 2, or to a 3274 Control Unit (all models) with a Type B terminal adapter installed.
- Attaches to the 3790 Communication System and the 8100 Information System.
- The maximum cable length between the 3288 and an attached control unit is 610 meters (2,000 ft).

3289 Line Printer

- The 3289 is a floor-standing line printer (Figure 2-10) with an integral forms stand/stacker.
- Model 1 prints up to 155 lines per minute.
- Model 2 prints up to 400 lines per minute.
- Models 1 and 2 have 4,016-character buffer capacity.
- Both models attach to the 3274 Control Unit (Type A terminal adapter only) or 3276 Control Unit Display Station.
- Both models can communicate with the 3790 Communication System, the 8100 Information System, and the 4331 Processor via a 3276 Control Unit Display Station.
- Both models can communicate with the 8100 and 4331 via a 3274 Control Unit Model 51C.
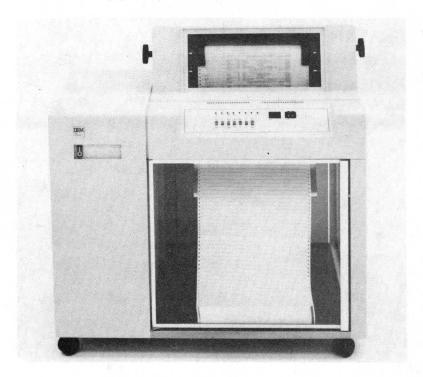- The maximum cable length between the 3289 and an attached 3274 or 3276 is 1 500 meters (4,920 ft).

Figure 2-10. IBM 3289 Line Printer

Chapter 3. Input/Output Functions

Functional Control Capability

To use the functional control capability of the IBM 3270 Information Display System effectively, the system designer must consider the display image formats, transaction design, communication facilities, operator wait times, operator costs, channel loading, number of CPU interruptions, number of TP messages, and application program design. This is best done by selecting a typical transaction and evaluating the effect of functional control capability on system costs and performance. This evaluation, coupled with an evaluation of operator control capabilities, system configuration considerations, physical considerations, and installation planning considerations, will determine the best ratio between cost and performance for a display system.

The following listing highlights the functional control capabilities of the 3270 display system:

Format Control by Data Field: The 3270 display system provides program control by data field. Each data field is established by a field-attribute character in the first position of the field. The field attribute character, written by the program, occupies a single nondisplayed character position at the beginning of a field and serves as a visual separation between successive fields. A field may be started at any character position of the display screen. The field characteristics defined by the attribute character include:

- Protected (from modification by a display operator) or unprotected (available for the operator to modify or enter data) field. The unprotected definition classifies a field as an input field.
- Alphanumeric (an input field in which an operator can enter alphabetic, numeric, or symbol characters) or numeric (has special meaning for protected fields, data entry keyboards, and the Numeric Lock special feature) field.
- Character display (nondisplay, display, intensified display).
- Detectability or nondetectability (by use of the selector light pen).
- Tab stop positions (first character position of unprotected fields).

Note: *A secondary effect of the protection and intensity attributes is the control of field color on all models of the 3279 Color Display Station and on the 3287 Printer Models 1C and 2C when in base color mode. Fields can be displayed in four base colors: red, blue, green, and white. Fields can be printed in up to four colors.*

Format Control by Data Field and Character: Extended attribute codes control the following additional characteristics:

- Extended highlighting (reverse video, blinking, and underscore)
- Extended color (seven colors)
- Programmed symbols

These attributes can be associated with fields or individual characters.

Note: *Extensions to the 3270 data stream permit the use of these attribute codes on all 3278 models, on the 3279 Models 2B and 3B, and on the 3287 Models 1C and 2C. Extended highlighting, however, is functional only on the 3278 and on the 3279 Models 2B and 3B. The 3287 permits underscore only. The seven colors (red, blue, green, white, yellow, turquoise, and pink) are displayed on the 3279 Models 2B and 3B only. Programmed symbols are available on all units except the 3279 Models 2A and 3A.*

For details of base color, extended highlighting, extended color, and programmed symbols capabilities, see *IBM 3270 Information Display System: Color and Programmed Symbols*, GA33-3056.

Character Addressing: Addressing facilities allow starting a program write at any character position of the display screen. The write address can be set any number of times during an image write or update, or both. This allows selective writes to various noncontiguous areas of the display screen. This facility also allows the modification of single- or multiple-field attribute characters as well as data characters.

Null Suppression: To minimize message lengths while providing maximum length input fields, 3270 display system data fields can be erased to null codes under operator or program control. As an operator keys input data into a field, data codes replace null codes, leaving null codes in any unkeyed positions of the field. When a read modified message is sent to the host system, null codes are not transmitted as part of the message. This eliminates the transmission of nonmeaningful codes from unused positions of a field.

BSC and SDLC Protocol: BSC protocol provides transmission reliability and comprehensive data checking. SDLC protocol, compared with BSC protocol, provides more extensive data-checking capability and results in greater transmission efficiency and utilization of common-carrier facilities.

Channel Interface Speeds: Data transfer rates of 10,000 to 650,000 characters per second allow operation at the speed of the channel to reduce response time and host systems loading by allowing faster completion of a transaction.

Communication Line Speeds: Transmission rates of up to 9,600 bps are possible (dependent upon unit and selected features).

Protected Data Image Format: Protected data image format prevents the operator from entering data on specific areas of the screen. This allows field labels, instructions, and field control information to be written to a display station once and reused any number of times with variable input or output data. For example, in file inquiry, a protected data image format can be written to the display station once, allowing subsequent transmission of only the variable data records. Similarly, a protected data image format can be written to a display station once and can be used many times for repetitive key entry input transactions.

Select: Display systems directly attached to a channel require a buffer load delay to prepare to execute a write operation. A select operation allows a selector or block multiplexer channel to be released for other use during this delay time.

Remote General Poll: Provisions are made in the control unit hardware to allow the program, with a general poll instruction, to interrogate all devices attached to the control unit with just one request. This results in greatly reduced polling overhead and minimizes communication line loading.

Read Modified Command: This command permits transfer of only operator-modified data fields with null codes suppressed. This operation reduces the message size by including essential data only, thus minimizing communication line and channel loading.

Short Read: Program Access (PA) keys permit an operator to communicate with the program without transmitting unprotected data fields to the host system. Pressing one of these keys causes a short read operation that restricts the information transmitted to that required to identify which of the keys caused the attention. This eliminates the transmission of nonmeaningful data to the host system CPU, thereby minimizing communication line and channel loading.

Write and Erase/Write Commands: These commands are used to load, format, and selectively erase device buffer data.

Write Structured Field Command: This command provides a general mechanism for conveying command-like functions, called *structured fields*, in the data stream to a terminal. These structured fields can be used by a program to perform various functions. For example, the program may interrogate a device to establish its characteristics, such as whether it supports color, or instruct the device on whether the attributes of color and highlighting should be included in data sent from the terminal to the host computer. It also establishes whether the operator can select these attributes from the display station keyboard. For a complete description of all functions performed using this command, see *IBM 3270 Information Display System Description and Programmer's Guide*, GA23-0061.

Erase Unprotected: An erase unprotected operation capability is provided that erases all unprotected data fields to null codes and positions the cursor in the first unprotected field of the image. This operation eliminates the buffer load delay that is associated with a normal write operation.

BSC Copy Command (3271 Models 1 and 2; 3274 Models 1C, 21C, 31C, and 51C (BSC only); and 3276 Models 1, 2, 3, and 4): The host-initiated BSC Copy command may be used with these control units to direct data transfer from one terminal to another terminal attached to the same control unit. Upon accepting the command addressed to the *to* terminal, the control unit controls the data transfer from the *from* terminal. This obviates the transfer of the buffer data to and from the host.

Host-Initiated Local Copy Function (SNA only: 3274; 3276 Models 11, 12, 13, and 14; and 3276 Models 1, 2, 3, and 4 with SDLC/BSC Switch Feature): By sending a write-type command with the print bit set, the host can initiate a local copy function. This function permits data transfer from a 3278 or 3279 display station to a printer(s) attached to the same control unit. Printer assignment is controlled by a print-control matrix stored in the control unit. This matrix specifies, for example, which displays may use a given printer. The matrix is loaded in the 3274 Control Unit from the host by the user-written application program or from the customized system diskette. Category A displays can transfer data only to Category A printers.

In the 3276, the matrix is determined by the physical attachment of the printers to the 3276 at power-on time. In this matrix, each display station is associated with the powered-on printer that has the next higher terminal address. Printer assignment can be changed at the attached display station keyboard.

Operator-Initiated Local Copy Function (Non SNA and SNA: 3274 and 3276): The operator initiates a local copy from a 3278 or 3279 display station to a printer(s) attached to the same control unit by pressing the Print key on the display station keyboard. As with the host-initiated local copy function (described above), printer selection is controlled by a print-control matrix in the 3274 or 3276.

Repeat Characters: To minimize the number of data characters that must be transmitted to a display station, a single character, transmitted once, can be repeated from a starting address to an ending address.

Program Tab: To minimize the length of a message transmitted to a display station, program tab permits writing data fields into successive unprotected data fields that were previously defined by an image format. This eliminates the requirement to transmit control characters to specify the starting address of noncontiguous data, reducing the number of control characters required.

Audible Alarm (3275, 3276, 3277, 3278, 3279): This feature can be used by the application program to alert the display station operator for any application. Additionally, the alarm sounds whenever the operator keys in a data character into the next-to-last character of the display image. The audible alarm is standard on the 3279 Color Display Station and a special feature of the 3275, 3276, 3277, and 3278 Display Stations.

Audible Alarm (3289): This feature sounds an alarm that alerts the operator to conditions that require operator intervention. The operator can set loudness level and duration.

Audible Alarm (3262 Optional Feature): The audible alarm is a signal that is activated by a code in the host program or by an error condition that occurs during printer operation. It can be disabled by the operator.

Operator Control Capability

The IBM 3270 Information Display System provides the following operator control capabilities.

Operator Information Area (3276, 3278, and 3279): An operator information area is located at the bottom of the display screen (outside the data area) to communicate terminal, cluster, or system status to the operator.

Selector Light Pen: This hand-held light-sensitive pen enables the operator to interact directly with the display by selecting appropriately designated character fields.

Operator-Initiated Print: A Print key on all models of the 3276, 3278, and 3279 display station keyboards permits the operator to copy the display buffer contents onto a printer attached to the same control unit without host system intervention, as described under "Operator-Initiated Local Copy Function." Operation of the IDENT key, followed by a 2-digit address, permits selection of specific destination printers.

Dual Case (3276, 3278, and 3279): Dual-case character sets are basic on the 3276, 3278, and 3279; however, a switch is provided to select either Mono Case or Dual Case display of characters.

Base Color Switch (3279 only): On all models of the 3279, this switch can be used by the operator to control whether the display is in the base color or the monochrome mode.

- In the base color mode, the color of fields is controlled by their protection and intensity characteristics.
- In the monochrome mode, the 3279 displays all characters on the screen in green except for fields where the intensity characteristic is bright. The characters in such a field are displayed in white.

On 3279 Models 2B and 3B, when the extended color mode is in use, the position of the base color switch does not affect the color displayed. A similar function is provided on the 3287 Printer Models 1C and 2C by use of the Set Alternate/Set Function procedure. For further details, see *IBM 3270 Information Display System: Color and Programmed Symbols*, GA33-3056.

Keyboard Functions

Many of the keyboard functions are briefly described below. However, for detailed descriptions of all keyboard functions, see the following IBM 3270 Information Display System operator's guides:

- *3276 Control Unit Display Station Operator's Guide*, GA18-2040
- *3278 Display Station Operator's Guide*, GA27-2890
- *3279 Color Display Station Operator's Guide*, GA33-3057

For a complete description of the keyboards available with the 3270 display system, see *IBM 3270 Information Display System: Character Set Reference*, GA27-2837.

Note: *All alphanumeric, special symbol, and cursor move keys on the 3276, 3278, and 3279 have typamatic capability.*

Cursor Select Key (3276, 3278, and 3279): The selector-light-pen operation can be duplicated by use of the cursor select key. The character field is selected by positioning the cursor in the field and then pressing the CURSOR SELECT key.

Cursor Positioning Controls: Several cursor controls are provided to permit rapid positioning of the cursor to any character position on the display image. Included in these cursor controls are:

- Up (⬆), Down (⬇), Left (⬅), and Right (➡) keys
- Backspace (⬅) key
- Tab (⭢) or SKIP (3275/3277 only) and Backtab (⭠) keys
- New line (⬐) key
- Cursor Home Key (3276/3278/3279)

  A cursor home key is basic to all 3276, 3278, and 3279 keyboards. Operation of this key repositions the cursor to the first nonprotected character position on the display.

- Operator Selectable Alternate Cursor (3276/3278/3279)

  The operator may elect to display either an underscore cursor or a reverse image cursor. Either of these two cursor types can be displayed in normal (continuous display) or blinking mode. Cursor selection and display mode are determined by the operator via keyboard control.

- Double-Speed Cursor (3276/3278/3279)

  The operator can select the double-speed cursor (typamatic) by pressing the alternate (ALT) key and cursor left (◄─►) or cursor right (◄─►) key at the same time.

Editing Controls: Two keys, INS MODE and DEL (3275/3277) or ⋏ and ⧸ (3276/3278/3279), enable a display operator to perform unique editing functions. The INS MODE (3275/3277) or ⋏ (3276/3278/3279) key allows characters to be inserted into a field, while all characters following the point of insertion are shifted to the right. The DEL (3275/3277) or ⧸ (3276/3278/3279) key has an opposite function: characters can be deleted from a field, while all characters on the same line and following the point of deletion are shifted left.

Program Function and Program Access Keys: Program function (PF) keys allow any input data on the screen to be transmitted to the program together with a code that identifies which program function key was pressed. Program access (PA) keys allow a code to be transmitted to the program to identify which key was pressed, but no input data from the screen is transmitted to the program.

Keyboard Numeric Lock Feature: This feature provides a means of alerting the display operator to certain keying errors. When the cursor is positioned within a numeric input field and the Keyboard Numeric Lock feature is installed, the keyboard is electrically locked on the next character if any key other than the numerals 0 through 9, minus (-), decimal sign, or duplicate (DUP) is pressed.

Note: *On Austrian/German, Belgian, Danish, French, Italian, Norwegian, Portuguese, and Spanish keyboards with the Numeric Lock feature installed (3275/3277 only), the comma (,) is the decimal sign.*

Shift Keys: All typewriter and operator console keyboards are provided with typewriter shift keys: SHIFT and LOCK. These keys allow access to upshift characters. Data entry keyboards are provided with the ALPHA (alphameric) and NUMERIC shift keys. The ALPHA shift key is used to override a numeric (input) field definition and the Keyboard Numeric Lock feature to purposely input alphameric data into a numeric field. The NUMERIC shift key also overrides the numeric field definition and numeric lock condition to permit upshift character entry for other characters. The SHIFT, LOCK, NUMERIC, and ALPHA keys are represented by graphic forms on the 3276, 3278, and 3279.

Duplicate (DUP) Key: This key allows a unique code, which is displayed as an asterisk (* or * on 3276s, 3278s, and 3279s operating in dual case), to be sent to the host system while the cursor is advanced automatically to the next input field. The DUP code is typically interpreted by the program to mean "Duplicate this field from the previous record."

Erasing Controls: The CLEAR, ERASE EOF, and ERASE INPUT keys provide erasing functions by setting to null codes any character positions on the display image that are affected by the key operation. If the operator must erase the entire display screen and the display format, the CLEAR key is used. The ERASE EOF key is used when the display operator inputs data into part of a field and wants the rest of the field erased. The ERASE INPUT key is used to erase all data input fields on the display screen.

Attribute Select Keys (3278 and 3279): On the 87-Key EBCDIC Attribute Select Typewriter Keyboard, the 87-Key EBCDIC Attribute Select Typewriter/APL Keyboard, and the 87-Key EBCDIC Overlay Keyboard, the upper and alternate shifts on the group of 12 PF keys at the right-hand side of the keyboard can be used by an operator, under program control, to select the extended highlighting, extended color, and programmed symbol attributes of a character that is being entered. For further details, see *IBM 3270 Information Display System: Color and Programmed Symbols*, GA33-3056.

Switch Control Unit (3278 and 3279): This feature permits switching operational control of the display station between two different control units.

Security Enhancements

The following security enhancements are provided:

Security Keylock: This feature provides a display operator with a key that can be used to disable the display station or printer (where available) whenever it is to be left unattended. This unit is enabled when the proper key is inserted in the lock and turned to the on position.

Operator Identification Card Reader (3275 and 3277): This feature is provided to enter system user identification. This capability enhances the (programmed) control of operator access to data and an audit of operator actions. Additionally, this feature may be used to enter any sequence of characters (prerecorded on a card) for other purposes, such as transaction control, account control, and billing.

Magnetic Slot Reader (3276, 3278, and 3279): This accessory (Figure 2-6) is a free-standing magnetic slot reader that reads encoded information from a magnetic stripe. The magnetic slot reader allows the user to read magnetic-stripe tags and badges which are passed through a slot. The magnetic slot reader has three indicators and a buzzer which provide information to the user on the status of the read data.

Magnetic Hand Scanner (3278 and 3279): This accessory (Figure 3-1) attaches to the display station to permit the operator to read magnetic-stripe labels that are attached to shelves, cartons, and other objects. It can also be used to read magnetic-stripe tags that are hand-held or placed on a flat surface. The scanner has three lights and a buzzer which provide feedback to the operator on the status of the scanned data. The stripe can be read in either direction.

Nondisplay Keying Mode: This mode of operation permits program definition of fields so they will accept data entered from the keyboard without displaying the data on the screen.

Address Keylock (3276): This feature provides the display operator with a key that can be used to open the Operator Panel Drawer to a position that exposes the address and transmit level switches (where installed). When the drawer is locked, these switches are inaccessible.

Encrypt/Decrypt: This feature, used in conjunction with other IBM Cryptographic Subsystem products and operating in an SNA/SDLC environment, permits transmission of data between the 3274 Control Models 1C, 21C, 31C, and 51C, or the 3276 Control Unit Display Station Models 11, 12, 13, and 14, and the host computer in a form that precludes accidental or intentional disclosure and modification of the data without detection.

Figure 3-1. Magnetic Hand Scanner

Chapter 4. Applications

Displays, printers, and their control units can be configured flexibly to match the particular requirements of a wide range of applications, such as:

- Inquiry and update
- Data entry
- Personal computing
- Interactive program development
- System operator's console

Application Types

Inquiry and Update

A display station that is used with an inquiry application allows the operator to have rapid access to the host system file. Depending on the complexity of the inquiry, one or more logical files may be accessed. Following an inquiry, an update entry may be initiated by the operator at the display station. Five types of inquiry applications are described below.

Simple Inquiry

In a simple-inquiry application, there is a small input message, for example, a name or an account number. The output message is short (for example, "yes" or "no"), predictable within a narrow range of possibilities, and required quickly.

A credit house uses a simple-inquiry application to determine whether a charge customer should be allowed to make additional charge purchases. Usually, the person who needs the information has telephoned the request to the credit house and waits for the reply.

Complex Inquiry

In a complex-inquiry application, the input message is small (up to 100 characters). The output message is large (an entire screen or several screens of data) and often contains historical or status information.

This type of application is used by insurance companies to get policy information about policyholders. A credit house uses a complex-inquiry application when getting a complete credit history of a person who is trying to establish credit.

Inquiry with File Update

In an inquiry with file update application, the input message is again relatively small (up to 100 characters), and the output message can be several screens of data. Part of the displayed record is modified by the display operator after the output message has been viewed.

A customer service application is a specialized form of the inquiry with file update application. State and local governments (for example, departments of tax and welfare) use inquiry with file update applications to review and change official records. This application is also used by a credit house to record credit payments and by an insurance company to make policy changes.

Conversational Inquiry

In a conversational application, a progression of input and output messages leads up to a completed transaction. The output message often determines the next input message; for example, an output message that contains a series of items from which the operator must make a selection is the basis of the next input message.

Conversational Inquiry with File Update

In an inquiry application that combines conversational and file update, many input and output message steps complete one transaction that initiates other processing transactions (for example, production and warehouse control, shipping, and receiving), which are not necessarily done on the display. These other processing transactions are applications that are used by distributors, manufacturers, and service order businesses.

Data Entry

A display used for a data entry application, that is, entering data by keying, magnetic slot reader, or magnetic hand scanner, can replace conventional keypunch equipment. Two types of data entry applications are described below: source file update and online key entry.

Source File Update

In a source file update application, the first step is some type of inquiry to get access to the data that must be modified. Next, the transaction is processed, and the data in the working file is updated immediately.

A state department of motor vehicles uses this type of application to update the large central files on drivers and vehicles as information is sent in from local offices.

Online Key Entry

In an online key entry application, records are batched and are entered into an intermediate file that is online, usually on disk. This file is rapidly available to the processing program. The online key entry procedure is used to copy large amounts of data and is designed for high productivity and efficiency. The aim is to eliminate from the computing installation clerical functions that are not essential to data-processing activity.

Payroll and inventory control are applications in which large amounts of data are entered into a computing system for separate processing by the application program.

The 3270 display system can be used for online key entry. The editing tools help the operator verify that input data is correct. Formatted fields and protected data make the operation more productive because input need not be in a character-oriented stream. Remotely attached displays can be used (even though an online key entry application is directed toward high volume) because the devices have high data-transmission efficiency.

Personal Computing

Personal computing refers to the use of a computer by non-data-processing professionals. This use is via a terminal and with an end-user-oriented programming language and/or application packages. Personal computing can assist in a wide variety of functions: planning, modeling, and simulation; financial and statistical analysis; mathematical, scientific, and engineering problem-solving;

and econometrics. Patterns of personal computing usage vary widely. An end-user may simply use a single application package "as is" without modification or extension. Another may use an end-user-oriented language to write his own programs. Others may use an interactive application developed for them by the data processing department.

For example, with the Data Analysis–APL feature installed, an interactive environment for APL users is provided by Virtual Storage Personal Computing (VSPC), Conversational Monitor System under the Virtual Machine Facility/370 (VM/370 (CMS)), and VS APL. With the APL/Text feature installed, this environment is provided by VSPC and VM370 (CMS). Direct interaction between the terminal user and host APL programs is made available, and entry, revision, and printing of data files are made possible at the remote terminal site.

Program Development

The 3270 display system can be used in an interactive environment for program development and testing. Interactive subsystems that provide program development facilities include Conversational Monitor System (CMS) under VM/370, Structured Programming Facility (SPF) under TSO, and Virtual Storage Personal Computing (VSPC). These facilities allow programmers, at remote 3270 terminal locations, to create, compile, test, and update programs.

System Operator's Console

A display station can be used as a system operator's console in place of a conventional typewriter console. The display console can hold many system messages and can display them faster than a typewriter console. The two types of system operator's console applications are the display operator console and the output-only display console. In a display operator console application, the system operator uses the display station to control the operation of the system by entering data into the system and receiving it from the system. In an output-only application, the display console can be used for status displays or operator messages, but it cannot be used to enter data into the system. Display consoles used in this type of application monitor system activity.

Color Applications

Because data presented in color is easier to separate, it is easier to comprehend. An operator rarely needs to read all the data on a display, usually, only sections of it. The distinctions that color permits make recognition of particular fields easier and quicker. Color extends the operator's ability to differentiate a number of different levels simultaneously. Other applications for this facility are:

- Data sources: The display operator may need to be able to distinguish clearly and quickly between data that has been entered at the keyboard or that has been program-generated, data that is held on file, messages from the host, and so on.
- Data types: The display operator may need to be able to distinguish clearly between headings, field names, data as originally entered, data entered and since changed, and/or instructions from the program.
- Data codes: In applications where the information being displayed is categorized by a numeric code, about seven coded categories are the most that an operator can handle readily. If an additional categorization coded in color is introduced, the operator can handle about six categories in each dimension and thus about 36 altogether. Color can often be more effective than other

methods (such as underscoring or high intensity) for drawing the operator's attention to exception conditions. Further, the choice of available colors offers a range of coding levels, which can be matched to the severity or importance of the exception condition.

For more information on color applications, see *IBM 3270 Information Display System: Color and Programmed Symbols*, GA33-3056.

Alphanumeric and Graphic Applications

Alphanumeric applications are those in which the capability provided by programmed symbols is used to extend the range of special characters, symbols, or signs that can be displayed or printed in text. Some examples of the programmed symbols that a user might define are:

- Characters of different sizes
- Characters from foreign alphabets
- Mathematical signs and symbols
- Scientific signs and symbols
- Special type fonts, for example, italics

Graphic applications are those in which the programmed symbols capability is used to define shapes or picture components that, when combined with other such components in adjoining character positions on the screen or printed page, create a pictorial, or graphic, representation. A graphic representation of data can be an effective alternative to a numeric representation. Unlike words or numbers, pictures are an almost universal language. Pictures can convey information more directly by the use of patterns, colors, and shapes. Numerical data can thus be made more meaningful by being converted into a graphic form. Among the many applications of graphics are:

- Scheduling — Noncomputerized scheduling typically involves large, manually prepared charts. In addition to eliminating the cumbersome manual preparation, the automation of scheduling makes it possible for complex scheduling data to be graphically presented simultaneously in different offices, even in different geographical locations. Color may also be regarded as essential.
- Process Monitoring and Control — Graphics can be used to show the status of a process or operation diagrammatically. Typical examples include flow diagrams in chemical processing plants and oil refineries. The interpretation of the data in such diagrams is often of critical importance, so the use of color will often be regarded as essential.
- Project Management and Control — Graphics will typically be used in this application to display critical paths and dependencies in the management of complex projects. Enterprises likely to utilize this application of graphics include the construction industry, utilities and services such as railroads and electrical supply, and local and central government projects.
- Graphic Arts and Publishing — In graphic arts and publishing, the creation of designs and of illustrations is often an end in itself. The graphic capability provided by programmed symbols, especially when augmented by color, has considerable potential in the fields of graphic design, visualization, and illustrations.

- Computer-Assisted Instruction – Graphics, especially when combined with color, have great potential in the enhancement of computer-assisted instruction and online tutorial material.

- Technical Data Analysis – Information that is available in numeric form may be presented graphically with improved comprehension and resultant improved productivity. Typical users are research and development professionals.

Other alphanumeric and graphic applications are: creation of forms for payroll, billing, reports, and orders; flowcharts and diagrams in programming; analysis of test and experimental data, electrocardiograms, scans, and pathological analysis in the medical field; and data reduction and analysis, and modeling and simulation in engineering applications.

For more information on graphic applications, see *IBM 3270 Information Display System: Color and Programmed Symbols*, GA33-3056.

Advantages of Display Systems

Many installations must answer questions concerning the status of an account or check the disposition of an order while someone waits on the telephone or in the office; also, there may be a high volume of requests for information. When a display station is used, the person waiting can be given fast service. Furthermore, the information is obtained directly from the computer file, thereby avoiding unnecessary clerical operations.

Because terminals (display stations and printers) can be connected remotely to the computer by means of communication facilities, the terminals can be far from the central file. There can be many people at many locations using the system at the same time. The users at one location can have rapid response to input, even though the files are maintained at a distant central location.

An operator of a display station is probably familiar with several parts of the device because the parts are similar to common objects. For example, the keyboard used to enter data is similar to a typewriter keyboard, and the output is displayed on a TV-like screen. The display operator can treat the displayed information as if it were in a book: turn the pages of the file, look at one page at a time, make additions and corrections to the data in the format displayed on the screen, check each page for accuracy, and extract needed information.

Advantages of the 3270 Display System

The 3270 display system is well-suited to the types of applications listed above. Some of the specific benefits offered by the system follow.

Entry of Data

The display operator can enter data in free form. For example, the operator types in the name and account number of a customer's file; then types in an order that consists of part number, quantity, price, and special instructions. The sequence of items in the entry is important, but the location of the items on the screen is not. The data could be entered on one or two lines, or each item could be entered on one line.

The display operator can also enter data in formatted form. For example, in typing in a sell-stock order, he would type data opposite the following labels:

ACCOUNT NUMBER:
STOCK IDENTIFIER:
QUANTITY:
SELLING PRICE:

After the operation, the screen would show:

ACCOUNT NUMBER: 7246
STOCK IDENTIFIER: ABC
QUANTITY: 50 SHARES
SELLING PRICE: 5 1/2

Operator Aids

There are aids to help the display operator manipulate data that is to be entered in formatted form.

• The operator is prevented from entering data into a protected field. In an application where certain items must be entered (renewal data of driver's license, amount to be paid, and change of address), but where other items cannot be modified (driver's license number), the operator is prevented from doing so. The operator can skip over a protected field by pressing the SKIP key or the Tab key.

• The operator can change unprotected alphameric data, use special keys to change numeric-only data, erase the screen, a field, or characters in a field, and use the two edit keys (INS MODE and DEL) to correct data. Characters to be corrected are located easily, because the cursor can be moved rapidly in any one of four directions.

• The display operator can enter data in fields that are programmed to prevent data from being displayed or printed out. This benefits applications where there are security restrictions on some part of files. In such a use, the operator must enter a special password or identification for access to the data. This identification can be entered in nondisplay fields to prevent unauthorized acquisition of the identification.

• Selected data can be underscored or displayed at brighter intensity or in reverse video to gain operator attention. When programmed symbols are used, categories of information can be distinguished by different character sizes and fonts. When color displays are used, both different and related categories of information can be distinguished by the judicious use of color.

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Chapter 5. Programming Support

Following are some of the access methods, program products, interactive subsystems, and program facilities that support the use of the 3270 Information Display System[1]. Check with your IBM marketing representative for details.

TP Access Methods

- Basic Telecommunications Access Method (BTAM) under OS, DOS, OS/VS, and DOS/VS
- Basic Telecommunications Access Method Extended Support (BTAM-ES) under DOS/VSE
- Telecommunications Access Method (TCAM) under OS and OS/VS
- Advanced Communication Function/Telecommunications Access Method (ACF/TCAM) under OS/VS
- Virtual Telecommunications Access Method (VTAM) under DOS/VS and OS/VS
- Advanced Communications Function/Virtual Telecommunications Access Method (ACF/VTAM) under DOS/VS, DOS/VSE, and OS/VS
- Advanced Communications Function/Virtual Telecommunications Access Method Entry (ACF/VTAME) under DOS/VSE
- Extended Telecommunications Modules (EXTM) feature of CICS/DOS/VS

Other Program Products, Interactive Subsystems, and Program Facilities

- Advanced Text Management System-III (ATMS-III)
- Airline Control Program (ACP)
- Customer Information Control System (CICS) and CICS/VS
- Development Management System (DMS) CICS/VS
- Display console support for local 3270 displays and printers used as operator's consoles is available through Device-Independent Display Operator Console Support (DIDOCS) and Status Display Support (SDS) OS and OS/VS.
- Display Exception Monitoring Facility (DEMF)
- Display Management System/Virtual Storage (DMS/VS)
- Distributed Processing Control Executive (DPCX)
- Distributed Processing Programming Executive (DPPX)
- Generalized Information System/Virtual Storage (GIS/VS)
- Graphical Data Display Manager (GDDM) with Presentation Graphics Feature (PGF)
- Information Management System (IMS) and IMS/VS
- Interactive Format Services (IFS)
- Interactive Instruction System (IIS)
- Network Communications Control Facility (NCCF) and Network Problem Determination Application (NPDA)

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[1] For a description of applicable System/3 programming support, see the appropriate System/3 manuals.

- Network Operation Support Program (NOSP)
- Programmed Cryptographic Facility and ACF/VTAM Encrypt/Decrypt feature
- Storage and Information Retrieval System/Virtual Storage for OS/VS (STAIRS/VS)
- Structured Programming Facility (SPF)
- System/370 Planning, Control, and Decision Evaluation System/Interactive (PLANCODE/I)
- Timesharing Option (TSO) of TCAM and VTAM
- Timesharing Option (TSO) Session Manager
- Virtual Machine Facility/370-Conversational Monitor System (VM/370-CMS) as well as Basic System Extension Program Product and System Extension Program Product
- Virtual Storage/A Programming Language (VS APL)
- Virtual Storage Personal Computing (VSPC)
- Visual Data Entry Online/370 (VIDEO/370)

Chapter 6. Installation Planning and Setup

The physical characteristics and environmental requirements of 3270 units permit their installation in an office or computer room. For information on workspace considerations, site preparation, cables and connectors, and machine specifications, see *IBM 3270 Information Display System: Installation Manual-Physical Planning*, GA27-2787. Other installation and planning manuals that might be of interest are listed in *IBM 3270 Information Display System Library User's Guide*, GA23-0058.

Selected units of the 3270 display system are designated customer setup units. These are:

- 3274 Control Unit Models 1C, 21C, 31C, and 51C
- 3276 Control Unit Display Station
- 3278 Display Station
- 3279 Color Display Station
- 3262 Line Printer
- 3287 Printer
- 3289 Line Printer

The setup process consists of two steps: physical setup and checkout. Once the units are unpacked and placed in position, customer personnel capable of operating the units should be able to set them up and check them out. Instructions for customer setup are in the manuals listed in the *User's Guide*. These setup instructions are also shipped with the appropriate unit.

Since these units can be set up immediately upon arrival, the time from receipt of the unit until it is operational and ready for use should be minimized. Flexibility of relocation of units within a location is further enhanced by customer setup. For further details about customer setup, see your IBM marketing representative.

Chapter 7. Problem Determination

Significant function has been designed into the 3270 units to provide greater availability to the customer. This has been done through the use of problem determination procedures and recovery routines that have been designed for ease of use.

Problem Determination Guides are provided for the 3274 and 3276 as well as for the 3262, 3278, 3279, 3287, and 3279. These manuals are delivered with the unit and are designed to be used by the operator.

The following IBM software products help to provide effective problem determination at the host level:

Network Problem Determination Application (NPDA) 5735-XX8
Working with the Network Communications Control Facility (NCCF) 5735-XX6 (a program that provides communications and data base facilities for collecting, storing, and retrieving data on network errors), this program collects, organizes, and displays error statistics, as well as data about communication controllers, transmission lines, control units, and terminals. NPDA helps the NCCF operator locate a component causing problems.

Supported SNA communication environments include VTAM, TCAM, ACF/VTAM, and ACF/TCAM with NCP under OS/VS and also ACF/VTAM and ACF/VTAME with NCP under DOS/VSE. See *Network Communications Control Facility (NCCF) General Information,* GC27-0429, and *Network Problem Determination Application (NPDA) General Information,* GC34-2010, for information about these products.

Display Exception Monitoring Facility (DEMF)
This software tool for network problem determination and isolation enhances the availability of the 3274 and 3276 when operating in BSC mode. See *OS/VS Display Exception Monitoring Facility (DEMF) User's Guide,* GC34-2003, for details concerning the required software configuration, communication facility, and operating procedures.

Network Error Management Facility (NEMF) OS/DOS/CICS 5798-DAW
This program collects, organizes, and displays error statistics and data about communication controllers, transmission lines, control units, and terminals. It also helps locate a component causing problems.

Supported communication environments include BTAM and TCAM operating under OS/VS, and BTAM under DOS/VS. When using SNA protocol, supported environments include EXTM and ACF/VTAM with NCP under DOS/VS. (All environments require CICS.)

Facility Error Recognition System (FERS)
This facility permits logging of 3270 display system and transmission line statistics at the host. Retrieval of this data through the FERS facility permits problem determination to the suspected 3270 display system. See the *3270 Facility Error Recognition System (FERS) Service Aid Description,* G229-7029, the *DOS/CICS User's Guide,* G229-7030, and the *OS/CICS User's Guide,* G229-7029, for configuration, implementation, and operation information.

Abbreviations

A/FE. Americas/Far East
ACF/TCAM. Advanced Communications Function/
Telecommunications Access Method
ACF/VTAM. Advanced Communications Function/Virtual
Telecommunications Access Method
ACF/VTAME. Advanced Communications Function/Virtual
Telecommunications Access Method Extended
APL. A Programming Language
ASCII. American National Standard Code for Information
Interchange

bps. Bits per second
BSC. Binary synchronous communications
BTAM. Basic Telecommunications Access Method
BTAM-ES. Basic Telecommunications Access
Method – Extended Support

CCITT. Consultative Committee on International Telephone
and Telegraph
CICS. Customer Information Control System
CPU. Central processing unit
cps. characters per second

DCC. Disconnect chain command
DDS. Digital data service
DOS. Disk Operating System

E/ME/A. Europe/Middle East/Africa
EBCDIC. Extended binary-coded decimal interchange code
EIA. Electronic Industries Association

NCP. Network control program

OS. Operating System

PS. Programmed Symbols

SDLC. Synchronous data link control
SNA. Systems network architecture
SNEU. Switched network backup

TCAM. Telecommunications Access Method
TCU. Transmission control unit

VS. Virtual storage
VSE. Virtual Storage Extended
VSPC. Virtual Storage Personal Computing
VTAM. Virtual Telecommunications Access Method
VTAME. Virtual Telecommunications Access Method
Extended

Glossary

This glossary includes definitions developed by the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). This material is reproduced from the *American National Dictionary for Information Processing*, copyright 1977 by the Computer and Business Equipment Manufacturers Association, copies of which may be purchased from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

A

access method. A technique for moving data between main storage and an input/output device.

adapter. In 3270, hardware that is generally required for transferring data and commands between the processor and an I/O device.

alphanumeric.* Pertaining to a character set that contains letters, digits, and, usually, other characters, such as punctuation marks. Synonymous with *alphameric*.

American National Standard Code for Information Interchange X3.4-1968 (ASCII). A standard code consisting of control characters and graphic characters; used for information interchange between data processing and communication systems and associated equipment.

B

binary synchronous communication (BSC). Communication using binary synchronous transmission, that is, data transmission in which synchronization of characters is controlled by timing signals generated at the sending and receiving stations.

block-multiplexer channel. A multiplexer channel that interleaves blocks of data. See also *byte multiplexer channel*. Contrast with *selector channel*.

buffer. The hardware portion of a display station, control unit, or buffered printer in which display or print data is stored.

byte multiplexer channel. A multiplexer channel that interleaves bytes of data. See also *block-multiplexer channel*. Contrast with *selector channel*.

C

channel interface. The communication link between the channel unit and its attached control units, consisting of shared control and data lines.

character set. A defined collection of characters.

cluster control unit. A device, such as the 3274 Control Unit, that can control the input/output operations of more than one terminal, such as a group (cluster) of 3278 Display Stations.

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*American National Dictionary for Information Processing

communication controller. A type of communication control unit whose operations are controlled by a program stored and executed in the unit. Examples are the IBM 3704 and 3705 Communication Controllers.

communication facility. Anything used or available for use in furnishing data communication service.

customizing procedure. The multistep process, performed at the 3274 Control Unit, of constructing a configuration image of the 3270 subsystem.

D

data link. The physical connection and the connection protocols between units that exchange data over a communication line.

data-link-attached loop. In 8100, a data communication transmission loop used to attach I/O devices to the system by a data link facility rather than directly by cables. Contrast with *directly attached loop*.

data stream. All data transmitted through a channel in a single read or write operation to display station or printer.

directly attached loop. In 8100, a loop that connects to the loop adapter by cables, rather than through a data link facility, and allows attachment of a variety of I/O devices. Contrast with *data-link-attached loop*.

diskette. A thin, flexible magnetic disk and a semi-rigid protective jacket in which the disk is permanently enclosed.

duplex.* (1) (ISO) In data communication, pertaining to a simultaneous two-way independent transmission in both directions. Synonymous with *full duplex*. (2) Contrast with *half-duplex*.

H

half-duplex.* (1) In data communication, pertaining to an alternate, one-way-at-a-time, independent transmission. (2) Contrast with *duplex*.

hardware.* (1) (ISO) Physical equipment used in data processing, as opposed to computer programs, procedures, rules, and associated documentation. (2) Contrast with *software*.

I

interface.* A shared boundary. An interface might be a hardware component to link two devices or it might be a portion of storage or registers accessed by two or more computer programs.

L

leased line. See *nonswitched line*.

M

modem. (1)* (modulator-demodulator) A device that modulates and demodulates signals transmitted over data communication facilities. (2) Also called *data set*.

multiplexer channel. A channel designed to operate with a number of I/O devices simultaneously. Several I/O devices can transfer records at the same time by interleaving items of data.

N

nonswitched line (also called *leased line*). A connection between a remote terminal and a host system that does not have to be established by dialing.

P

protocol. (1) In SNA, the sequencing rules for requests and responses by which network addressable units in a communication network coordinate and control data transfer operations and other operations. (2) Synonymous with *line control discipline, line discipline*.

S

selector channel. An I/O channel designed to operate with only one I/O device at a time. Once the I/O device is selected, a complete record is transferred one byte at a time. Contrast with *block-multiplexer channel* and *multiplexer channel*.

selector light pen. A pen-like instrument that can be attached to the display station as a special feature. When pointed at a detectable portion of an image and than activated, the selector light pen senses the presence of light at a display field and identifies that portion of the displayed message for entry into the data processing system.

software.* (1) (ISO) Computer programs, procedures, rules, and possibly associated documentation concerned with the operation of a data processing system. (2) Contrast with *hardware*.

switched line. A communication line in which the connection between the computer and a remote station is established by dialing.

synchronous data link control (SDLC). A discipline for managing synchronous, transparent, serial-by-bit information transfer over a communication channel. Transmission exchanges may be duplex or half-duplex over switched or nonswitched data links. The communication channel configuration may be point-to-point, multipoint, or loop.

systems network architecture (SNA). The total description of the logical structure, formats, protocols, and operational sequences for transmitting information units through the communication system. Communication system functions are separated into three discrete areas: the application layer, the function management layer, and the transmission subsystem layer. The structure of SNA allows the ultimate origins and destinations of information – that is, the end users – to be independent of, and unaffected by, the specific communication-system services and facilities used for information exchange.

T

time-sharing. Refers to the interleaved use of the operating time of a device.

transmission control unit (TCU). A communication control unit whose operations are controlled solely by programmed instructions from the computing system to which the unit is attached; no program is stored or executed in the unit. Contrast with *communication controller*. Synonymous with *telecommunication control unit*.

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*American National Dictionary for Information Processing

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