GA27-3640-0

IBM 3728 Communication Control Matrix Switch

Introduction

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First Edition (July 1985)

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About This Guide

This guide introduces planners and evaluators to the functions and capabilities of the IBM 3728 Communication Control Matrix Switch (referred to as Matrix Switch). It is written to help you determine if the Matrix Switch could be a useful component in your telecommunication network. It also describes how you would incorporate the Matrix Switch into your telecommunication network.

This guide is divided into four chapters and one appendix:

- **Chapter 1 - Overview of the Matrix Switch** describes the Matrix Switch and lists the advantages of using it in a telecommunication network.
- **Chapter 2 - Matrix Switch Applications in a Telecommunication Network** describes each function of the Matrix Switch and how it operates as a part of a telecommunication network. The guide also describes the characteristics of the Matrix Switch.
- **Chapter 3 - Major Components of the Matrix Switch Hardware** describes the hardware components of the Matrix Switch.
- **Chapter 4 - Customer Procedures** describes the responsibilities of the owner of the Matrix Switch in terms of setting up the switch and handling operational problems.
- **Appendix A - Signals Supported** provides a list of the RS-232C/CCITT V.24 and CCITT V.35 signals supported by the Matrix Switch.

This guide also includes:

- **Glossary**
- **Index**

Prerequisite Knowledge

There is no required prerequisite knowledge.

Related Publications

The following manuals might be helpful to you in understanding the information presented in this guide:

- *IBM 3725 Communication Controller Introduction*, GA33-0010
- *IBM 3725 Communication Controller Operating Guide*, GA33-0014
- *IBM 3728 Communication Control Matrix Switch Installation Planning and Configuration Guide*, GA27-3641

If you need additional information on any topic covered in this manual, talk to your IBM Marketing Representative.

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Figures

Chapter 1

Overview of the Matrix Switch

This chapter briefly describes the Matrix Switch and its major advantages and features.

Contents

General Information

The Matrix Switch (shown in Figure 1-1) electronically switches lines in a telecommunication network. Because it switches lines, the Matrix Switch can be used to configure, reconfigure, monitor, and test your network. All operations that the Matrix Switch performs are operator-controlled and monitored through an IBM 3161 Display Station (switch control console) or an IBM 5160 Personal Computer XT (support processor).

The Matrix Switch eliminates the need to physically connect and disconnect interface lines when configuring, reconfiguring, testing, or monitoring a telecommunication network. Because the Matrix Switch gives you an easy and fast method for switching network lines, the Matrix Switch can increase the manageability and reliability of your network.

In a telecommunication network, the Matrix Switch can be connected between:

- Data terminal equipment (DTE) and data circuit-terminating equipment (DCE)
- DCEs and telecommunication lines
- DTEs and DTEs (direct attach).

Figure 1-2 shows a simplified, but typical, arrangement of a Matrix Switch in a telecommunication network.

As a switching device, the Matrix Switch can perform a variety of functions in a telecommunication network. The Matrix Switch can:

- Reconfigure a network. Reconfiguring a network enables an operator to:
  - Switch a failed DCE, DTE, or line out of a network
  - Switch a working DCE, DTE, or line into a network
  - Facilitate load sharing.
- Monitor a network's signal activity. An operator can easily connect test equipment to the lines connected to the Matrix Switch. The test equipment can be used to monitor and test signal activity online with no disruption to your network.

The Matrix Switch provides an additional feature that allows you to set up error thresholds on the signals that pass through the switch. If any alarm parameter is reached, the Matrix Switch automatically notifies the Matrix Switch operator. In this way, the switch maintains a constant surveillance of signal activity with a minimum of operator effort.

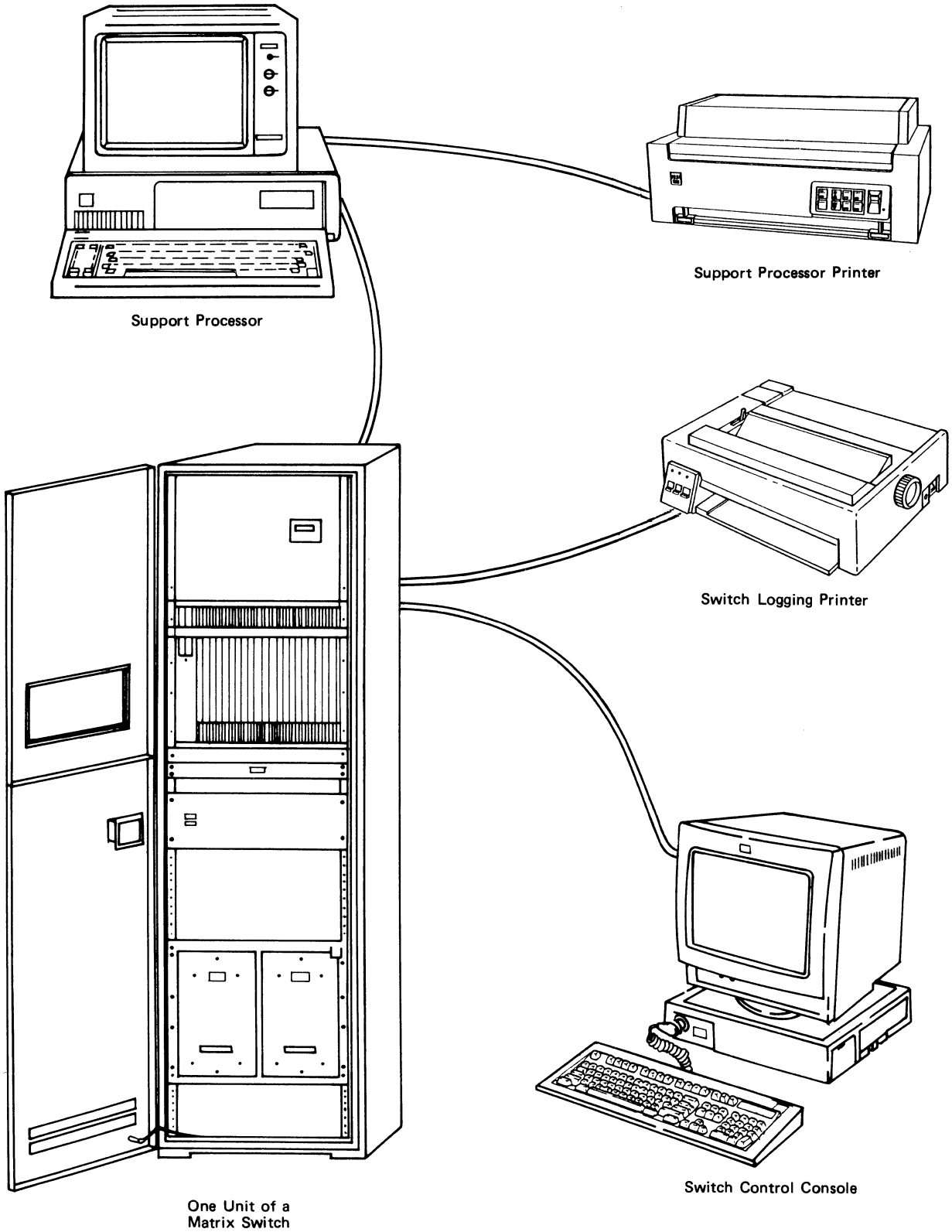

Figure 1-1. The Matrix Switch

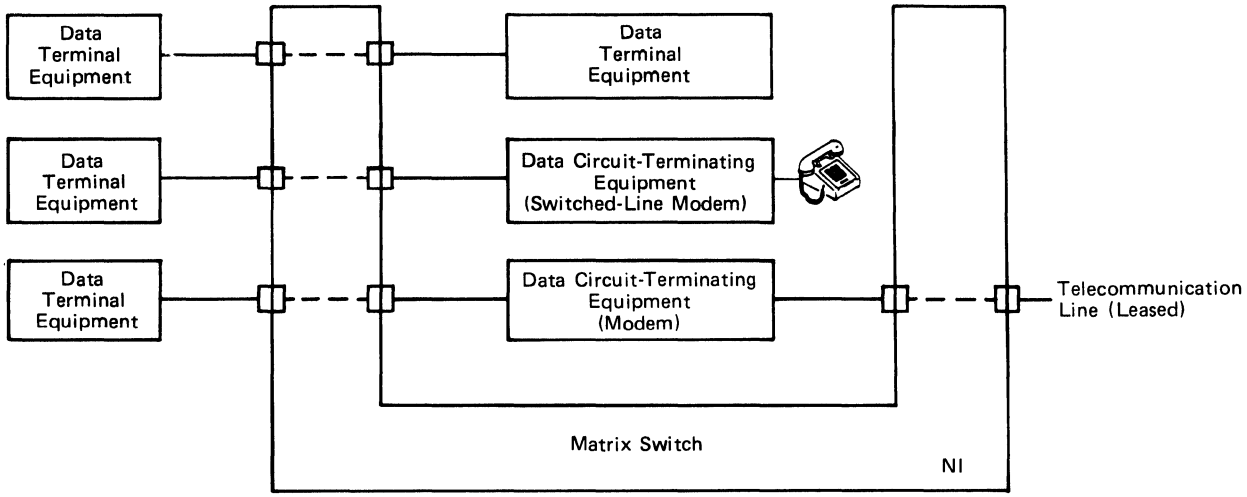

Figure 1-2. Matrix Switch in a Telecommunication Network

Major Advantages

The Matrix Switch has many advantages as a device for managing a telecommunication network. These include:

- The Matrix Switch decreases network downtime. Because the Matrix Switch is fast and efficient, it can be used to:
  - Quickly recover from line, DCE and DTE failures in a network
  - Monitor a network and increase the chances of preventing a network failure.
- The Matrix Switch is versatile. The Matrix Switch supports most applications of telecommunication networking. Compatible interfaces are:
  - EIA RS-232C[1]/CCITT V.24[2]
  - CCITT V.35[3]
  - Four Wire Private Line.[4]
- The Matrix Switch is easy to use. The operation of the Matrix Switch is controlled from either an IBM 3161 Display Station or an IBM Personal Computer XT. All of the operating procedures are user friendly and

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1 See Appendix A for signals supported.
2 CCITT V.24 refers to CCITT recommendation V.24, Series 100 circuits, with V.28 electrical characteristics throughout this document.
3 See Appendix A for V.35 signals supported.
4 For attachment to analog lines compatible with CCITT recommendation M1020.

menu driven. With the help of the *IBM 3728 Communication Control Matrix Switch Operations Guide*, GA27-3643, and the Matrix Switch panels, Matrix Switch operation can be quickly mastered. After an operator has mastered the operation, the menus can be bypassed and commands entered on one line. The Matrix Switch also provides messages that keep the operator informed on such matters as:

- Operator errors
- Matrix Switch hardware failures
- Operational events.

- The Matrix Switch is reliable. All the major subsystems of the Matrix Switch are provided in duplicate pairs. A failure in any major subsystem causes the redundant counterpart of the pair to automatically take control. A failure in any major subsystem does not result in interruption of Matrix Switch operation.

- The Matrix Switch is expandable. Additional units can be added to a Matrix Switch to meet the requirements of a growing telecommunication network. Additional Matrix Switches can be connected in different locations in your network. It is possible to control up to 60 remote and one local Matrix Switch from a single site.

- The Matrix Switch is online serviceable. The Matrix Switch provides front panel lights and event reports displayed on the switch control console to identify failed subsystems. Failed subsystems can be replaced by an IBM Customer Engineer while the Matrix Switch remains online and operating.

Other Highlights

In addition to the Matrix Switch's major advantages:

- The Matrix Switch can be controlled by either a switch control console (IBM 3161 Display Station) or a support processor (IBM Personal Computer XT).

  The switch control console is a standard ASCII terminal from which up to 61 Matrix Switches can be controlled.

  The support processor is optional, but can be used instead of or in addition to the switch control console. The support processor further enhances network manageability by automatically controlling operations that a switch control console operator would have to implement manually at the keyboard. The support processor can also:

  - Emulate an IBM 3727 Operators Console and control both local and remote IBM 3725 Communication Controllers
  - Replace an IBM 3727 Operators Console as a device to control the 3725.

- The Matrix Switch operational activity is recorded on a switch logging printer (IBM 4201 Proprinter). If a Matrix Switch uses a support

processor, a support processor printer (IBM 5182 Personal Computer Color Printer) can replace or be used in addition to the switch logging printer.

- The Matrix Switch provides a connection to a remote diagnostic center. The remote diagnostic center can control or monitor the Matrix Switch, or any Matrix Switch in the network, as an aid to the IBM Customer Engineer for diagnosing problems.

Chapter 2

Applications in a Telecommunication Network

This chapter describes how the Matrix Switch increases the reliability and manageability of a telecommunication network. It includes:

- An overview of the functions the Matrix Switch performs
- A description of the characteristics of the Matrix Switch

Contents

Matrix Switch Functions

The Matrix Switch electronically switches signals and provides connections between:

- DTEs and DCEs
- DCEs and telecommunication lines
- DTEs and DTEs (direct attach).

The typical DTE device is an IBM 3725 Communication Controller. The typical DCE device is a modem. The typical telecommunication lines are private (nonswitched) telephone lines.

The DTE, DCE, and telecommunication lines are connected to a Matrix Switch through ports. A complete connection between a DTE and a DCE, between two DTE devices, or between DCEs and telecommunication lines is accomplished through connections to at least two Matrix Switch ports. This is shown in Figure 2-1. One Matrix Switch can be equipped with a maximum of 3,840 ports connected to analog interfaces, 1920 ports connected to digital interfaces, or combinations of the two.

The total number of ports is limited by the type of interface switched (EIA RS-232C/CCITT V.24, CCITT V.35, or Four Wire Private Line). This is because a unique port card provides the connection to the Matrix Switch for each interface type. Each port card has a unique number of lines for which it can provide connection. See "Matrix Switch Characteristics" in this chapter for more details.

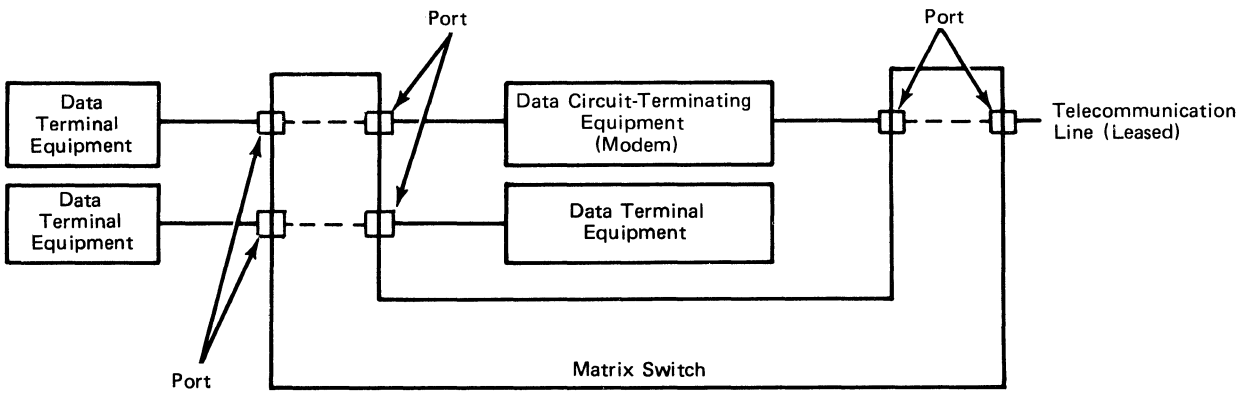

Figure 2-1. Matrix Switch Port Connections

By changing the port-to-port connections, the Matrix Switch operator can:

- Switch DCEs or DTEs in and out of the network to spare equipment and facilitate load sharing
- Connect test equipment to data lines to monitor and test the telecommunication network.

The Matrix Switch is also capable of alarming selected signals at each port. In port alarming, the operator defines an alarm condition, such as a signal transition, and the Matrix Switch alerts the operator each time the alarm condition is met.

Each Matrix Switch function is described in the following sections. All of these operations are performed from the keyboard-operated control terminal connected to the Matrix Switch.

Equipment Sparing

Equipment sparing is the most important function the Matrix Switch performs in terms of keeping your telecommunication network online and operating. The Matrix Switch can spare DCEs, DTEs, and telecommunication lines. Equipment sparing is accomplished by electronically changing the Matrix Switch's port connections. Figures 2-2 through 2-4 show examples of the sparing of each of the failed elements of a telecommunication network.

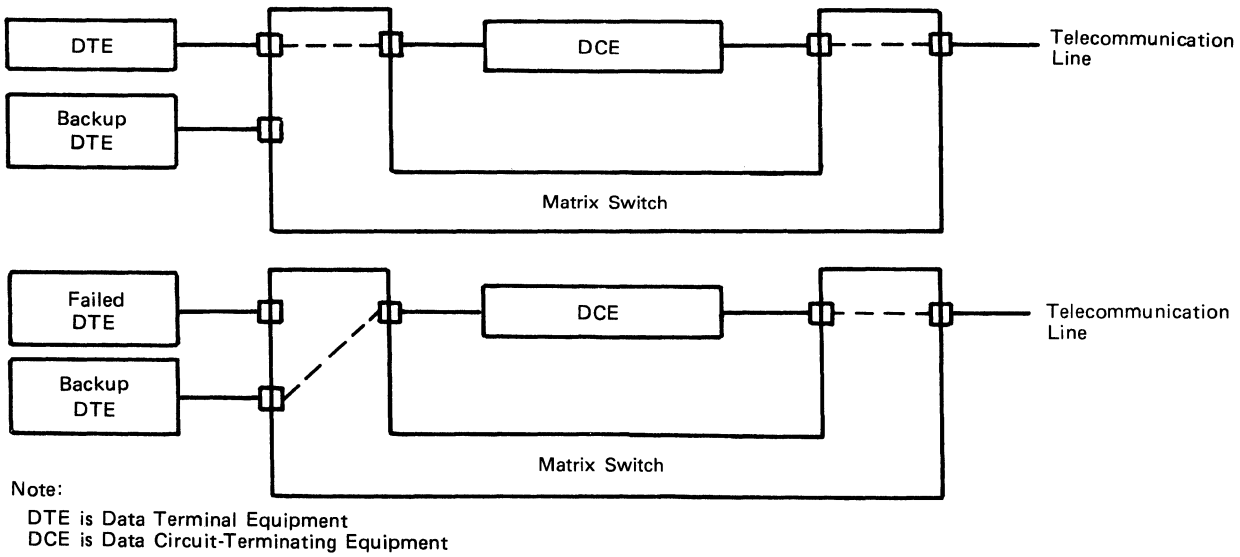

Figure 2-2. Sparing a Failed DTE

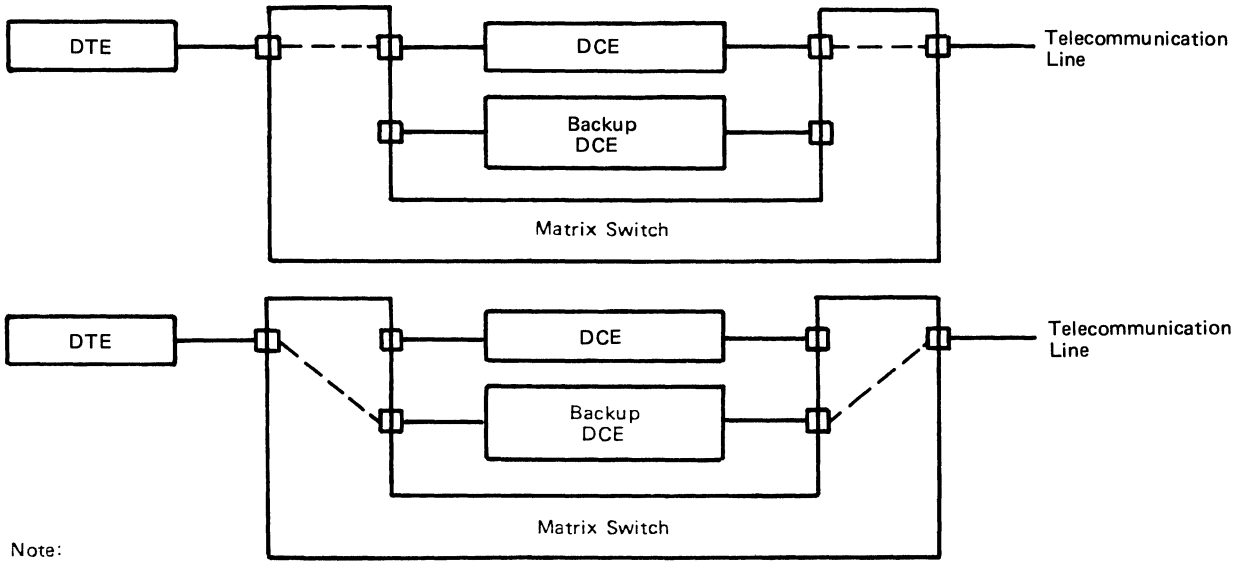

Figure 2-3. Sparing a Failed DCE

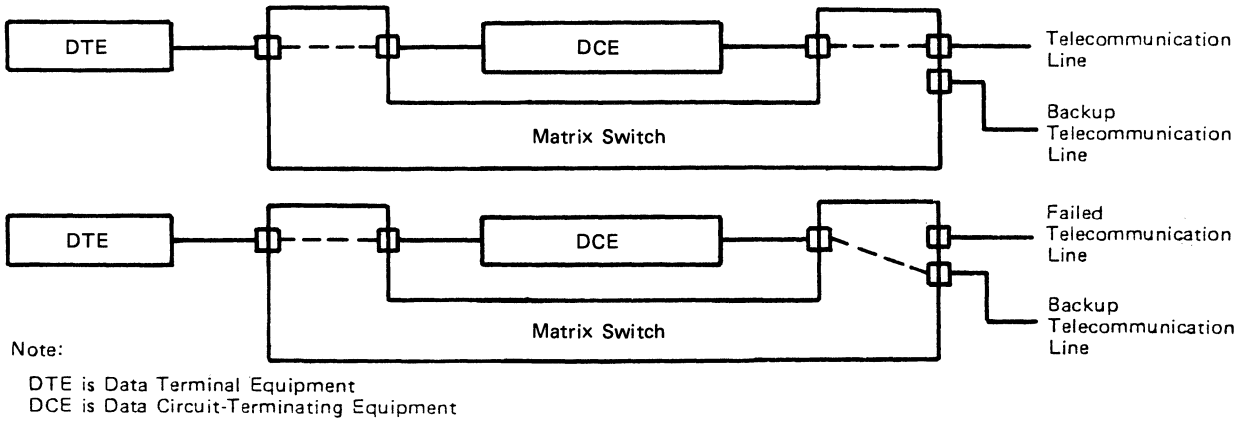

Figure 2-4. Sparing a Failed Telecommunication Line

Each equipment item to which the Matrix Switch connects is likely to have more than a single-line connection to the telecommunication network. Sparing an equipment item therefore generally requires changing more than one port connection. This can be accomplished in a variety of ways:

- Connect one port at a time. Connecting one port at a time requires the operator to establish the desired connection through a series of steps in which one port connection is set up in each step.

- Substitute port connections. Substituting allows the operator to swap the connection at one port for the connection at another port. Figure 2-5 shows an example of port substitution.

- Perform a group connection or substitution. The Matrix Switch allows you to define from one to 120 ports as a group. The operator can then, in one step:

  - Connect one group of ports to another group of ports.
  - Substitute one group of ports for another group of ports.

  Figure 2-6 shows an example of a group connection. Figure 2-7 shows an example of a group substitution.

- Change configuration. The Matrix Switch stores three unique port connection configurations. Each of the three configurations defines port connections throughout the switch. Each configuration is independent of the other two and can describe a completely unique port connection setup. Each time a different configuration is activated, all of its port connections are put into effect. Through the simple process of activating configurations, an operator can initiate anything from a slight change to a wide-sweeping change in a network's configuration.

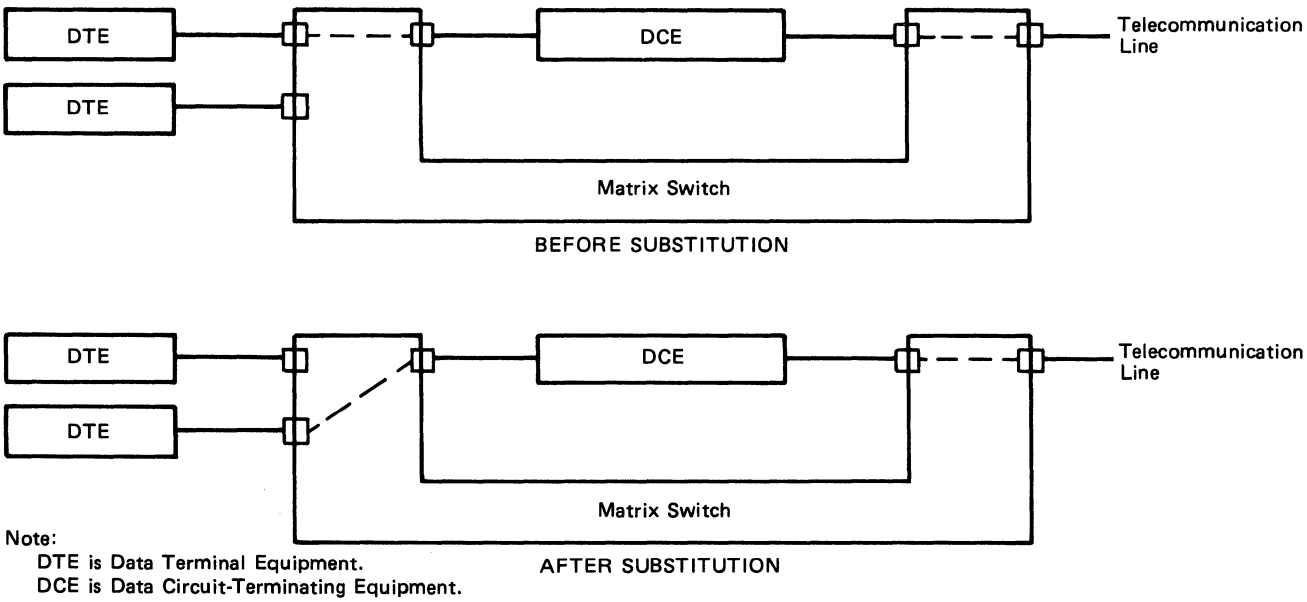

Figure 2-5. Port Substitution

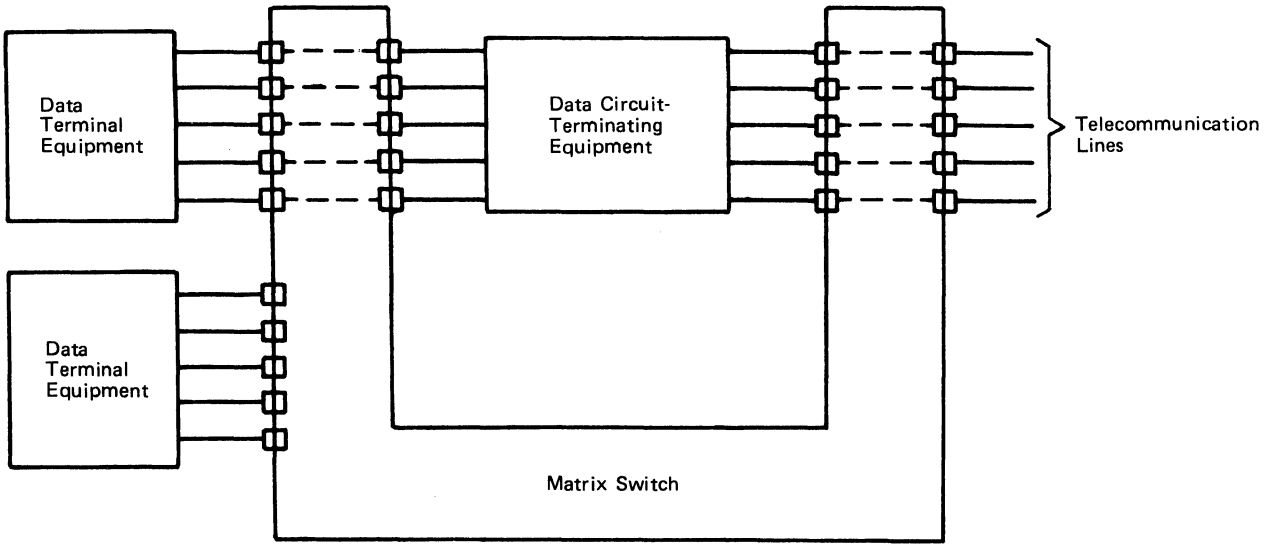

Figure 2-6. Group Connection

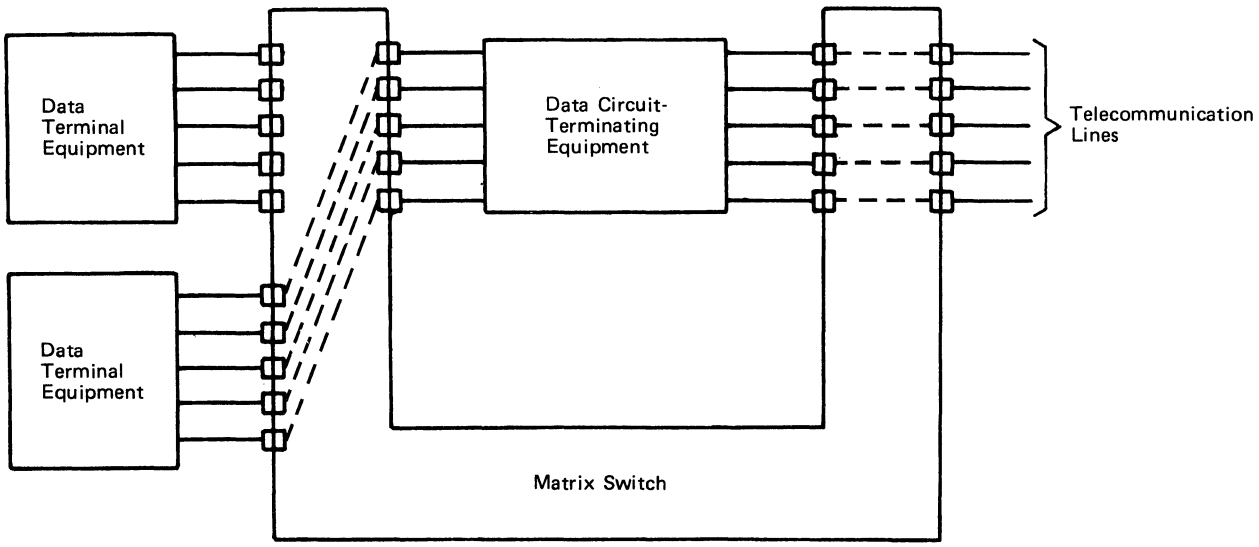

Figure 2-7. Group Substitution

Signal Alarming

Signal alarming is useful for minimizing a telecommunication network's downtime. Signal alarming allows the operator to define two signal conditions for each Matrix Switch port. When these conditions are met (or exceeded), the Matrix Switch operator is notified by a report of the alarm that displays on the screen. This report alerts the operator, who can then take corrective measures.

Network Testing and Monitoring

The Matrix Switch allows an operator to passively monitor or actively monitor the signal activity at the Matrix Switch ports.

- Passive monitoring allows an operator to examine, but not interfere with, the port signal activity.

- Active monitoring allows an operator to generate and inject test signals into the data flow and to examine the results.

Passive monitoring and active monitoring require the use of option cards (option cards are described in Chapter 3) and external test equipment. With these accessories, an operator can monitor and test any signal at any port on the Matrix Switch.

Matrix Switch Characteristics

Signal Interface

The Matrix Switch interfaces are defined as follows:

- DCE-DTE or DTE-DTE Interfaces:

  - EIA RS-232C/CCITT V.24
  - CCITT V.35

- Telecommunication Line Interface:

  - Four Wire Private Line

Each Matrix Switch can support many combinations of interfaces. Each connection to the Matrix Switch is made through a port card which is dedicated to a specific type of digital or analog interface. Each Matrix Switch can be set up with different types and numbers of ports. The type and number of ports included on a switch depends on how you want to configure your network.

Port Characteristics

The maximum number of ports possible on a Matrix Switch depends on:

- The size of the Matrix Switch. A Matrix Switch can be as small as one base unit or as large as one base unit and up to 15 extension units. (Base units and extension units are described in Chapter 3.) Each unit of a Matrix Switch has the same maximum number of ports. Therefore, a base unit with one extension unit has up to twice as many ports as a single base unit. A base unit with two extension units has up to three times as many ports as a single base unit. This progression continues, up to the switch with a base unit and 15 extension units, which has up to 16 times as many ports as a single base unit.

- The type of signal interfaced. The hardware connections to the Matrix Switch are different for the different types of signals interfaced. The maximum number of ports that can provide connection to a Matrix Switch is determined by what type or types of signals you want the switch to support and, for the V.35 interface, the bit rate. The signal types and maximum number of ports are:

Signal Type	Maximum Bit Rate (Kilobits per second)	Maximum Ports (on one unit)
EIA RS-232C/CCITT V.24	19.2	120
CCITT V.35	76.8	60
	153.6	30
Four Wire Private Line	—	240

The maximum ports' quantity applies if every port in the unit is used for the associated signal type. You can have one, two, or three of the signal types on one switch in any combination.

For a Matrix Switch that consists of a base unit and extension units, connections can be established between any two of the same-type ports in any unit, and limited connections can be established between any two of the same-type ports in different units. (Same-type means that two ports support the same type of interface.) Port connection between units requires the use of the multiunit switch/8 circuit card, which is optional. (The multiunit switch/8 circuit card is described in Chapter 3.)

Matrix Switch Network Characteristics

A Matrix Switch network can consist of from one to 61 nodes. A node is a Matrix Switch or a support processor. From any node in a Matrix Switch network, any switch in the network can be controlled and monitored. Every node in the network is capable of receiving event reports from any other node. Event reports are issued from Matrix Switches to inform the operator of events such as equipment failure and operating status.

Chapter 3

Major Components of the Matrix Switch Hardware

This chapter describes the Matrix Switch hardware configuration and provides a description of the major components of a Matrix Switch.

Contents

Hardware Configuration

The major components of a Matrix Switch are shown in Figure 3-1. Figure 3-1 shows:

- The Matrix Switch cabinet. The cabinet measures 81 × 61 × 180 cm (34 × 24 × 70 3/4 in.) and has front and rear doors, and side covers for access to interior components. The Matrix Switch cabinet interior components include:

  - Power supplies
  - Circuit cards
  - Minicassette tape drive (optional in extension units)
  - Cooling fans.

- The terminals and printers that can be used to control a Matrix Switch. These include:

  - Switch control console
  - Support processor
  - Switch logging printer
  - Support processor printer.

The minimum requirement for the controlling and monitoring of a Matrix Switch is one switch control console and one switch logging printer. The support processor and support processor printer are all optional, but enhance the ease and efficiency of Matrix Switch operation. The support processor can replace or be used in addition to the switch control console. If the support processor is used, the switch control console and switch logging printer are optional.

A Matrix Switch is defined as a base unit or a base unit and up to 15 extension units. A Matrix Switch unit is represented on Figure 3-1 as the cabinet and the cabinet interior components. When speaking of a Matrix Switch, the size of the switch is not implied. A single Matrix Switch can include from 1 to 16 units.

Extension units provide additional ports on a Matrix Switch. Extension units are needed when all of the ports offered by a base unit support connections, and more connections are still needed. With the addition of each extension unit, the number of available ports increases up to 120 digital or 240 analog ports. Extension units do not require additional terminals or printers for Matrix Switch control.

Extension units resemble base units in their hardware makeup. The major difference is that the base unit contains two components that are not needed on extension units:

- The minicassette tape drive

- The network control interface card (optional).

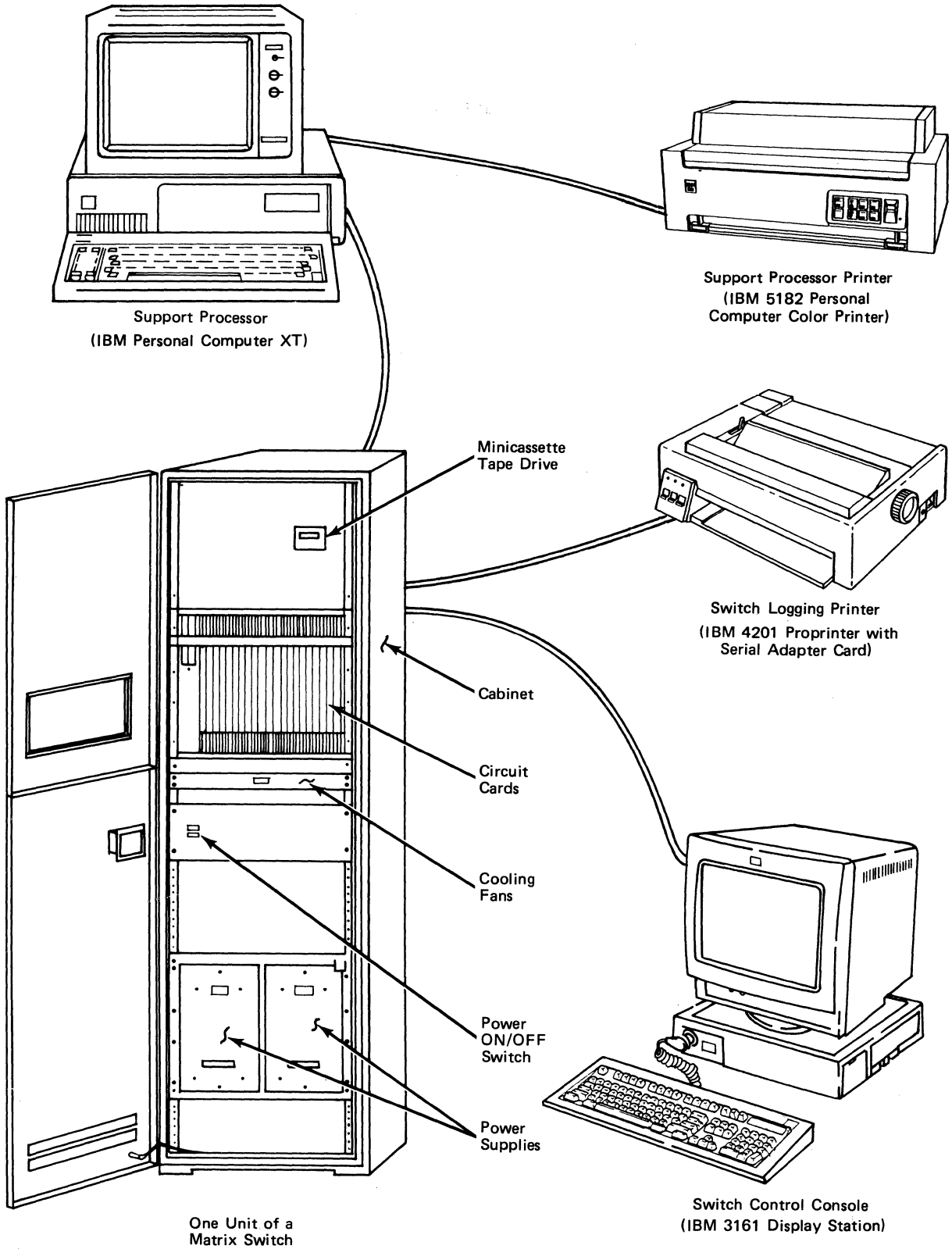

Figure 3-1. Major Components of a Matrix Switch

The minicassette tape drive is optional on extension units. Including a minicassette tape drive on extension units decreases program loading time.

All of these components of the Matrix Switch are described in more detail in the following sections.

Power Supplies

A Matrix Switch unit has two duplicate power supplies. Each power supply produces +5 and ±12 volts DC for Matrix Switch operation. Both power supplies normally share the total Matrix Switch unit current demand. If one power supply fails, the other power supply assumes the total current load.

Circuit Cards

A Matrix Switch uses three types of circuit cards:

- System cards:
  - Microprocessor card
  - Master timing card
- Port cards:
  - EIA/8 card
  - V.35/2 card
  - V.35/4 card
  - VF/16 card
- Option cards:
  - Network control interface card
  - Extension unit control card
  - Multiunit switch/8 card
  - Real-time monitor card
  - Active/passive test switch card
  - V.35 real-time test card

Each circuit card is mounted in a card cage as shown in Figure 3-2. Each card cage slot is dedicated to a particular type of circuit card. On the card cage, there are:

- Two master timing card slots
- Two microprocessor card slots
- Fifteen port card slots
- Four switch option card slots.

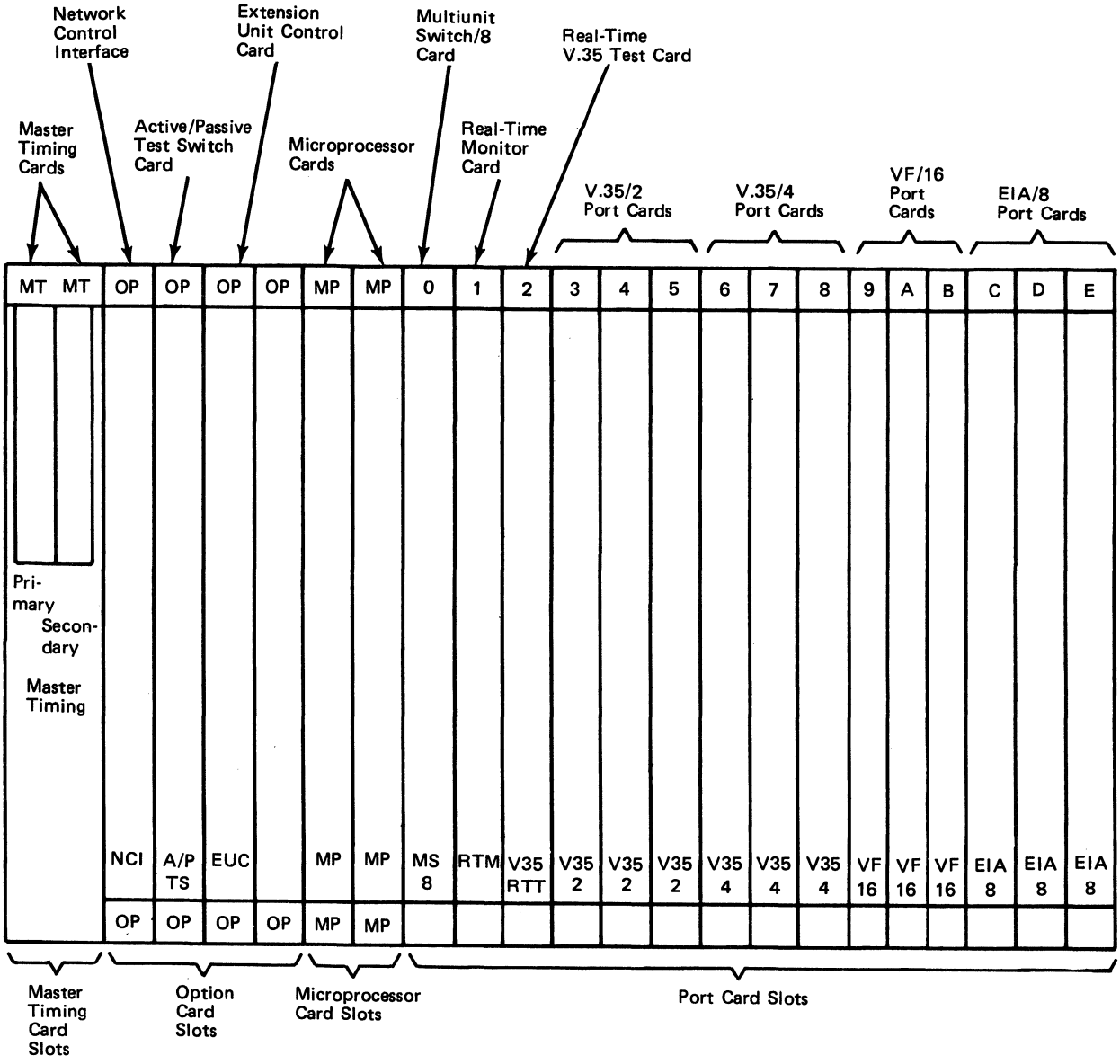

Figure 3-2. Matrix Switch Card Cage

The switch option cards are installed in the switch option card slots. Three option cards must be installed in port slots. These are the:

- Multiunit switch/8 card
- Real-time monitor card
- V.35 real-time test card.

Using any of these option cards causes you to lose a port card slot; this decreases the number of available ports on a Matrix Switch.

Each Matrix Switch circuit card has a front panel that contains:

- An ON/OFF switch. The ON/OFF switch is used by the IBM Customer Engineer to apply power to and remove power from the card.
- A POWER light. The POWER light shows that the Matrix Switch is powered on and the card's ON/OFF switch is set to ON.
- An ON LINE light. The ON LINE light shows that the card is online and enabled.

Each circuit card also has other lights that provide the status of the card's operation. These lights are unique to each card.

The following sections provide a description of each of the Matrix Switch circuit cards.

System Cards

The microprocessor card and the master timing card implement control and monitoring of a Matrix Switch. These cards are described in the following sections.

Microprocessor Card:
Controls a Matrix Switch. The microprocessor card contains:

- A 256KB random access memory. This stores the Matrix Switch microcode program.
- A 6KB random access memory. The Matrix Switch stores three switch configurations; each configuration describes unique port connections. The 6KB random access memory, known as the configuration memory (CMEM), stores the three configurations. Because the configuration memory is battery backed, if line power to the Matrix Switch is lost, the three configurations are held in memory and the active configuration is automatically reestablished when power is restored. Without line power, the configuration memory can hold the three configurations for up to two years.
- A programmable read-only memory that contains the microprocessor initialization program.

Each unit of a Matrix Switch contains two redundant microprocessor cards: a primary and a secondary. If the primary microprocessor card fails, the secondary microprocessor card takes over automatically and Matrix Switch's operation is not interrupted. Lights on the microprocessor card's front panel indicate which card is the primary and which is the secondary. As redundant cards, the two microprocessor cards contain the same information in their 256KB random access memory and 6KB configuration memory.

Master Timing Card:
Generates all of the timing signals used by a Matrix Switch. Each unit of a Matrix Switch has two redundant master timing cards: a primary and a secondary. If the primary master timing card fails, the secondary master timing card takes over automatically and Matrix Switch's operation is not interrupted. Lights on the master timing card's front panel indicate which card is the primary and which is the secondary.

If a Matrix Switch includes extension units, all master timing cards are synchronized to the master timing card in the base unit.

Port Cards

The port cards implement the switching operations of a Matrix Switch. Each port card is defined by:

- The type of signal the card switches
- The number of ports the card supports.

The name of each port card gives you this information. Each port card name includes a slash (/). The letters and/or numbers before the slash indicate the type of signal the port card switches. The number after the slash indicates how many ports the card supports.

For example, an EIA/8 port card supports eight EIA RS-232C ports.

Each port card contains a transmit light and a receive light for each of its ports. The transmit and receive lights allow the operator to visually monitor the transmit and receive activity on each port.

Up to 15 port cards, of one type or any combination of types, can be installed on one unit of a Matrix Switch.

Each port card is described in the following sections.

EIA/8 Port Card:
Switches EIA RS-232C/CCITT V.24 signals. The EIA/8 port card services up to eight ports and switches 14 digital signals at each port. The card supports dedicated synchronous and asynchronous applications at speeds of up to 19.2 kilobits per second (kbps).

The EIA/8 port card is compatible with both DTEs and DCEs. Lights on the EIA card's front panel indicate whether the card is being equipped with a DTE or DCE connector panel.

V.35/2 Port Card:
Switches CCITT V.35 signals. The V.35/2 port card services up to two ports and switches up to 12 of the 14 digital signals at each port. The maximum bit rate of the V.35/2 port card is 153.6 kbps.

The V.35/2 port card is compatible with both DTEs and DCEs. Lights on the V.35/2 card's front panel indicate if the card is being equipped with a DTE or DCE connector panel.

V.35/4 Port Card:
Switches CCITT V.35 signals. The V.35/4 port card services up to four ports and switches up to 11 of the 13 digital signals at each port. The maximum bit rate of the V.35/4 port card is 76.8 kbps.

The V.35/4 port card is compatible with both DTEs and DCEs. Lights on the V.35/4 card's front panel indicate whether the card is being equipped with a DTE or DCE connector panel.

VF/16 Port Card:
Switches analog signals (four wire private line). The VF/16 card services up to 16 ports and switches four-wire analog signals at each port. The VF/16 port card generally services the telecommunication lines on the analog side of a modem.

Option Cards

The option cards, described in the following sections, extend the range of the Matrix Switch's functions.

Switch Feature Option Cards:
Increase the communication capability of a telecommunication network. The switch feature option cards are described in the following sections.

Network Control Interface Card
The network control interface card provides for communication between the Matrix Switch and other nodes of the network. A node is a Matrix Switch or a support processor. If your Matrix Switch network contains more than one node, you must include in each switch one network control interface card. A network control interface card can provide interface with up to four different nodes. The network control interface card is installed in an option card slot in the base unit. Extension units do not require a network control interface card.

Up to two network control interface cards can be installed in a base unit.

Extension Unit Control Card
The extension unit control card provides for communication between the base units and extension units of a Matrix Switch. If your Matrix Switch includes extension units, you must include an extension unit control card in the base unit. Extension units are automatically equipped with an extension unit control card. The extension unit control card is installed in an option card slot. A seven-segment display on the extension unit control card's front panel indicates the number of the unit in which the card is installed. Unit numbers are as follows:

- The base unit is numbered 0.

- The extension units are numbered 1 through 15.

Multiunit Switch/8 Card
The multiunit switch/8 card provides eight channels for sharing port data and monitoring information between Matrix Switch units. This allows you to:

- Monitor, with the real-time monitor card in one unit, port activity in another unit.

- Connect a port in one unit to a port in another unit.

The multiunit switch/8 card is installed in a port slot, and must be located in each Matrix Switch unit for which inter-unit communication is desired. The base unit must be equipped first, then the adjacent extension units. One or more multiunit switch/8 cards can be installed in each Matrix Switch unit. If a port slot in one Matrix Switch unit is occupied by a multiunit switch/8 card, that same port slot in other units of the Matrix Switch must also contain a multiunit switch/8 card or be left unoccupied.

Test and Monitor Option Cards:
Allow you to actively test or passively monitor the signal activity on the Matrix Switch ports.

- In active testing, test signals are generated either by test equipment (such as a bit error rate tester) or are taken from a Matrix Switch port; the test signals are injected into the communication link.

- In passive monitoring, port activity is monitored but data flow is not altered.

The following sections describe the test and monitor option cards.

Real-Time Monitor Card
The real-time monitor card allows you to passively monitor the activity of up to four ports that connect to EIA RS-232C/CCITT V.24 signals. The real-time monitor card can also be used to passively monitor the activity of up to four ports that connect to analog (four wire private line) signals; this requires the use of the analog real-time monitor adapter, which can be ordered with the switch. The real-time monitor card provides:

- A display on its front panel to monitor the activity of one port.

- A means of monitoring up to four ports simultaneously on external test equipment.

Ports that are used for DTEs or DCEs can be monitored. Lights on the real-time monitor card's front panel allow data from one port to be visually displayed in addition to being routed to the external test equipment. The port number and type (DCE/DTE) are also displayed.

The real-time monitor card is installed in a port card slot. Several real-time monitor cards can be installed in each unit of a Matrix Switch.

Active/Passive Test Switch Card

The active/passive test switch card allows you to permanently connect one single test equipment to the 3728 to perform both active testing and passive monitoring of EIA RS-232C/CCITT V.24 signals or four wire private line analog signals without moving cables. The card operates as follows:

- For passive testing, test equipment is connected to the Matrix Switch ports through a real-time monitor card. For active testing, the test equipment is connected to the Matrix Switch ports via one port dedicated to testing. Lights on the front panel of the active/passive test switch card indicate whether the card is being used for analog or digital and active or passive testing.

- Ports that are used for DTEs or DCEs can be actively tested or passively monitored. Lights on the active/passive test switch card indicate the type of connection established through the card: active or passive, DCE or DTE, or analog.

- The active/passive test switch card is installed in an option card slot. Up to four active/passive test switch cards can be installed in each unit of a Matrix Switch.

V.35 Real-Time Test Card

The V.35 real-time test card allows for active and passive testing of two ports that connect to CCITT V.35 signals. The V.35 real-time test card provides connections to test equipment with either V.35-type connectors (female) or V.24/EIA D-type connectors (female).

Ports that are used for DTEs or DCEs can be actively tested or passively monitored. Lights on the V.35 real-time test card allow data from one port to be visually displayed in addition to being routed to the external test equipment. The port number and type (DCE/DTE) are also displayed.

The V.35 real-time test card is installed in a port card slot. One or more real-time monitor cards can be installed in each unit of a Matrix Switch.

Minicassette Tape Drive

The minicassette tape drive holds the Matrix Switch microcode program. If a Matrix Switch includes extension units, the program can load from a

minicassette tape drive provided in the base unit. But the program is loaded one unit at a time, and the process can take up to seven minutes for each extension unit. Installing a minicassette tape drive in the base unit, as well as in the extension units, enables program loading to take place simultaneously in each unit. This reduces the program load time to three minutes.

Another alternative, is to install the minicassette tape drive in the 3rd, 6th, 9th, 12th and 15th extension units. This reduces the program load time to 10 minutes.

Cooling Fans

Each unit of a Matrix Switch has two cooling fans that prevent the circuit cards from overheating. On the front of the cooling fan rack is the Matrix Switch POWER ON/OFF switch. This switch applies AC line power to the Matrix Switch. Each unit of a Matrix Switch is powered on and off individually. The POWER ON/OFF switch is accessible through an opening in the lower front door of the cabinet.

Switch Control Console

The switch control console is an IBM 3161 Display Station from which an operator controls the Matrix Switch.

The switch control console consists of a keyboard and a CRT. Each Matrix Switch unit allows for a switch control console, but additional switch control consoles are not needed to control the operations of a Matrix Switch that includes extension units. However, the capability of additional consoles is intended to allow several operators to simultaneously manage their respective area of responsibility for telecommunication resources. From the switch control console, local and remote Matrix Switches can be controlled.

Support Processor

The support processor is an IBM Personal Computer XT that can replace or be used in addition to a switch control console for Matrix Switch control. The support processor is optional but provides many advantages over the switch control console, and enhances the ease of Matrix Switch control. Some of the advantages are:

- The support processor can store and automatically execute sequences of commands that would have to be executed one at a time at a switch control console.

- The support processor can perform all of the functions performed by a switch control console.

- The support processor can emulate an IBM 3727 Operators Console and control a local or remote IBM 3725 Communication Controller.
- The support processor can transfer files between its disk and a diskette.
- The support processor can access the disk files of a remote support processor.
- The support processor can store up to 600 switch configurations.

Switch Logging Printer

The switch logging printer is an IBM 4201 Proprinter with a serial adapter card. The switch logging printer is required for documenting Matrix Switch activity. The switch logging printer can keep a record of all operational events that occur at the local Matrix Switch and at remote Matrix Switches. If you use a switch control console, you must also use a switch logging printer. If you use a support processor, the switch logging printer is optional.

Support Processor Printer

The support processor printer is an IBM 5182 Personal Computer Color Printer. The support processor printer is used only with the support processor. It can replace, or be used in addition to, the switch logging printer. The support processor printer is optional. It can replace a switch logging printer and document support processor operations.

Matrix Switch Cables

The cabling requirements for the Matrix Switch are determined when the Matrix Switch is being ordered. The *IBM 3728 Communication Control Matrix Switch Installation Planning and Configuration Guide*, GA27-3641, describes all the Matrix Switch cabling requirements.

Chapter 4

Customer Procedures

This chapter describes how to choose a site for the Matrix Switch and how to set up the Matrix Switch. A description of how to handle equipment failure problems is also provided in this chapter.

Contents

Choosing a Site for the Matrix Switch

The Matrix Switch is designed to operate in a raised-floor environment that is free from extremes of heat, humidity, and dust. One unit of a Matrix Switch measures 81 × 61 × 180 cm (34 × 24 × 70 3/4 in.), and requires 91 cm (36 in.) on all sides for service clearances. Fully equipped, the Matrix Switch unit weighs approximately 169 kg (350 lb).

In choosing a site for the Matrix Switch, it is important to remember:

- The switch must be within 35 m (115 ft) of your DCEs and 35 m (115 ft) of your DTEs.
- There must be additional room nearby for the selected additional equipment:
  - Switch control console
  - Support processor
  - Switch logging printer
  - Support processor printer.

  This equipment can be placed on a nearby table.
- You may in the future want to expand your Matrix Switch, and will require more room for Matrix Switch extension units.

Setting Up the Matrix Switch

Before the Matrix Switch is configured and delivered, you have to determine what you want the switch to do in your telecommunication network. The *IBM 3728 Communication Control Matrix Switch Installation Planning and Configuration Guide*, GA27-3641, provides easy-to-use, step-by-step directions for determining your requirements for:

- Circuit cards
- Ports
- Optional equipment
- Cabling.

All relevant information for configuring and installing a Matrix Switch must be entered on installation and configuration planning forms supplied in the *Installation Planning and Configuration Guide*. With completed forms, your IBM Marketing Representative can configure your Matrix Switch to your specifications. An IBM Customer Engineer can then completely set up your switch and make all the necessary hardware connections.

It is your responsibility to:

- Set up groups of ports and connect groups
- Set up three configuration tables
- Set up signal alarms.

All of these operations are detailed in easy-to-use, step-by-step procedures in the *IBM 3728 Communication Control Matrix Switch Operations Guide*, GA27-3643.

Handling Problems

Matrix Switch equipment failure is resolved by IBM Customer Engineers. It is your responsibility to note and report symptoms of problems to the IBM Customer Engineer. The Matrix Switch provides the following indications of problems:

- Lights on the circuit cards' front panels.
- Event reports sent to the switch control console or the support processor.
- Alarms reported by the 3725 Communication Controller.
- System messages from CPU operating console.

Most failures in the Matrix Switch major subsystems can be corrected by the IBM Customer Engineer without interruption to Matrix Switch operation.

Appendices Glossary Index

Appendix A provides a list of signals supported by RS-232C/CCITT V.24 and CCITT V.35. The appendix is followed by a glossary and an index.

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Appendix A. Signals Supported

The following is a list of the RS-232C/CCITT V.24 and V.35 signals supported by the Matrix Switch.

RS-232C/CCITT V.24 Signals Switched

Pin	Signal	DTE Port	DCE Port
2	Transmit Data (TD)	D	R
3	Receive Data (RD)	R	D
4	Request to Send (RTS)	D	R
5	Clear to Send (Ready for Sending RFS)	R	D
6	Data Set Ready (DSR)	R	D
8	Carrier Detect (CD)	R	D
14*†	New Synch (NS)	D	R
15	Transmit Clock (TC)	R	D
17	Receive Clock (RC)	R	D
18*	Local Loopback (LLB)	D	R
22	Ring Indicate (RI)	R	D
23	Data Rate Select (DRS)	D	R
25*	Test Indicate (TI)	R	D
20	Data Terminal Ready (DTR)	D	R

Note: D = Driver, R = Receiver

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* These signals may not be supported by some equipment interfaces.

† Not defined as an EIA standard.

CCITT V.35 Signals Switched

Pin	Signal	DTE Port	DCE Port
Y,a	Transmit Clock (TC)	R	D
V,X	Receive Clock (RC)	R	D
U,W	Transmit Clock Complement	D	R
P,S	Transmit Data (TD)	D	R
R,T	Receive Data (RD)	R	D
C	Request to Send (RTS)	D	R
D	Clear to Send (Ready for Sending RFS)	R	D
F	Carrier Detect (CD)	R	D
n	In Service (IS)	D	R
Either:			
E	Data Set Ready (DSR)	R	D
H	Data Terminal Ready (DTR)	D	R
Or:			
J	Ring Indicator (RI)	R	D
K	Local Loopback (LLB)	D	R

Note: D = Driver, R = Receiver

Glossary

active configuration: The group and port connections currently maintained by the Matrix Switch.

active testing: The process whereby test equipment capable of generating test signals, is connected to a port on the Matrix Switch either directly, or by the active/passive test switch card, or by the V.35 real-time test card.

alarm command: The command that defines port signal parameters which, when met, cause an event report to be produced.

American Standard Code for Information Interchange (ASCII): A standard code using a coded character set consisting of 7 information bits and 1 parity bit for error-checking purposes.

backup: The hardware and software resources available for recovery following a failure in one or more system components. The Matrix Switch features redundancy in each of its three critical subsystems: power supplies, master timing card, and microprocessor card.

base unit: The unit number 0 of a multi-unit Matrix Switch. This is the only unit that connects to other nodes, and it coordinates the execution of commands in all units of the multi-unit Matrix Switch.

card type: The mnemonic information that identifies a particular card in the Matrix Switch.

CCITT: The International Telegraph and Telephone Consultative Committee.

command sequence: The command and all of the parameters it effects.

common carrier: In the USA and Canada, a government-regulated private company that furnishes the general public with telecommunication service facilities. For example, a telephone or telegraph company.

communication controller: A type of communication control unit whose operations are controlled by one or more programs stored and executed in the unit.

configuration: A predefined set of specifications representing group/port names and their connections.

configuration memory (CMEM): The battery-backed memory located on the microprocessor cards which stores group names, port names, group/port connection records and monitoring commands. Also stores destination address registers for port cards.

configuration number: One of the three configurations (0, 1, and 2) stored in a Matrix Switch unit for activation on request. In addition to the numbered configurations, the letter "N" is used to represent the Null

configuration (in which no configuration changes will be made by the software) and the letter "A" represents the configuration currently active, which may be 0, 1, 2, or N.

customer engineer (CE): An individual who provides field services for IBM products.

data circuit-terminating equipment (DCE): The equipment installed at the user's premises that provides all the functions required to establish, maintain, and terminate a connection, and the signal conversion and coding between the data terminal equipment (DTE) and the line.

Note: The DCE may be separate equipment or an integral part of other equipment.

data terminal: A device, usually equipped with a keyboard and a display device, capable of sending and receiving information over a link.

data terminal equipment (DTE): That part of a device that serves as a data source, data sink, or both, and provides for the data communication control function, according to protocols. Typically a communication controller.

DCE interface: See *DCE/DTE connections*.

DCE/DTE connections: A data circuit-terminating equipment (DCE) connection means the Matrix Switch is presenting a DCE interface and connecting to data terminal equipment (DTE). A DTE connection means the Matrix Switch is presenting a DTE interface and connecting to DCE.

DTE interface: See *DCE/DTE connections*.

Electronic Industries Association (EIA): A trade association of the electronics industry which formulates technical standards, disseminates marketing data, and maintains contact with government agencies in matters relating to the electronics industry.

error message: The message printed on the switch logging printer stating the cause and location of a fault condition.

event queue: The space the queue sets aside to store up to 64 event reports.

event report: The system message indicating an occurrence in the system such as cutover to a redundant subsystem, advisory message, or operator command.

extension unit: Any unit in a multi-unit Matrix Switch other than the base unit.

group: A collection of from 1 to 120 ports.

group name: An alphanumeric name of 1 to 9 characters, used to identify a group of ports within a Matrix Switch.

initial microcode loading (IML): The initialization procedure that causes the Matrix Switch microcode to be loaded, so that the computer program can then proceed under its own control.

input/output (I/O): Pertaining to either input or output, or both.

inter-unit connection: The process of connecting a port in one unit (base or extension) to a port in another unit, where both are local attached units.

I/O panel: A series of connectors mounted on sheet metal. I/O panels are affixed to the rear of each Matrix Switch.

main panel: One of two panels directly beneath the mode panel in the hierarchy. The system panel and the panel displayed when Matrix Switch mode is selected from the mode panel are main panels. A main panel is important because the RETURN PF key causes the main panel for the present subtree to be displayed. It is the starting point for entering a command with full prompting.

Matrix Switch network: A collection of Matrix Switches connected by communication links that are used to perform central control of the switches.

microcode: A program that is loaded in a processor to replace a hardware function.

mode panel: The panel displayed on the screen immediately after a successful logon.

modem: A functional unit that modulates and demodulates signals. One of the functions of a modem is to enable digital data to be transmitted over analog transmission facilities.

monitoring: The process of observing data links for traffic, errors, and condition of interface levels.

multi-unit: Pertaining to a Matrix Switch node that contains 2 to 16 units.

network: A group of Matrix Switches, in the same or different locations, connected together by communication links.

node: A Matrix Switch or support processor in a network, addressable by a single node name or number. A Matrix Switch node may contain multiple units.

node name: An alphanumeric name of 3 to 6 characters, beginning with an alphabetic character, used to identify a particular Matrix Switch or support processor.

node number: A hexadecimal number that uniquely identifies a particular Matrix Switch or support processor.

option cards: The cards that reside in the option slots located to the left of the microprocessor cards. They include the network control interface card, extension unit control card, and active/passive test switch card.

option slots: The card slots reserved for the option cards. Located to the left of the microprocessor card slots.

page: The portion of a panel of information which will fit on the screen at one time.

panel: A collection of information to be displayed on the screen when the dialog is in a particular state. A panel may contain more information than can be displayed on the screen at one time, in which case it is said to have multiple pages.

panel display: The display surface of a display device.

port: A physical connector on the Matrix Switch.

port card: A printed circuit board supporting multiple ports. Port cards feature drivers and receivers for the communication interface, as well as destination address registers for each port.

port name: An alphanumeric name of 3 to 9 characters, beginning with an alphabetic character, used to identify a particular port which can be switched. Port names must be unique within a Matrix Switch.

port number: A hexadecimal number between 0 and E which uniquely identifies a particular port on a Matrix Switch. If the Matrix Switch has more than one unit, the unit number must be included at the beginning of the port number, with an underscore separating the unit number from the port number (for example, 3_21). If the unit number does not appear, unit 0 is assumed.

port slot: The location of the printed circuit backplane where port cards are inserted. Port slots accept port cards, real-time monitor card, V.35 real-time test card, and multiunit switch/8 card.

power supplies: The assemblies that provide +5, +12, and −12 volt potentials to the Matrix Switch.

reconfigure: To activate the selected configuration and reset the alarm counters for each port. The selected configuration contains port and group connect definitions that are read and invoked.

redundancy: A Matrix Switch feature providing automatic backup to the power supplies, master timing card, and microprocessor card if a failure occurs.

remote node: The distant Matrix Switch site served by a network control interface link.

remote-test port: A dial-up diagnostic port located on the microprocessor connector panel. Allows the IBM Customer Engineer to connect the Matrix Switch to the remote diagnostic center for aid in diagnosing problems.

screen: A physical CRT display device. It is different from the information displayed on it, which is called a panel.

slot number: A numeral identifying a port slot location.

support processor: An intelligent controller that provides enhanced capabilities to manage a network of Matrix Switches.

switch: A cabinet or cabinet's circuit cards and power supplies physically connected together in one location. Consoles and printers connect to the switch, and control and monitor switch operation.

switch control console: An asynchronous ASCII terminal used to control the Matrix Switch.

switched line: A transmission line in which connections are established by dialing, only when data transmission is needed. The connection is point-to-point and uses a different transmission line each time it is established.

switch logging printer: An IBM 4201 Proprinter (with a serial adapter card) serving as a logging device. Prints hard copies that chronicle all switch activity.

switch name: A 3 to 6 character mnemonic that identifies a unique switch site. No two switch sites may share the same switch name.

switching network: A network that includes the local system and the switching systems that are directly or indirectly connected to it.

synchronous: A type of transmission where the transmitter and receiver exchange information at the same rate of speed. Typically block-oriented.

system cards: The master timing card and the microprocessor card.

system slots: The location on the printed circuit backplane where the option cards, microprocessor cards, and master timing cards are inserted.

telecommunication: Communication by telegraph or telephone.

telecommunication line: A data circuit used to transfer data.

telecommunication network: A collection of telecommunication equipment (such as modems and communication controllers) connected to a Matrix Switch network.

unit: One frame of a Matrix Switch, contained in a single physical rack. A single unit is the smallest entity capable of providing switching functions.

unit number: A hexadecimal number between 0 and F which identifies one unit of a multi-unit configuration.

username: A name of 1 to 12 alphanumeric characters used to log on to the support processor.

3725 communication controller: An example of telecommunication network equipment that connects to the Matrix Switch. Unless otherwise stated, reference to the 3725 implies that it or an equivalent device is applicable for connection to the Matrix Switch.

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