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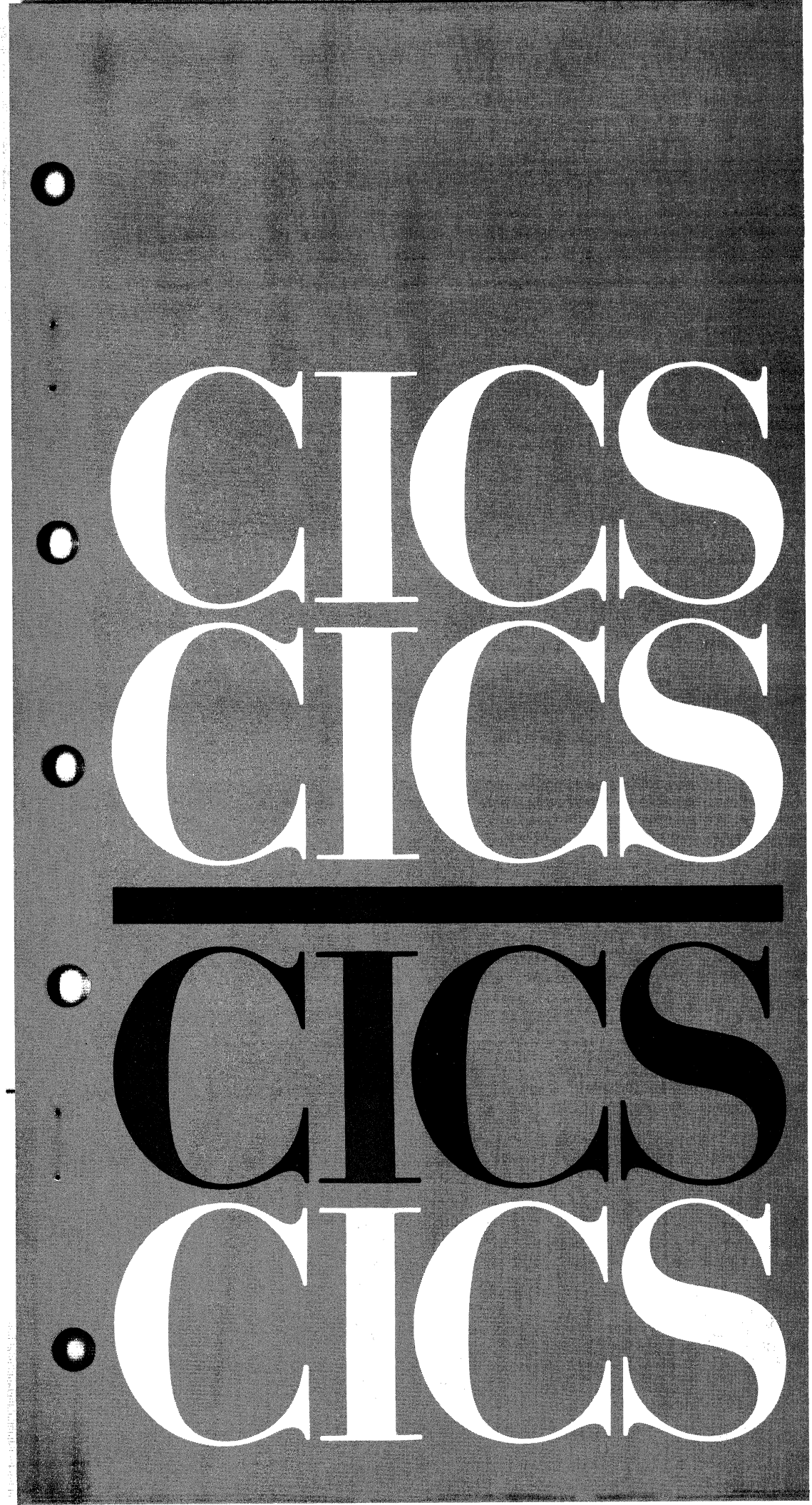
IBM 3270 Data Stream Device Guide



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Customer
Information
Control
System
CICS/DOS/VS

Licensed Program
Version 1.7

Program Number
5746-XX3

IBM 3270 Data Stream Device Guide

SC33-0096-2

Third Edition (July 1987)

This edition applies to Version 1 Release 7 (Version 1.7) of the IBM licensed program Customer Information Control System/Disk Operating System/Virtual Storage (CICS/DOS/VS), program number 5746-XX3.

This edition is based on the earlier combined OS/DOS book for Release 1.6, the *CICS/VS IBM 3270/8775 Guide*, SC33-0096-1 (which remains applicable and current for users of Version 1.6). Changes in DOS information are indicated by vertical lines to the left of the changes.

Changes are made periodically to the information herein; before using this publication in connection with the operation of IBM systems, consult the latest *IBM System/370, 30XX, and 4300 Processors Bibliography*, GC20-0001, for the editions that are applicable and current.

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Preface

What This Book Is About

This book provides information for CICS users who intend to install a CICS/DOS/VS system that communicates with terminals of the IBM 3270 Information Display System and terminals that use the 3270 data stream.

Who This Book Is For

This book is for:

System designers
System programmers
Application programmers.

What You Need to Know to Understand This Book

We assume that you are familiar with the standard CICS facilities that are provided for communication with remote terminals. (An overview of these facilities is given in the *CICS/DOS/VS Facilities and Planning Guide*.) We also assume that you are familiar with the principles of operation of the terminals and their host communication facilities, and with IBM Systems Network Architecture (SNA) if you are using SNA networks.

Notes on Terminology

In this book, 'VTAM' refers to ACF/VTAM and to ACF/VTAME. 'BTAM' refers to BTAM-ES. For further details of system requirements, refer to the publication *CICS General Information*.

Most resource definition is described in this book in terms of macros; you should be aware that PPTs, PCTs, and certain TCTs can now be defined online. For more details see the *CICS/DOS/VS Resource Definition (Online)* manual.

Some references to CICS application programming in this book are made in terms of the macro-level interface. We recommend that all new applications be written in the command-level interface. A list of macro-level to command-level equivalents is given in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

Book Structure

Bibliography

CICS/DOS/VS Version 1 Release 7 Library

General

- General Information — GC33-0155
- Release Guide — GC33-0130
- Messages and Codes — SC33-0081
- Library Guide — GC33-0356
- Master Index — SC33-0095

Planning

- Facilities and Planning Guide — SC33-0228
- Intercommunication Facilities Guide — SC33-0133
- Recovery and Restart Guide — SC33-0135
- Performance Guide — SC33-0134
- Performance Data — SC33-0219
- 3270 Data Stream Device Guide — SC33-0096
- 3650/3680 Guide — SC33-0073
- 3767/3770/6670 Guide — SC33-0074
- 3790/3730/8100 Guide — SC33-0075
- 4700/3600/3630 Guide — SC33-0072

Administration

- Installation and Operations Guide — SC33-0070
- Resource Definition (Online) — SC33-0238
- Resource Definition (Macro) — SC33-0149
- Customization Guide — SC33-0131
- CICS-Supplied Transactions — SC33-0080

End User

- Report Controller User's Guide — SC33-0382

Programming

- Application Programming Primer — SC33-0139
- Application Programmer's Reference Manual (Command Level) — SC33-0077
- Application Programmer's Reference Summary (Command Level) — GX33-6012
- Application Programmer's Reference Manual (RPG II) — SC33-0085
- Application Programmer's Reference Manual (Macro Level) — SC33-0079

Service

- Problem Determination Guide — SC33-0089
- Program Debugging Reference Summary — SX33-6010
- Data Areas — LY33-6033
- Diagnosis Reference — LC33-0105
- Remote Server Diagnosis — LC33-0438

Books from Related Libraries

3270 Information Display System

An Introduction to the 3270 Information Display System, GA27-2739
3270 Information Display System: 3276 Control Unit/Display Station — Description and Programmer's Guide, GA18-2081
3270 Information Display System: 3271 Control Unit, 3272 Control Unit, 3275 Display Station — Description and Programmer's Guide, GA23-0060
3270 Information Display System: 3274 Control Unit Description and Programmer's Guide, GA23-0061

IBM 8775

An Introduction to the IBM 8775 Display Terminal, GA33-3040
IBM 8775 Display Terminal: Component Description, GA33-3044
IBM 8775 Display Terminal: Terminal User's Guide, GA33-3045

IBM 3180

IBM 3180 Model 1 Display Station Introduction and Preinstallation Planning, GA21-9465
IBM 3180 Model 2 Display Station Introduction and Preinstallation Planning, GA21-9466

IBM 3290

IBM 3290 Information Panel, Description and Reference, GA23-0021

IBM 3270 PC/G and PC/GX

Introducing the IBM 3270 Personal Computer/G and /GX Work Stations, GA33-3141

IBM 5550

5550 System General Information, N: GA18-2155

Note: This book is available only in Japanese.

SDF/CICS

SDF/CICS Program Reference Manual, SH19-6077

Systems Network Architecture (SNA)

Systems Network Architecture: Concepts and Products, GC30-3072
Systems Network Architecture: Sessions Between Logical Units, GC20-1868

Contents

Figures

Summary of Amendments

Amendments for Latest Edition (CICS/DOS/VS Version 1 Release 7)

The information in this book is now applicable to all devices that use the 3270 data stream. Information has been added on query support for these devices.

Appendix A has been updated to correct the information on bind images.

Changes have been made to add information about the dynamic definition of terminals using resource definition online.

Amendments for CICS/VS 1.6

- BMS simplification
- Support for the IBM 8775 Display Terminal, including:
  - Partitions
  - Scrolling
  - Trigger fields
  - Support for magnetic slot readers.
- New FORMFEED option
- ASCII 3270 terminals
- Data compression user exit.
- CEDA, the online resource definition transaction
- The restructured CICS library of manuals.

For Version 1.6 we also reorganized the book by revising the chapters that describe support for the 3270 terminal, and screen formatting and BMS. The new chapters reflected the improvements to BMS in this release.

Questionnaire IBM 3270 Data Stream Device Guide

(CICS/DOS/VS Version 1 Release 7)

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easy to understand	1	2	3	4	5	incomprehensible
adequately illustrated	1	2	3	4	5	inadequately illustrated
has enough examples	1	2	3	4	5	has too few examples

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Chapter 1. Introduction

Throughout this manual a term such as "3270 display" refers to a device in the 3270 Information Display System, or to a device that uses the 3270 data stream. Note that certain functions are not available on all devices. To determine which functions are supported by any particular 3270 device in your configuration, see the appropriate device manual from the 3270 library.

The 3270 Information Display System is a family of visual display units, printers, and control units. The system offers users a wide selection of components and configurations, and a variety of standard and special features provide additional operational capabilities.

Other devices that use the 3270 data stream include:

- IBM 8775 Display Terminal
- IBM 3180 Display Station
- IBM 3290 Information Panel
- IBM 3270 Personal Computer/G Work Station
- IBM 3270 Personal Computer/GX Work Station
- IBM 5550 Administrative System.

You should refer to the appropriate device description manual for more information on these devices.

CICS/DOS/VS is an IBM licensed program that provides most of the standard functions required by application programs for communication with local and remote terminal systems. That is, it provides data communication (DC) facilities. It also has data base (DB) capabilities, and control functions that allow many application programs serving many terminals to run concurrently. For a general overview of CICS/DOS/VS facilities, see the *CICS/DOS/VS Facilities and Planning Guide.*

CICS provides comprehensive DC support for the 3270 system, and a CICS/3270 system can be tailored to meet the requirements of many kinds of applications.

Notes:

1. *Most resource definition is described in this book in terms of macros; you should be aware that PPTs, PCTs, and certain TCTs can now be defined online. For more details see the CICS/DOS/VS Resource Definition (Online) manual.*

2. *Some references to CICS application programming in this book are made in terms of the macro-level interface. We recommend that all new applications be written in the command-level interface.*

System Components

There are three major components of a teleprocessing network employing 3270 terminals:

- **The host processor**. CICS, access methods, and CICS application programs, all run in the host processor. The access methods may be one or both of the Virtual Telecommunications Access Method (VTAM) or Basic Telecommunications Access Method (BTAM).

- **The communications controller or transmission control unit**. A network control program runs in the communications controller.

- **The 3270 terminal subsystem**, possibly including a control unit and terminal devices.

CICS also supports local attachment of 3270 devices, in which case there is no communications controller or transmission control unit.

Figure 1 on page 3 shows the relationship of the components.

This manual describes CICS data communication facilities in such a network. In particular, it provides information about installing CICS, setting up tables that CICS requires to communicate with 3270 terminals, and writing CICS application programs for 3270 terminals.

The combination of access method, line discipline, and 3270 control unit must be chosen carefully, since not all combinations are valid. A list of combinations supported by CICS is given in the *CICS/DOS/VS Facilities and Planning Guide*.

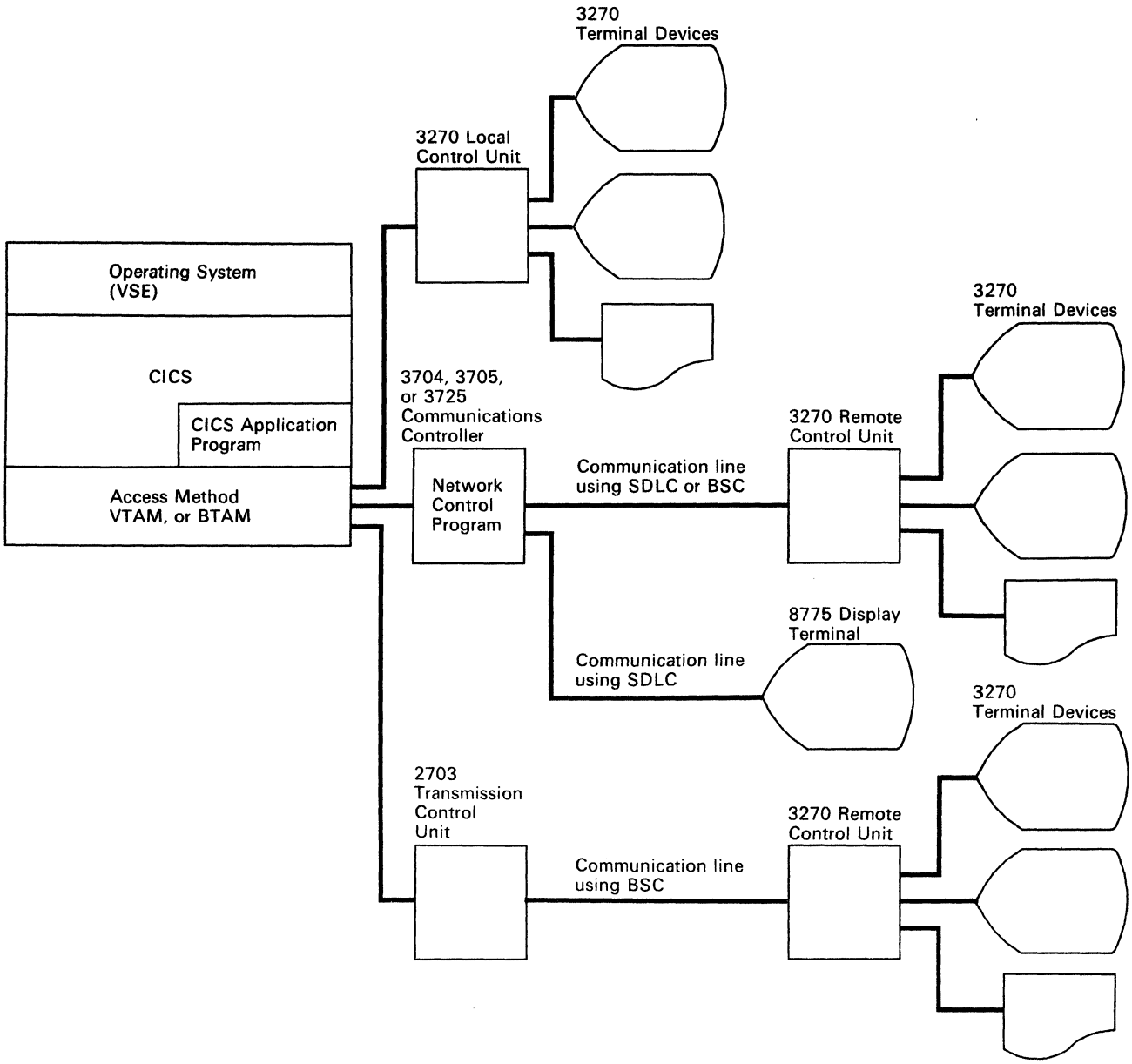

Figure 1. Components of a Network

Chapter 2. CICS Data Communication Facilities

This chapter outlines the CICS data communication facilities applicable to terminals that use the 3270 data stream.

CICS provides two interfaces for application programs to use:

- Terminal control (TC)
- Basic mapping support (BMS).

Terminal control is the lower level interface. It is powerful enough to relieve you of many of the details of data communication programming, such as addressing terminals, polling, and line control. However, programs that use the terminal control interface are dependent on the data formatting requirements of the devices that they communicate with. Thus if you write terminal control application programs, you must have a detailed knowledge of the 3270 data stream.

BMS allows application programming at a higher level. The programs can be independent of any particular device, and you can concentrate on communicating with the terminal operator, without being concerned with the intervening data stream.

Programmers should use the BMS interface whenever possible, in preference to the terminal control interface. As BMS is at a higher level, it simplifies application programming, and allows applications to run on a wide range of terminal types.

Both interfaces provide a SEND command for output to the terminal, and a RECEIVE command for input from the terminal. In addition, terminal control provides the CONVERSE command, which is equivalent to a SEND immediately followed by a RECEIVE. Both interfaces are described in outline in this chapter. The terminal control interface is described in more detail in "Chapter 5. Application Design and Programming" on page 49. The BMS interface is described in full in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

In addition to terminal control and BMS, we provide an interface for creating reports that can be managed using the **report controller**. Note that the report controller is an optional feature of CICS/DOS/VS. The reports can be printed on 3270-type printers defined to CICS. The commands provided are:

```
SPOOLOPEN ... REPORT
SPOOLWRITE ... REPORT
SPOOLCLOSE ... REPORT
```

The options you can use with these commands are described in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*. For an introduction to the report controller, read the *CICS/DOS/VS Facilities and Planning Guide*.

Terminal Control

Before a program executes a terminal control SEND or CONVERSE command, it must create, in an output data area, a message conforming with the data stream requirements. The 3270 data stream is described in the *IBM 3270 Information Display System Data Stream Programmer's Reference*, GA23-0059. See also the component description manual for the device you are using.

CICS appends the appropriate command code and write control character (WCC) to your message. You are responsible for ensuring that the rest of the message is valid for the target terminal type.

After executing a terminal control RECEIVE or CONVERSE command, the program can access the input data stream from the terminal. CICS transfers the incoming message to an input data area acquired by the program. The complete message is stored in this data area, except the attention identifier (AID) and cursor position. These are stored in a control block, called the exec interface block (EIB), which the program can access. Your program has to interpret the message, which typically means locating and extracting input data entered by the terminal operator.

The main advantage of the terminal control interface over BMS is that it provides complete access to all features of 3270 terminals.

Basic Mapping Support

The level of function provided by BMS depends on which version of the mapping support (MINIMUM, STANDARD, or FULL) is selected. This section summarizes the features of BMS. For a fuller description of how BMS supports 3270 terminals, see the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

Mapping

BMS mapping facilities provide both **device independence** and **format independence**. This means that the application program is independent of the characteristics of the device with which it is communicating, and of the way in which the data is presented at that device. BMS achieves device independence by obtaining the device characteristics from the CICS terminal control table (TCT), which is prepared by the system programmer. BMS achieves format independence by obtaining the presentation requirements for the terminal type from a **map** prepared by the system or application programmer. Both the application program and the map may refer specifically to device characteristics, and these will be ignored by BMS if the target terminal does not support them. Different versions of a map can be defined for different terminal types.

For output, BMS merges the terminal characteristics and presentation requirements with output data that is supplied in standard form by the application program, and generates the necessary 3270 data stream. It passes this to the terminal control program for transmission to the terminal. Conversely, for input, BMS receives the 3270 data stream from terminal control, interprets it based on the device characteristics and the presentation requirements, and returns it to the application program in standard form. In summary, BMS mapping facilities convert the data between a form convenient to you

and the form required by the terminal, so as to give a presentation convenient to the terminal operator.

Mapping is done by SEND MAP and RECEIVE MAP commands in the application program. The MAP option names the map to be used for this input or output request.

A map describes the form in which the data is to be presented at the terminal. It defines and names the 3270 fields to be used, describing their positions, lengths, attributes, and initial data content. You define the map using the map definition macros (DFHMSD, DFHMDI, and DFHMDF) which must be assembled twice. One assembly produces a **physical map**, which is stored in the CICS program library and used by BMS to convert data between the application program form and 3270 data stream. The second assembly produces a **symbolic description map** to be included in the application program.

As an alternative to using the BMS map definition macros, you can define maps interactively with the Screen Definition Facility/CICS (SDF/CICS licensed program, program number 5746-XXT. This is fully described in the *SDF/CICS Program Reference Manual.*

The symbolic description map is the standard form in which data is passed between the application program and BMS. It is a set of source language programming statements that define a data structure. The elements of this data structure represent named fields in the source map. Each named field has one or more data elements in the structure. There is one element for the data, one for its length (not always present or used), and one or more for its attributes, depending on whether the map employs extended attributes.

For output requests, the application program can control the attributes and data content of a display field by setting a valid value in the corresponding elements of the symbolic description map. Similarly, for input requests, the application program can determine the length and content of data entered by the terminal operator, by testing the corresponding elements of the symbolic description map. You can define constant data by using unnamed fields in the source map. Such data is not represented in the symbolic description map, and thus the application program cannot access it.

Device Controls

You can use BMS to control features of 3270 terminals, such as the cursor position, the audible alarm, or an attached magnetic slot reader (MSR). This can be done in conjunction with mapping by options on the SEND MAP command, or without mapping by similar options on the SEND CONTROL command. BMS supports the following device controls:

- **Cursor positioning**. An application program can position the cursor at a specified screen offset, or under the first character of a specified map field.
- **Write control character settings**. The 3270 write control character (WCC) controls features such as the audible alarm, and whether the keyboard is unlocked. These options can be associated with a map, or specified on the BMS SEND commands.
- **Screen erasure**. An application program can erase the entire 3270 screen, or erase only unprotected fields.
- **Form feed**. An application program can control paper movement on a printer.

- **Magnetic slot reader (MSR).** An application program can control the various indicator lights and buzzers on an MSR.

These controls are fully discussed in the next chapter.

Text Handling

BMS allows an application program to provide a text string of arbitrary length, containing optional imbedded blanks, new line characters, and character attribute controls. BMS formats this data into lines whose width is equal to the target terminal width. Each line starts with a blank attribute byte. BMS ensures that words are not split across line boundaries and, if necessary, splits the text into pages with application program-defined page headers and trailers.

This function is provided by the SEND TEXT command. The application program can control the position of text lines by means of the JUSTIFY, JUSTFIRST, and JUSTLAST options. There is no BMS support for text input.

Partitions

BMS supports displays that can be partitioned into independent **logical screens**. Each partition is associated with an area of the display screen, called the **viewport**, and a share of the display terminal's buffer, called the **presentation space**. At any one time, the cursor is displayed in only one partition, called the **active** partition and the keyboard is logically connected only to that partition. The active partition can be changed by the terminal operator using the PARTITION JUMP key, or by a CICS application program.

Note: Some terminals support a single scrollable partition, which allows a logical screen size larger than the physical screen area.

The partition layout of such displays is defined by the system or application programmer in a **partition set**, using the partition set definition macros (DFHPSD and DFHPDI). This partition set is assembled once only, and stored in the CICS program library. It can be referenced by an application program by the SEND PARTNSET command, or associated with it by the PARTSET operand of the program control table (PCT).

You can associate a map with a particular partition by using the PARTN operand of the DFHMSD and DFHMDI map definition macros. On output, a BMS application program can direct data to a particular partition, and control the active partition by the OUTPARTN and ACTPARTN options on SEND commands. On input, by using the INPARTN option on the RECEIVE MAP command, you can ensure that the terminal operator enters data in a particular partition. By using the RECEIVE PARTN command, you can have your program accept input from any partition and determine the name of that partition.

Cumulative Processing and BMS Paging

During cumulative BMS processing (achieved through the ACCUM option on SEND commands) BMS accumulates data for as many maps or blocks of text as will fit on a BMS page, and defers data-stream generation until "page overflow." This allows a BMS application program to handle arbitrary amounts of data and make optimum use of the available screen or printed page size. The size of a BMS page is determined by the PGESIZE and ALTPGE operands of the DFHTCT TYPE=TERMINAL macro, as described in "Chapter 4. System Programming" on page 21. The SEND PAGE command terminates this cumulative processing, and forces data stream generation for the last (often partially full) page.

BMS paging (specified with the PAGING option on SEND commands) writes pages of a BMS logical message to CICS temporary storage, from where the terminal operator can retrieve them using BMS paging commands. A BMS logical message is started by the first SEND command with the ACCUM or PAGING option, and terminated by a SEND PAGE command.

Cumulative processing and paging are normally used together in conjunction with **floating maps**, to display arbitrary amounts of data. A floating map is one that is positioned relative to the previous map. BMS splits this data into pages of the maximum size that will "fit" onto the target terminal. An application program can gain control of page overflow, and add page headers and trailers.

The BMS terminal operator paging commands allow you to retrieve pages in any order, to copy pages to other terminals, to chain together pages from several CICS transactions, and to delete selected BMS logical messages. These commands are fully described in the *CICS/DOS/VS CICS-Supplied Transactions* manual.

Routing

The BMS ROUTE command allows an application program to specify a list of terminals and/or terminal operators that are to receive a BMS logical message. BMS generates an appropriate data stream for each terminal in the route list. The ROUTE command can specify a time (or time interval) at which the message is to be delivered, and a title for the message.

The routed message is usually a paged message, and is thus stored on CICS temporary storage like any other BMS logical message. It is thus usually retrieved by the recipient terminal operator using the BMS terminal operator paging commands.

Message Switching

BMS provides a transaction (CMSG) that a terminal operator can use to send a text message to one or more other terminals and/or terminal operators. This uses BMS paging and routing facilities and is fully discussed in the *CICS/DOS/VS CICS-Supplied Transactions* manual.

Chapter 3. How CICS Supports 3270 Terminals

This chapter introduces the CICS application designer and programmer to the functions of 3270 terminals. For each function, it describes the appropriate BMS and terminal control support.

The descriptions of terminal control refer to aspects of the 3270 data stream. This is summarized in "Chapter 6. 3270 Data Streams Used by CICS" on page 67.

Basic Operations

Fields and Formatted Data

The screen of a 3270 display unit or the output of a 3270 data stream printer can be divided into fields. The start of each field in the 3270 data stream is indicated by a Start Field (SF) order. Following the SF order is a set of attributes associated with the field. The attribute set is encoded into a single byte that occupies space in the device buffer but is displayed or printed as blank. These attributes determine such characteristics as whether the field is displayed as printed, whether it is highlighted, and whether, on display units, the operator can type into it.

The 3270 extended data stream is used to access device functions such as color, extended highlighting, or programmed symbols. The start of each field is indicated by a Start Field Extended (SFE) order, which is followed by a set of type and value pairs for the field. These name the attribute type (for example, color or extended highlighting) and set the value (that is, color, type of highlighting) for this field. These type and value pairs, with one exception, do not occupy space in the display or print buffer. The exception is the base 3270 attribute type where the value corresponds to the base 3270 attribute byte, and this single byte is treated as above to maintain compatibility with base 3270. See "Chapter 6. 3270 Data Streams Used by CICS" on page 67 for more information on the various field attributes.

Data divided into fields is said to be **formatted**. A field is the smallest unit of data (other than attention identifier) that may be transmitted to the host from a formatted display.

Fields are fully supported for input and output by both terminal control and BMS.

Terminal Control: On output, the application program must insert the appropriate 3270 Start Field order (SF or SFE) in the data stream, at the start of the output data that is intended to comprise a field. This is often preceded by a Set Buffer Address (SBA) order, followed by the start address of the field, which positions the field in the display or printer

buffer. To access a field on input, the program must locate it in the 3270 data stream returned by CICS, in which fields are delimited by SBA orders and their start addresses.

BMS: The positions and lengths of fields are defined by the map definition macros. For output, the attributes and data contents of the fields are (1) specified in the map definition (for constant data), or (2) stored by the application program, in the data structure represented by the symbolic description map (for variable data). On input, CICS stores the data from each field that has been modified by the terminal operator in the corresponding element of the data structure. Elements corresponding to unmodified fields are set to nulls.

Unformatted Data

If the data sent to a terminal is not divided into fields, it is said to be **unformatted**.

Only the terminal control interface supports unformatted data. To create unformatted output, the application program must transmit the data without inserting formatting orders (SF, SFE) into the data stream. On input, the data stream contains just data, with no field-delimiting SBA orders.

BMS will not transmit output data without formatting it. On input, BMS passes any unformatted data to the application program and raises the MAPFAIL condition.

Character Attribute Output

In addition to field attributes, the 3270E data stream can include individual character attributes. Thus, for example, a single character can be set to a specified color. Character attributes override the corresponding field attributes.

Character attributes are fully supported by terminal control, but are only partially supported by BMS.

Terminal Control: On output, the application program must insert the appropriate Set Attribute (SA) orders in the output data stream.

BMS: BMS provides limited support of character attribute output by the SEND TEXT command. The application program must imbed the required SA sequences in the text data that is to be formatted by the SEND TEXT command.

Cursor Position

Terminal Control: On output, the cursor position is set by an Insert Cursor (IC) order in the data stream. On input, CICS extracts the cursor position from the data stream, and stores it as a two-byte binary value in the field EIBCPOSN in the exec interface block.

BMS: The BMS application program can set the cursor to a particular offset from the first position on the screen, or at the first character of a specified field. This is done by the CURSOR option of the SEND MAP, SEND TEXT, or SEND CONTROL command. Alternatively, the cursor can be set to the first position of a specified field during map definition. On input, CICS takes the same action as for terminal control.

Erasing Data

The 3270 system allows the host to clear either the entire screen of a display unit or printer buffer, or just those fields with the unprotected attribute. Both facilities can be used with terminal control and BMS.

To clear the entire screen before displaying a new screenful of data, the ERASE option has to be specified on the SEND, SEND MAP, SEND TEXT, SEND CONTROL, or CONVERSE command. To erase unprotected fields only, the ISSUE ERASEAUP command has to be issued, or the ERASEAUP option has to be coded on a SEND MAP, SEND TEXT, or SEND CONTROL command.

Selecting Screen or Buffer Size

Some terminal models have two effective screen sizes (or printer buffer sizes), known as the **default size** and **alternate size**. A CICS transaction uses one size or the other, but never both. The system programmer selects the size by coding the SCRNSZE operand of the program control table (PCT) entry for that transaction. (See "Screen Sizes" on page 39 and the *CICS/DOS/VS Resource Definition (Macro)* manual.)

A terminal that supports both sizes is switched from one mode to the other by the same output data stream that erases the contents of the display or printer buffer. For this reason, the first output command of a CICS application program that may be used on dual-size terminals should specify the ERASE option. Otherwise the terminal retains the screen size of the previous transaction, which may be incorrect.

The terminal operator can erase a display screen by means of the CLEAR key. This resets the terminal to the default screen size. CICS then resets the required screen size by appending the ERASE option to the next SEND command.

Output Control Operations

As well as sending displayable and printable data to the terminal, a CICS application program can control certain other facilities of the terminal. These are listed below under "BMS." They are supported by both terminal control and BMS.

Terminal Control: The operations are controlled by the write control character (WCC), which is set by the CTLCHAR option of the SEND or CONVERSE command. If the option is omitted, a default WCC specifying keyboard restore and reset MDT is generated.

BMS: The output operations can be controlled either by options of the CTRL operand during map definition, or by options of the SEND MAP, SEND TEXT, and SEND CONTROL commands.

The keywords are the same in both cases. The operations and keywords are as follows:

Operation	Keyword
Sound alarm	ALARM
Keyboard restore	FREEKB
Reset MDTs	FRSET
Print format definition	L40, L64, L80, or HONEOM
Start printer	PRINT

Attention Identifier

The terminal operator can transmit a message to the host by means of the ENTER key, the PA keys, the PF keys, the CLEAR key, the CLEAR PARTITION key, an attached magnetic slot reader, an attached operator identification card reader, and the selector light pen or CURSR SEL key. The means used is indicated to the host by the attention identifier (AID), which is a one-byte code in the input data stream.

After each terminal control or BMS input operation, CICS removes the AID from the data stream and stores it in the field EIBAID in the exec interface block.

Light Pen and CURSR SEL Key

Some display units are fitted with a selector light pen that the terminal operator can use to select a field or list of fields displayed on the screen, and have the selections transmitted to the host. The CURSR SEL key provided on some keyboards performs an equivalent function.

To be pen detectable, the field must be created in a special format. It must be given the detectable attribute, and its first character, called a designator character, must be a "?", a space, a null, or a "&".

If the designator is a "?", the field is called a **selection field**. This means that when it is selected by the terminal operator, the "?" is changed to " > ", to record the selection. A subsequent reselection of this field changes the " > " back to "?", marking the field as unselected. Any subsequent action by the terminal operator that initiates a transmission to the host (such as hitting the ENTER key, or selecting an attention field) will cause the field to be transmitted in the same way as a field that has been modified by the operator.

If the designator character is other than "?", the field is called an **attention field**. This means that selecting it initiates a transmission to the host. If the designator character is a space or null, the input message will contain the buffer addresses of any fields that the operator selected or modified. If the designator is a "&", the addresses and contents of the modified fields and the selected " > " and "&" field (but not of any other selected fields) are transmitted.

The operator action that initiated the transmission is indicated by the attention identifier (AID) sent in the input data stream. Selection of the "&" attention field generates the same AID as the ENTER key. Space or null attention fields generate their own AID.

Selection is supported by both terminal control and BMS.

Terminal Control: The application program must build the output data stream, containing the detectable attributes and designator characters, in the output data area. On input, the application is passed the data stream as transmitted by the terminal. The AID is extracted and stored in the field EIBAID in the exec interface block.

BMS: The definition for the output map must specify the detectable attribute for any fields intended for selection by the light pen or CURSR SEL key. The fields can be initialized in the map definition to have the designator characters in their first positions. Otherwise the application program must insert the required character. If an input-only map specifies the detectable attribute, BMS map definition generates an input data structure containing only one character for the field. Otherwise BMS map definition generates a normal data structure. On input, BMS sets the first character of a light-pen-selected field to hex FF.

Trigger Fields

Some fields on some displays may be defined as trigger fields, by means of the trigger validation field attribute. When the cursor leaves a trigger field that the terminal operator has modified, the field contents and trigger AID are transmitted to the host. Further terminal operator keystrokes are queued. When the queue is full, further keystrokes are inhibited.

The host can acknowledge the trigger positively or negatively. A positive acknowledgment causes the queued keystrokes to be processed. A negative acknowledgment causes them to be rejected.

Trigger fields can thus be used to initiate host validation of a field, without interrupting the terminal operator's keystroking. However, the host must quickly acknowledge the trigger field, before the keystroke queue is full.

Trigger fields are supported by both terminal control and BMS.

Terminal Control: The application program must define the field with a trigger validation attribute. Receipt of the trigger AID is detected by a HANDLE AID command, or by testing the exec interface block field EIBAID after a RECEIVE or CONVERSE command. The application program must then examine the trigger field contents, and accept or reject it by a suitable SEND command. Data streams that constitute a positive or negative acknowledgement of the trigger field, are described in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level).*

BMS: BMS support of trigger fields is similar to terminal control support. The main difference is that a field can be given the trigger validation attribute by BMS map definition.

Forms Control

A CICS application program can control the creation of new pages on a printer. This is supported by both terminal control and BMS.

Terminal Control: The application program must include a Form Feed order (hex 0C) in the data stream to be transmitted to the terminal. For 3270 printers, this must occupy the first print position on a line.

BMS: The FORMFEED option can be specified on a SEND MAP, SEND TEXT, or SEND CONTROL command. BMS will then generate a Form Feed order in the first terminal buffer position. It may sometimes be appropriate to send a form feed to a display unit, to ensure that a printed screen copy starts on a new page.

Printer Tabulation Control

CICS application programs can exploit the horizontal and vertical tabulation facilities of 3270 printers using the SNA character string (SCS) data stream. Such printers must be defined in the CICS terminal control table as TRMTYPE=SCSPRT. Use of printer tabulation may result in a shorter data stream.

For both terminal control and BMS applications, the tab stop settings must first be sent to the printer. This must be done by a terminal control SEND command using the Set Horizontal Format (SHF) and Set Vertical Format (SVF) orders, as described in "Setting Printer Tabulation Stops" on page 62.

Terminal Control: The application program must first send the tabstop settings to the printer as described above. These settings can then be used by imbedding appropriate Horizontal Tab (HT) and Vertical Tab (VT) orders in outbound data streams.

BMS: The application program must first send the tabstop settings to the printer as previously described. The same settings are then associated with a set of maps by means of the HTAB and VTAB operands of the DFHMSD map definition macro. BMS will then generate HT and VT orders in the output data stream, rather than blanks and new line characters. This will often result in a shorter data stream.

Printing Displayed Data

Where a terminal configuration is suitable and includes at least one printer as well as one or more display units, the data displayed on a screen can be printed. The printing can be initiated by either the terminal operator or a CICS application program.
Terminal-initiated printing may or may not involve CICS. The CICS application program, whether it uses BMS or terminal control, can initiate printing by executing an ISSUE PRINT command. Further information is given in "Printing Displayed Data" on page 44.

Operations Requiring Structured Fields

Extended 3270 functions are accessed by a special data stream that contains **structured fields.** (Note that a "field" here is not the same as a field in a formatted 3270 display or printout. A structured field is a particular type of data stream format.)

As described in "Sending Structured Fields" on page 72, a structured field consists of length, operation code, and data subfields, the length of which depends on the structured field type. Any number of structured fields may be sent to the terminal by a single terminal control SEND or CONVERSE command. The structured fields must be built by the application program in the output data area, and the terminal control SEND or CONVERSE command must specify the STRFIELD option. Note that CICS does not generate write control characters (WCCs) when STRFIELD is specified. The WCC should be imbedded, where appropriate, within the structured field data.

The following extended 3270 terminal functions require structured fields:

- Partitions
- Magnetic slot reader
- Programmed symbols
- Determining terminal characteristics
- Character attribute input.

Partitions

You can divide the screen of some 3270 terminals into partitions, each of which can be regarded as a separate "logical screen". Each partition is associated with (1) a one-byte partition identifier, (2) an area of the display screen, called the **viewport**, and (3) a share of the display terminal buffer called the **presentation space**. At any one time, the cursor is displayed in only one partition, called the **active** partition. The keyboard is logically connected only to the active partition. The partition can be changed by the terminal operator using the PARTITION JUMP key, or by a CICS application program.

The CLEAR key erases the entire display screen, and hence destroys all partitions, resetting the terminal to **base state**. A CLEAR PARTITION key is available to clear the active partition only.

Partitions are supported by both terminal control and BMS.

Terminal Control: An application program controls partitions by means of structured fields. The partitions must first be created on the terminal by a series of Create Partition structured fields. However, before that is done, it is advisable to destroy any previous partitions by a Reset Usable Area structured field. An individual partition can be destroyed by a Destroy Partition structured field. Output data can then be sent to a particular partition by an Outbound 3270 structured field. A partition can be activated by an Activate Partition structured field.

Creation of a partition puts the terminal into partitioned state. In this state, data entered into a partition by a terminal operator is returned in an Inbound 3270 structured field, except for data entered in partition zero, which is returned in a normal 3270 input data stream. When CICS terminal control receives an Inbound 3270 structured field, it does not copy the cursor position into EIBCPOSN and the the AID into EIBAID. Instead, EIBCPOSN is set to zero, and EIBAID to hex 88. The application program must thus extract the cursor position and AID from the Inbound 3270 structured field. The terminal control user should avoid Create Partition structured fields for partition zero, because of this partition's special characteristics.

If no partitions exist, the display is in base state and has a single partition with an identifier of zero. This is known as **implicit partition zero**. The data stream sent and received by implicit partition zero does not use structured fields.

Terminal control applications that use partitions should have PARTSET=OWN specified on their program control table (PCT) entries.

BMS: The system or application programmer defines the partition layout of a terminal in a **partition set,** using the partition set definition macros (DFHPSD and DFHPDI). This partition set is assembled once only and stored in the CICS program library. It can be referenced by an application program through the SEND PARTNSET command, or associated with it by the PARTSET operand of the program control table (PCT).

A map can be associated with a particular partition by use of the PARTN operand of the DFHMSD and DFHMDI map definition macros. On output, a BMS application program can direct data to a particular partition by the OUTPARTN option, and activate a particular partition by the ACTPARTN option. These options are available on the SEND MAP, SEND TEXT, and SEND CONTROL commands.

Note: You must not use the ACTPARTN option for devices that have only a single partition.

On input, a BMS application program can ensure that the terminal operator enters data in a particular partition by the INPARTN option of the RECEIVE MAP command. The program can also accept input from any partition, and determine the name of that partition, by the RECEIVE PARTN command. In either case, BMS copies the inbound cursor position into EIBCPOSN, and the inbound AID into EIBAID.

Magnetic Slot Reader Control

Some terminals support application program control of the lights and buzzers of an attached magnetic slot reader (MSR). This has three colored lights (red, amber, and green) and a buzzer (giving a short buzz and a long buzz). Application programs can communicate information to terminal operators by these lights and buzzer. For example, a red light and long buzz could mean "look at an error message on the display."

MSR control is supported by both terminal control and BMS.

Terminal Control: The application program must control the MSR by means of the Set MSR Control structured field.

BMS: The application program can control the MSR by means of the MSR option of the SEND MAP, SEND TEXT, and SEND CONTROL commands.

Loading Programmed Symbols

Some 3270 terminals support application program-defined characters, called programmed symbols (PS). Before programmed symbols can be used by a terminal control or BMS application program, they must first be loaded onto the terminal. This can be done using a terminal control SEND STRFIELD command and a Load PS structured field, as further discussed in Appendix C, "Loading Programmed Symbols" on page 99.

There is no BMS support for loading programmed symbols.

Determining Terminal Characteristics

3270 terminals that support the 3270 extended data stream also support the Query structured field. The terminal responds to a Query structured field with a Query Reply structured field, whose data indicates the terminal characteristics. Thus the Query structured field should be used with a terminal control CONVERSE command, rather than a SEND command followed by a RECEIVE command.

A terminal control application must build the Query structured field in the output data area of the CONVERSE command, and analyze the Query Reply returned in the input data area of the CONVERSE command.

You can let CICS determine those device characteristics that affect BMS by specifying the Query feature when you define the terminal to CICS. You do this by specifying QUERY(COLD) or QUERY(ALL) in the CEDA DEFINE TYPETERM command for resource definition online (RDO). Alternatively, if you are not using RDO to define terminals, you can code FEATURE=QUERYCOLD or FEATURE=QUERYALL in the DFHTCT TYPE=TERMINAL macro for the entry in the terminal control table. CICS will then issue a query to the device (1) after the first logon after a cold start for QUERY(COLD) or FEATURE=QUERYCOLD or (2) after every logon for QUERY(ALL) or FEATURE=QUERYALL.

Character Attribute Input

Terminals that support the 3270 extended data stream also allow the operator to select character attributes for inbound data. A terminal control application program can receive this input. It must first permit character attribute input by sending a set Inbound Reply Mode structured field to the terminal, to set the inbound reply mode to "character". Character attributes are then returned to the CICS application program in the inbound data stream in the normal way.

There is no BMS support for character attribute input. Furthermore, BMS assumes that the terminal has an inbound reply mode of "field". Application programs which modify the inbound reply mode must ensure that it is set to Field before using a BMS input command.

The WCC reset bit, described in "The WCC Reset Bit" on page 65 may be used to reset the inbound reply mode to "field".

Chapter 4. System Programming

This chapter describes two tasks generally carried out by the system programmer:

- CICS system generation
- CICS table preparation.

CICS Generation

CICS consists of a set of management, service, and utility programs that provide a very wide range of functions for the user. To provide a CICS system that meets the needs of a particular installation, CICS can be tailored by a system generation process that is similar to the generation of the operating system itself. For details of the system generation process, see the *CICS/DOS/VS Installation and Operations Guide.*

Preassembled Modules

Preassembled modules eliminate the need for CICS users to specify a range of optional features, and then to assemble the required modules. This greatly simplifies system generation, and reduces the cost. For these reasons, we recommend that users build their systems from these modules.

This section describes the terminal control program (TCP) and basic mapping support (BMS) preassembled modules, which are particularly important to 3270 users. For a complete list of preassembled modules see the *CICS/DOS/VS Installation and Operations Guide.*

IBM supplies several preassembled versions of the TCP and BMS modules, and the system programmer can select those that most closely match the requirements of the installation.

By means of the DFHSIT macro instruction, the system programmer can specify, in the system initialization table (SIT), the names of the modules that are required to be loaded. If necessary, the SIT can be overridden (by startup overrides) at system initialization.

The DFHSIT operands that specify the modules for the terminal control program and BMS are described here; all other DFHSIT operands are described in the *CICS/DOS/VS Resource Definition (Macro)* manual.

The various versions of a module, whether preassembled or generated by the system programmer, are identified by two-character suffixes added to their names. (The character $ in a suffix is reserved for IBM use.) Preassembled modules generally have suffixes of the form X$, where X is a single digit or character.

The system programmer specifies the required version in the DFHSIT macro instruction (or in startup overrides) by means of an operand consisting of the last three characters of the module name and the required suffix. For instance, to use the terminal control module DFHTCP2$, TCP = 2$ is specified as an operand in the DFHSIT macro instruction.

Terminal Control Modules

There are five preassembled versions of the terminal control program from which the 3270 user can choose. Their main options are shown in Figure 2.

Suffix	3270 Connection	Access method	DFHSIT operand(s)
1$	Local	BTAM	TCP=1$ and ZCP=1$
2$	Remote	BTAM	TCP=2$ and ZCP=2$
3$	Local and remote	BTAM	TCP=3$ and ZCP=3$
E$	Local and remote	VTAM	TCP=E$ and ZCP=E$
S$	Local and remote	BTAM and VTAM	TCP=S$ and ZCP=S$

Figure 2. Preassembled Modules for Terminal Control Program

All the preassembled modules referred to in Figure 2 support the use of the console as a CICS terminal. In addition, they provide support for certain other optional features of CICS and of the access methods, including:

- Automatic transaction initiation
- Translation of input into upper case
- Wrap list support (BTAM-supporting versions only)
- Chain assembly (VTAM-supporting versions only).

Inclusion of this support does not commit the installation to employing these features. They will generally be used only if specified in the appropriate CICS table, such as the terminal control table (TCT) or the program control table (PCT), as well.

The version suffixed S$ provides the maximum possible function. It includes support of all access methods and a wide range of terminal types besides the 3270.

BMS Modules

One of three versions of BMS modules (MINIMUM, STANDARD, or FULL) can be generated. The simplest version provides least function, and uses little storage. The other two versions add function, but require more storage. However, the MINIMUM version code is included as a fast path in the STANDARD and FULL versions. Thus only the MINIMUM version code resides in real memory while minimum function requests (the majority of BMS requests) are being processed.

Figure 3 lists the support provided by each version. Full function BMS support is needed for the report controller.

The suffixes of the pre-generated BMS versions are BMS = E$ for minimum support, BMS = A$ for standard support, and BMS = S$ for full support.

BMS Version	Devices Supported	Command Format	Function Provided
Minimum BMS=E$	All 3270 displays and printers except SNA character string printers, which are defined as TRMTYPE= SCSPRT in DFHTCT.	Must be command level	SEND MAP command RECEIVE MAP command SEND CONTROL command Default and alternate screens Extended attributes Map set suffixes Screen coordination with null maps Block data
Standard BMS=A$	All devices supported by BMS. These are listed in the Application Programmer's Reference Manual (Command Level).	Can be command level or macro level	All function of MINIMUM PLUS Outboard formats Partitions Controlling a magnetic slot reader NLEOM mode for 3270 printers SEND TEXT command Subsystem LDC controls
Full BMS=S$	All devices supported by BMS. These are listed in the Application Programmer's Reference Manual (Command Level).	Can be command level or macro level	Same as STANDARD PLUS Terminal operator paging Cumulative mapping Page overflow Cumulative text processing Routing Message switching Returning BMS-generated data stream to program before output

Figure 3. Pregenerated Versions of BMS

Required CICS Transactions

Full support of 3270 terminals requires some standard CICS-supplied transactions. These must be defined in the program control table (PCT) and processing program table (PPT). The DFHPCT TYPE=GROUP and DFHPPT TYPE=GROUP macros allow the system programmer to create PCT and PPT entries for these standard CICS transactions without having to code a full TYPE=ENTRY macro for each one. The standard transactions that may be required by the 3270 user, and the operands that generate entries for these are described here. Further information about the transactions is given in the *CICS/DOS/VS Resource Definition (Macro)* manual.

FN=BMS Generates entries for the following transactions for use by BMS: CSPG, CSPQ, and CSPS. These transactions are only needed if FULL function BMS is used.

FN=HARDCOPY Generates entries for the transaction CSPP that supports the application program ISSUE PRINT command and 3270 Local Copy commands.

FN=VTAMPRT Generates entries for the following transactions for use with VTAM-connected terminals using the print function: CSCY, CSPK, CSRK.

If the CEDA transaction is used to define PCT and PPT entries, then the standard groups DFHBMS, DFHHARDC, and DFHVTAMP should be included in the group list used to initialize CICS. This group list is further discussed in the *CICS/DOS/VS Resource Definition (Online)* manual. These entries are created, in turn, when the system definition file is initialized. This process, and the groups it generates is described in the *CICS/DOS/VS Installation and Operations Guide.*

Table Preparation

It is necessary for the system programmer to supply CICS with a considerable amount of data specifying the way in which it is to operate. The data is stored by CICS in various tables, for instance the terminal control table (TCT), which holds information about the terminals and communication paths to them. The system programmer supplies the data in two ways:

- Using resource definition online (RDO) to define VTAM-connected devices. To define terminals you would use the CEDA DEFINE TERMINAL and CEDA DEFINE TYPETERM commands.
- By coding and assembling CICS system programmer macros with appropriate operands. To generate the terminal control table, for instance, a set of DFHTCT macros is required.

Definition of the TCT is described in some detail, because it particularly concerns the 3270 user. Generating the program control table (PCT) is also described (though less fully) because some aspects are particularly important when the programs are to run with 3270 terminals.

For further information on RDO, see the *CICS/DOS/VS Resource Definition (Online)* manual.

Full details of the CICS system programmer macros are given in the *CICS/DOS/VS Resource Definition (Macro)* manual.

Terminal Control Table

The output data streams that CICS has to generate and the responses that it has to handle depend on the characteristics of terminals with which it is communicating and the communication paths to them. CICS holds data describing these characteristics in the terminal control table (TCT). You can supply this data to CICS in two ways:

- Using RDO to define VTAM-connected terminals.
- Using the DFHTCT macro instruction.

As well as describing the terminals and communication paths, the TCT specifies certain optional and variable features of CICS, of the terminal, and of the communication path.

For RDO, you use the CEDA DEFINE TERMINAL and CEDA DEFINE TYPETERM commands to define your VTAM-connected terminals.

If you are using the DFHTCT macro, you must code several different types. The first one must always be a DFHTCT TYPE=INITIAL, and the last a DFHTCT TYPE=FINAL. The other macros depend on the types of connection to the terminals, as follows:

VTAM-Connected Terminals: For RDO you must define a TERMINAL entry and an associated TYPETERM entry for each terminal. Terminals having the same characteristics can use the same TYPETERM, but each must have a separate TERMINAL entry. For the DFHTCT macro, each terminal must have one TYPE=TERMINAL macro to describe it. The information is stored in the terminal control table terminal entry (TCTTE), of which there is one for every terminal.

Note: Some terminals (such as the IBM 3290) support multiple logical units (MLUs). For such terminals, you must have a TERMINAL entry or code a DFHTCT TYPE=TERMINAL macro for each logical unit.

BTAM-Connected Terminals: The BTAM communication lines in a network are divided into groups, all the members of each group having similar facilities and supporting similar terminals. Each BTAM line group is described in one TYPE=SDSCI macro. In addition, there must be one TYPE=LINE macro describing each communication line to the terminals and one TYPE=TERMINAL macro describing each terminal. Information from the TYPE=LINE macro is stored in the terminal control table line entry (TCTLE), of which there is one for each line, and from the TYPE=TERMINAL macro in the terminal control table terminal entry (TCTTE), of which there is one for each terminal. All the terminals connected to a line must be described immediately following the description of the line.

For details of how to define terminals using RDO, and for a cross-reference table of macro operand and RDO keyword equivalents, you should see the *CICS/DOS/VS Resource Definition (Online)* manual.

The operands of the DFHTCT macro are described in full in the *CICS/DOS/VS Resource Definition (Macro)* manual. In addition, certain operands that are of particular concern to the 3270 user are introduced here. Some other operands have no special relevance to the 3270, for instance, the OPERID operand of TYPE=TERMINAL, which defines an operator identification to be used when CICS signs a terminal on. These are not described here, although they may be required by the 3270 user.

The operands depend on how the terminal is connected to the host; separate descriptions are provided here for each of the following types of connection:

- BTAM local
- BTAM remote
- VTAM non-SNA
- VTAM SNA

Those operands of the TYPE=TERMINAL macro that do not depend on the type of connection are described subsequently under "Operands of the DFHTCT TYPE=TERMINAL Macro for All Connections" on page 37.

For the VTAM connection examples, the RDO keywords are shown in Figure 10 on page 33.

```
TYPE=INITIAL
   ACCMETH=(NONVTAM[,VTAM])  NONVTAM must be specified; VTAM is optional.
TYPE=SDSCI
   DEVICE=L3270              Indicates local BTAM connection.
   CU=3272                   Indicates local 3270 control unit is
                             attached to channel.
   LINELST=(nnn,mmm,...)     Specifies VSE symbolic units for this
                             line group are to be SYSnnn, SYSmmm, etc.
                             There must be one entry in the list for each
                             device in the line group. The position of each
                             device in the list is indicated in LVUNIT
                             operand of its DFHTCT TYPE=TERMINAL macro.

TYPE=LINE
   ACCMETH=BTAM              Indicates access method.
   TRMTYPE=L3270 or L3270P   Specifies that local 3270 display unit or
                             printer is the default if TRMTYPE not specified
                             on TYPE=TERMINAL macro.
   INAREAL=nnn               Specifies minimum length of the input area
                             for data from any terminal on this line.
                             Should be at least as great as the length of
                             expected input message. In any case, CICS
                             cannot read a message whose length exceeds
                             the INAREAL value by more than 4000 bytes.
   TRMMODL=1 or 2            Specifies default buffer size to be assumed
                             for terminals on this line if TRMMODL is omitted
                             from TYPE=TERMINAL macro. See "Operands of
                             DFHTCT TYPE=TERMINAL Macro for all
                             Connections."
TYPE=TERMINAL
   TRMTYPE=L3270 or L3270P   Indicates local 3270 display unit or printer.
   LVUNIT=n                  Specifies the terminal's relative position in
                             the corresponding TYPE=SDSCI LINELST
                             operand.
   TRMMODL                   )
   DEFSCRN                   )
   ALTSCRN                   ) These operands are applicable to all
   PGESIZE                   ) types of connection and are described
   ALTPGE                    ) later in "Operands of DFHTCT
   ALTSFX                    ) TYPE=TERMINAL Macro for all Connections."
   TRMSTAT                   )
   ERRATT                    )
   FEATURE                   )
   FF                        )
```

Figure 4. Operands of the DFHTCT Macro for Local BTAM Connections

```
*             LOCAL BTAM 3270S
L3270    DFHTCT TYPE=INITIAL,SUFFIX=LB,ACCMETH=NONVTAM
         DFHTCT TYPE=SDSCI,                                              *
                CU=3272,                                                 *
                DEVICE=L3270,                                            *
                LINELST=(023,024,025,026,027,028),                       *
                DSCNAME=DD3270L
         DFHTCT TYPE=LINE,                                               *
                ACCMETH=BTAM,                                            *
                TRMTYPE=L3270,TRMMODL=2,                                 *
                INAREAL=3440,                                            *
                DSCNAME=DD3270L,                                         *
                POOLADR=P3270L
*               3278 MOD 4    -    EXTDS PS HILIGHT
P3270L   DFHTCT TYPE=TERMINAL,                                           *
                TRMIDNT=L78A,                                            *
                DEFSCRN=(24,80),ALTSCRN=(43,80),                         *
                LVUNIT=1,                                                *
                ERRATT=BLINK,ALTSFX=4,                                   *
                FEATURE=(DCKYBD,UCTRAN,AUDALARM,PS,HILIGHT,EXTDS),       *
                TRMSTAT=TRANSCEIVE
*               3278 MOD 5
         DFHTCT TYPE=TERMINAL,                                           *
                TRMTYPE=L3270,                                           *
                TRMIDNT=L78B,                                            *
                DEFSCRN=(24,80),ALTSCRN=(27,132),                        *
                LVUNIT=2,                                                *
                ERRATT=INTENSIFY,ALTSFX=5,                               *
                FEATURE=(DCKYBD,UCTRAN,AUDALARM),                        *
                TRMSTAT=TRANSCEIVE
*               3277 MOD 1
         DFHTCT TYPE=TERMINAL,                                           *
                TRMIDNT=L78C,                                            *
                TRMMODL=1,                                               *
                LVUNIT=3,                                                *
                ERRATT=INTENSIFY,ALTSFX=1,                               *
                FEATURE=(DCKYBD,SELCTPEN,AUDALARM,UCTRAN),               *
                TRMSTAT=TRANSCEIVE
*               3279 MOD 2B   -    EXTDS COLOR PS HILIGHT
         DFHTCT TYPE=TERMINAL,                                           *
                TRMIDNT=L78D,                                            *
                DEFSCRN=(24,80),                                         *
                LVUNIT=4,                                                *
                ERRATT=(BLINK,RED),                                      *
                FEATURE=(SELCTPEN,UCTRAN,AUDALARM,PS,HILIGHT,COLOR),     *
                TRMSTAT=TRANSCEIVE
*               3284 MOD 2
         DFHTCT TYPE=TERMINAL,                                           *
                TRMTYPE=L3270P,                                          *
                TRMIDNT=L870,                                            *
                TRMMODL=2,                                               *
                LVUNIT=5                                                 *
                FEATURE=PRINT,                                           *
                TRMSTAT=RECEIVE
*               3287    -    BUFFER SIZE 3440  EXTDS PS HILIGHT
         DFHTCT TYPE=TERMINAL,                                           *
                TRMTYPE=L3270P,                                          *
                TRMIDNT=L890,                                            *
                DEFSCRN=(24,80),ALTSCRN=(43,80),                         *
                LVUNIT=6,                                                *
                FEATURE=(PRINT,PS,HILIGHT),                              *
                TRMSTAT=TRANSCEIVE,                                      *
                LASTTRM=POOL
          DFHTCT TYPE=FINAL
```

Figure 5. Example of TCT Definition for Local BTAM Connection

```
TYPE=INITIAL
   ACCMETH=(NONVTAM[,VTAM])  NONVTAM must be specified, VTAM is optional.
TYPE=SDSCI
   DEVICE=R3270              Indicates remote BTAM connection.
   CU=2701 or 2703           Indicates control unit attached to channel.
   LINELST=(nnn,mmm,...)     Specifies VSE symbolic units for this
                             line group are to be SYSnnn, SYSmmm, etc.
                             There must be one entry in the list for each
                             line in the line group. Position of each
                             entry in the list is indicated in BTAMRLN
                             operand of DFHTCT TYPE=LINE macro.


TYPE=LINE
   ACCMETH=BTAM              Indicates access method.
   TRMTYPE=R3270 or R3270P   Specifies remote 3270 display unit or
                             printer is default if not specified on
                             TYPE=TERMINAL macro.
   INAREAL=nnn               Specifies minimum length of the input area
                             required for data from any terminal on this
                             line. Must be at least 255 bytes.
   FEATURE=AUTOPOLL          Indicates terminal has automatic polling
                             feature.
   LISTADR=name              Indicates the name of the BTAM DFTRMLST macro
                             in which the polling list for this line is
                             specified.
   BTAMRLN=n                 Indicates position of this line within the
                             line group.

TYPE=TERMINAL
   TRMTYPE=R3270 or R3270P   Indicates remote 3270 display unit or
                             printer.
   POLLPOS=n                 Indicates that this terminal is connected
                             to the nth control unit on the line.
   TRMADDR=name              Indicates the label of the BTAM DFTRMLST
                             macro associated with this terminal.
   TIOAL=nnn                 Specifies minimum length of input area
                             required for data from this terminal.
   TRMMODL                   )
   DEFSCRN                   )
   ALTSCRN                   ) These operands are applicable to all
   PGESIZE                   ) types of connection and are described
   ALTPGE                    ) later in "Operands of DFHTCT
   ALTSFX                    ) TYPE=TERMINAL Macro for all Connections."
   TRMSTAT                   )
   ERRATT                    )
   FEATURE                   )
   FF                        )

Note:
If more than 3000 bytes of data are being sent to a remote BTAM
terminal, CICS will split this into multiple transmissions, each
containing less than 3000 bytes.
```

Figure 6. Operands of the DFHTCT Macro for Remote BTAM Connections

```
*
*     REMOTE BTAM 3270S
*
RB3270   DFHTCT TYPE=INITIAL,SUFFIX=RB,ACCMETH=NONVTAM
         DFHTCT TYPE=SDSCI,                                              *
                CU=2703,                                                 *
                DEVICE=R3270,                                            *
                LINELST=(035),                                           *
                DSCNAME=DD3274R
R3274     DFTRMLST AUTOWLST,3732,40407F7F2D
         DFHTCT TYPE=LINE,                                               *
                ACCMETH=BTAM,                                            *
                CLASS=(BISYNC,VIDEO),                                    *
                TRMTYPE=R3270,                                           *
                DSCNAME=DD3274R,                                         *
                INAREAL=500,TRMMODL=2,                                   *
                BTAMRLN=1,                                               *
                LISTADR=(R3274,WRAP),                                    *
                FEATURE=AUTOPOLL,                                        *
                LINSTAT='OUT OF SERVICE',                                *
                BSCODE=EBCDIC
*              3278 MOD 4   -   EXTDS PS HILIGHT
         DFHTCT TYPE=TERMINAL,                                           *
                TRMTYPE=R3270,                                           *
                TRMIDNT=R78A,TRMADDR=AR78A,                              *
                DEFSCRN=(24,80),ALTSCRN=(43,80),                         *
                POLLPOS=1,TIOAL=3000,                                    *
                ERRATT=BLINK,ALTSFX=4,                                   *
                FEATURE=(DCKYBD,UCTRAN,AUDALARM,PS,HILIGHT,EXTDS),       *
                TRMSTAT=TRANSCEIVE
*              3278 MOD 5
         DFHTCT TYPE=TERMINAL,                                           *
                TRMTYPE=R3270,                                           *
                TRMIDNT=R78B,TRMADDR=AR78B,                              *
                DEFSCRN=(24,80),ALTSCRN=(27,132),                        *
                POLLPOS=1,TIOAL=3000,                                    *
                ERRATT=INTENSIFY,ALTSFX=5,                               *
                FEATURE=(DCKYBD,UCTRAN,AUDALARM),                        *
                TRMSTAT=TRANSCEIVE
*              3277 MOD 1
         DFHTCT TYPE=TERMINAL,                                           *
                TRMIDNT=R78C,TRMADDR=AR78C,                              *
                TRMMODL=1,                                               *
                POLLPOS=1,TIOAL=1000,                                    *
                ERRATT=INTENSIFY,ALTSFX=1,                               *
                FEATURE=(DCKYBD,SELCTPEN,AUDALARM,UCTRAN),               *
                TRMSTAT=TRANSCEIVE
*              3279 MOD 2B   -   EXTDS COLOR PS HILIGHT
         DFHTCT TYPE=TERMINAL,                                           *
                TRMIDNT=R78D,TRMADDR=AR78D,                              *
                DEFSCRN=(24,80),                                         *
                POLLPOS=1,TIOAL=2000,                                    *
                ERRATT=(BLINK,RED),                                      *
                FEATURE=(SELCTPEN,UCTRAN,AUDALARM,PS,HILIGHT,COLOR),     *
                TRMSTAT=TRANSCEIVE
*              3284 MOD 2
         DFHTCT TYPE=TERMINAL,                                           *
                TRMTYPE=R3270P,                                          *
                TRMIDNT=R870,TRMADDR=AR870,                              *
                TRMMODL=2,                                               *
                POLLPOS=1,TIOAL=2000,                                    *
                FEATURE=(PRINT,COPY),                                    *
                TRMSTAT=RECEIVE
*              3287   -   BUFFER SIZE 3440  EXTDS PS HILIGHT
```

Figure 7 (Part 1 of 2). Example of CICS/DOS/VS TCT Definition for Remote BTAM Connection

```
         DFHTCT TYPE=TERMINAL,                                          *
                TRMTYPE=R3270P,                                         *
                TRMIDNT=R890,TRMADDR=AR890,                             *
                DEFSCRN=(24,80),ALTSCRN=(43,80),                        *
                POLLPOS=1,TIOAL=3000,                                   *
                FEATURE=(PRINT,PS,HILIGHT,COPY),                        *
                TRMSTAT=TRANSCEIVE,                                     *
                LASTTRM=LINE
AR78A    DFTRMLST OPENLST,(606040402D)
AR78B    DFTRMLST OPENLST,(6060C1C12D)
AR78C    DFTRMLST OPENLST,(6060C2C22D)
AR78D    DFTRMLST OPENLST,(6060C3C32D)
AR870    DFTRMLST OPENLST,(6060C6C62D)
AR890    DFTRMLST OPENLST,(6060C7C72D)
         DFHTCT TYPE=FINAL
 END DFHTCTBA
```

Figure 7 (Part 2 of 2). Example of CICS/DOS/VS TCT Definition for Remote BTAM Connection

```
TYPE=INITIAL
   ACCMETH=(VTAM[,NONVTAM])  VTAM must be specified, NONVTAM is optional.

TYPE=TERMINAL
   ACCMETH=VTAM              Must be specified.
   TRMTYPE=3270 or 3270P     Indicates 3270 display unit or printer.
   PRINTTO=name              For display units, specifies the primary 3270
                             printer to be used for print requests from
                             this terminal.
   ALTPRT=name               Specifies alternate printer to be used when
                             primary printer specified in PRINTTO
                             operand is unavailable.
   TIOAL=nnn                 Specifies minimum length of input area
                             required for data from this terminal.
   TRMMODL                   )
   DEFSCRN                   )
   ALTSCRN                   ) These operands are applicable to all
   PGESIZE                   ) types of connection and are described
   ALTPGE                    ) later in "Operands of DFHTCT
   ALTSFX                    ) TYPE=TERMINAL Macro for all Connections."
   TRMSTAT                   )
   ERRATT                    )
   FEATURE                   )
   FF                        )
```

Figure 8. Operands of the DFHTCT Macro for Non-SNA VTAM Connections (3270 Logical Unit)

```
*
*          VTAM 3270S (NON-SNA)
*
V3270     DFHTCT TYPE=INITIAL,ACCMETH=VTAM,                              *
               SUFFIX=V3
*         3278 MOD 4   -   EXTDS PS HILIGHT
VTRM1     DFHTCT TYPE=TERMINAL,TRMIDNT=L78A,TRMTYPE=3270,                *
               DEFSCRN=(24,80),ALTSCRN=(43,80),                         *
               TIOAL=3000,RELREQ=(YES,YES),                             *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN,PS,HILIGHT,EXTDS),     *
               ACCMETH=VTAM,ERRATT=BLINK,GMMSG=YES,                     *
               TRMSTAT=(TRANSCEIVE),PRINTTO=(VTRM8),ALTSFX=4
*         3278 MOD 5
VTRM2     DFHTCT TYPE=TERMINAL,TRMIDNT=L78B,TRMTYPE=3270,                *
               DEFSCRN=(24,80),ALTSCRN=(27,132),                        *
               TIOAL=3000,RELREQ=(YES,YES),                             *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN),                      *
               ACCMETH=VTAM,ERRATT=INTENSIFY,GMMSG=YES,                 *
               TRMSTAT=(TRANSCEIVE),PRINTTO=(VTRM8),ALTSFX=5
*         3277 MOD 1
VTRM3     DFHTCT TYPE=TERMINAL,TRMIDNT=L78C,TRMTYPE=3270,TRMMODL=1,      *
               TIOAL=1000,RELREQ=(YES,YES),                             *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN),PRINTTO=(VTRM7),      *
               ALTPRT=(VTRM8),ACCMETH=VTAM,GMMSG=YES,ERRATT=INTENSIFY,  *
               TRMSTAT=(TRANSCEIVE),ALTSFX=1
*         3279 MOD 2B
VTRM4     DFHTCT TYPE=TERMINAL,TRMIDNT=L78D,TRMTYPE=3270,                *
               DEFSCRN=(24,80),                                         *
               TIOAL=2000,RELREQ=(YES,YES),                             *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN,COLOR,PS,HILIGHT),     *
               ERRATT=(BLINK,RED),GMMSG=YES,                            *
               ALTPRT=(VTRM8),ACCMETH=VTAM,                             *
               TRMSTAT=(TRANSCEIVE),PRINTTO=(VTRM7),ALTSFX=2
*         3284 MOD 2
VTRM7     DFHTCT TYPE=TERMINAL,TRMIDNT=L870,TRMTYPE=3270P,TRMMODL=2,     *
               TIOAL=2000,                                              *
               ACCMETH=VTAM,TRMSTAT=(RECEIVE)
*         3287  -  BUFFER SIZE 3440 EXTDS HILIGHT PS
VTRM8     DFHTCT TYPE=TERMINAL,TRMIDNT=L890,TRMTYPE=3270P,               *
               DEFSCRN=(24,80),ALTSCRN=(43,80),                         *
               TIOAL=3000,                                              *
               FEATURE=(EXTDS,PS,HILIGHT),                              *
               ACCMETH=VTAM,TRMSTAT=(TRANSCEIVE),LASTTRM=VTAM
          DFHTCT TYPE=FINAL
          END DFHTCTBA
```

Figure 9. Example of TCT Definition for Non-SNA VTAM Connection

```
DEFINE TYPETERM

   BUILDCHAIN                 Indicates whether chains will be assembled.
   DEVICE(LUTYPE2) or         3270 display unit.
    DEVICE(LUTYPE3) or        3270 printer (3270 data stream).
    DEVICE(SCSPRINT)          3270 printer (SCS data stream).
   RECEIVESIZE                ) Specify the length of data that the
   SENDSIZE                   ) terminal can send and receive.
   IOAREALEN(nn,nn)           Specifies minimum and maximum input area
                              to be used for data from this terminal.
   TERMMODEL(1) or (2)        Indicates terminal default buffer size. "1"
                              implies buffer size of 480 characters
                              (12x40), "2" implies 1920 (24x80).
   DEFSCREEN                  Indicates the default screen or buffer size
                              of the terminal.
   ALTSCREEN                  Indicates the alternate screen or buffer size
                              of the terminal.
   PAGESIZE                   Specifies the default page size to be used.
   ALTPAGE                    Specifies the alternate page size to be used.
   ALTSUFFIX                  Specifies a suffix for map set and partition
                              set names to be assumed by BMS when
                              alternate screen size is being used.
   ATI                        Automatic transaction initiation
   ERRHILIGHT                 Highlighting of CICS messages.
   ERRCOLOR                   Color of CICS messages.
   ERRINTENSIFY               Intensification of CICS messages.
   ERRLASTLINE                Position of CICS messages.
   ASCII(7)                   Indicates that the terminal uses ASCII-7
                              to communicate with CICS.
   ASCII(8)                   Indicates that the terminal uses ASCII-8
                              to communicate with CICS.
   AUDIBLEALARM               Audible alarm.
   DUALCASEKYBD               Display unit keyboard can transmit upper and
                              lower case.
   LIGHTPEN                   Display unit has selector pen attached.
   EXTENDEDDS                 3270 data stream extensions.
   COLOR                      Extended color.
   HILIGHT                    Extended highlighting (reverse video,
                              blink, underscore).
   PARTITIONS                 Partitions.
   PROGSYMBOLS                Programmed symbols.
   KATAKANA                   Supports KATAKANA character set and does
                              not transmit lowercase characters since they
                              are reserved for KATAKANA. Standard CICS
                              transactions such as CEMT and CECI avoid
                              sending lowercase characters to a KATAKANA
                              terminal.
                                                          (continued)
```

Figure 10 (Part 1 of 2). RDO Keywords for SNA VTAM Connections (3270 Logical Unit)

(continued)	
MSRCONTROL	Supports application program control of a magnetic slot reader.
COPY	Remote BTAM or non-SNA VTAM only: 3270 Copy command.
PRINTADAPTER	3275 terminal only: 3284 model 3 printer is attached and eligible for print requests.
UCTRAN	CICS will translate lowercase input to uppercase. Can be overridden by the ASIS option on input commands.
VALIDATION	Indicates all three kinds of validation (TRIGGER, MANDATORY ENTER, MANDATORY FILL) can be used with the terminal.
QUERY(COLD)	CICS will query device characteristics after the first logon after a cold start.
QUERY(ALL)	CICS will query device characteristics after every logon.
SOSI	Supports mixed EBCDIC and DBCS fields.
OUTLINE	Field outlining on the IBM 5550. of a magnetic slot reader. Implies EXTDS.
BACKTRANS	Background transparency.
FORMFEED	Indicates that the terminal supports form feed.
VERTICALFORM	DEVICE(SCSPRINT) only: indicates that the terminal supports vertical tabs.
HORIZFORM	DEVICE(SCSPRINT) only: indicates that the terminal supports horizontal tabs.
CGCSGID	Specifies the range of character set identifiers.
DEFINE TERMINAL	
PRINTER(name)	For display units, specifies the primary 3270 printer to be used for print requests from this terminal.
ALTPRINTER(name)	Specifies alternate printer to be used when primary printer specified in PRINTER keyword is unavailable.
INSERVICE(YES)	Status of terminal is "in service."

Figure 10 (Part 2 of 2). RDO Keywords for SNA VTAM Connections (3270 Logical Unit)

```
TYPE=INITIAL
   ACCMETH=(VTAM[,NONVTAM])  VTAM must be specified, NONVTAM is optional.

TYPE=TERMINAL
   ACCMETH=VTAM              Must be specified.
   CHNASSY=YES               Must be specified.
   TRMTYPE=                  Indicates type of logical unit in terminal,
                             as follows:
         LUTYPE2             3270 display unit.
         LUTYPE3             3270 printer (3270 data stream).
         SCSPRT              3270 printer (SCS data stream) (LU Type 1).
   PRINTTO=name              For display units, specifies the primary 3270
                             printer to be used for print requests from
                             this terminal.
   ALTPRT=name               Specifies alternate printer to be used when
                             primary printer specified in PRINTTO
                             operand is unavailable.
   BUFFER=nnn                Specifies maximum length of data, in bytes,
                             that the logical unit can receive.
                             Recommended values depend on TRMTYPE
                             specification, as follows
                             LUTYPE2: 1536
                             LUTYPE3: 256
                             SCSPRT: 256
   RUSIZE=nnn                Specifies maximum size of request unit (RU)
                             that can be transmitted from the terminal.
                             Default is 256. If value is specified, it
                             must meet requirements of device as,
                             indicated in the device's related publication.
   TIOAL=(value1, value2)    Value1 and value2 specify the minimum
                             and maximum input area respectively, to be
                             used for data by this terminal.
   TRMMODL                   )
   DEFSCRN                   )
   ALTSCRN                   ) These operands are applicable to all
   PGESIZE                   ) types of connection and are described
   ALTPGE                    ) later in "Operands of DFHTCT
   ALTSFX                    ) TYPE=TERMINAL Macro for all Connections."
   TRMSTAT                   ) Note: ALTSCRN, DEFSCRN,
   ERRATT                    ) ALTPGE, ALTSFX are not applicable
   HF                        ) to TRMTYPE=SCSPRT.  HF and VF are
   VF                        ) only applicable to TRMTYPE=SCSPRT.
   FF                        )
   FEATURE                   )
```

Figure 11. Operands of the DFHTCT Macro for SNA VTAM Connections

```
*
*      VTAM 3270 SNA DEVICES (LU1, LU2, AND LU3)
*
S3270     DFHTCT TYPE=INITIAL,ACCMETH=VTAM,                              *
               SUFFIX=S3
*         3278 MOD 4   -   EXTDS PS HILIGHT
VTRM1      DFHTCT TYPE=TERMINAL,TRMIDNT=S78A,TRMTYPE=LUTYPE2,            *
               DEFSCRN=(24,80),ALTSCRN=(43,80),BUFFER=1536,RUSIZE=256,  *
               TIOAL=(3000,4000),RELREQ=(,YES),                         *
               NETNAME=LU3278A,GMMSG=YES,ALTSFX=4,CHNASSY=YES,          *
               TRMSTAT=(TRANSCEIVE,'OUT OF SERVICE'),                   *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN,PS,HILIGHT,EXTDS),     *
               PRINTTO=(VTRM8),ACCMETH=VTAM,ERRATT=BLINK
*         3278 MOD 5
VTRM2      DFHTCT TYPE=TERMINAL,TRMIDNT=S78B,TRMTYPE=LUTYPE2,            *
               DEFSCRN=(24,80),ALTSCRN=(27,132),BUFFER=1536,            *
               RUSIZE=256,TIOAL=(3000,4000),                            *
               RELREQ=(YES),NETNAME=LU3278B,GMMSG=YES,CHNASSY=YES,      *
               TRMSTAT=(TRANSCEIVE,'OUT OF SERVICE'),ALTSFX=5,          *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN),                      *
               PRINTTO=(VTRM8),ERRATT=INTENSIFY,ACCMETH=VTAM
*         3278 MOD 1
VTRM3      DFHTCT TYPE=TERMINAL,TRMIDNT=S78C,TRMTYPE=LUTYPE2,TRMMODL=1,  *
               DEFSCRN=(12,40),ALTSCRN=(12,80),BUFFER=1536,RUSIZE=256,  *
               TIOAL=(1000,4000),RELREQ=(,YES),                         *
               NETNAME=LU3278C,GMMSG=YES,CHNASSY=YES,                   *
               TRMSTAT=(TRANSCEIVE,'OUT OF SERVICE'),ALTSFX=1,          *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN),ERRATT=INTENSIFY,     *
               PRINTTO=(VTRM7),ALTPRT=(VTRM8),ACCMETH=VTAM
*         3279 MOD 2B
VTRM4      DFHTCT TYPE=TERMINAL,TRMIDNT=S78D,TRMTYPE=LUTYPE2,            *
               TIOAL=(2000,4000),RELREQ=(,YES),                         *
               DEFSCRN=(24,80),CHNASSY=YES,BUFFER=1526,RUSIZE=256,      *
               NETNAME=LU3278D,GMMSG=YES,ERRATT=(BLINK,RED),            *
               TRMSTAT=(TRANSCEIVE,'OUT OF SERVICE'),ALTSFX=4,          *
               FEATURE=(SELCTPEN,AUDALARM,UCTRAN,PS,HILIGHT,COLOR),     *
               PRINTTO=(VTRM7),ALTPRT=(VTRM8),ACCMETH=VTAM
*        3287 SCSPRT
VTRM6      DFHTCT TYPE=TERMINAL,TRMIDNT=SSCS,TRMTYPE=SCSPRT,              *
               TIOAL=(2000,4000),NETNAME=LU32SCS,BUFFER=256,RUSIZE=256,*
               TRMSTAT=TRANSCEIVE,ACCMETH=VTAM,CHNASSY=YES
*        3287 - BUFFER SIZE 1920
VTRM7      DFHTCT TYPE=TERMINAL,TRMIDNT=S870,TRMTYPE=LUTYPE3,TRMMODL=2,   *
               TIOAL=(2000,4000),BUFFER=256,                            *
               RUSIZE=256,NETNAME=LU32870,GMMSG=YES,CHNASSY=YES,        *
               TRMSTAT=(TRANSCEIVE,'OUT OF SERVICE'),                   *
               ACCMETH=VTAM
*        3287  -  BUFFER SIZE 3440 EXTDS HILIGHT PS
VTRM8      DFHTCT TYPE=TERMINAL,TRMIDNT=S890,TRMTYPE=LUTYPE3,             *
               DEFSCRN=(24,80),ALTSCRN=(43,80),                         *
               TIOAL=(3000,4000),BUFFER=256,                            *
               RUSIZE=256,NETNAME=LU32890,GMMSG=YES,CHNASSY=YES,        *
               FEATURE=(EXTDS,PS,HILIGHT),                              *
               TRMSTAT=(TRANSCEIVE,'OUT OF SERVICE'),                   *
               ACCMETH=VTAM,
*         8775  -  BUFFER SIZE (CSU) 3440 PARTITIONS
VTRM9      DFHTCT TYPE=TERMINAL,TRMIDNT=L54A,TRMTYPE=LUTYPE2,             *
               ALTSCRN=(43,80),DEFSCRN=(24,80),ALTPAGE=(43,80),         *
               PGESIZE=(24,80),ALTSFX=4,FEATURE=(PARTNS,UCTRAN),        *
               TIOAL=(1500,4000),RELREQ=(,YES),                         *
               NETNAME=LU8775A, TRMSTAT=(TRANSCEIVE,'OUT OF SERVICE')   *
               BUFFER=1536, CHNASSY=YES,                                *
               ACCMETH=VTAM, LASTTRM=VTAM
           DFHTCT TYPE=FINAL
           END DFHTCTBA
```

Figure 12. Example of TCT Definition for SNA VTAM Connection

Operands of the DFHTCT TYPE = TERMINAL Macro for All Connections

This section describes those operands of the DFHTCT TYPE = TERMINAL macro that are of particular relevance to the 3270 user, and do not depend on the access method being used.

Some of the operands are discussed further in subsequent sections, as follows:

- TRMMODL, DEFSCRN, ALTSCRN, PGESIZE, ALTPGE in "Screen Sizes" on page 39.
- TRMSTAT in "Terminal Status" on page 38.
- ERRATT in "Error Messages" on page 44.

TRMMODL=1 or 2		Indicates terminal default buffer size. "1" implies buffer size of 480 characters (12x40), "2" implies 1920 (24x80).
DEFSCRN		Indicates the default screen or buffer size of the terminal.
ALTSCRN		Indicates the alternate screen or buffer size of the terminal.
PGESIZE		Specifies the default page size to be used.
ALTPGE		Specifies the alternate page size to be used.
ALTSFX		Specifies a suffix for map set and partition set names to be assumed by BMS when alternate screen size is being used.
TRMSTAT		Specifies the terminal's status.
ERRATT		Specifies attributes to be associated with CICS messages sent to the terminal.
FEATURE=		Indicates that the terminal supports various features, as follows.
	ASCII-7	Indicates that the terminal uses ASCII-7 to communicate with CICS.
	ASCII-8	Indicates that the terminal uses ASCII-8 to communicate with CICS.
	AUDALARM	Audible alarm.
	DCKYBD	Display unit keyboard can transmit upper and lower case.
	SELCTPEN	Display unit has selector pen attached.
	EXTDS	3270 data stream extensions.
	COLOR	Extended color. Implies EXTDS.
	HILIGHT	Extended highlighting (reverse video, blink, underscore). Implies EXTDS.
	PARTNS	Partitions. Implies EXTDS.
	PS	Programmed symbols. Implies EXTDS.
	KATAKANA	Supports KATAKANA character set and does not transmit lowercase characters since they are reserved for KATAKANA. Standard CICS transactions such as CEMT and CECI avoid sending lower case characters to a KATAKANA terminal.
	TRANSPARENCY	Remote BTAM only: Indicates BSC transparency feature. Required for data stream. extensions. Implied by EXTDS.

(continued)

Figure 13 (Part 1 of 2). Operands of the DFHTCT TYPE = TERMINAL Macro.

(continued)		
	MSRCNTRL	Supports application program control of a magnetic slot reader. Implies EXTDS.
	PRINT	BTAM-connected printers only: Printer eligible to receive print requests.
	COPY	Remote BTAM or non-SNA VTAM only: 3270 Copy command.
	PTRADAPT	3275 terminal only: 3284 model 3 printer is attached and eligible for print requests.
	UCTRAN	CICS will translate lowercase input to uppercase. Can be overridden by the ASIS option on input commands.
	VALIDATION	Indicates all three kinds of validation (TRIGGER, MANDATORY ENTER, MANDATORY FILL) can be used with the terminal.
	QUERYCOLD	CICS will query device characteristics after the first logon after a cold start.
	QUERYALL	CICS will query device characteristics after every logon.
	SOSI	Supports mixed EBCDIC and DBCS fields.
	OUTLINE	Field outlining on the IBM 5550.
	BTRANS	Background transparency.
FF		Indicates that the terminal supports form feed.
HF		SCSPRT only: indicates that the terminal supports horizontal tabs.
VF		SCSPRT only: indicates that the terminal supports vertical tabs.
CGCSGID		Specifies the range of character set identifiers.

Figure 13 (Part 2 of 2). Operands of the DFHTCT TYPE=TERMINAL Macro.

Terminal Status

The uses of a terminal may be restricted by means of the TRMSTAT operand. There are four values that may be specified, and in increasing order of restriction they are: TRANSCEIVE, TRANSACTION, RECEIVE, and OUT OF SERVICE.

TRANSCEIVE indicates that the terminal may send input to and receive output from CICS, may initiate transactions, and may have transactions initiated on it by the automatic transaction initiation (ATI) facility.

TRANSACTION indicates that the terminal may send input to and receive output from CICS, and may initiate transactions, but may not have transactions initiated on it by ATI.

RECEIVE indicates that the terminal may receive output from CICS, and may have transactions initiated on it by ATI. In other words, it is an output-only terminal.

OUT OF SERVICE may be specified with any of the other keywords. It means no input or output is to take place at this terminal. It may be put in service by the master terminal operator, at which time its status becomes that specified in the other operand. For VTAM-connected terminals, out-of-service status causes the session to be closed.

In general, 3270 display units should be designated TRANSCEIVE and printers RECEIVE. However, there are two cases in which printers need TRANSCEIVE status because they send input to CICS.

- When they support structured fields and the query function is to be used. The input is the reply to the query.
- When they are SCS printers and the PA keys are to be used. The input comprises the character strings ("APAK 01" and "APAK 02") generated by these keys.

In addition to these states, the TRMSTAT operand can be used for VTAM-connected terminals, to specify whether CICS is allowed to create a session in response to automatic transaction initiation requests for terminals which have not yet logged onto CICS. The INTLOG operand allows session creation, and NOINTLOG prevents it.

Terminal Types

The types of terminal with which CICS is to communicate are specified by means of the TRMTYPE operand in either the DFHTCT TYPE=LINE or the DFHTCT TYPE=TERMINAL macro. If specified in both, the TYPE=TERMINAL specification overrides the TYPE=LINE.

With 3270 terminal systems, the operands specified in this operand depend on whether the connection is local or remote, on the access method used, and on the components of the user's terminal system. Figure 14 on page 40 and Figure 15 on page 41 are provided to aid selection of the correct operands.

Screen Sizes

One of the items of information about a terminal that CICS holds in the TCTTE is its physical screen size, that is, the the maximum number of lines per screen, and the number of character positions per line. The screen sizes are specified in the DFHTCT TYPE=TERMINAL macro, using the TRMMODL operand, and for dual screen size terminals only, the DEFSCRN and ALTSCRN operands.

A CICS transaction running on a terminal that has the alternate screen size facility uses one size or the other. It is not possible to use both screen sizes in one transaction. The screen size to be used by a transaction is defined by the SCRNSZE operand of the program control table (PCT). This is set to either DEFAULT or ALTERNATE. The SCRNSZE operand has no effect if the transaction is run on a single-screen-size terminal.

The system programmer can either specify screen sizes for the TCTTEs, or allow CICS to assume default values. All types of terminal device, including printers, have specified or assumed screen sizes stored in their TCTTEs. As well as a screen size indicating the physical characteristics of the terminal, the system programmer can specify an area within the screen, the page size, to be used by BMS.

When generating the TCTTEs for terminals with the dual screen sizes, DEFSCRN is used to define the default size and ALTSCRN the alternate size. If ALTSCRN is omitted, then the alternate size is set to the default size. If DEFSCRN is omitted, then the default size is set by the TRMMODL operand. If TRMMODL is omitted, then the default size is set to 12 lines per screen by 40 characters per line for display units, and 12 by 80 for printers.

Cntl unit			Device type											
Type	Modl	Connctn	3275	3276	3277	3278	3279	3284	3286	3287	3288	3289	8775	5550	3290
3271	1	BSC			A			G	G						
	2	BSC			A			G	G		G				
	11	SDLC			B			H	H						
	12	SDLC			B			H	H		H				
3272	1	Local			C			I	I						
	2	Local			C			I	I		I				
3274	1A	Lcl SNA			F	F	F	J	J	K	J	K			F
	1B	Local			C	C	C	I	I	I	I	I			C
	1C)	SDLC			F	F	F	J	J	K	J	K			F
	)	BSC			A	A	A	G	G	G	G	G			A
	1D	Local			C	C	C	I	I	I	I	I			C
3275	1	BSC	D					*							
	2	BSC	D					*							
	11	SDLC	E					*							
	12	SDLC	E					*							
3276	1	BSC		A		A				G		G			
	2	BSC		A		A	A			G		G			
	3	BSC		A		A	A			G		G			
	4	BSC		A		A	A			G		G			
	11	SDLC		F		F	F			K		K			
	12	SDLC		F		F	F			K		K			
	13	SDLC		F		F	F			K		K			
	14	SDLC		F		F	F			K		K			
8775	11	SDLC											F		
	12	SDLC											F		
5550		SDLC												F	

* Used for printing data displayed by 3275 only. Not addressable by the host.

To use this table, find the key letter in Part 1 that corresponds to the control unit/connection/device combination to be defined. Then look up the required TRMTYPE operand opposite this letter in Part 2.

Figure 14. TRMTYPE Selection Table (Part 1)

If a display terminal is defined with the QUERYCOLD or QUERYALL feature and no explicit values are given for DEFSCRN and ALTSCRN, a default screen size of 24 rows by 80 columns will be used. The alternate screen size will be that defined by the terminal.

If the terminal does not have the alternate screen size capability, then the screen size is defined by the TRMMODL operand. If this is omitted, then a size of 12 by 40 is used for display units and 12 by 80 for printers.

The screen size specifications required for the various 3270 devices are shown in Figure 16 on page 42. Where the DEFSCRN and ALTSCRN operands are used, the number of lines per screen and the number of characters per line are specified. Where TRMMODL is used, a specification of "1" or "2" is given, "1" indicates a size of 12 lines by 40 characters per line, and "2" indicates 24 by 80.

The area of a screen size used by BMS is called the BMS page size. This is usually equal to the screen size. The BMS page width must be equal to the screen width, or BMS will

Code	BTAM	VTAM
A	R3270	3270
B	–	3270
C	L3270	3270
D	R3275	3275 (note 1)
E	–	3275 (note 2)
F	–	LUTYPE2
G	R3270P	3270P
H	–	3270P
I	L3270P	3270P
J	–	LUTYPE3
K	–	LUTYPE3 or SCSPRT if SCS feature fitted

Notes:

1. *Specify TRMMODL=1 or 2*
2. *Specify TRMMODL=11 or 12*
3. *The following operands may be used as alternatives to those given in the table.*
   For L3270: L3277 For L3270P: L3284 or L3286
   For R3270: 3277 For R3270P: 3284 or 3285
   For 3270: 3277 or L3277 For 3270P: 3284, 3286, L3284, or L32 86

Figure 15. TRMTYPE Selection Table (Part 2)

format the displayed data incorrectly. The BMS page depth may be less than the screen depth. This will prevent BMS using the entire screen, thus reserving some lines at the bottom of the screen, perhaps for error messages.

The BMS page size is defined by the PGESIZE operand of the DFHTCT TYPE=TERMINAL macro for the default screen size mode, and by the ALTPGE operand for the alternate screen size mode.

Terminal	Model No or Buffer Size*	DFHTCT TYPE=TERMINAL operands	
		Default (or only) Screen or Buffer size	Alternate Screen or Buffer Size
3275	1 2 11 12	TRMMODL=1 TRMMODL=2 TRMMODL=1 TRMMODL=2	– – – –
3276	1 2 3 4 11 12 13 14	DEFSCRN=(12,40) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(12,40) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80)	ALTSCRN=(12,80) ALTSCRN=(24,80) ALTSCRN=(32,80) ALTSCRN=(43,80) ALTSCRN=(12,80) ALTSCRN=(24,80) ALTSCRN=(32,80) ALTSCRN=(43,80)
3277	1 2	TRMMODL=1 TRMMODL=2	– –
3278	1 2 3 4 5	DEFSCRN=(12,40) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80)	ALTSCRN=(12,80) ALTSCRN=(24,80) ALTSCRN=(32,80) ALTSCRN=(43,80) ALTSCRN=(27,132)
3279	2A 2B 3A 3B	DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80)	ALTSCRN=(24,80) ALTSCRN=(24,80) ALTSCRN=(32,80) ALTSCRN=(32,80)
3284	1 2 3	TRMMODL=1 TRMMODL=1 –	– – –
3286	1 2	TRMMODL=1 TRMMODL=2	– –
3287	480* 960* 1920* 2560* 3440*	TRMMODL=1 DEFSCRN=(12,40) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80)	– ALTSCRN=(12,80) ALTSCRN=(24,80) ALTSCRN=(32,80) ALTSCRN=(43,80)
3288	2	TRMMODL=2	–
3289	960* 1920* 2560* 3440* 3564*	DEFSCRN=(12,40) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80) DEFSCRN=(24,80)	ALTSCRN=(12,80) ALTSCRN=(24,80) ALTSCRN=(32,80) ALTSCRN=(43,80) ALTSCRN=(27,132)
8775		DEFSCRN(24,80)	ALTSCRN (See Note)

* The effective (that is, print operation) buffer sizes of the 3287 and 3289 printers do not depend on model number, but are ordered by feature number.

Figure 16. Screen Size Selection

For other devices, see the appropriate documentation for the device.

Note: For the 8775 and 3290, ALTSCRN must match customer set-up (CSU) selection. See the *IBM 8775 Display Terminal: Component Description* manual or the *IBM 3290 Information Panel, Description and Reference* manual.

For transactions that run in default mode on dual size terminals, BMS uses the PGESIZE value, or if this is omitted, the default screen size. For transactions that run in alternate mode, BMS uses the ALTPGE value, or if this is omitted, the alternate screen size.

If the terminal does not have the alternate screen size capability, BMS uses the PGESIZE value, or if this is omitted, the screen size value. When using BMS partition support, the page size is obtained from the partition definition.

The default sequences for screen and page sizes are summarized in Figure 17.

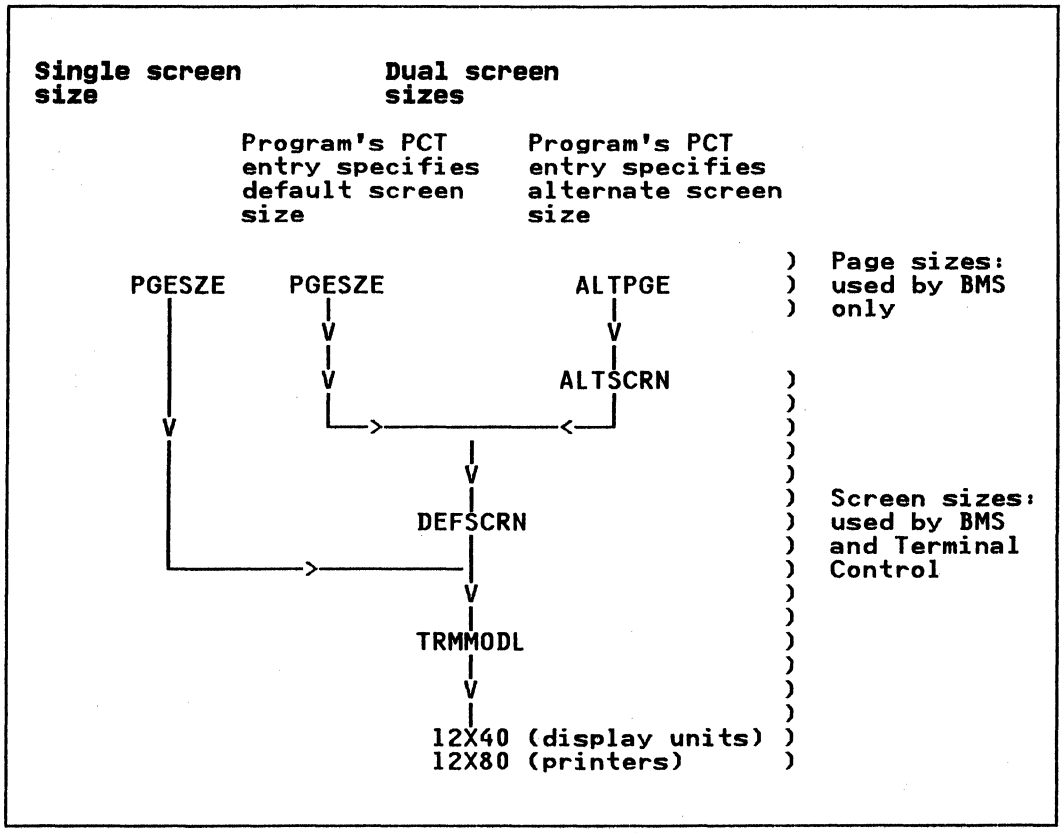

Figure 17. Defaulting Sequence for Page and Screen Sizes

CICS generates a data stream that explicitly sets the screen size only when the application program executes an output command with the ERASE option specified. Any program that may be used with a dual screen size terminal should include this option on its first output command, in case a previous transaction has left the screen in the wrong mode. Further information on the setting of screen sizes by application programs is given in "Chapter 5. Application Design and Programming" on page 49.

Error Messages

The ERRATT operand of the DFHTCT TYPE=TERMINAL macro controls the placement and attributes of CICS error messages output to the terminal. The default is ERRATT=NO. This indicates that the error message will be positioned at the current cursor position, and will inherit the attributes applicable to this position. This may produce an unreadable message, if for example, the cursor is in a field with unexpected programmed symbols (PS). The error message may also be positioned so that it overwrites parts of the user data, thus obscuring the cause of the error.

ERRATT=LASTLINE positions the error message on the line nearest the bottom of the screen such that the entire error message fits on the screen. The error message is displayed with base programmed symbols, and with the attributes specified by the ERRATT operand.

If partitions are used in a BMS application program, use of CICS error message partition facilities should be considered. If the application partition set contains an error message partition, then CICS error messages will be output to this partition, and will be given the attributes defined by the ERRATT operand of the DFHTCT macro. However, the LASTLINE option will be ignored, and the error message will be positioned at the top of the partition. If partitions are used, and the application partition set does not contain an error message partition, then all partitions are destroyed, and error messages are output to a cleared screen.

It is possible that CICS will generate multiple error messages for the same error. If ERRATT=LASTLINE is specified, or an error message partition is in use, multiple error messages will overwrite each other.

Printing Displayed Data

CICS copies displayed data to a printer, at the request of either the application program or the terminal operator. In addition, some 3270 terminals allow the operation to be performed locally, without the involvement of the host computer and hence of CICS. Where possible, 3270 Local Copy should be used in preference to the CICS function. Information about how attributes are copied is given in "Attribute Suppression" on page 64.

Using the CICS facilities, the application program initiates printing by executing an ISSUE PRINT command, and the terminal operator by hitting a PA key. To enable these functions to work, the system programmer must carry out certain tasks, namely:

- Generate CICS support for them using operands of the DFHSIT macro.
- Include the necessary CICS-supplied transactions in the PCT and PPT.
- Indicate which printer is to be used by means of operands of the DFHTCT macro.

The last task varies according to the connection, and is described under separate headings for each type of connection, together with other connection-dependent information.

The PRINT operand of the DFHSIT macro determines which types of printing facility are to be available, as follows:

PRINT=

NO Specifies no print support is required, that is, no application can execute an ISSUE PRINT command, and the terminal operators cannot use the PA key facility.

YES Specifies that an application program may execute an ISSUE PRINT command, but the terminal operators cannot use the PA key facility.

PA1, PA2, or PA3 Specifies that an application program may execute an ISSUE PRINT command and the terminal operators may use the specified PA key to print the contents of screens.

The PCT and PPT entries are generated as described in "Required CICS Transactions" on page 24.

The next sections describe the DFHTCT operands for different connections.

Local BTAM Connection: The print request, whether made by the ISSUE PRINT command or a PA key, will cause the contents of the screen to be printed on the first available and eligible printer.

For a printer to be available, it must be in service and not currently attached to a task.

For a printer to be eligible, it must be on the same control unit as the display unit, have a buffer capacity equal to or greater than the display unit, and have FEATURE=PRINT specified on its DFHTCT TYPE=TERMINAL macro.

As an example, consider the network as previously defined in Figure 5 on page 28. If a transaction that was defined as using the alternate screen size (in the SCRNSZE operand of its DFHPCT TYPE=ENTRY macro) is executing on terminal L78A, then if a print request was issued, the data would be printed on printer L890. The considerations leading to the use of this printer are as follows:

1. The first printer on the control unit is L870. It has FEATURE=PRINT specified.
2. The screen size being used by the transaction is the one defined in the ALTSCRN operand of the definition for L78A, namely 43x80 or 3440 bytes.
3. The buffer size of printer L870 is derived from its TRMMODL operand. It is 24x80 or 1920 bytes. This is less than the buffer size of the display unit, so this printer is not eligible.
4. The next printer on the control unit is L890. It has FEATURE=PRINT specified.
5. Printer L890 has an alternate buffer size, defined in its ALTSCRN operand, of 43x80 or 3440 bytes. This is the same size as the display unit's buffer, so this printer is eligible.

6. Assuming L890 is available as well as eligible, CICS selects this device to print the data displayed by L78A. It does so by issuing a CICS RECEIVE BUFFER command to read the display unit's buffer, followed by a SEND command to write the data received to the printer.

Remote BTAM Connection: The considerations described in the previous section for local BTAM connections apply to remote connections as well. The print request is satisfied by the first available and eligible printer. The system programmer must specify FEATURE=PRINT on the DFHTCT TYPE=TERMINAL macro of any printer intended to be used for print requests.

Remote BTAM-connected 3270 control units support the 3270 Copy command. This provides a more efficient way of printing displayed data than the method described for local BTAM connections. To use it, FEATURE=COPY,PRINT must be specified on the printer's DFHTCT TYPE=TERMINAL macro. The same rules for printer selection apply as for local connection, that is the first available and eligible printer is used.

If the network previously defined in Figure 7 on page 30 and the transaction described for the local connection are used as an example, then steps 1 to 5 of the local case apply. In step 6, the data is printed on L890, as in the local case. However, in the remote case, CICS would execute an ISSUE COPY command specifying that the data should be copied from L78A to L890. This is preferable to the RECEIVE BUFFER and SEND method, since it involves fewer transmissions between host and terminal.

If the terminal is a 3275, none of the above considerations apply. The system programmer must simply specify FEATURE=PRTADAPT instead of FEATURE=PRINT, to indicate that the 3275 has a 3284 model 3 printer attached to it, and that this is to be used to satisfy print requests.

VTAM Connection: A print request will cause the contents of the screen to be printed on the printer specified in the PRINTTO operand of the display unit's DFHTCT TYPE=TERMINAL macro. If this printer is not available, the one specified in the ALTPRT operand is used. A printer is unavailable if it is not in service or is attached to another task.

It is not necessary to specify FEATURE=PRINT in the VTAM case.

Some control units that use non-SNA VTAM connections implement the 3270 Copy command. To use this command for the print function, COPY must be specified on the PRINTTO and ALTPRT operands. Otherwise, CICS implements the print function by reading the display unit's buffer and writing it out again to the printer. Using the Copy command is the more efficient method.

CICS does not check that the printer's buffer is large enough to take the data from the display unit. The system programmer must ensure that the printers selected by the PRINTTO and ALTPRT operands have large enough buffers.

If the terminal is a 3275, PRINTTO and ALTPRT do not apply. In this case, FEATURE=PRTADAPT must be specified, to indicate that the 3275 has a 3284 model 3 printer attached to it, and that this is to be used to satisfy print requests.

SNA character string (SCS) printers do not accept 3270 data streams, but only SCS control codes and data. They therefore cannot be used to print the contents of a display unit's buffer. In other words, a printer defined as TRMTYPE=SCSPRT in its DFHTCT TYPE=TERMINAL macro must not be specified in a PRINTTO or ALTPRT operand.

Local Copy Function: Some models of control unit provide a Local Copy function, allowing data to be transferred directly from the display unit to the printer when the terminal operator hits a special key, the PRINT key. No transmission to or from the host is involved in the transfer, so performance will be better than with the CICS print facility. For this reason, it is better to avoid the CICS PA key function on terminals connected to these control units.

To use the Local Copy function, a print authorization matrix must be defined, as described in the appropriate *IBM 3270 Information Display System* manual. A CICS transaction may be used to load the matrix into the control unit, as described in Appendix B, "Printer Authorization Matrix" on page 97.

Report Controller

If you are using the report controller (an optional feature of CICS/DOS/VS), there are some RDO attributes or DFHTCT operands to which you should give some consideration when defining printers and display devices. For some guidance on this, see the *CICS/DOS/VS Resource Definition (Online)* manual. The attributes are listed in the reference section of that book. The operands are listed in the *CICS/DOS/VS Resource Definition (Macro)* manual.

Program Control Table

The program control table (PCT) holds information about transactions. It is defined by the system programmer using the DFHPCT macro, or the resource definition online (RDO) transaction, CEDA. Some of the information is dependent on the types of terminal with which the transactions may be run, and on the CICS facilities required to support them. This section describes the RDO commands and keywords that relate to 3270 terminals, and the corresponding DFHPCT operands.

RDO Commands and Keywords

The characteristics of the transaction can be defined using the RDO command, CEDA DEFINE TRANSACTION. The keywords of particular relevance to 3270 terminals are TASKREQ and PARTSET (if partitions are being used). If the transaction can run on terminals with the dual screen size capability, the SCRNSZE keyword should be specified on a profile associated with the transaction by the PROFILE keyword of the DEFINE TRANSACTION command. In all cases, the RDO keywords are the same as the corresponding operands of the DFHPCT macro.

The following points should also be noted:

- If a profile is named, there must be a corresponding RDO profile definition produced using a DEFINE PROFILE command.
- If a partition set is named, there must be a corresponding partition set RDO entry produced using a DEFINE PARTITIONSET command.

- If BMS mapping is being used, there must be a corresponding RDO map set definition produced using a DEFINE MAPSET command.
- The program named by the PROGRAM keyword of the DEFINE TRANSACTION command must also be defined by a DEFINE PROGRAM command.

Operands of the DFHPCT TYPE = ENTRY Macro

The DFHPCT TYPE = ENTRY macro creates an entry for a transaction in the PCT. The system programmer must specify at least a transaction identification by means of either the TASKREQ or TRANSID operand, and the name of the first program to be initiated.

The operands of the DFHPCT macro are as follows:

SCRNSZE Specifies which screen size the transaction is to use. If DEFAULT is specified, the transaction will be run in default screen size mode, using values for screen width and depth specified in the DEFSCRN and PGESIZE operands of the DFHTCT TYPE = TERMINAL macro. If ALTERNATE is specified, the transaction will be run in alternate mode, using the values specified in the ALTSCRN and ALTPGE operands of the DFHTCT TYPE = TERMINAL macro. SCRNSZE has no effect when the transaction is run on a single screen size terminal. For more information, particularly about rules for defaulting in the absence of the DFHTCT operands, see "Screen Sizes" on page 39.

TASKREQ Specifies one of the following 3270 facilities, in response to which the transaction will be initiated: a PA or PF key, an operator identification card reader, a magnetic slot reader, or a light pen attention AID.

TRANSID Specifies a one- to four-character transaction identifier. If these characters are sent at the start of message from a terminal on which no transaction is running, the transaction defined by this PCT entry will be initiated. The terminal operator can send the transaction identifier from a 3270 display unit by typing it onto a blank screen and then hitting ENTER.

PARTSET Specifies a one- to six-character default application partition set name for the transaction. BMS will load this partition set into the terminal when the transaction first transmits data. The program can override the choice of partition set by issuing the SEND PARTNSET command.

If the PARTSET operand is omitted, CICS assumes that the transaction is to run on an unpartitioned screen, and thus destroys any existing partitions. The application program can, of course, create new partitions by the SEND PARTNSET command.

There are two special values of the PARTSET operand, KEEP and OWN. KEEP indicates that the transaction is to use the same partition as the previous transaction. It is required for pseudo-conversational transactions which use partitions. OWN indicates that a terminal control application program is managing its own partitions, by using appropriate structured fields.

Chapter 5. Application Design and Programming

This chapter describes the commands and other facilities available to the application programmer. CICS provides two interfaces for the application program to transmit data to a terminal and receive data from it: terminal control (TC) and basic mapping support (BMS) (as described in "Chapter 2. CICS Data Communication Facilities" on page 5).

This chapter emphasizes the terminal control interface, as the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)* fully describes BMS support of 3270 and 8775 terminals. Despite this emphasis, application programs should use BMS wherever possible. This will result in simple device-independent programs.

In addition to a detailed description of the terminal control interface for 3270 and 8775 terminals, this chapter discusses miscellaneous application programming facilities, which may be used by both BMS and terminal control application programs.

Transmitting and Receiving Data

This section describes the aspects of the terminal control interface applicable to 3270 and 8775 terminals.

Writing to the Terminal (SEND Command)

This command transmits a message constructed by the application program to the terminal. The user must ensure that the content of the message is a valid 3270 data stream, as described in the device's related publication – see "Books from Related Libraries" on page vi.

The syntax of this command for all 3270 and 8775 terminals except SCS printers is as follows:

```
SEND FROM(data-area)
     {LENGTH(data-value) | FLENGTH(data-value)}
     [WAIT]
     [STRFIELD | [[ERASE] [CTLCHAR(data-value)]]]
     [INVITE | LAST]                                    VTAM only
     [DEFRESP]                                          VTAM only
```

3270 SCS printers are supported only via VTAM. The syntax of the command is as follows:

```
SEND FROM(data-area)
     {LENGTH(data-value) | FLENGTH(data-value)}
     [WAIT]
     [STRFIELD]
     [INVITE | LAST]
     [DEFRESP | CNOTCOMPL]
```

The complete message, apart from the 3270 output command code and the write control character (WCC), must be stored by the application program in a data area named in the FROM option. The program must specify the length of the message in the LENGTH option if two-byte lengths are being used, or in the FLENGTH option if four-byte lengths are being used.

The WCC may be specified in the CTLCHAR option. Alternatively, CICS will construct a default WCC that resets all modified data tags (MDTs) to zero, and resets (unlocks) the keyboard.

The terminal control interface may be used to send structured fields to the terminal. The structured fields must be constructed in the FROM data area, and the STRFIELD option specified on the SEND command. Structured fields do not require WCCs, and CICS does not generate a default WCC when STRFIELD is specified. Instead, the application program must include the WCC (where WCCs are required) in the structured field data, as described in "Chapter 6. 3270 Data Streams Used by CICS" on page 67.

The SEND command may be used to output structured fields to:

- Load programmed symbols (see Appendix C, "Loading Programmed Symbols" on page 99).
- Set the inbound reply mode of the terminal, perhaps to receive character attribute input.
- Create, destroy and activate partitions.
- Send data to a specified partition.
- Control the indicator lights and buzzers of a magnetic slot reader.

The SEND command with the STRFIELD option should not be used to query the terminal characteristics. The CONVERSE command with the STRFIELD option should be used instead.

The SEND command with the STRFIELD option should be used with SCS printers to load programmed symbols. CICS terminal control then appends an appropriate format management header (FMH) to the outbound data stream.

The ERASE option is provided to clear the screen (or printer buffer) before the data in the message is displayed. It is not applicable to SCS printers. ERASE is required for the first output message to devices that have default and alternate buffer sizes, to ensure that the correct buffer size is selected. This is discussed in "Screen Sizes" on page 39.

CICS normally returns control to the application as soon as it has started to process the SEND command. This allows processing of the SEND command to be overlapped with application processing. For VTAM-connected SNA terminals, the message will not be transmitted immediately. CICS will defer transmission until a later event such as the execution of a RECEIVE command, a further SEND command, or the termination of the transaction. This optimizes the use of the communications medium by allowing SNA indicators to be added to the message, where they would otherwise require a separate transmission.

If the application does not wish to overlap SEND processing with further application processing, the WAIT option should be specified. This causes the application to wait until the message has been acknowledged by the access method. Since the WAIT option causes each SEND to be scheduled individually, there may be extra transmissions to carry the SNA indicators. For VTAM-connected SNA terminals, the DEFRESP option may be specified. This implies the WAIT option, and suspends application processing until the message has been acknowledged by the receiving terminal.

If the logic of the application allows, some optimization of communications may be performed by the INVITE and LAST options. If the application logic requires the use of the WAIT (or DEFRESP) option, but the next terminal command is certain to be a RECEIVE, then the INVITE option should be used. This causes the SNA change direction (CD) indicator to be attached to the SEND transmissions, thus avoiding an extra outbound transmission as part of the RECEIVE command processing. Similarly, the LAST option causes the SNA end bracket (EB) indicator to be attached to an outbound transmission. This immediately disconnects the session from the application instead of requiring an extra transmission during RETURN command processing.

The CNOTCOMPL option indicates that this message does not complete the SNA chain. Thus an application program can use several SEND commands to build a single SNA chain, omitting CNOTCOMPL from the last SEND command. This may be useful if a long message is to be sent, and there is inadequate buffer space in the receiving terminal.

Reading from the Terminal (RECEIVE Command)

This command receives a message from the terminal, and returns the data to the application program.

The syntax of the RECEIVE command is as follows:

```
RECEIVE {INTO(data-area) | SET(ptr-ref)}
     {LENGTH(data-area) | FLENGTH(data-area}
     [MAXLENGTH(data-value) | MAXFLENGTH(data-value)]
     [NOTRUNCATE]
     [ASIS]
     [BUFFER]

Exception Conditions:
     LENGERR
     EOC                                                VTAM only
```

If the BUFFER option is omitted, the RECEIVE command only reads fields whose modified data tags (MDTs) are set on. These MDTs may be set on as a result of

terminal operator input, or they may be set on by the application program as a field attribute when the field is created.

If the 3270 display screen is unformatted (no fields have been created), the RECEIVE command reads all characters on the screen, with null characters suppressed.

If the BUFFER option is specified, CICS sends a Read Buffer command to the terminal, causing the entire contents of the 3270 buffer to be read. For an inbound reply mode of Field (see below) this includes the field contents and their 3270 attributes, but not extended field attributes or character attributes. The data stream returned by the RECEIVE BUFFER command can subsequently be sent back to the terminal by a SEND command. The BUFFER option thus allows an application program to save the contents of a 3270 display, and subsequently restore them.

If a Read Buffer function is required in conjunction with partitions, the CONVERSE command should be used to send a suitable Read Partition structured field to the terminal, and receive the reply.

The form of the returned data depends on the inbound reply mode of the terminal. This can be set by an application program using the Set Inbound Reply Mode structured field. The default inbound reply mode is Field. This is reset when the terminal is powered on, or by the WCC reset bit on a SEND ERASE command. (See "The WCC Reset Bit" on page 65.) The rest of this section assumes an inbound reply mode of Field. Refer to "Inbound Reply Mode" on page 65 and to the terminal manuals for information on the other inbound reply modes.

On completion of the RECEIVE command, CICS removes the attention identifier (AID) and cursor position from the inbound data stream, and stores them in the exec interface block (EIB) fields EIBAID and EIBCPOSN respectively. Before moving the cursor position into EIBCPOSN, CICS translates it into a two-byte binary value. If no cursor position is returned by the terminal (for example, if the AID indicates a PA key), EIBCPOSN is set to zero.

If an Inbound structured field is received, CICS removes the structured field pseudo-AID hex 88 from the inbound data stream, and stores it in the exec interface block field EIBAID. It also sets the field EIBCPOSN to zero. The application program must then decode the rest of the inbound structured field.

A 3270 application program is unlikely to use the FLENGTH, MAXLENGTH, MAXFLENGTH and NOTRUNCATE options.

If the INTO option is specified and the NOTRUNCATE option is omitted, CICS copies as much data as will fit into the INTO area. If the INTO area is too small, then CICS raises the LENGERR condition, and truncates the data. The length of the INTO area is specified by the MAXLENGTH option as a two-byte value, or by the MAXFLENGTH option as a four-byte value. If MAXLENGTH and MAXFLENGTH are both omitted, then the length of the INTO area is specified by the LENGTH or FLENGTH options. In either case, CICS returns the length of received data (before any truncation) in the LENGTH option as a two-byte value, or in the FLENGTH option as a four-byte value.

If the SET option is specified and the NOTRUNCATE option is omitted, CICS sets the specified pointer to point to the received data and returns the length of the received data in the LENGTH option as a two-byte value, or in the FLENGTH option as a four-byte value. The MAXLENGTH or MAXFLENGTH options specify the two-byte or four-byte maximum length of input data that the application program is prepared to receive in a single RECEIVE command. If more data is received, the LENGERR condition is raised and the excess data is discarded. If both the MAXLENGTH and MAXFLENGTH options are omitted, then the application program is prepared to receive all the input data in a single RECEIVE command.

If the NOTRUNCATE option is specified, CICS will not discard excess input data and raise the LENGERR condition. Instead, CICS will hold onto the rest of the input data, which the application program may then retrieve by further RECEIVE commands. The exec interface block field EIBCOMPL is set to hex FF when all the input data has been received.

The ASIS option overrides any upper case translation requested in the terminal's terminal control table entry by the FEATURE = UCTRAN operand of the DFHTCT macro. However, the ASIS option does not apply to data that initiates a transaction. This is because the data has already been received and upper case translation performed by CICS before the RECEIVE command is encountered.

A RECEIVE can be executed with no options. In this case, the exec interface block is updated, but any data sent by the terminal is lost.

The EOC (end of chain) condition is raised when a RECEIVE command receives the last SNA request unit in a chain. This will always happen for 3270 terminals. The default system action is to ignore the condition.

Writing to, then Reading from, the Terminal (CONVERSE Command)

It is frequently necessary for an application program to converse with the terminal by writing to it and then immediately reading from it. The CONVERSE command can be used for this, since for most purposes it is equivalent to a SEND command followed by a RECEIVE command, with a wait operation in between to allow the SEND to complete.

The syntax of this command for all 3270 and 8775 terminals except SCS printers is as follows:

```
CONVERSE FROM(data-area)
     {FROMLENGTH(data-value) | FROMFLENGTH(data-value)}
     {INTO(data-area) | SET(ptr-ref)}
     {TOLENGTH(data-area) | TOFLENGTH(data-area)}
     [MAXLENGTH(data-value) | MAXFLENGTH(data-value)]}
     [NOTRUNCATE]
     [STRFIELD | [[ERASE]
     [CTLCHAR(data-value)]]
     [DEFRESP]                                          VTAM only

Exception Conditions:
     LENGERR
     EOC                    VTAM only
```

3270 SCS printers are supported only via VTAM. The syntax of the command is as follows:

```
CONVERSE FROM(data-area)
     {FROMLENGTH(data-value) | FROMFLENGTH(data-value)}
     {INTO(data-area) | SET(ptr-ref)}
     {TOLENGTH(data-area) | TOFLENGTH(data-area)}
     [MAXLENGTH(data-value) | MAXLFLENGTH(data-value)]}
     [NOTRUNCATE]
     [STRFIELD]
     [DEFRESP]

Exception Conditions:
     LENGERR
     EOC                                                VTAM only
```

The FROM, FROMLENGTH, FROMFLENGTH, DEFRESP, ERASE and STRFIELD options are equivalent to the FROM, LENGTH, FLENGTH, DEFRESP, ERASE, and STRFIELD options on the SEND command.

The INTO, SET, TOLENGTH, TOFLENGTH, MAXLENGTH, MAXFLENGTH, and NOTRUNCATE options are equivalent to the INTO, SET, LENGTH, FLENGTH, MAXLENGTH, MAXFLENGTH and NOTRUNCATE options on the RECEIVE command.

CONVERSE should always be used in preference to SEND and RECEIVE for the Query structured field function.

Printing Data (ISSUE PRINT Command)

The application program can copy the data displayed on a screen to a 3270 printer, by executing an ISSUE PRINT command.

The syntax of this command is as follows:

```
ISSUE PRINT
```

The printer used depends on the network definition provided by the system programmer, as described in "Printing Displayed Data" on page 44.

Copying Data (ISSUE COPY Command)

The ISSUE COPY command allows an application program to copy data into the buffer of the BSC terminal to which it is connected, from the buffer of another terminal on the same control unit. It may thus be useful for transactions that run on printers.

The syntax of this command is as follows:

```
ISSUE COPY TERMID(name)
      [CTLCHAR(data-value)]
      [WAIT]

Exception Conditions:
     TERMIDERR
```

The TERMID option specifies the name of the terminal from which the data is copied. The CTLCHAR option allows the program to control certain output operations, in a similar way to that described for this option on the SEND command. The WAIT option is provided to allow the copy operation to complete before control is returned to the application program.

Erasing Data (ISSUE ERASEAUP Command)

The screen of a display unit or buffer of a printer may be cleared before data is displayed by including the ERASE option on the SEND or CONVERSE command. Unprotected fields may be cleared to nulls without any data being sent to the terminal's buffer by executing an ISSUE ERASEAUP command.

The syntax of this command is as follows:

```
ISSUE ERASEAUP
      [WAIT]
```

The WAIT option can be specified to allow the operation to complete before control is returned to the program.

If all unprotected fields in a partition are to be cleared, a SEND STRFIELD command should be used to output an outbound 3270 structured field containing an ERASEAUP command code.

Controlling the Terminal Connection

A CICS application program can control the 3270 terminal connection by the ISSUE RESET and ISSUE DISCONNECT commands.

The ISSUE RESET command applies to BTAM-attached BSC terminals only. It is used to relinquish use of a BTAM communication line. The syntax of this command is as follows:

```
ISSUE RESET
```

The ISSUE DISCONNECT command applies to both BTAM- and VTAM-attached terminals. It terminates the connection between CICS and the transaction's primary terminal.

For BSC terminals connected via switched lines, the line connection is broken. For SNA terminals the session between CICS and the terminal is only terminated if the RELREQ operand of the DFHTCT macro specifies (,YES). This session can be re-established by logging the terminal back onto CICS in the normal way. The syntax of this command is as follows:

```
ISSUE DISCONNECT
```

Access to Information about the Terminal and the System

EXEC Interface Block (EIB)

CICS provides this control block to allow the application program to obtain information about the terminal and the current task. The information is contained in fields in the EIB, which the application program can address by name. The information and corresponding field names include:

- The attention identifier (AID) and two-byte binary cursor position associated with the last BMS or terminal control input operation (EIBAID and EIBCPOSN).
- The terminal identifier (EIBTRMID).
- The transaction identifier of the current task (EIBTRNID).
- The response code from the function requested by the last application program command (EIBRCODE).
- The date and time at which the task started (EIBDATE and EIBTIME).

Fields whose contents depend on the execution of a CICS function are updated on completion of the function. Control may return to the program before a function is complete, unless the WAIT option was specified on the command that invoked the function. The RECEIVE command is always executed with an implied WAIT.

The RECEIVE command may be executed with no options, to update the EIB and allow the program to determine the AID and cursor position. Any data sent by the terminal is lost because no input data area has been provided.

CICS System Storage Areas (ADDRESS Command)

CICS will supply the application program with the addresses of certain of its storage areas. An ADDRESS command must be executed with the names of pointer variables that are to be set to the addresses of the required control blocks.

Some of the storage areas accessible by this command are the common work area (CWA), the terminal control table user area (TCTUA) and the transaction work area (TWA). All these areas are used for passing information between application programs.

CICS System Values (ASSIGN Command)

This command provides access to information held in CICS tables about the terminal and task. The command must include a set of options indicating what information is required, and each option must include the name of a variable into which the information is to be stored by CICS.

Available information includes:

- The type and model number of the terminal:

  ASSIGN TERMCODE

- The screen size being used by the application:

  ASSIGN SCRNHT

  ASSIGN SCRNWD

- Whether or not the 3270 data stream extensions (including color, programmed symbols, extended highlighting, validation, partitions, and MSR control) are supported by the terminal:

  ASSIGN EXTDS

  ASSIGN COLOR

  ASSIGN PS

  ASSIGN HILIGHT

  ASSIGN VALIDATION

  ASSIGN PARTNS

ASSIGN MSRCNTRL

ASSIGN OUTLINE

ASSIGN SOSI

ASSIGN BTRANS

ASSIGN GCHARS

ASSIGN GCODES

BMS-related information such as the page number of the current page, the name of the most recent input partition, and the size and position of the most recently positioned map. These options are described in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

The ASSIGN command is particularly useful in terminal control application programs that may be run on several models of display unit or printer. The program can use information supplied by this command to dynamically match its data to the characteristics of the devices on which it is run.

Query Structured Field

For terminals that support the 3270 data stream extensions, the application can use the Query structured field to enquire directly from the terminal what features it supports. The program can use the ASSIGN EXTDS command to ascertain whether the terminal supports the 3270 data stream extensions, and if so, execute a CONVERSE command to issue the query.

The data area specified in the CONVERSE command must contain a Query structured field, as described in the device's related publication, and the command must have the STRFIELD option specified. CONVERSE should be used rather than a terminal control SEND followed by a RECEIVE.

CICS can determine the characteristics of a device that are relevant to BMS by using Query support. You must define the terminal with QUERY(COLD) or QUERY(ALL) in the CEDA DEFINE TYPETERM command, or FEATURE=QUERYCOLD or FEATURE=QUERYALL in the DFHTCT TYPE=TERMINAL macro. For QUERY(COLD) or FEATURE=QUERYCOLD, CICS will issue a query to the device after the first logon after a cold start. For QUERY(ALL) or FEATURE=QUERYALL, CICS will issue a query to the device after every logon.

Exceptional Condition and Attention Identifier (AID) Handling

Exceptional Conditions (HANDLE CONDITION Command)

Exceptional conditions may occur during the execution of a CICS command. For instance, the LENGERR condition will be raised if the length of the data received following a RECEIVE INTO terminal control command exceeds the length of the INTO area. Because exceptional conditions usually represent design or coding errors in the application program, the usual default action by CICS is to terminate the transaction.

To trap an exceptional condition and prevent CICS taking the default action, the application should execute a HANDLE CONDITION command specifying the condition. This command must be executed prior to the command which may give rise to the condition, and should include a label in the program to which control is to be transferred if the condition does arise. Code can then be included at the label to recover from the condition.

The conditions that may arise from any particular command are described with the command in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

If no HANDLE CONDITION command is in effect for a particular condition when it arises, then as part of the default action, the ERROR condition is raised. This general condition can be trapped by a HANDLE CONDITION ERROR command, and control passed to general error-handling code.

Attention Identifiers (AIDs) (EIBAID Field and HANDLE AID Command)

There are two ways in which the application program can detect the receipt of an attention identifier (AID) from a terminal: by testing the one-byte field EIBAID in the exec interface block (EIB), or by executing a HANDLE AID command prior to the input command.

The AID is placed in EIBAID exactly as it is received from the terminal. CICS provides a standard list of AIDs for testing the contents of this field. The list is called DFHAID, and it is obtained by copying it into the source program. The constants in DFHAID are listed in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

The HANDLE AID command operates in a similar way to HANDLE CONDITION. Operands representing the AIDs to be handled are specified, together with labels to which control is to be passed when they are received. For instance, HANDLE AID PF3(LABEL1) will transfer control to the code at LABEL1 when the terminal operator presses PF3.

Application Design Considerations

Task Initiation

A terminal operator can initiate a transaction by entering a one-to-four character transaction identifier, or by using a PA or PF key, an operator identification card or magnetic slot reader, or a selector light pen attention (or CURSR SEL key). If the light pen (or CURSR SEL key) method is used, the screen must have been left formatted with selector light pen attention fields by a previous transaction.

The means of initiating a transaction is specified by the system programmer using the CEDA DEFINE TRANSACTION command or the DFHPCT TYPE=ENTRY macro, together with the name of the application program to which control is initially given. A transaction identifier is specified in character form in the TRANSID operand. Additionally, a special input facility (for example a PF key) can be specified in the TASKREQ operand. Also, an identifier in hexadecimal format can be specified in the XTRANID operand. TRANSID must be always specified for a transaction.

Provided the terminal operator used an initiation method other than a PA key or a space or null selector pen attention field, the initial data stream contains all data in the buffer, except for null characters, together with the AID and the cursor position. The application program can obtain the data received from the terminal by executing a terminal control RECEIVE command. Alternatively, if the terminal is a display unit and it has been formatted by a previous transaction, the application program can issue a RECEIVE MAP command to map the formatted screen. In either case, all data received from the terminal, including the first four bytes containing any transaction identifier, is stored by CICS in the program's input data area. The EIB fields EIBAID and EIBCPOSN are also set.

If the terminal operator used a PA key, only the AID is transmitted, causing only EIBAID to be set. If the operator used a space or null selector pen attention field, the AID, cursor position, and addresses of selected fields are transmitted, causing EIBAID and EIBCPOSN to be set.

A transaction may be initiated by entering data in a partition on an 8775 terminal. If the PARTSET operand is omitted from the transaction's program control table (PCT) entry, or the transaction initiating data is received by a RECEIVE MAP or RECEIVE PARTN command, then the inbound 3270 structured field is decoded. The input AID and cursor position are removed from the inbound data stream and stored in the exec interface block in the normal way. Otherwise the inbound 3270 structured field is not decoded. The field EIBAID is set to hex 88, and EIBCPOSN is set to zero.

SCS printers (that is, printers supporting the SNA character string data stream) are provided with PA keys that may initiate transactions. The two keys cause the character strings "APAK 01" and "APAK 02" to be transmitted to CICS. "APAK" may therefore be used as a transaction identifier, and the rest of the string as data to the program. The transaction identifier must be specified in the DFHPCT TYPE=ENTRY macro as TRANSID=APAK. The keys do not operate in the same way as PA keys on a display unit, so specifying PA1 or PA2 in the TASKREQ operand is not a valid method.

Uses of PA and PF Keys

There are at least five possible uses for PA (program attention) and PF (program function) keys on a display unit. The uses, or meanings, are assigned by the system programmer and application designer, and the meaning of any particular key may vary according to the circumstances in which it is used. Some consideration needs to be given to these assignments, preferably at the level of an installation standard. This avoids meanings that may confuse the terminal operator.

The possible uses are:

- To initiate printing (PA keys only). This use is specified in the PRINT operand of the DFHSIT macro or its bring-up override. Once so defined, a key cannot be used for any other purpose. Note that the print key is not supported from a terminal in a partitioned state.

- To initiate a transaction. This use is defined in the TASKREQ operand of the DFHPCT TYPE=ENTRY macro. A key may be defined to have this meaning when there is no transaction running on the terminal, and other transaction specific meanings when there is a transaction running on the terminal.

- To initiate a BMS page retrieval session. This use is, in principle, the same use as the previous one, since it is defined by specifying that the key is to invoke the BMS page retrieval program DFHTPR. BMS paging is described in the *CICS/DOS/VS CICS-Supplied Transactions* manual.

- For BMS single keystroke page retrieval. This use is specified in the SKRxxxx operand of the DFHSIT macro. The key may be defined to have other meanings outside a BMS page retrieval session.

  These keys may also be defined as initiating a BMS page retrieval session.

- For providing input to an application program. This use is defined during application design, and implemented by coding the program to test the attention identifier (AID) received from the terminal. A key used for this purpose may have other uses when the transaction is not running.

Writing to Printers

Transactions that Write to Printers

Printers cannot, in general, initiate transactions. SCS printers have PA keys that send the character strings "APAK 01" and "APAK 02" to the host, and APAK can be defined as a transaction identifier. Transactions that write to printers are not usually initiated from those devices. The APAK transaction code was designed to allow the user to write a transaction to align special forms on the printer.

A transaction initiated from a display unit can copy the displayed data to a printer, using the ISSUE PRINT command.

A BMS transaction may initiate the BMS page retrieval transaction on a printer using the BMS ROUTE command. This is described in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

The CICS automatic transaction initiation (ATI) facilities may be used to initiate transactions communicating exclusively with printers. The printer must have been assigned a suitable status in the TRMSTAT operand of the DFHTCT TYPE=TERMINAL macro (as described in "Terminal Status" on page 38).

CICS will initiate a transaction automatically when the number of items on a transient data queue reaches a predefined level. The transaction may be one that writes to a printer, and typically prints items from the queue. The trigger level is defined by the system programmer in the TRIGLEV operand of the DFHDCT TYPE=INTRA macro, and the transaction name in the TRANSID operand of the same macro. If the transaction is associated with a printer, the transient data destination name must be the same as the printer name. If several different transactions, or several instances of the same transaction, write to a transient data queue, their outputs will be interleaved. The ENQ and DEQ commands can be used to prevent this by controlling access to the queue resource.

Alternatively, the transaction may be initiated using the interval control facilities. An application program issues a START command, specifying the transaction that is to write to a printer in the TRANSID option, and specifying the printer in the TERMID option. The transaction issuing the START command may have been initiated from a display unit.

Using the Report Controller

The report controller provides EXEC-level commands for writing reports to VSE/POWER spool files. The printing of these reports can be controlled using the report controller transactions. The commands are described in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*. For an introduction to the report controller, read the *CICS/DOS/VS Facilities and Planning Guide*.

Using BMS to Write to Printers

BMS provides comprehensive facilities for formatting data for printers. These are described in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

Setting Printer Tabulation Stops

If SCS printer tab stops are to be used, the settings must first be sent to the printer. They are set by a user-written program that sends the SHF (set horizontal format) and SVF (set vertical format) control codes to the terminal, using a terminal control SEND command. An example of such a program is given in Figure 18 on page 63.

```
PGMX     CSECT
         exec CICS SEND FROM(TABS) LENGTH(TABSLEN) WAIT LAST
         exec CICS RETURN
         SPACE 1
*
* TAB SETTING DATA STREAM
*
TABS     DS    0H
         SPACE 1
HTAB     DC    X'2BC1'          CONTROL CHAR INDICATING HTAB'S
         DC    AL1(HTABLEN-2)   COUNTER
         DC    AL3(0)           RESERVED FOR MPP(MAX.PRINT.POS.),
*                               LM(LEFT MARG.),RM(RIGHT MARG.)
         DC    AL1(1,11,21,31,41,51) HTAB'S : -1-11-21-31-41-51-
HTABLEN  EQU   *-HTAB
         SPACE 1
VTAB     DC    X'2BC2'          CONTROL CHAR INDICATING VTAB'S
         DC    AL1(VTABLEN-2)   COUNTER
         DC    AL3(0)           RESERVED FOR MPL(MAX.PRINT.LINES)
*                               TM(TOP MARG.),BM(BOTTOM MARG.)
         DC    AL1(10,20,30)          VTAB's : -10-20-30-
VTABLEN  EQU   *-VTAB
         SPACE 1
TABSLEN  EQU   *-TABS  DATA STREAM LENGTH
         SPACE 1
         END   PGMX
```

Figure 18. Physical Tab Setting Sample Program

Copying from Displays to Printers

Local and Host-Initiated Copy Facilities

Data displayed on a screen can be copied to a printer, at the request of either the terminal operator or the application program. The application program initiates the printing by executing an ISSUE PRINT command. The terminal operator uses either a PA key defined by the CICS system programmer, or, on some terminals, a special key, the PRINT KEY.

The system programmer must generate support for the ISSUE PRINT command and the PA key facility, as described in "Printing Displayed Data" on page 44.

The PRINT key is a hardware facility entirely local to the terminal. It should be used wherever possible in preference to the PA key facility, because it does not involve transmissions to and from the host, and because it does not cause extended attributes to be lost.

If the BMS page retrieval command is used to display the screen data, the displayed data can be copied to another terminal (normally a printer) by a BMS page copy command. This is described in the *CICS/DOS/VS CICS-Supplied Transactions* manual. This form of copy removes field and character attributes not supported by the target terminal. If the target terminal is of a different type, or has a different width than the source terminal, the data is reformatted and all field and character attributes are lost during the copy.

Attribute Suppression

If the ISSUE PRINT command or PA print key is used, then any 3270 attribute characters in the display unit buffer are copied into the printer's buffer. They are printed as spaces. If the attribute character specifies a nondisplay/nonprint field, the field is printed as spaces. An attribute character may be interpreted in base color mode by a color printer. Otherwise, the attribute character has no effect on how the data is printed.

If the display unit supports the 3270 data stream extensions, including the color, PS, or extended highlighting attributes, and if CICS has to read from the display unit in order to write to the printer, then these attributes will be lost. This means that the printed output will be in monochrome, and all characters will be taken from the basic character set. It is recommended that only the local copy facility or the 3270 copy command implementation of the CICS print request facility be used for these display units.

Programmed Symbols

If the copied displayed data contains programmed symbols, it is the user's responsibility to ensure that the same programmed symbols are loaded onto the target printer. Loading programmed symbols is further discussed in Appendix C, "Loading Programmed Symbols" on page 99.

Sharing a Display

BMS provides a way of coordinating shared use of a display by BMS and another screen-managing program, such as the IBM licensed program Graphical Data Display Manager (GDDM). This is described in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

Resetting Terminal States

Cleared and Unformatted Screens

If the terminal operator hits the CLEAR key, all character positions in the display unit's buffer are set to nulls. A previously-formatted screen thus becomes unformatted. Similarly, the screen is unformatted immediately after it is powered on. Both actions also reset a display unit operating with an alternate screen size to the default size; this is discussed in "Setting Buffer Size" on page 65.

If the display unit is partitioned, the CLEAR key destroys all the partitions, and sets the terminal to base state. The next BMS output request will re-create the partitions (but not restore their contents), using the application partition set.

The CLEAR PARTITION key on a partitioned display clears only the active partition. It has no effect on other partitions, and is ignored if the terminal is in base state.

An application program can detect the use of the CLEAR and the CLEAR PARTITION keys in the same way as any other key. A CLEAR or CLEAR PARTITION received between transactions is ignored, and the terminal keyboard is unlocked.

The MAPFAIL condition is raised if the BMS RECEIVE MAP command receives data from an unformatted screen. The condition can be trapped by a previously-executed HANDLE CONDITION MAPFAIL command; otherwise, the program will terminate abnormally.

Setting Buffer Size

Some models of display unit and printer can operate with two buffer sizes, default, and alternate. The application can determine the size to be used. The terminal operator can reset an alternate mode terminal to default mode by hitting the CLEAR, TEST, or (for SNA terminals only) the SYS REQ key, or by switching the power off.

A CICS transaction runs in one mode only: it uses either the default size or the alternate size, depending on the specification in the SCRNSZE operand of its DFHPCT TYPE=ENTRY macro. CICS generates a data stream that sets the mode of the terminal whenever the application program executes an output command with the ERASE option.

If a transaction is to be used with dual mode display units or printers, then to ensure that the device is set to the correct mode, the first output command issued by the first program of the transaction should always have the ERASE option. This is necessary even if it is known that the transaction will use only the default mode, because a previous transaction may have set the device to alternate mode.

If CLEAR is hit during execution of a transaction, CICS detects the action, and if the alternate screen size is in use, switches the mode back to alternate in the next output message.

Inbound Reply Mode

An application reading from a terminal that supports structured fields may require that the terminal is set to a particular inbound reply mode, for example to receive character attribute input. The mode can be set by a Set Inbound Reply Mode structured field.

The reply modes that can be set are Field, Extended Field, and Character. Further information is given in "Chapter 6. 3270 Data Streams Used by CICS" on page 67, and in the device's related publication – see "Books from Related Libraries" on page vi.

BMS requires an inbound reply mode of Field. The application program should not execute a BMS RECEIVE command with the terminal set to any other mode.

A terminal will be reset to its default state, in which the inbound reply mode is Field, when the operator hits the CLEAR key, or when the terminal is powered on.

The WCC Reset Bit

The hex 40 bit of the write control character (WCC) is the reset bit. When this is sent to a terminal by a SEND or CONVERSE command specifying the ERASE option and omitting the STRFIELD option, the terminal state is reset. All partitions are destroyed, and the inbound reply mode is set to Field. CICS usually sets the reset bit on, so a SEND or CONVERSE command executed at the start of a transaction can be used to reset the terminal. This action can be overridden by specifying a WCC with the reset bit off in the CTLCHAR option of either the SEND or CONVERSE command.

Chapter 6. 3270 Data Streams Used by CICS

How CICS Communicates with the Terminal

When an application program executes an output command, CICS creates a message for the terminal in a buffer. To transmit this message, CICS passes the buffer to the access method, together with control information, such as the identification of the terminal for which the message is intended.

The message created in the buffer contains any data to be displayed or printed, together with commands and other special codes for use by the terminal. To the access method, however, the message is simply data; the commands and codes are not interpreted until they are received by the terminal.

On input, the access method passes to CICS a buffer containing data and special codes from the terminal, together with control information such as its origin.

This chapter describes the contents of the buffers, otherwise known as the **data stream**. The interface between CICS and the access method is internal to CICS, and is not described in this manual.

This chapter only discusses the terminal control interface. Users of this interface must fully understand the 3270 data stream. Users of the BMS interface need not be concerned with the details of the 3270 data stream.

Display Output Facilities

Writing to the Display

CICS normally uses four types of 3270 output command to transmit data to display units: Write, Erase/Write, Erase/Write Alternate, and Write structured field. They are generated in response to SEND or CONVERSE commands in the application program. If the STRFIELD option is omitted, the 3270 output command codes are generated as described in Figure 19 on page 68. If the STRFIELD option is specified, the 3270 command code is always Write structured field.

SCRNSZE Definition in PCT	ERASE Option on SEND or CONVERSE Command	
	Yes	No
DEFAULT	Erase/Write	Write
ALTERNATE	Erase/Write Alternate	Write

Figure 19. 3270 Display Output Commands used by CICS

The first byte following the command in a data stream that does not include structured fields, must be a write control character (WCC). This defines ancillary write operations for a display device, such as whether the alarm is to be sounded. Users of the CICS terminal control interface can specify a WCC in the CTLCHAR option of the SEND or CONVERSE command.

An example of an Outbound 3270 data stream is shown in Figure 20 on page 70. SBA and SF are 3270 orders.

In a CICS terminal control application program, the entire content of the data stream except the 3270 output command and the write control character must be placed by the program in the data area specified in the FROM option of the SEND or CONVERSE command.

CICS sometimes generates other command codes. The ISSUE ERASEAUP command simply generates a 3270 Erase All Unprotected command. The ERASEAUP option on BMS SEND commands generates a 3270 Erase Unprotected to Address order (EUA). The ISSUE PRINT and ISSUE COPY commands generate the data stream to cause these functions.

3270 Orders

The data stream sent to a terminal with one of the output commands may contain orders, as well as the command and data. Orders control the way in which data is written into the control unit buffer. Examples are the Start Field (SF) order, which indicates that the next byte in the data stream is an attribute byte, the Set Buffer Address (SBA) order, which indicates from which buffer address a write operation is to start or continue, and the Insert Cursor (IC) order, which repositions the cursor.

A program that uses the terminal control interface must insert any necessary orders into the data stream to be transmitted to the terminal.

The orders are described in full in the device's related publication – see "Books from Related Libraries" on page vi. Some of the more important orders are outlined in the next section.

Buffer Addresses

Data is placed in the terminal's buffers in consecutive character positions, unless an SBA or Repeat to Address (RA), or an EAU order is encountered in the terminal's data stream.

The SBA order is followed by a two-byte buffer address, and ensures that the following data is positioned starting at this address. The RA order is followed by a two-byte buffer

address, and the one-byte character to be repeated. It copies the specified character into the terminal's buffer, until the specified address is reached. The EUA order is followed by a two-byte buffer address. It places nulls in all unprotected characters between the current buffer address and the stop address.

Three types of buffer address are available:

- 12-bit addresses. These are supported by all 3270 terminals. The 12 address bits permit buffer addresses up to 4095. The 12 address bits are transmitted to and received from the terminal as two printable characters. CICS application programs which use the terminal control interface must be able to convert between the 12 address bits and the corresponding two-byte printable character form.

  Converting a two-byte character address into a 12-bit address is straightforward. The hex 80 and hex 40 bits are removed from each character, and the bottom six bits of the first character are shifted to be contiguous with the bottom six bits of the second character.

  Converting a 12-bit address into a two-byte character address is more difficult. One technique is to shift the bottom six bits of the 12-bit address into the bottom six bits of the second character, and the top six bits of the 12-bit address into the bottom six bits of the first character. The top two bits of each character can then be added by a table look up. The device's related publications (see "Books from Related Libraries" on page vi) contain tables showing how two-character screen addresses are related to the corresponding screen positions.

- 14-bit addresses. These are supported by all 3270 terminals which support extended features such as extended highlighting. A 14-bit address is simply a two-byte binary address with the top two bits of the first address byte always zero. It can thus always be distinguished from a 12-bit address.

  A terminal which accepts 14-bit buffer addresses will only transmit 14-bit addresses to CICS if the buffer size is larger than 4095 characters.

- 16-bit addresses. These are only supported in conjunction with partitions. When a partition is created by a Create Partition structured field, the buffer address mode may be set to 12/14 bit, or 16 bit. A 16-bit address is simply a two-byte binary address, and thus cannot always be distinguished from a 12-bit address.

Attributes and Fields

The attributes are controlled from the host by means of 3270 orders in the output data stream. The orders are SF (Start Field), SFE (Start Field Extended), and MF (Modify Field) for field attributes; and SA (Set Attribute) for character attributes. All models of 3270 control and display unit implement the SF order and its corresponding attributes, but only certain models implement the SFE, MF, and SA orders and their attributes. The four orders and sets of attributes are described separately.

SF Order and Attributes

The SF order is followed in the data stream by a one-byte attribute control code which in turn is optionally followed by data. An example is shown in Figure 20. The attribute control codes are stored in the 3270 display buffer with the data. The attribute bytes are displayed as spaces and are protected from overtyping. Adjacent fields are therefore separated on the screen by single protected spaces.

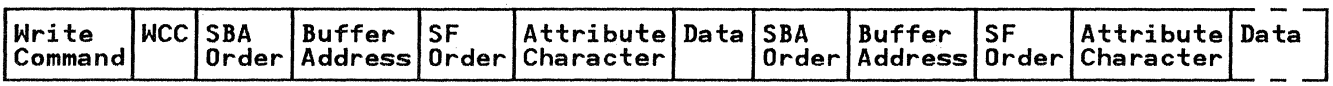

Figure 20. Example of 3270 Output Data Stream

The characteristics that an SF attribute byte can specify for a field are:

- Whether it is displayable
- Whether it is unprotected or protected (that is, whether or not a terminal operator can enter keyboard characters into it)
- Whether the keyboard is set to numeric shift when data is entered into it
- Whether it is to be highlighted by displaying at high intensity
- Whether it may be selected by a light pen
- Whether its first byte is a tab stop position.

A CICS application program that uses the terminal control interface and requires the screen to be formatted must insert the SF order and attribute control codes into the data stream.

Certain color displays can operate in base color mode, which means that they use the intensity and protection attributes to define the color of a field (see Figure 21). The CICS user sets these attributes in the same way as for monochrome displays.

Intensity	Protection	Color
On	On	White
On	Off	Red
Off	On	Blue
Off	Off	Green

Figure 21. Colors Displayed in Base Color Mode

If the terminal operator presses the CLEAR key, all the character positions in the 3270 buffer, including the attribute characters, are set to nulls. The screen will then be completely unformatted. Otherwise, the screen will remain in the same format until either one or more attribute bytes are overwritten by a Write command, or an Erase/Write (or Erase/Write Alternate) command is received.

SFE Order and Attributes

The SFE order allows a more complex attribute specification than the SF order. The data stream transmitted from the host is correspondingly more complicated. The SFE order is followed by a byte (the attribute count byte) that indicates the number of attributes to be specified, which in turn is followed by the attribute specifications. Each attribute is specified as a one-byte attribute type indicator followed by a one-byte attribute value (see Figure 22).

SFE Order	Att. Cnt.	Att. type	Att. value	Att. type	Att. value	Data

Figure 22. Data Stream Containing Start Field Extended Order

The extended attribute specification supports certain models of control and display station that have capabilities additional to those supported by the SF order. The additional capabilities are:

- Extended color. This means displaying in color using explicit color attributes.
- Programmed symbols (PS). This means that the display can use more than one character set, and the symbols displayed by some sets are defined by the user.
- Extended highlighting. This means that blinking, underscore, and reverse video can be used for highlighting, as well as high intensity.
- Validation. This means that the terminal operator must enter data into, and/or completely fill a field. In addition the field may be a trigger field, as described in "Trigger Fields" on page 15.

The SFE order may also be used to define the basic 3270 attribute of a field, as if it were an extended attribute.

The total number of bytes in the data stream between the SFE order and the first byte of data depends on the number of attributes specified. The basic attributes – that is, those specifiable with the SF order – are stored in the display unit buffer. The other attributes are stored elsewhere. When displayed, the fields are separated by single protected spaces, like fields defined with the SF order.

CICS applications that use the terminal control interface must insert the SFE order, the number byte, and the attribute specifications into the data stream.

MF Order and Attributes

The MF order allows modification of the attributes of a previously-defined field. The order is similar to the SFE order, described earlier in this chapter. The MF order can be used to modify a single attribute of a field. Thus the color of a field can be changed, and the other field attributes left unchanged.

CICS applications that use the terminal control interface must insert the MF order, the number byte, and the attribute specifications into the data stream. The MF order should be preceded by an SBA order that locates the field whose attributes are to be modified. If the address does not locate the start of field, the order is rejected by the device.

SA Order and Character Attributes

To define attributes on a character basis, an output command must be transmitted to the 3270, and the ensuing data stream must contain an SA order. The order is followed by a two-byte attribute specification. The attribute will be applied to all subsequent data characters in the outbound data stream until either a new SA order changes the attribute or another 3270 output command is transmitted. The attribute does not occupy space in the 3270 data buffer, and does not result in any spaces on the screen.

The extended color, programmed symbol, and extended highlighting attributes can be specified in the SA order.

CICS applications that use the terminal control interface must insert the SA order and the attribute specifications into the data stream.

Sending Structured Fields

Some models of control and display unit provide functions that require data in a special format, known as the structured field. Such data must be preceded in the data stream by a special command, Write Structured Field. The functions provided by structured fields include:

- Loading programmed symbols
- Querying the characteristics of the device
- Defining an alternate character set
- Setting the inbound reply mode, that is, defining the contents of any data streams transmitted from the device to the host
- Creating, destroying, and activating partitions
- Directing data to a specified partition
- Controlling a magnetic slot reader.

A structured field consists of a two-byte length field, a one-byte structured field type code, and a variable length field containing the structured field data. A typical data stream is shown in Figure 23.

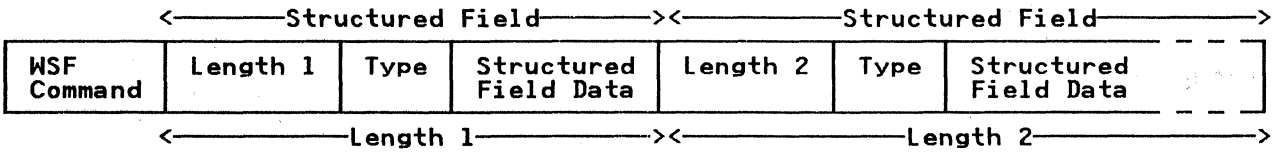

Figure 23. Example of Structured Field Data Stream

CICS application programs that require structured fields can use the terminal control interface. The entire contents of the structured field must be built by the program. The SEND or CONVERSE command used to transmit the field must specify the STRFIELD option. This causes CICS to generate a Write Structured Field command and insert it into the data stream.

Sending Data to a Partitioned Terminal

Partitions are created on an 8775 terminal by a terminal control application program using Create Partition structured fields. Part of the data in the Create Partition structured field is a one-byte partition identifier or PID. An application program can send data to a partition whose PID is zero, by using a normal SEND or CONVERSE command, as if the terminal were unpartitioned. Note, however, that if the ERASE option is specified, the WCC reset bit (see "The WCC Reset Bit" on page 65) should be set off, or all the partitions will be destroyed. An application program can send data to any other partition, by using an Outbound 3270 structured field; see Figure 24. This contains the PID of the target partition, together with the required output operation for this partition (Write or Erase/Write) and the WCC. An Outbound 3270 structured field can also be used to send data to a partition with a PID of zero.

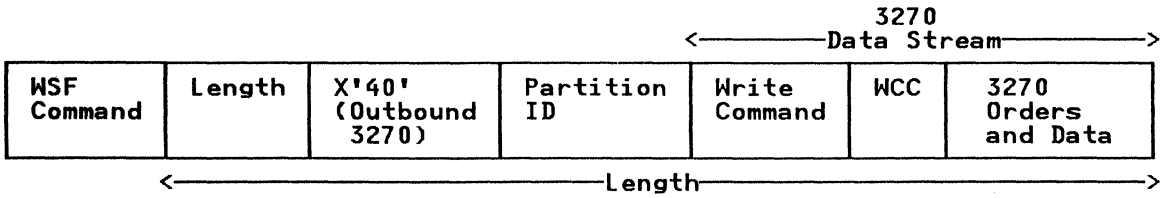

Figure 24. Example of an Outbound 3270 Structured Field Data Stream

Copying Between Buffers

An application program connected to a terminal via a BSC link can cause CICS to transmit a 3270 Copy command to the terminal. It does so by executing an ISSUE COPY command. The contents of a specified terminal buffer are transferred to the buffer of the terminal from which the transaction executing the ISSUE COPY was initiated. The copy control character (CCC), which identifies the type of copy operation to be performed, must be sent with the Copy command. It is specified in the application program by means of the CTLCHAR operand of the ISSUE COPY command.

The 3270 Copy command is not supported by SNA terminals.

Some 3270 devices support the Local Copy function, which allows copying from a display unit to a printer without the intervention of CICS. Although CICS is not involved in these copy operations, it can be used to load the control unit with a printer authorization matrix, which controls certain aspects of the print operation. Further information is given in Appendix B, "Printer Authorization Matrix" on page 97.

Compressing an Output Data Stream

CICS transmits all characters, including blanks, in output data streams. The performance of some data communication programs can be improved by removing long strings of padding characters, and replacing them with compact instructions to repeat a single character many times. How this compression should be done depends upon the nature of the data stream. CICS therefore provides a user exit (XZCOUT1 for VTAM, XTCOUT for BTAM) that can drive a user-data handling program. This makes it possible to design the optimum handling routine for programs in the installation.

The ENABLE command is used to enable, activate, and start a user exit. The command is described in the *CICS/DOS/VS Customization Guide.*

A program must be written to handle the exit. The following rules should be observed when writing such a program.

- Data that precedes the first 3270 order cannot be compressed by using the Repeat-to-Address during a WRITE, because the data address depends upon the cursor position, which is difficult to determine.
- Control characters, form control characters, and structured field data should not be reduced.

Invalid Data Streams

CICS does not check that data streams sent to a 3270 or 8775 terminal will be acceptable. A terminal control application program can include invalid orders and codes in the data stream it constructs. An application program can include invalid attribute values, and code invalid data characters in the symbolic description map's data structure. Furthermore, BMS may generate an unacceptable data stream if the terminal characteristics defined in the terminal control table do not match the actual terminal capabilities.

Most 3270 terminals detect invalid data streams. BSC terminals respond with error information, and SNA terminals respond with sense codes. Such errors are detected by CICS terminal control and normally terminate the transaction with an ATNI abend. However, the system programmer can define a terminal error program (TEP) for BTAM terminals and a node error program (NEP) for VTAM terminals, to intercept terminal errors. TEPs and NEPs are discussed in the *CICS/DOS/VS Customization Guide.*

Display Input Facilities

Data is normally transmitted from a 3270 terminal as a result of a poll operation conducted by the communications controller. This causes a Read Modified operation to be performed by the 3270.

CICS issues an explicit Read Buffer command when an application issues a receive command with the BUFFER OPTION. Read Buffer transmits the contents of the 3270 buffer at the time the command is received.

If the screen is not formatted into fields, the Read Modified operation causes transmission of all data in the buffer, except that null characters are suppressed. If the screen is formatted, it causes transmission of data relating to those fields that have their modified data tags (MDTs) set on, and suppresses null characters.

The MDT is a bit in the field attribute byte. If a field is modified by the terminal operator, or selected with a selector light pen or with the CURSR SEL key, this bit is turned on. Alternatively, the application program may set the MDT on before it transmits the output to the 3270, and thus cause data relating to that field to be transmitted in any subsequent Read Modified operation, whether or not it was modified by the terminal operator.

If no transaction is interacting with a terminal, then the data received as a result of the poll operation may contain the identifier of the transaction that the terminal operator wishes to use. The identifier consists of one to four characters typed by the operator as the first data on the screen. The identifier is associated with a particular program by the system programmer, who specifies it in the TRANSID operand of the transaction's DFHPCT TYPE=ENTRY macro.

If the terminal is not ready to send when the poll operation is received, no data transmission takes place. A terminal is set into a ready to send state by one of a number of operator actions. These actions are:

- Pressing one of the following keys: ENTER, CLEAR, CLEAR PARTITION, CNCL, any PA key, any PF key.
- Using the selector light pen on an attention selector light pen field, or using the CURSR SEL key on such a field.
- Using the operator identification card reader.
- Using a magnetic slot reader or magnetic hand scanner.
- Moving the cursor out of a primed trigger field. A primed trigger field is one that has been modified by the terminal operator.

The 3270 indicates which operator action caused the transmission by means of the attention identifier code (AID) sent with the data. CICS removes this from the inbound data stream, and moves it unchanged into the exec interface block (EIB) field EIBAID.

In addition to the AID, the 3270 also sends the cursor position (unless the AID is a PA key, the CLEAR key, or the CLEAR PARTITION key). CICS removes this from the inbound data stream, converts it to a two-byte binary value, and moves it to the EIB field EIBCPOSN.

Using the ENTER key, a PF key, an operator identification card, a magnetic slot reader or scanner, causes the transmission of the AID, the cursor position, the addresses and data contents of all the fields that have their MDTs set on.

Using the CLEAR key, the CLEAR PARTITION key, the CNCL key, or one of the PA keys causes the AID only to be transmitted with no data, even if there are fields with their MDTs set on.

Moving the cursor out of a trigger field following a Read Modified causes the trigger AID cursor position and trigger field data to be transmitted. Other modified fields are not transmitted.

The result of using the selector light pen (or the CURSR SEL key) depends on the designator character chosen when the selected field was defined at the host. If a space or null was used, the transmission contains the AID, the cursor position and the addresses of all the fields that have their MDTs set on. If an ampersand was used, the transmission contains the AID, the cursor position, the addresses of all the fields with their MDTs set on, and the data contained in those fields. Designator characters can be defined either in the application program or by BMS map definition macros.

The data from the 3270 is passed to the CICS application program. In the case of a program that uses the terminal control interface, all the incoming data stream, apart from the AID and the cursor position, is placed in the data area specified in the INTO operand of the RECEIVE or CONVERSE command. Any interpretation of the data stream as fields must be carried out by the application program.

Inbound Reply Mode

For terminals that support structured fields, the data stream transmitted by the terminal can take one of three forms. The form can be selected by the application program using a Set Inbound Reply Mode structured field. The three possible modes are field mode, extended field mode, and character mode. BMS requires that the inbound reply mode is always Field. Terminals that do not support structured fields operate in field mode only. Figure 25 and Figure 26 show typical Field mode data streams transmitted by the 3270. An Extended Field mode data stream may contain SFE orders and attributes, in addition to those items shown in the diagrams. A Character mode data stream may contain character attributes, in addition to those items that may be present in an Extended Field mode data stream.

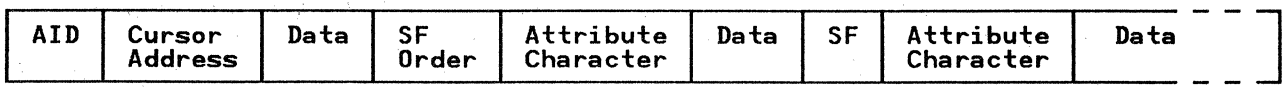

Figure 25. Example of 3270 Read Buffer Data Stream

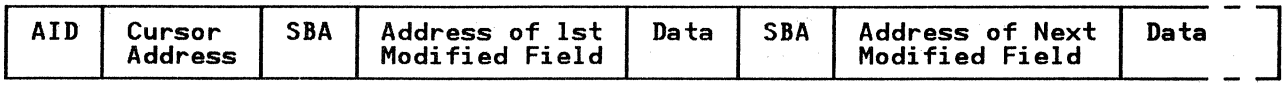

Figure 26. Example of 3270 Read Modified Data Stream

Receiving Data from a Partitioned Terminal

If the terminal operator takes one of the above actions while the terminal is partitioned, the inbound data stream depends on which partition was active, that is, which partition contained the cursor. If the partition identifier (PID) of the active partition is zero, the data stream sent to the host is the same as that sent by an unpartitioned terminal. If the PID of the active partition is non-zero, the data stream sent to the host is an Inbound 3270 structured field; see Figure 27. The structured field data includes the PID of the active partition, the AID, and the cursor position. As the AID and cursor position are part of the structured field data, CICS terminal control does not remove them from the data stream and place them in the exec interface block. The PID of a partition is set by the Create Partition structured field that created it.

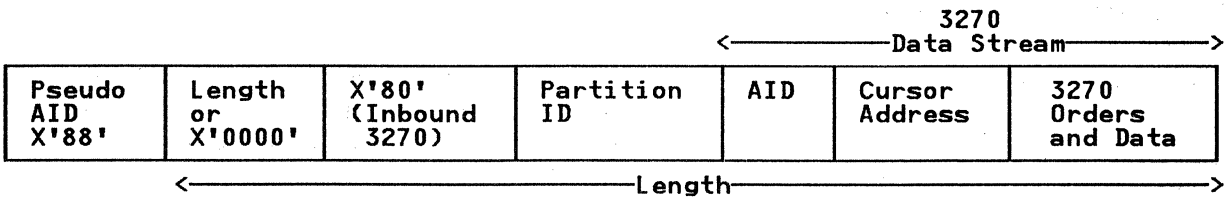

Figure 27. Example of an Inbound 3270 Structured Field Data Stream

Receiving Structured Fields

A 3270 or 8775 terminal may send structured fields to the host in response to a Read Partition SF. Normally it would be an Inbound 3270 structured field containing data from a partition whose partition identifier (PID) is non-zero. If the read partition SF is a query, a query reply SF will be returned.

The first byte of an inbound structured field is a pseudo-AID of hex 88. This identifies the following data as an Inbound structured field. CICS terminal control removes this pseudo-AID from the inbound data stream, and moves it to the EIB field EIBAID. The remainder of the Inbound structured field is passed unchanged to the application program.

Printer Facilities

CICS transmits data to printers in the same way as to display terminals, using Write, Erase/Write, Erase/Write Alternate or Write Structured Field commands. Write is used whenever a program issues a SEND command without the ERASE or STRFIELD options. Erase/Write and Erase/Write alternate are used for SEND ERASE and CONVERSE ERASE commands issued by programs that are defined as using the default and the alternate buffer sizes, respectively. Write Structured Field is used for SEND and CONVERSE commands specifying the STRFIELD option.

Printer data streams contain write control characters and may contain orders, exactly as for displays. As with displays, the WCC is inserted into the data stream by CICS, and orders are provided by the terminal control application program.

The WCC for a printer is different from that for a display unit. In particular it contains printer format bits specifying the required printer line width (40, 64, or 80 characters, or the device maximum width), and a start print bit indicating that the printer buffer is to be printed. These bits are further discussed in "Printer Data Streams" on page 78.

Certain models of 3270 control unit need to be loaded with a printer authorization matrix to control the use, in local copy operations, of printers attached to the control unit. The matrix may be transmitted from the host using a CICS transaction. Further information is given in Appendix B, "Printer Authorization Matrix" on page 97.

Some printers support structured fields. Thus a CICS application program can load programmed symbols onto the printer, or query the printer characteristics. If a printer is queried, it sends a Query Reply structured field to CICS, and must therefore be defined with a status of TRANSCEIVE in the terminal control table (see "Terminal Status" on page 38 for further information).

SNA Character String (SCS) Printers

Certain models of 3270 printer support SNA character string (SCS) output. The data transmitted to the printer must then contain SCS control codes, instead of 3270 orders. They perform similar functions to 3270 orders, in that they allow the output to be formatted, but the range of control is greater.

SCS control codes must be inserted into the data stream terminal control application programs.

SCS printers can transmit input, as well as receive output. It is transmitted when the operator presses the PA1 or PA2 key following receipt of a Read Modified command. It takes the form of the character string "APAK 01" or "APAK 02" and an attention identifier. If there is no read outstanding, the terminal will transmit a signal command, which will raise the SIGNAL condition in the CICS application program. This can happen if a transaction is issuing a series of SEND commands when the PA key is hit.

This input can be used by CICS programs in the same way as any other. A typical way of using it is to define "APAK" as the identifier of a transaction that sets the horizontal and vertical formatting controls of the printer. The definition is made in the TRANSID operand of the DFHPCT TYPE=ENTRY macro, in the same way as for any other character-string transaction identifier. Since they can send input to CICS, these printers must be defined with a status of TRANSCEIVE in the terminal control table; see "Terminal Status" on page 38 for further information.

It is possible to use a SEND or CONVERSE command specifying the STRFIELD option in conjunction with SCS printers. The SEND STRFIELD command may be used to load programmed symbols. The CONVERSE STRFIELD command may be used to query the printer characteristics. SCS printers do not support the Write Structured Field Output command. Instead, a format management header (FMH) is used to indicate that the following data contains structured fields. CICS terminal control builds this FMH for a SEND or CONVERSE command specifying the STRFIELD option. Similarly CICS terminal control removes the FMH from an Inbound structured field from an SCS printer.

Printer Data Streams

For non-SCS printers, the output data stream may contain orders, of two types: buffer control orders, like set buffer address (SBA), and print format orders, like new line (NL) and form feed (FF).

Buffer control orders apply to the buffers of both display units and printers. They are executed as they are received by the control unit, and control the way in which the buffer is filled.

Print format orders are not executed when they are received, but are stored in the buffer along with the data. They are executed only during the print operation. They control the way that the data appears on the hard copy.

The output command to non-SCS printers is always followed by a write control character. This contains two flags that control printing; the start printer bit and the print format bits. When the start printer bit is set off, the buffer is filled with the incoming data, according to the buffer control orders, but no printing is carried out. When it is set on, the buffer is first filled, then printing is started. At this stage the print format orders are executed.

The print format bits are concerned with the length of the print line. They specify either that lines are to be ended by NL, end of message (EM) or carrier return (CR) print format orders in the data stream, (subject to the maximum line length of the printer), or that the length is always to be 40, 64 or 80 characters, in which case any NL, CR and EM orders are printed as graphic characters. The bits are set by the CTLCHAR option the terminal control SEND command.

If printer data is formatted using SBA orders, the application program should be aware that 3270 printers suppress null lines. This is discussed in the *CICS/DOS/VS Application Programmer's Reference Manual (Command Level)*.

The data stream to SCS printers does not contain a WCC or orders, only data and SCS control codes. The codes allow the printed page to be formatted, and include, for example, NL, SHF (set horizontal format), and HT (horizontal tab). Each output message is printed when it is received, and the data stream must contain data and control codes in the order in which they are to be interpreted. This contrasts with non-SCS printers, where the buffer locations may be filled in any order using the SBA order, and printing may be postponed until a SEND command using the WCC start print bit is encountered.

Chapter 7. Systems Network Architecture

CICS supports SNA 3270 terminals as secondary logical units (SLUs) in the SNA network. The supported types of logical units (LUs) are:

- LU Type 0 – a set of implementation-defined protocols applicable to SDLC versions of the 3271 and 3275 control units. CICS uses the VTAM record mode interface with LOGMODE = IBMS3270 to support these devices. These are not considered further in this chapter.
- LU Type 1 – printers using the SCS data stream are specified as TRMTYPE = SCSPRT in the DFHTCT macro.
- LU Type 2 – displays using the 3270 data stream are specified as TRMTYPE = LUTYPE2 in the DFHTCT macro.
- LU Type 3 – printers using the 3270 data stream are specified as TRMTYPE = LUTYPE3 in the DFHTCT macro.

Descriptions of the logical units and the protocols they use are given in the SNA publications *Concepts and Products* and *Sessions Between Logical Units.*

Control of the Session

The Bind Command

Many aspects of the session between CICS and a logical unit are determined by the parameters of the SNA bind command sent by CICS to the logical unit when the session is opened. The formats of the bind commands used by CICS when opening sessions are given in Appendix A, "Bind Formats" on page 85. The parameter values may be influenced by the CICS system programmer in several ways.

The system programmer can control the maximum request unit (RU) sizes for messages to and from the logical unit by means of operands of the the DFHTCT TYPE = TERMINAL macro. The maximum outbound RU size is defined by the BUFFER operand, and the maximum inbound size by the RUSIZE operand. Information about the maximum sizes that the 3270 system can handle is given in the device's related publication – see "Books from Related Libraries" on page vi.

LU Type 1

The bind image provided by CICS includes the mandatory functions of LU Type 1. The system programmer can use other functions by selecting a suitable LOGON mode from the VTAM logon mode table, by means of the LOGMODE operand of the DFHTCT TYPE=TERMINAL macro.

LU Type 2 and LU Type 3

The screen or buffer sizes for the bind are taken by CICS from the DEFSCRN and ALTSCRN operands of the DFHTCT TYPE=TERMINAL macro or from the TRMMODL operand; see "Chapter 4. System Programming" on page 21.

Chaining

RU chaining is used for all transmissions between CICS and the logical unit. As described in the previous section, the RU size can be controlled by the system programmer using the BUFFER and RUSIZE operands of the DFHTCT TYPE=TERMINAL macro.

CHNASSY=YES may be specified on the DFHTCT TYPE=TERMINAL macro. It is defaulted for the 3270. It causes CICS to assemble inbound RUs into chains, and return the complete chain in response to a RECEIVE command.

On output, CICS will split messages into RUs of the length specified in the BUFFER operand. If the application wishes to control outbound chaining for SCS printers, MSGPREQ=CCONTRL is specified in the DFHPCT TYPE=ENTRY macro for the transaction.

Response Protocols

The BIND command that CICS sends to the logical unit specifies that both definite and exception responses are permitted. CICS always requests definite responses for SNA commands (such as BIND). It requests exception responses for all other transmissions (such as normal data flows), unless one or more of the following applies.

- The message integrity option (that is, the MSGINTEG operand of the DFHPCT TYPE=ENTRY macro) is specified for the transaction.
- The application program specifies the DEFRESP option on a SEND or CONVERSE command.
- The Start Print bit in the WCC is on (for LU Type 2 and LU Type 3 terminals only, that is, 3270 display units and printers).

Definite responses have the advantage of allowing increased system integrity, but the disadvantage of increasing the amount of traffic over the communication line. In the case of the MSGINTEG facility, particularly, there is a considerable performance cost, and the option should not be specified unless there is good reason to require that the application program synchronizes with the device.

SNA Signal Command

The LU Type 2 logical unit (3270 display unit) will send a signal command to CICS when the ATTN key is pressed. The LU Type 1 logical unit (SCS printer) will send a Signal command when a PA key is pressed.

The CICS application program can detect the inbound signal by means of the HANDLE CONDITION SIGNAL command. This command must have been executed before the signal arrives, and it must specify a label to which control is to be passed if it does arrive. The SIGNAL condition will be raised in the program on execution of the first SEND, CONVERSE or RECEIVE command following receipt of the SNA signal. Control is then passed to the specified label.

If it is required that the SIGNAL condition is raised as soon as the SNA signal is received, the program must execute a WAIT SIGNAL command, but no processing will take place until it does.

Indicators

CICS provides some application programming aids to efficient use of the session. It allows the program to generate CD (change direction) and EB (end bracket) indicators, using the INVITE and LAST options of the SEND command. Further information is given under "Writing to the Terminal (SEND Command)" on page 49.

Appendix A. Bind Formats

The record format that accompanies the Bind command transmitted by VTAM to a 3270 is supplied by CICS in a bind area addressed from the node initialization block (NIB). CICS generates the record from operands of the TCTTE macro, unless the LOGMODE operand is specified, when the VTAM logmode table is used. This appendix lists typical formats and parameter values for the four types of logical unit supported in this way.

The bind images for LU Types 1, 2, and 3 are built dynamically by CICS prior to opening the session. At this time, parameter values may be added to these basic bind images, based on information obtained from the terminal control table. This allows the system programmer to influence the bind image. Detailed information is given in "Chapter 7. Systems Network Architecture" on page 81.

BYTE	VALUE	MEANING
0	X'31'	BIND Request Code
1	0000.... 0001	Bind Format 0 Bind Type 1 (cold)
2	X'02'	FM Profile 2 (LU-LU)
3	X'02'	TS Profile 2 (LU-LU)
4	0....... .1...... ..11.... ....00.. ......0. 1	Primary LU Protocol No Chaining Delayed Request Mode Definite/Exception Response No Compression Primary may send EB
5	0....... .1...... ..00.... ....00.. ......0. 0	Secondary LU Protocol No Chaining Delayed Request Mode No Response No Compression Secondary may not send EB
6	0....... .0...... ..1..... ...0.... ....0... ....1... 000	Common Protocol No FMHs allowed Bracket Protocol Used Bracket Termination Rule 2 Alternate Code not Allowed Alternate Code Allowed (ASCII-8)
7	10...... ..0..... ...0.... ....01.. ......0. 0	Common Protocol Half Duplex Flip/Flop PLU has Recovery Responsibility SLU is First Speaker ASCII-8 (Note 2) SLU is Contention Winner
8	00...... ..xxxxxx	SLU Send Pacing Count (Note 1)
9	00...... ..xxxxxx	SLU Receive Pacing Count (Note 1)

Figure 28 (Part 1 of 2). Bind Format for LU Type 0 BRACKET=YES

BYTE	VALUE	MEANING
10	X'85'	SLU to PLU RU Size 256 bytes
11	X'85'	PLU to SLU RU Size 256 bytes
12	00..... ..xxxxxx	PLU CPMGR Send Pacing Count (Note 1)
13	00..... ..xxxxxx	PLU CPMGR Receive Pacing Count (Note 1)
14	0..... .0000000	LU Type 0

Notes:

1. *Supplied by VTAM.*
2. *When byte 6 = ...1...*

Figure 28 (Part 2 of 2). Bind Format for LU Type 0 BRACKET=YES

BYTE	VALUE	MEANING
0	X'31'	BIND Request Code
1	0000.... 0001	Bind Format 0 Bind Type 1 (cold)
2	X'02'	FM Profile 2 (LU-LU)
3	X'02'	TS Profile 2 (LU-LU)
4	0....... .1...... ..11.... ....00.. ......0. 0	Primary LU Protocol (Note 3) No Chaining Delayed Request Mode Definite/Exception Response No Compression Primary may not send EB
5	0....... .1...... ..00.... ....00.. ......0. 0	Secondary LU Protocol No Chaining Delayed Request Mode No Response No Compression Secondary may not send EB
6	0....... .0...... ..0..... ...0.... ....0... ....1... 000	Common Protocol (Note 4) No FMHs Allowed No brackets Alternate Code not Allowed Alternate Code Allowed (ASCII-8)
7	10...... ..0..... ...0.... ....01.. ......0. 0	Common Protocol Half Duplex Flip/Flop PLU has Recovery Responsibility SLU is First Speaker ASCII-8 (Note 2) SLU is Contention Winner
8	00...... ..xxxxxx	SLU Send Pacing Count (Note 1)
9	00...... ..xxxxxx	SLU Receive Pacing Count (Note 1)

Figure 29 (Part 1 of 2). Bind Format for LU Type 0 BRACKET=NO

BYTE	VALUE	MEANING
10	X'85'	SLU to PLU RU Size 256 bytes
11	X'85'	PLU to SLU RU Size 256 bytes
12	00..... ..xxxxxx	PLU CPMGR Send Pacing Count (Note 1)
13	00..... ..xxxxxx	PLU CPMGR Receive Pacing Count (Note 1)
14	0..... .0000000	LU Type 0

Notes:

1. *Supplied by VTAM.*
2. *When byte 6 = ...1...*
3. *Byte 4 was previously X'71'.*
4. *Byte 6 was previously X'20'.*

Figure 29 (Part 2 of 2). Bind Format for LU Type 0 BRACKET=NO

BYTE	VALUE	MEANING
0	X'31'	BIND Request Code
1	0000.... 0001	Bind Format 0 Bind Type 1 (cold)
2	X'03'	FM Profile 3 (LU-LU)
3	X'03'	TS Profile 3 (LU-LU)
4	1....... .0...... ..11.... ....00.. ......0. 1	Primary LU Protocol Multiple RU Chains Immediate Request Mode Definite/Exception Response No Compression Primary may send EB
5	1....... .0...... ..11.... ....00.. ......0. 0	Secondary LU Protocol Multiple RU Chains Immediate Request Mode Definite/Exception Response No Compression Secondary may not send EB
6	0....... .0...... ..1..... ...1.... ....0... ....1... 000	Common Protocol No FMHs Allowed Bracket Protocol Used Bracket Termination Rule 1 Alternate Code not Allowed Alternate Code Allowed (ASCII-8)
7	10...... ..0..... ...0.... ....01.. ......0. 0	Common Protocol Half Duplex Flip/Flop PLU has Recovery Responsibility SLU is First Speaker ASCII-8 (Note 2) SLU is Contention Winner
8	00...... ..xxxxxx	SLU Send Pacing Count (Note 1)
9	00...... ..xxxxxx	SLU Receive Pacing Count (Note 1)

Figure 30 (Part 1 of 2). Bind Format for LU Type 1 (SCS Printer)

BYTE	VALUE	MEANING
10	X'85'	SLU to PLU RU Size 256 bytes
11	X'85'	PLU to SLU RU Size 256 bytes
12	00..... ..xxxxxx	PLU CPMGR Send Pacing Count (Note 1)
13	00..... ..xxxxxx	PLU CPMGR Receive Pacing Count (Note 1)
14	0..... .0000001	LU Type 1

Notes:

1. *Supplied by VTAM.*
2. *When byte 6 = ...1...*

Figure 30 (Part 2 of 2). Bind Format for LU Type 1 (SCS Printer)

BYTE	VALUE	MEANING
0	X'31'	BIND Request Code
1	0000.... 0001	Bind Format 0 Bind Type 1 (cold)
2	X'03'	FM Profile 3 (LU-LU)
3	X'03'	TS Profile 3 (LU-LU)
4	1....... .0...... ..11.... ....00.. ......0. 1	Primary LU Protocol Multiple RU Chains Immediate Request Mode Definite/Exception Response No Compression Primary may send EB
5	1....... .0...... ..11.... ....00.. ......0. 0	Secondary LU Protocol Multiple RU Chains Immediate Request Mode Definite/Exception Response No Compression Secondary may not send EB
6	0....... .0...... ..1..... ...1.... ....0... ....1... 000	Common Protocol No FMHs Allowed Bracket Protocol Used Bracket Termination Rule 1 Alternate Code not Allowed Alternate Code Allowed (ASCII-7 or ASCII-8)
7	10...... ..0..... ...0.... ....00.. ....01.. ......0. 0	Common Protocol Half Duplex Flip/Flop PLU has Recovery Responsibility SLU is First Speaker ASCII-7 (Note 2) ASCII-8 (Note 2) SLU is Contention Winner
8	00...... ..xxxxxx	SLU Send Pacing Count (Note 1)
9	00...... ..xxxxxx	SLU Receive Pacing Count (Note 1)

Figure 31 (Part 1 of 2). Bind Format for LU Type 2 (3270 Display Unit)

BYTE	VALUE	Meaning
10	X'85'	SLU to PLU RU Size (Note 1) 256 bytes
11	X'85'	PLU to SLU RU Size (Note 1) 1536 bytes
12	00..... ..xxxxxx	PLU CPMGR Send Pacing Count (Note 1)
13	00..... ..xxxxxx	PLU CPMGR Receive Pacing Count (Note 1)
14	0..... .0000010	LU Type 2
15–23	XL9'00'	
24	X'00'	Base Level Bind – Screen Sizes not Specified

For extended data stream devices, byte 15 is X'80' and bytes 20 to 24 can be:

Byte 20	21	22	23	24	
00	00	00	00	01	Model 1
00	00	00	00	02	Model 2
00	00	00	00	03	Model 2 - alternate screen size to be defined by customer setup
a	b	c	d	7F	Default screen size: a rows by b columns alternate screen size: c rows by d columns

Notes:

1. *Supplied by VTAM.*
2. *When byte 6 = ...1...*

Figure 31 (Part 2 of 2). Bind Format for LU Type 2 (3270 Display Unit)

BYTE	VALUE	MEANING
0	X'31'	BIND Request Code
1	0000.... 0001	Bind Format 0 Bind Type 1 (cold)
2	X'03'	FM Profile 3 (LU-LU)
3	X'03'	TS Profile 3 (LU-LU)
4	 1..... .0.... ..11.... ....00.. .....0. 1	Primary LU Protocol Multiple RU Chains Immediate Request Mode Definite/Exception Response No Compression Primary may send EB
5	 1..... .0.... ..11.... ....00.. .....0. 0	Secondary LU Protocol Multiple RU Chains Immediate Request Mode Definite/Exception Response No Compression Secondary may not send EB
6	 0..... .0.... ..1.... ...1.... ....0... ....1... 000	Common Protocol No FMHs Allowed Bracket Protocol Used Bracket Termination Rule 1 Alternate Code not Allowed Alternate Code Allowed (ASCII-7 or ASCII-8)
7	 10.... ..0.... ...0.... ....00.. ....01.. .....0. 0	Common Protocol Half Duplex Flip/Flop PLU has Recovery Responsibility SLU is First Speaker ASCII-7 (Note 2) ASCII-8 (Note 2) SLU is Contention Winner
8	 00.... ..xxxxxx	 SLU Send Pacing Count (Note 1)
9	 00.... ..xxxxxx	 SLU Receive Pacing Count (Note 1)

Figure 32 (Part 1 of 2). Bind Format for LU Type 3 (3270 Printer)

BYTE	VALUE	Meaning
10	X'85'	SLU to PLU RU Size (Note 1) 256 bytes
11	X'85'	PLU to SLU RU Size (Note 1) 256 bytes
12	00..... ..xxxxxx	PLU CPMGR Send Pacing Count (Note 1)
13	00..... ..xxxxxx	PLU CPMGR Receive Pacing Count (Note 1)
14	0..... .0000011	LU Type 3
15–23	XL9'00'	
24	X'00'	Base Level Bind – Screen Sizes not Specified

For extended data stream devices, byte 15 is X'80' and bytes 20 to 24 can be:

Byte 20	21	22	23	24	
00	00	00	00	01	Model 1
00	00	00	00	02	Model 2
a	b	c	d	7F	Default screen size: a rows by b columns alternate screen size: c rows by d columns

Notes:

1. *Supplied by VTAM.*
2. *When byte 6 = ...1...*

Figure 32 (Part 2 of 2). Bind Format for LU Type 3 (3270 Printer)

Appendix B. Printer Authorization Matrix

Certain types of 3270 device support the Local Copy function. This allows the terminal operator to copy from a display unit to a printer, without involving the application. The device on which the output is printed and some aspects of its format are controlled by the printer authorization matrix, which is stored in the 3270 controller. Information on local copy operations and on the printer authorization matrix is given in the appropriate 3270 Information Display System manual.

Although CICS is not involved in Local Copy operations, a CICS application program may be used to load the printer authorization matrix. Details of how this may be done are given here.

Defining the Printer Authorization Matrix

Basic mapping support provides a convenient way of defining a printer authorization matrix. A typical map definition is shown in Figure 33 on page 98.

The first two rows of the map do not form part of the printer authorization matrix; they are used to present descriptive information to the display operator.

The third row of the map contains a sequential string of attribute characters that uniquely identifies the buffer data that follows as a printer authorization matrix. The required string of attribute characters is hex 60, hex C1, hex D4, hex 60. The first character, hex 60, is generated by specifying ATTRB=PROT in the DFHMDF macro; the remaining characters are specified in the XINIT operand. Note that each of these characters is preceded by the SF (start field) control character hex 1D to identify it as an attribute byte.

The fourth line of the map identifies a printer connected to address 03, operating in shared mode, and available for local copy operations initiated from the terminals with addresses 00, 01, and 02. Further printers may be defined as required on succeeding lines.

The final line of the map contains the string of attribute characters that identifies the end of the matrix.

```
*************************************************************************
PRAM     DFHMSD TYPE=MAP,                                               *
               MODE=INOUT,                                              *
               CTRL=(FREEKB,FRSET)
PRAM1    DFHMDI SIZE=(12,80)
         DFHMDF POS=(1,1),                                              *
               ATTRB=PROT,                                              *
               LENGTH=79,                                               *
               INITIAL='SCREEN IS FORMATTED TO LOAD PRINT AUTHORIZATION*
                MATRIX'
         DFHMDF POS=(2,1),                                              *
               ATTRB=PROT,                                              *
               LENGTH=79,                                               *
               INITIAL='HOLD DOWN ALT KEY AND PRESS EOF KEY'
         DFHMDF POS=(3,1),                                              *
               ATTRB=PROT,                                              *
               LENGTH=6,                                                *
               XINIT='1DC11DD41D60'
*        NEXT MACRO DEFINES PRINTER ON PORT 03
*        OPERATING IN SHARED MODE
*        NO DEVICE CLASSES ARE SPECIFIED
*        VALID SOURCE DEVICES ARE ON ADDRESSES 00, 01, AND 02
         DFHMDF POS=(4,1),                                              *
               ATTRB=PROT,                                              *
               LENGTH=51,                                               *
               INITIAL='03JXXXXXXXXXXXXXXX111YYYYYYYYYYYYYYYYYYYYYYYY*
               YYYY'
         DFHMDF POS=(5,1),                                              *
               ATTRB=PROT,                                              *
               LENGTH=6,                                                *
               XINIT='1DC51DD51DC4'
         DFHMSD TYPE=FINAL
*************************************************************************
```

Figure 33. Map Definition for Printer Authorization Matrix

Loading the Printer Authorization Matrix

The CICS user must write a transaction to transmit the printer authorization matrix to the controller. If a map such as that shown in Figure 33 is employed, it may be transmitted by a command of the form:

```
EXEC CICS SEND MAPSET('PRAM') MAP('PRAM1') MAPONLY ERASE
```

The transaction must be invoked from the terminal at port 0 of a controller. When the matrix is displayed, the terminal operator loads the matrix by holding down the ALT key and pressing the EOF key.

The display must be operating in 80-column mode to load the matrix. This corresponds to alternate screen-size mode for some models of display unit; the correct mode may thus be selected by coding SCRNSZE = ALTERNATE in the PCT entry for the matrix-load transaction. The ERASE option in the EXEC CICS SEND commands ensure that the display is set to the correct mode before the map is displayed.

Appendix C. Loading Programmed Symbols

Some models of display unit are supplied with special storage into which the user can load programmed symbols. This permits the definition of symbol sets which contain special characters, for example italic lettering, or Greek symbols. Up to six character sets may be defined, containing up to 191 characters each.

Although it is possible to load a symbol set from any application program, the user will probably wish to prohibit this, and will allocate programmed-symbols storage to installation standard symbol sets. The start-up procedure should therefore include execution of a transaction which loads as many as six symbol sets.

The data to be loaded is stored in Load PS structured fields. The user-written application program which loads the structured fields will use a SEND command of the following form:

```
EXEC CICS SEND FROM(data-area)
               LENGTH(data value)
               WAIT
               STRFIELD
```

FROM Indicates the name of the data area from which the symbol set is to be taken. Information on the format of this data area is given in the device's related publication – see the list of publications in the Preface of this book.

LENGTH Indicates the length of the data string containing the set of programmed symbols.

WAIT Indicates that the application must wait until the set of symbols has been loaded.

STRFIELD Indicates that the data is stored in the form of a structured field and that CICS is to use the Write Structured Field command to transmit the data.

Appendix D. Double-Byte Character Sets

Some models of display unit support double-byte character sets (DBCSs) that require each character to be represented in the data stream by two bytes of data.

Each displayable character is represented in the data stream by a bit pattern 16 bits long, and it occupies two bytes in the display unit buffer. It also occupies two cells on the screen.

The characters to be displayed are defined in programmed symbol set 8.

CICS allows the use of double-byte character data streams. The application program must create the required 16-bit codes in the output data areas. If the terminal control interface is used, the application must include in the output data stream an attribute specification selecting programmed symbol set 8.

BMS maps may be used to format the output data stream. Any initial data must be specified in hexadecimal using the XINIT operand of the DFHMDF macro. The required programmed symbol set must be specified by coding PS = 8 in this macro.

For a 3278 Model 52, the following restrictions apply:

- Each character must start on an even-numbered byte in the buffer, and an attribute byte must be in the odd-numbered position immediately preceding the first character in a field. The even-numbered byte preceding the attribute byte is unused. In application programs, the 16-bit codes in the output data areas must be aligned on even-numbered byte boundaries, counting the initial byte in the display buffer as zero.

- If an application program uses the Repeat to Address (RA) or Erase All Unprotected to Address (EAU) order, the end address for the operation must be an odd-numbered byte.

- For BMS maps, all fields must be written to even-numbered bytes of the terminal's buffer. This means that they must be on even-numbered bytes of the map if the map is to start on an even-numbered byte in the buffer, or an odd-numbered bytes of the map if it is to start on an odd-numbered byte.

Appendix E. ASCII Terminal Support for SNA

The systems network architecture (SNA) provides for the user data part of the request unit (RU) to be coded in ASCII. There are two forms of ASCII, a 7-bit form (ASCII-7), and an 8-bit form (ASCII-8). Either of these types can be specified within an SNA network to terminals containing the equivalent support.

The use of the ASCII option is determined at session initiation by BIND parameters set by CICS as a result of the value specified in the FEATURE parameter of the DFHTCT TYPE=TERMINAL macro. The SNA bind is described in Appendix A, "Bind Formats" on page 85.

Use of ASCII-7 is restricted to LU types 2 and 3 using basic 3270 data streams. That is, 3270 functions that use either extended attributes or structured fields cannot be used. Furthermore, ASCII-7 support is limited to devices attached to the following controllers:

- 3274 Models 1C and 51C
- 3276 Model 12.

The ASCII-7 support is available on 3274-1C as an option on the configuration of the standard microcode.

ASCII-8 can be used with 3270 SNA displays and printers using LU type 1, 2 or 3 protocols and using either basic or extended 3270 or SCS data streams. CICS support of ASCII-8 is available to all devices attached to CICS using SNA LU types 1, 2, or 3. However, only terminals that attach to a 3274, support ASCII-8.

The ASCII-8 support is available as a microcode RPQ on the 3274 and is mutually exclusive with the ASCII-7 option.

Any terminal configured with the ASCII-7 option will have all user data outbound from CICS converted to ASCII-7, and all user data inbound to CICS converted to EBCDIC. Only user data will be translated. This user data cannot include structured fields or extended attributes. All other data in the RU such as LU status or sense data will be assumed to be in EBCDIC on input and will be transmitted in EBCDIC on output.

Any terminal configured with the ASCII-8 option will have all user data outbound from CICS converted to ASCII-8, and all user data inbound to CICS converted to EBCDIC. This user data can include structured fields and extended attributes. Any other form of the RU such as LU status or sense data will be assumed to be in EBCDIC on input and will be transmitted in EBCDIC on output.

Note that ASCII support is intended only for devices that operate in EBCDIC but will translate the data stream to or from ASCII. This is because the data stream is treated as a character string and any binary number fields will be translated byte by byte as though they were graphic characters, thus they may not represent their true value while in ASCII form.

Appendix F. Keywords for Resource Definition Online

This appendix contains information on keywords of the DEFINE TYPETERM command for dynamically defining devices with the resource definition online (RDO) transaction CEDA. For more information see the *CICS/DOS/VS Resource Definition (Online)* manual.

Most of the keywords of DEFINE TYPETERM are dependent on the combination of DEVICE and SESSIONTYPE keywords. The following table shows the required and optional keywords as follows:

A - means accepted.

AW - means accepted but a warning message is issued.

R - means required and assumed if not specified or invalid.

Blank - means not accepted. CEDA will diagnose all cases.

DEVICE ..... SESSIONTYPE ... ***..... ...***..... .....***..... .....***... PARAMETER .***	3 2 7 03 2 7 5	3 2 7 0 P	LUTYPE2	LUTYPE3	SCSPRT	LUTYPE4	
TERMMODEL.....	R	R	R	R			See Note 1
DEFSCREEN.....	A	A	A	A			See Note 2
ALTSCREEN	A	A	A	A			See Note 2
PAGESIZE	A	A	A	A	A	A	See Note 3
ALTPAGE	A	A	A	A			See Note 2
PAGE/DEFSCREEN .	xx	xx	xx	xx	24	50	See Note 3
SIZE default ...	xx	xx	xx	xx	80	80	See Note 3
AUTOPAGE No	A	AW	A	AW	A	A	See Note 4
AUTOPAGE Yes ...	A	A	A	A	A	A	See Note 4
APLKYBD Yes	A	A	A	A	A	A	
APLTEXT Yes	A	A	A	A	A	A	
AUDIBLEALARM Yes	A	A	A	A			
COLOR Yes	A	A	A	A	A		
COPY Yes	A	A					
DUALCASEKYBD Yes	A	A	A	A			
EXTENDEDDS Yes .	A	A	A	A	A		See Note 5
HILIGHT Yes	A	A	A	A	A		
KATAKANA Yes ...	A	A	A	A	A	A	
LIGHTPEN Yes ...	A	A	A	A			
MSRCONTROL Yes .	A	A	A	A			
UCTRAN Yes	A	A	A	A	A	A	
PARTITIONS Yes .	A	A	A	A			
PRINTADAPTER Yes	A	A	A	A			
PROGSYMBOLS Yes	A	A	A	A	A		
VALIDATION Yes .	A	A	A	A			
TEXTKYBD Yes ...	A	A	A	A	A	A	
TEXTPRINT Yes ..	A	A	A	A	A	A	
QUERY Cold All .	A	A	A	A	A		
OUTLINE Yes	A	A	A	A	A		
SOSI Yes	A	A	A	A	A		
BACKTRANS Yes ..	A	A	A	A	A		
CGCSGID	A	A	A	A	A	A	
ASCII 7			A	A			See Note 6
ASCII 8			A	A	A	A	
FORMFEED Yes ...	A	A	A	A	A	A	
HORIZFORM Yes...	A	A	A	A	A	A	
VERTICALFORM Yes	A	A	A	A	A	A	
LDCLIST						A	
SHIPPABLE Yes ..	A	A	A	A	A	A	
RECEIVESIZE	A	A	A	A	A	A	
SENDSIZE			A	A	A	A	
BRACKET No	R	R					
BRACKET Yes			R	R	R	R	
AUTOCONNECT No .	A	A	A	A	A	A	
AUTOCONNECT Yes	A	A	A	A	A	A	
BUILDCHAIN No...	A	A		A	A	A	
BUILDCHAIN Yes .	A	A	R	A	A	A	
IOAREALEN	A	A	A	A	A	A	
LOGMODE	A	A	A	A	A	A	

DEVICE	3	3	L	L	S	L
SESSIONTYPE ...	2	2	U	U	C	U
***	7	7	T	T	S	T
...***	03	0	Y	Y	P	Y
.....***	2	P	P	P	R	P
.....*** ...	7		E	E	T	E
PARAMETER .***	5		2	3		4
ALTSUFFIX	A	A	A	A	A	A
FMHPARM Yes	A	A	A	A	A	A
OBOPERID Yes ...	A	A	A	A	A	A
OBFORMAT Yes ...	A	A	A	A	A	A
ROUTEDMSGS	A	A	A	A	A	A
ERRLASTLINE	A		A			
ERRINTENSIFY ...	A		A			
ERRCOLOR	A		A			
ERRHILIGHT	A		A			
ATI	A	A	A	A	A	A
CREATESESS Yes .	A	A	A	A	A	A
RELREQ	A	A	A	A	A	A
DISCREQ	A	A	A	A	A	A
SIGNOFF Yes	A	A	A	A	A	A
LOGONMSG	A	A	A	A	A	A
USERAREALEN	A	A	A	A	A	A

See Note 7

Notes:

1. *TERMMODEL may be 1, 2, 11, or 12 in the macro. CEDA changes 11 to 1 and 12 to 2 and defaults to 1, where applicable.*

2. *When applicable, the following table describes the defaulting rules for DEFSCREEN and ALTSCREEN:*

DEFSCREEN	Not Specif.	Specified	Not Specif.	Specified
ALTSCREEN	Not Specif.	Not Specif.	Specified	Specified
TERMMODEL not specif	DEF=(12,40) ALT= (0,0)	DEF=(value) ALT=DEFval.	DEF=(12,40) ALT=(value)	DEF=(value) ALT=(value)
TERMMODEL *.. 1 ..*	DEF=(12,40) ALT= (0,0)	DEF=(value) ALT=DEFval.	DEF=(12,40) ALT=(value)	DEF=(value) ALT=(value)
TERMMODEL *.. 2 ..*	DEF=(24,80) ALT= (0,0)	DEF=(value) ALT=DEFval.	DEF=(24,80) ALT=(value)	DEF=(value) ALT=(value)

When applicable, the following table shows the defaulting rules for ALTPAGE:

ALTSCREEN	Not Specif.	Not Specif.	Specified	Specified
ALTPAGE	Not Specif.	Specified	Not Specif.	Specified
********	ALTPG=ALTSC	ALTPG inval	ALTPG=ALTSC	ALTPG=value

3. *If PAGESIZE is not specified, it is set to the DEFSCREEN value for the following terminals:*

   - *3270 and 3275*
   - *3270P*
   - *LUTYPE2 and LUTYPE3.*

   For the other terminal types, if PAGESIZE not specified, it is set to the value according to the first table in Note 2.

4. *AUTOPAGE(No) is the default 3270, 3275 and LUTYPE2. Otherwise assume Yes as a default. A warning is given when No is used with 3270P or LUTYPE3.*

5. *EXTENDEDDS is set to (Yes) if any of the following is specified:*

   - *COLOR(Yes)*
   - *HILIGHT(Yes)*
   - *PROGSYMBOLS(Yes)*
   - *VALIDATION(Yes)*
   - *MSRCONTROL(Yes)*
   - *PARTITIONS(Yes)*
   - *QUERY(Cold\|All)*
   - *OUTLINE(Yes)*
   - *SOSI(Yes)*
   - *BACKTRANS(Yes).*

6. *ASCII(7) is invalid if EXTENDEDDS(Yes) is specified or implied.*

7. *ERRLASTLINE(Yes) is implied by any of the others not being No.*

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Numerics

Customer Information Control System
CICS/DOS/VS Version 1 Release 7
IBM 3270 Data Stream Device Guide

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