

z/VM



General Information

Version 3 Release 1.0

z/VM



General Information

Version 3 Release 1.0

Note:

Before using this information and the product it supports, read the information in "Notices" on page 95.

Second Edition (January 2001)

This edition applies to Version 3, Release 1, Modification 0 of IBM® z/VM (product number 5654-A17) and to all subsequent releases and modifications until otherwise indicated in new editions.

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Preface

This book provides general information about the IBM z/VM licensed program. It discusses the following topics:

- Introduction to z/VM
- New functions and enhancements
- Hardware and program requirements
- Components, additional facilities, and features
- Library structure and content
- Processor, guest, and device support

Who Should Read This Book

This book is intended for current users of VM products, as well as new users. It provides information to help users evaluate z/VM 3.1.0 and determine the resources necessary to run it. This book is also intended for anyone interested in a general overview or introduction to z/VM.

You might use the information in this book if you:

- Plan to install z/VM 3.1.0 and want to get acquainted
- Plan to migrate to z/VM 3.1.0 from a previous VM system
- Need basic knowledge about z/VM for any reason

None of the information in this book is meant to be used as a guide or reference for **using** z/VM.

Related Information

You can obtain more information about z/VM from the books listed in the z/VM library guide, which begins on page 55. The library guide includes an abstract for each z/VM book.

How to Send Your Comments to IBM

Your feedback is important in helping us to provide the most accurate and high-quality information. If you have comments about this book or any other VM documentation, send your comments to us using one of the following methods. Be sure to include the name of the book, the form number (including the suffix), and the page, section title, or topic you are commenting on.

- Visit the z/VM web site at:
<http://www.ibm.com/servers/eserver/zseries/zvm>

There you will find the feedback page where you can enter and submit your comments.

- Send your comments by electronic mail to one of the following addresses:

Internet: pubrcf@vnet.ibm.com

IBMLink™: GDLVME(PUBRCF)

- Fill out the Readers' Comments form at the back of this book and return it using one of the following methods:
 - Mail it to the address printed on the form (no postage required in the USA).

- Fax it to 1-607-752-2327.
- Give it to an IBM representative.

Chapter 1. Introducing z/VM

z/VM is a high-performance, interactive, multiple-access operating system for IBM z/Architecture and S/390® (ESA/390) servers. It provides a unique mix of services in support of interactive users, client/server environments, and the capability to run full-function operating systems such as z/OS, LINUX® for zSeries, and z/VM itself as “guest” systems.

Note: z/VM is the successor to IBM’s VM/ESA® product. Many products and functions supported on z/VM may continue to use VM/ESA in their names.

z/VM Supports Open Environments

By supporting a wide range of public and industry standards, protocols, and interfaces, z/VM provides a VM foundation for open enterprise network computing.

Network Computing

The network computing paradigm is not new to VM. z/VM supports today’s computing environments by providing a natural infrastructure for network computing, enabling you to participate in multisystem environments. You can connect your z/VM system and its data to a corporate intranet or serve your data to customers on the Internet and the World Wide Web. Through the use of shareware or IBM Business Partner Web servers and Web-related products on z/VM, information stored on z/VM can be presented to your organization and your customers using the latest Web technology.

z/VM networking support includes:

- **TCP/IP Feature for z/VM.** TCP/IP provides common protocols and applications that enable access to data from heterogeneous system platforms.
- **IBM® Java™ Port for VM/ESA.** The object-oriented Java programming language permits object code portability across any platform that supports Java. This is an ideal technology for building intranet/Internet applications using standard gateway interfaces.
- **NetRexx™.** NetRexx is a general-purpose programming language that is a blend of the Rexx and Java languages. You can use NetRexx as an alternative to Java, which makes writing and using Java classes quicker and easier than writing in Java.
- **MQSeries® Client for VM/ESA.** IBM Message Queuing Series (MQSeries) enables applications on different systems and architectures to work together. VM support for MQSeries enables client or server applications in the network to connect to applications on VM that have implemented the MQSeries communication protocol. (Use of the MQSeries APIs on VM requires the deployment of an MQSeries server somewhere in the network.)

OpenExtensions™

Through its support of selected Institute of Electrical and Electronics Engineers (IEEE) portable operating system interface for computer environments (POSIX) standards and X/OPEN portability guide (XPG) standards, z/VM provides a set of UNIX®-based programming interfaces that allows you to port applications from

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UNIX and other POSIX-compliant platforms to z/VM. It also allows you to develop POSIX-compliant applications on z/VM and port them to other POSIX-compliant platforms.

z/VM also supports a collection of Open Software Foundation (OSF) Distributed Computing Environment (DCE) technologies and services. DCE support enables you to develop and deploy distributed applications that access resources such as files, data, applications, and services that reside on other hardware and software platforms.

Heterogeneous Connectivity

z/VM provides a wide range of networking and connectivity options and adheres to many of the industry standards, enabling communications across distributed heterogeneous environments. Examples include:

- Transmission control protocol/internet protocol (TCP/IP)
- Systems network architecture (SNA)
- Binary synchronous communications (BSC)
- X.25
- Token-Ring
- Ethernet
- X-Windows
- Network file system (NFS)
- File transfer protocol (FTP)
- Simple mail transfer protocol (SMTP)
- X.400 mail exchange protocol
- Fiber distributed data interface (FDDI)

Network management support is provided through support of the simple network management protocol (SNMP) and through IBM-defined interfaces supported in NetView®.

Enterprise Computing

z/VM supports a wide range of enterprise computing alternatives, including a relational database and a shared file system:

- **IBM DATABASE 2™ Server for VSE & VM (DB2® Server for VM).** DB2 Server for VM provides local relational database support, as well as distributed access and update of distributed relational data on various platforms using IBM's Distributed Relational Database Architecture™ (DRDA®).
- **CMS shared file system (SFS).** SFS allows data sharing among users and across multiple VM system images or processors.

z/VM Provides Guest Support

z/VM presents a unique approach to computer operating systems. It provides each end user with an individual working environment known as a *virtual machine*. The virtual machine simulates the existence of a dedicated real machine, including processor functions, storage, and input/output (I/O) resources.

But virtual machines support much more than just end users. Application programs and complete operating systems can run in virtual machines. z/VM provides the capability to support multiple complete z/Architecture and S/390 operating systems as guests of z/VM. (To provide full support for z/Architecture guests, z/VM must be running on a z/Architecture server.) For example, you can run z/OS, LINUX for S/390, OS/390®, VM/ESA, VSE/ESA™, and other z/VM

systems on the same z/VM system that is supporting z/VM applications and end users. As a result, application development, testing, and production environments can share a single physical computer.

The virtual machine capability of z/VM allows you to:

- **Test programs that can cause abnormal termination of real machine operations and, at the same time, process production work.** The isolation that is provided for a virtual machine enables system-oriented programs and teleprocessing applications, for example, to be tested on the virtual machine while production work is in progress, because this testing cannot cause abnormal termination of the real machine.
- **Test a new operating system release.** A new release of the primary operating system, or of z/VM itself, can be generated and tested at the same time the existing release is performing production work. This enables the new release to be installed more quickly. The ability to operate multiple operating systems concurrently under z/VM also enables an installation to continue running programs that operate only under a back-level release (programs that are release-sensitive and uneconomical to convert, for example) concurrently with the most current release.
- **Test a new operating system.** The existing operating system can be used to process production work concurrently with the generation and testing of a new operating system. Experience with the new system can be obtained before it is used on a production basis, without dedicating the real machine to this function.
- **Perform operating system maintenance concurrently with production work.** The installation and testing of program temporary fixes (PTFs) for the primary operating system and z/VM can be done at the same time normal production operations are in progress.
- **Provide backup facilities for the primary operating system.** A generated z/VM system is not model-dependent and can operate on various processor models as long as the minimum hardware requirements are present. This enables a smaller processor model that has less real storage, fewer channels, fewer direct access devices, and fewer unit record devices than a larger processor model to provide backup for the larger model (normally at a reduced level of performance).
- **Perform operator training concurrently with production work processing.** The real machine does not have to be dedicated to training additional or new operators or to providing initial training when a new operating system is installed. Operator errors cannot cause termination of real machine operations.
- **Simulate new system configurations before the installation of additional channels and I/O devices.** The relative load on channels and disk devices can be determined in this way using the existing smaller I/O configuration. Experience with generating and operating a z/OS or OS/390 multiple-system configuration can be obtained using one real machine.

z/VM Provides Host-Based Services for the Workstation Environment

Because z/VM is built on a client/server-like model, it can function both as a mainframe server to LAN users and as a client to a LAN server or another mainframe. z/VM supports the following products in a client/server environment:

- **Tivoli® Storage Manager for VM.** Tivoli Storage Manager is a client/server tool that enables backup, archiving, and restoration of workstation files, utilizing the host VM system and DASD. Tivoli Storage Manager moves the responsibility for storage management to VM, while providing client applications for a number of workstation-based environments, such as Microsoft® Windows®, Apple Macintosh, UNIX, and OS/2®.

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- **LAN Resource Extension and Services/VM (LANRES/VM).** LANRES/VM (available as a no-charge feature of z/VM) provides VM disk, print, administrative, and data distribution services to Novell NetWare LAN users.

z/VM Supports Application Development and Deployment

z/VM supports a number of programming languages and environments, including:

- REXX
- Assembler
- COBOL
- FORTRAN
- C
- PL/I
- PASCAL
- C++
- Java
- NetRexx
- Language Environment®
- MQSeries Client
- VisualAge® Generator

z/VM also provides a rich set of application development services, including:

- OpenExtensions Services
- OpenExtensions Shell and Utilities
- OpenEdition® DCE Feature for VM/ESA
- Integrated editors and support for code version management
- Trace and debug facilities

z/VM supports program development not only for z/VM applications, but also for operating systems supported as guests of z/VM.

Special facilities are available to CMS applications, such as:

- Extended Architecture (XC) support
- CMS Pipelines
- CMS multitasking services
- Callable services library (CSL)
- Reusable Server Kernel
- CMS macros and functions
- OS/MVS simulation
- DOS/VSE support

z/VM Provides a Rich Set of User Services

z/VM provides end user services in several important environments:

- Decision support, problem solving, expert systems
- Document creation, editing, and publishing
- Image storage and retrieval
- Graphics development and manipulation
- Office task management
- Communications and document exchange with users on other systems
- Computer Integrated Manufacturing
- Engineering/scientific computing
- Application development
- Application testing
- Communications services
- Backup/archive of programmable workstation or LAN server data

- Services for NetWare and OS/2 LAN servers
- Accessing other systems
- System management
- Network management
- System testing
- Graphical user interface

z/VM Is Proven

z/VM is built on a foundation of system integrity and security, and incorporates many design features for reliability and availability.

- Integrity and security:
 - IBM will correct any integrity exposures introduced by unauthorized programs into the system.
 - Integrated access control and authentication services may be augmented with the addition of external security managers.
 - Distributed computing poses additional security considerations. The OpenEdition DCE Feature for VM/ESA includes the DCE Security Service Client, which controls access to resources and provides user registration, authorization, and authentication services for distributed applications.
 - Kerberos authentication and Secure Socket Layer (SSL) support are provided through the TCP/IP Feature for z/VM.

Also see “Integrity and Security of z/VM” on page 30.

- Availability and reliability:
 - Application recovery: z/VM provides services which permit recovery of incomplete interactions with resource managers.
 - Automated operations: z/VM offers several levels of automated system management support. One example is the Programmable Operator. For a higher degree of automation, IBM SystemView® Host Management Facilities/VM can be added. Both the Programmable Operator and Host Management Facilities/VM can interact with NetView on z/VM, which in turn can interact with NetView on z/OS, OS/390, or MVS/ESA™.
 - z/VM provides duplexed data with transparent ongoing synchronization between the primary and backup copy, and automatic transparent cut-over to the backup copy in case of an error in the primary copy.
 - On-line configuration changes eliminate many previously-required outages.
 - z/VM systems can be connected for improved server and user availability.
 - Fast restart reduces the end user impact of any outage.

Introducing z/VM

Chapter 2. New Functions, Enhancements, and Other Changes

This chapter provides an overview of the major functions and enhancements provided in z/VM 3.1.0 (compared with VM/ESA 2.4.0). These new functions and enhancements, plus other important changes, are briefly described in the following sections:

- “Network Computing”
- “Support for New Products and Hardware Architecture” on page 9
- “Application Development and Deployment” on page 10
- “Operating System Enhancements” on page 11
- “Other Changes” on page 12

Network Computing

This section describes enhancements to the network computing capabilities of z/VM.

TCP/IP Feature for z/VM, Level 3A0

TCP/IP Level 3A0 contains the functions available in TCP/IP Function Level 320 plus the following:

- Multiple Protocol Route (MPROUTE) Capability

This enhancement implements the Open Shortest Path First (OSPF) and Routing Information (RIP) protocols, providing an alternative to the static TCP/IP gateway definitions. When configured properly, the VM host running the MPROUTE server becomes an active OSPF and/or RIP router in a TCP/IP network. Either (or both) of these two routing protocols can be used to dynamically maintain the host routing table.

Greater efficiency within a TCP/IP network can be realized by allowing MPROUTE to determine whether a new route has been created, a route is temporarily unavailable, or whether a more efficient route exists.

For more information, see *z/VM: TCP/IP Level 3A0 Planning and Customization*.

- Queued Direct I/O support

TCP/IP now supports the Queued Direct I/O hardware facility, which is a functional element of an IBM z/Architecture or S/390 processor that allows a program to directly exchange data with an I/O device without performing traditional S/390 I/O instructions. This hardware facility allows for a direct connection between the TCP/IP stack and the OSA Express adapter. Some of the changes include:

- New BLOCK DIAGNOSE subfunction for DIAGNOSE code X'98'
- New DEVICE statement for OSD devices
- New FIXEDPAGESTORAGEPOOL statement allowing for the manual tuning of the Fixed Page Storage Blocks

For more information on the different OSA Express protocols and support provided by TCP/IP, see *z/VM: TCP/IP Level 3A0 Planning and Customization*.

- VM NFS Client Support

This enhancement allows CMS users and applications transparent access to data on remote systems with NFS servers supporting Sun NFS V2 or V3 protocols. If

New Functions, Enhancements, and Changes

the remote system provides the necessary NFS server support, the VM NFS Client can access the data on that system.

The remote data accessed by an NFS client is mounted on the CMS BFS structure in a single virtual machine. A mount is issued to CMS to attach the remote file system to mount point on the CMS BFS structure. Once mounted, the remote file system is accessible using interfaces currently available in z/VM. The major functions and changes include:

- New OPENVM QUERY DEBUG and OPENVM SHOWMOUNT commands
- Updated OPENVM DEBUG, OPENVM MOUNT, OPENVM OWNER, and QUERY MOUNT commands

For more information, see the following books:

- *z/VM: TCP/IP Level 3A0 User's Guide*
- *z/VM: OpenExtensions Command Reference*

- **FTP Web Browser Support**

The FTP server has been enhanced to better accommodate web browser and graphical FTP clients. The changes and new function include:

- The ability to provide UNIX-format list information in response to client DIR subcommand requests
- The ability to perform automatic EBCDIC-ASCII data translation for transferred files, based on file types (or file extensions)
- New subcommands
- A server-specific configuration file for FTP server startup information, so that configuration is more consistent with other TCP/IP servers.

For more information, see the *z/VM: TCP/IP Level 3A0 User's Guide*.

- **IP Multicast Support**

This support provides the ability to send an IP datagram to a group of hosts that are members of a single multicast group, and the ability for members of a multicast group to receive multicast datagrams.

Membership in multicast groups is dynamic and may be spread across separate physical networks. Hosts may join or leave a multicast group at any time, and they are not required to belong to a multicast group to send datagrams to its members. TCP/IP will maintain a list of host group memberships associated with each network interface.

For more information, see the *z/VM: TCP/IP Level 3A0 User's Guide*.

- **Secure Socket Layer (SSL) Support**

SSL is a TCP/IP protocol that provides privacy between two communicating applications (a client and a server) by encrypting the data. Under SSL protocol, the server is always authenticated and must provide a certificate to prove its identity. In addition to authentication, both the client and the server participate in a handshake protocol that produces the cryptographic parameters for the session.

The processing required for SSL support is provided by a new SSL server. Your installation identifies the ports that are secure and specifies the certificates to be used. Any VM server listening on a secure port can participate in an SSL connection with any external client that supports SSL according to RFC 2246. No changes to the VM server are required.

This SSL support provides 40-bit, 56-bit, and 128-bit encryption/decryption services.

For more information, see *z/VM: TCP/IP Level 3A0 Planning and Customization*.

- TCP/IP Kerberos Data Encryption Standard (DES) Feature has been integrated into the TCP/IP Feature for z/VM. This now provides 128-bit encryption/decryption services for the Kerberos authentication server as well as APIs for application programs.

Support for New Products and Hardware Architecture

This section describes support for new products and hardware architecture.

Note: You may have already added some of this support to your current VM system through APARs.

Support for IBM @server zSeries 900

z/VM supports the IBM @server zSeries 900 (z900). See “Appendix A. IBM Processors Supported by VM” on page 77.

z/VM exploits the z/Architecture (64-bit) capabilities of the z900, enabling 64-bit-capable operating systems such as z/OS, LINUX for zSeries, or z/VM to use their 64-bit capabilities when running as guests of z/VM on this server.

Support for IBM S/390 Multiprise® 3000 Enterprise Server

z/VM supports the IBM S/390 Multiprise 3000 Enterprise Server and its Internal Disk. See “Appendix A. IBM Processors Supported by VM” on page 77 and “Direct Access Storage Devices (DASD)” on page 86.

Support for IBM Enterprise Storage Server™ and Parallel Access Volumes

z/VM supports the IBM Enterprise Storage Server (2105 DASD Subsystem), which emulates a 3990 Model 3 or 6 Storage Control with either of the following:

- 3390 Model 2, 3, or 9 DASD
- 3390 Model 2 or 3 DASD in track compatibility mode

Use of the performance-oriented track level commands is supported for guests.

z/VM provides guest support for the Parallel Access Volumes feature. This feature allows the configuration of logical volumes (known as alias Parallel Access Volumes), where each logical volume (alias) has a unique device address but is actually an exposure of the existing real device (known as the base Parallel Access Volume). This allows the host to issue concurrent I/O requests to one real device, the base volume, through the different alias volumes.

Support for Parallel Access Volumes includes:

- The new CP QUERY PAV command, which displays information about the Parallel Access Volume devices on the system.
- Enhancements to the CP QUERY DASD DETAILS command to display additional information if the queried device is a Parallel Access Volume.
- A new CP Monitor Record, which has been added to Domain 6 (I/O) to record state change interrupts that indicate a change in the Parallel Access Volumes information:
 - Record 20 – MRIODSTC – State change

New Functions, Enhancements, and Changes

Other Parallel Access Volumes information will be recorded in the existing Device Configuration Data Record (Domain 1, Record 6) and the Vary On Device - Event Data Record (Domain 6, Record 1).

See “Direct Access Storage Devices (DASD)” on page 86.

For more information, see the *z/VM: CP Command and Utility Reference*.

Flash Copy Support

z/VM allows a native CP user to initiate a Flash Copy function (an instant copy of a disk or data set) of a source device to a target device on an IBM Enterprise Storage Server. Customers will find this feature especially beneficial for large databases, which normally require a long time to copy. Flash Copy support includes the new CP FLASHCOPY command.

For more information, see the *z/VM: CP Command and Utility Reference*.

Tape Support Enhancements

z/VM provides additional guest support for the IBM 3494 Virtual Tape Server (VTS):

- Peer-to-Peer VTS provides flexible component placement to meet 7x24 processing requirements and provides a solution for remote backup and recovery.
- Import/Export allows physical tapes to be removed from and inserted into the VTS logical tape library.

z/VM supports guest use of IBM 3590 A60 tape controllers attached with FICON™ channels when such guests themselves support the 3590 A60 on native FICON channels.

Support for S/390 Service Update Facility Version 3

z/VM supports the S/390 Service Update Facility (SUF) Version 3 Release 1 (available March 2001). For more information, visit the SUF home page at: www.ibm.com/s390/suf/.

Application Development and Deployment

This section describes enhancements to aid application development and deployment on z/VM.

Binder/Loader Support

CMS hosts the DFSMS/VM® Program Management binder and provides a native implementation of the corresponding program object loader functions. Included with this support is a new CMS command, BIND, to invoke the services of the binder to bind and store an executable file containing a program object on DASD (minidisk, SFS directory, or BFS directory). An executable file produced by the binder may be used on a CMS system containing the program object loader in exactly the same way as a conventional MODULE file generated by the CMS GENMOD command.

Also included in this support is an enhancement to the **c89** command to use the new BIND command in place of the combination of the Language Environment

New Functions, Enhancements, and Changes

prelinker and the old LOAD, INCLUDE, and GENMOD commands. In addition, the complete binder API is available to application programs that need to invoke the services of the binder dynamically.

CMS support of the binder and loader allows ready transportability of executable files between z/VM and OS/390 or z/OS systems and provides the infrastructure to permit CMS to exploit new and emerging programming language technology being developed for z/OS.

For more information, see *z/VM: Program Management Binder for CMS*.

CMS OS Simulation Enhancement

The new SET TAPENEVR command allows you to control CMS OS Simulation tape label date checking for 'Unexpired Files'. The new QUERY TAPENEVR command allows you to display the current setting.

For more information, see the following books:

- *z/VM: CMS Application Development Guide for Assembler*
- *z/VM: CMS Command Reference*

Tape FICON and RAS Support

Extended function in DIAGNOSE code X'210' allows application programs to find out the underlying real hardware that is associated with tape devices operating in emulation mode.

For more information, see *z/VM: Planning and Administration*.

Operating System Enhancements

This section describes new or enhanced z/VM operating system functions.

Choice of CP Image

z/VM provides two CP images:

- 32-bit, which can be IPLed on any supported S/390 or z/Architecture processor (see "Appendix A. IBM Processors Supported by VM" on page 77)
- 64-bit, which can be IPLed only on a z/Architecture processor

A dual-image CP is also provided with z/VM. If the dual-image CP is installed, it automatically determines at IPL if the processor is z/Architecture-capable. If it is, the 64-bit CP image is loaded; otherwise, the 32-bit CP image is loaded. This can be overridden on the IPL to load the 32-bit CP on a z/Architecture processor.

64-Bit Support

z/VM provides support for 64-bit addressing in:

- Storage configuration
- Display/dump/store of storage, registers, and PSWs
- Tracing

Storage Configuration

The CP DEFINE STORAGE command allows larger extents and discontinuous storage definitions. The display of the configurations has been changed.

New Functions, Enhancements, and Changes

Two new Directory Control Statements, STORAGE and MAXSTORAGE, allow you to define a default and a maximum virtual storage size for users.

The USER statement now allows a maximum storage of 16 exabytes.

Display/Dump/Store

All commands for displaying or dumping storage or registers accommodate larger registers and storage areas.

Tracing

Trace commands show new instructions, larger registers, PSWs, and storage areas. The new TRACEGG command allows you to trace changes in general-purpose registers for either a 64-bit or a 32-bit image of CP.

VM Dump Tool

The VM Dump Tool assists in analyzing dump data from a dump file created by the DUMPLOAD utility. The VM Dump Tool provides a variety of subcommands and macros that allow you to display, locate, and format dump data interactively. This tool can process CP stand-alone dumps, CP ABEND dumps, and virtual machine dumps of a CP system.

For more information, see *z/VM: VM Dump Tool*.

VMLINK Improvements

The VMLINK command has been overhauled with both code and documentation changes. Many enhancements and some additions were made to increase the usability of this command:

- Changes have been made to better validate some of the values in the VMLINK CONTROL file.
- The PUSH and POP options have been changed to ensure the behaviors are consistent and can be documented.
- File mode support has been made more complete and the documentation lists all the supported file mode definitions.
- Exits now support mixed-case parameters.
- The .EX and .PX VMLINK variables have been added to complete support for all possible NAMES file tags to be retrieved.
- Messages displayed when disks and directories are detached and released have been changed for consistency.
- Error reporting has been improved.
- The documentation has been completely reorganized. Guide information has been removed from the command description in the *z/VM: CMS Command Reference* and moved to the *z/VM: CMS User's Guide*.

Other Changes

This section describes other important changes to z/VM.

Graphical User Interface (GUI) Facility Changes

The following changes have been made to the GUI Facility:

- The GUI workstation agents, along with their Help files, are not shipped with z/VM. They are available with limited support from the VM Download Library at:

New Functions, Enhancements, and Changes

<http://www.ibm.com/s390/vm/download>

- The CMSDESK application modules and message repository are also available as part of the GUI package from the VM Download Library.
- The CMSDESK command and nucleus routines remain in CMS. Documentation is available from the GUI download package. To use these functions, you must download the workstation agents and GUI modules and put them on a CMS minidisk or SFS directory.

VM Library Changes

This section describes major changes to the VM library.

New Migration Guide

The *z/VM: Migration Guide* provides information to help you migrate to z/VM 3.1.0 from a VM/ESA 2.2.0 or later system. It identifies what external functions have changed. It also tells you what other books you need if you are migrating from a release prior to VM/ESA 2.2.0.

Note: The *VM/ESA: Conversion Guide and Notebook* has not been updated for z/VM 3.1.0.

Most z/VM Books Provided Only in PDF and BookManager® Formats

Six z/VM books are provided as printed books with the z/VM product. All other books in the z/VM library are provided only in PDF and/or BookManager format. For more information, see “Editions and Formats of VM Books” on page 70.

Relocated Information

The following table shows information that has been relocated within the z/VM library.

Table 1. Relocated Information

Topic	Old Location (Book)	New Location (Book)
CP trace table	<ul style="list-style-type: none">• <i>VM/ESA: CP Diagnosis Reference</i>• <i>VM/ESA: CP Diagnosis Reference Summary</i>	<i>z/VM: Diagnosis Guide</i>
internal DIAGNOSE codes (DIAGNOSE codes NOT intended as programming interfaces for customers)	<i>VM/ESA: CP Diagnosis Reference</i>	<i>z/VM: CP Programming Services</i>
DUMpload command	<i>VM/ESA: Dump Viewing Facility</i>	<i>z/VM: CP Command and Utility Reference</i>
TRACERED utility	<i>VM/ESA: Dump Viewing Facility</i>	<i>z/VM: CP Command and Utility Reference</i>

Deleted Books

The following books are not included in the z/VM 3.1.0 library:

- *VM/ESA: Conversion Guide and Notebook*
- *VM/ESA: CP Diagnosis Reference*
- *VM/ESA: CP Diagnosis Reference Summary*
- *VM/ESA: CMS Diagnosis Reference*
- *VM/ESA: Graphical User Interface Facility*

New Functions, Enhancements, and Changes

- *VM/ESA: Distributed Graphical User Interface Toolkit*

Chapter 3. Technical Information

This chapter discusses the hardware and software (program) requirements of z/VM, packaging and ordering information, and restrictions on the operation of this product. It contains the following sections:

- “Hardware Requirements”
- “Supported Processor Modes” on page 19
- “Device Support” on page 19
- “Program Requirements” on page 20
- “Operating Systems Supported as Guests” on page 27
- “Other Programs Supported on z/VM” on page 27
- “National Language Support (NLS)” on page 27
- “Packaging and Ordering Information” on page 28
- “Object Code Only and Limited Source Availability” on page 29
- “Restrictions” on page 29
- “Integrity and Security of z/VM” on page 30

Note: Some technical information may have changed since this book was published. For the latest requirements for any IBM licensed program, you should contact your IBM Support Center and request the product installation information (Install Bucket). Customers in some countries may be able to obtain this information online through IBM S/390 TechSupport Enhanced Services
(<http://techsupport.services.ibm.com/support/390.support/country/>).

Hardware Requirements

This section describes the minimum hardware and storage required for z/VM and for its additional facilities and optional features. It covers the following topics:

- “Minimum Hardware Configuration for the z/VM Base”
- “Storage Requirements” on page 16
- “Cross-System Extensions Hardware Requirements” on page 16
- “OSA and OSA/SF Hardware Requirements” on page 17
- “TCP/IP Feature for z/VM Hardware Requirements” on page 17
- “LANRES/VM Feature Hardware Requirements” on page 17

Minimum Hardware Configuration for the z/VM Base

The minimum hardware configuration supported is:

- A processor capable of running z/Architecture or ESA/390™ architecture (see “Supported Processor Modes” on page 19).

The processor must have:

- At least 8MB of real storage
- One processor unit
- One processor controller or support processor
- One channel subsystem
- One system console (to control the hardware processor)
- One operator console (to control the operating system; depending on the processor type, this may be the same physical device as the system console)
- Direct access storage devices:
 - Nine 3380 single-density or
 - Five 3380 double-density or

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- Three 3380 triple-density or
- Six 3390 single-density or
- Three 3390 double-density or
- Two 3390 triple-density or
- Six 9345 Model 1s or
- Four 9345 Model 2s or
- Ten 9336 Model-10s or
- Six 9336 Model-20s

Notes:

1. The 3390 Model 9 is not supported for installation.
 2. If you choose not to install some optional components and other items, your DASD requirements may be less than indicated above. For more information, see the *z/VM: Installation Guide*.
- One of the following input devices:
 - 3480 tape subsystem
 - 3490 tape subsystem
 - 3490E tape subsystem
 - 4mm variable-block tape cartridge unit
 - CD-ROM (emulating a 3422 tape drive)

It is highly recommended that a printer be included in the hardware configuration so that if a problem is encountered during IPL, important diagnostic information can be obtained.

Storage Requirements

The minimum real storage needed to generate z/VM is 8MB, and z/VM requires at least 8MB of real storage to function.

The block paging function requires more DASD space to transfer pages at maximum efficiency and speed.

You may need to increase the DASD space allocated for spooling because of the use of the spool file limit relief function in z/VM.

If you use a nonshared copy of CMS, your virtual machine size must be at least 20MB. If you use CMS as a named saved system (NSS), your virtual machine size must be at least 2MB (provided that CSL libraries have also been saved as a saved segment).

Cross-System Extensions Hardware Requirements

The Cross-System Extensions (CSE) function requires certain hardware, as follows:

- The CSE complex consists of two, three, or four VM systems.
- The systems in the CSE complex must be connected by channel-to-channel adapters or an IBM 3088 Multisystem Channel Communications Unit (MCCU).
- DASD shared by systems in the complex must be count-key-data (CKD) devices. Fixed-block architecture (FBA) devices are supported by the CSE function for spooling only. The cross system link function of CSE is not supported for FBA devices.

OSA and OSA/SF Hardware Requirements

A full list of OSA and OSA/SF hardware requirements is too detailed for the scope of this book. For that information, especially for the processors that the OSA supports, refer to the IBM sales manual or *S/390: Planning for the S/390 Open Systems Adapter (OSA-1, OSA-2) Feature*.

OSA/SF requires general disk space and a minidisk for each user ID. OSA/SF requires its own user ID and also requires a maintenance user ID for its installation. Refer to the OSA/SF program directory for more information.

To use the OSA/SF graphical user interface, you also need a workstation with sufficient processing and memory capabilities. See the *VM/ESA: Open Systems Adapter Support Facility User's Guide for OSA-2*.

TCP/IP Feature for z/VM Hardware Requirements

The TCP/IP Feature for z/VM requires one of the following:

- IBM 3172 Interconnect Controller with the Interconnect Controller Program (ICP) Version 3 (5621-425) or equivalent
- IBM Open Systems Adapter 2 (OSA-2) Token Ring, FDDI, Fast Ethernet, and 155 ATM
- IBM Open Systems Adapter Express (OSA-Express) Gigabit Ethernet, Fast Ethernet, and 155 ATM
- IBM 37xx Communications Controller using X.25 or SNA connections
Native attachment of the IBM 3745 to TCP/IP and associated dynamic IP routing within the 3745 are not supported.
- IBM 8232 LAN Channel Station Model 1 or 2
- HYPERchannel A220 Processor Adapter 42990007

TCP/IP Feature for z/VM supports the HYPERchannel Series A devices (and HYPERchannel Series DX devices that are functioning as Series A devices). For additional information, see the appropriate Network Systems Corporation documentation.

- IBM RS/6000[®] Channel Attachment using the Block Multiplexer Channel or ESCON[®] Adapter
- IBM 3088 Multi-system Channel Communication Unit

TCP/IP Feature for z/VM supports direct connection to another TCP/IP for VM, MVS/ESA, OS/390, z/OS, or LINUX for S/390 using the IBM 3088.

- IBM ESCON Channel-to-Channel Adapter

TCP/IP Feature for z/VM supports direct connection to another TCP/IP for VM, MVS/ESA, OS/390, z/OS, or LINUX for S/390 using the IBM ESCON Channel-to-Channel Adapter.

- A 3270-equivalent workstation for TCP/IP administration

LANRES/VM Feature Hardware Requirements

The LANRES/VM feature has the following hardware requirements:

- Any host processor supported by this z/VM release with:
 - Any tape drive supported by this z/VM release
 - One of following DASD is recommended for product programs and associated files:
 - FBA -- 103200 blocks
 - 3390 -- 86 cylinders

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- 3380 -- 86 cylinders
- 3375 -- 138 cylinders
- 3350 -- 118 cylinders
- One of the following on which to run the NetWare operating system:
 - An IBM Micro Channel[®] PS/2[®] (or equivalent) capable of running NetWare Version 3.11, Version 3.12, Version 4.01, or Version 4.02 with:
 - A minimum of 70MB hard disk
 - A minimum of 12MB RAM (16MB is recommended)

Note: More memory provides more room for caching, which means better performance for clients. With more memory, more files and volumes may be supported and the PS/2 can more easily perform non-LANRES/VM functions (the PS/2 does not have to be dedicated to LANRES/VM).

- A 3.5-inch 1.44MB-capable diskette drive
- A LAN adapter
- One or more of the following connectivities:
 - An IBM PS/2 Micro Channel to Mainframe Connection
Refer to Hardware Announcement 192-156, dated June 30, 1992, for description, supported models, and ordering information.
 - Hardware as required to support SNA LU6.2 communications
Refer to the appropriate NetWare for SAA[®] Administration Guide for details.
 - Hardware as required to support TCP/IP
Refer to the appropriate NetWare TCP/IP Transport Supervisor's Guide for details.
- An IBM 3172 Interconnect Controller Model 3 with the following:
 - Hardware Package1 (Feature code 2710) or Hardware Package2 (Feature code 2720)
 - 66 MHz Pentium[®] processor (Feature code 2850)
 - A LAN adapter supported by the NetWare operating system

Notes:

1. Additional memory provides more room for caching, which means better performance for clients. With more memory, more files and volumes may be supported and the controller can more easily perform non-LANRES/VM functions. For additional memory in 16MB increments up to 64MB, order feature code 2810.
 2. Refer to OITools (www.ibm.com/wwoi) for additional details on 3172 Model 3 requirements.
 3. NetWare v3.11J from IBM and NetWare 3.12J/V from IBM cannot be used on the 3172-3.
- One or more of the following connectivities:
 - For ESCON support, order the IBM ESCON Adapter (Feature code 2800); for parallel channel, order the Parallel Channel Adapter (Feature code 2501)
 - Hardware as required to support SNA LU6.2 communications
Refer to the appropriate NetWare for SAA Administration Guide for details.
 - Hardware as required to support TCP/IP

Refer to the appropriate NetWare TCP/IP Transport Supervisor's Guide for details.

- An IBM PS/55 (or equivalent) capable of running NetWare v3.11J from IBM or NetWare 3.12J/V from IBM with the following:
 - A minimum of 70MB hard disk
 - A minimum of 12MB RAM (16MB is recommended)
 - A 3.5-inch 1.44MB-capable diskette drive
 - A LAN adapter
 - One or more of the following connectivities:
 - An IBM PS/2 Micro Channel to Mainframe Connection
Refer to Hardware Announcement 192-156, dated June 30, 1992, for description, supported models, and ordering information.
 - Hardware as required to support TCP/IP
Refer to the appropriate NetWare TCP/IP Transport Supervisor's Guide for details.
This requires NetWare for SAA 1.3B from IBM (Japanese Version) and NetWare 3.12J/V from IBM. Refer to the appropriate NetWare for SAA Administration Guide for details.

Supported Processor Modes

z/VM supports basic mode on all supported z/Architecture and ESA/390 processors. For a list of the IBM processors supported by z/VM, see "Appendix A. IBM Processors Supported by VM" on page 77.

If the Processor Resource/Systems Manager™ (PR/SM™) feature is installed on the processor, z/VM also supports logically partitioned (LPAR) mode. For information on how z/VM operates on processors with the PR/SM feature, see "Processor Resource/Systems Manager (PR/SM)" on page 39.

The performance characteristics of z/VM may vary by processor or configuration.

Device Support

z/VM handles real devices as supported or unsupported.

Supported Devices

A supported device is one of those listed in "Appendix C. IBM Devices Supported by VM" on page 85. The use of such a device is fully supported by IBM through the service support available with z/VM. A supported device can be supported either for CP and guest use or for dedicated use by only a single guest.

A device supported for CP and guest use is one that CP and virtual machines can use. CP provides system services for the device, including error recovery for guest DIAGNOSE I/O requests, and a full command set (that is, you can use all of the device-oriented CP commands for the device). Such a device can also be shared among multiple guests if appropriate (as, for example, in the case of a DASD), or it can be dedicated to the exclusive use of a single guest.

A device supported for dedicated use by a single guest can be logically attached to only a single guest virtual machine at any one time. The guest must be capable of running with the device. CP cannot use the device itself, and DIAGNOSE I/O services are not available to the guest for such a device.

Unsupported Devices

In addition to the devices listed in “Appendix C. IBM Devices Supported by VM” on page 85, you can also connect other devices to z/VM if they are equivalent or similar to any of the supported devices. Such other devices are referred to as unsupported devices, and proper operation of such devices with z/VM and guest operating systems is your responsibility. IBM does not guarantee that unsupported devices run properly with z/VM, and service support for such device attachments is not supplied.

If a device is absolutely equivalent to a supported device, you can define it as such and use it in any way you would use the corresponding supported device. You are responsible for the determination of equivalence.

If a device is not equivalent to any supported device but is more or less similar to one, you can define it as an unsupported device. An unsupported device must be dedicated to a single guest; that is, an unsupported device cannot be a system or CP-owned device. You define an unsupported device by calling it a device type other than any of those shown in “Appendix C. IBM Devices Supported by VM” on page 85, and by specifying the CLASS operand of the RDEVICE macro. The CLASS value should be the one that comes closest to accurately describing the unsupported device (for example, DASD or TAPE). See the *z/VM: Planning and Administration* book for details of the definition and customization processes for unsupported devices.

Program Requirements

This section lists the licensed programs and other program materials required by z/VM and by its additional facilities and optional features. It covers the following topics:

- “Program Requirements for the z/VM Base”
- “Cross-System Extensions Program Requirements” on page 21
- “DFSMS/VM® Program Requirements” on page 22
- “OSA/SF Program Requirements” on page 22
- “Language Environment Program Requirements” on page 23
- “CMS Utilities Feature Program Requirements” on page 23
- “TCP/IP Feature for z/VM Program Requirements” on page 23
- “OpenEdition DCE Feature for VM/ESA Program Requirements” on page 24
- “LANRES/VM Feature Program Requirements” on page 24
- “Program Requirements for VM Related Products” on page 26
- “Online Books Program Requirements” on page 26

Program Requirements for the z/VM Base

The following IBM licensed programs are required:

- Environmental Record Editing and Printing (EREP/VM) Version 3 (5654-260) Release 5.0 with APAR VM62260
- Device Support Facilities: ICKDSF for VM (5684-042) Release 16 or later

Note: EREP/VM and ICKDSF are preinstalled on z/VM. Therefore, when ordering z/VM, you must already be licensed for these programs or you must place a separate order for each program to establish a license. Both the CMS version of ICKDSF and an IPLable standalone version (5747-DS1) are supplied with z/VM.

Installation from CD-ROM

Installation from CD-ROM on any supported processor *except* IBM S/390 Multiprise® 3000 Enterprise Server, IBM S/390 Integrated Server, IBM PC Server System/390®, or IBM RS/6000 with System/390 Server-on-Board, requires:

- IBM Optical Media Attach/2 Enabler Kit (5622-138), which contains the Optical Media Attach/2 Program (5621-264)

High Level Assembler

Although not a prerequisite for z/VM, the IBM High Level Assembler Version 1 (5696-234) is required for various tasks and functions:

- Release 2.0 or later is required for:
 - Creating a new DMSTRT for system languages (NLS)
 - Creating image libraries for system printers (FCBs)
 - Creating GCS application segments (CONTENTS macro)
 - Accessing major CMS application interfaces (CMSCALL)
 - Accessing most CP application interfaces (DIAGNOSE)
 - Modifying the AVS tuning control module (AGWTUN)
 - Using RAS tools such as MDCHECK, FS2SFSE, AFTCHAIN, PRINTBLK, PRINTFST, and so on
 - Using the API for data compression
 - Using the CMS Pipelines assembler macro interface
 - Customizing Language Environment or compiling assembler routines used in mixed-language user applications
 - Using exit routines in products such as DirMaint and RSCS
- Release 3.0 or later is required for:
 - Running applications that exploit the IEEE Floating Point hardware facility
- Release 4.0 or later is required for:
 - Installation:
 - Adding devices that cannot be sensed (updating HCPRIO ASSEMBLE)
 - Local modifications
 - Servicing the CP Loader (HCPLDR)
 - Creating the Stand-Alone Dump Utility (HCPSADMP EXEC)
 - Assembling any CP modules
 - Using CP exit routines
 - Installing and servicing RTM/ESA

OpenExtensions Program Requirements

To do OpenExtensions application development in C, you need the C compiler included in the following licensed program:

- IBM C for VM/ESA Version 3 (5654-033) Release 1.0

External Security Manager

If an external security manager is needed:

- Resource Access Control Facility (RACF®) Version 1 for VM (5740-XXH) Release 10.0 or its equivalent. APAR VM62598 is required to run in 64-bit mode on a z/Architecture processor.

Cross-System Extensions Program Requirements

A Cross-System Extensions (CSE) complex consists of two, three, or four VM systems.

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The following IBM licensed programs are required to support the CSE function:

- Directory Maintenance VM/ESA (DirMaint) Version 1 (5748-XE4) Release 5.0
- VM/Pass-Through Facility Version 2 (5684-100) Release 1.0 or later

A complex that contains both CSE and VM/ISF has these additional requirements:

- PTFs to VM/ISF Releases 1 and 2 that make communication with CSE possible
- The addition of the ISFNDSYN macro to the VM/ISF DUKSYS ASSEMBLE module
- Two dedicated RSCS virtual machines for the spool file bridge, one for the CSE side of the complex and one for the VM/ISF side of the complex
- The WAKEUP utility program distributed with the CMS Utilities Feature

DFSMS/VM[®] Program Requirements

DFSMS/VM requires the following licensed programs:

- Interactive System Production Facility (ISPF) Version 3 (5684-043) Release 2.0 or later to use the Interactive Storage Management Facility (ISMF) functions

Note: ISPF is not required if only 3495 Tape Library Dataserver support is needed.

- Directory Maintenance VM/ESA (DirMaint) Version 1 (5748-XE4) Release 5.0 to use the minidisk management functions
- RACF/VM Version 1 (4740-XXH) Release 10.0, or an equivalent product, if an external security manager is needed
- To use the Migration Level 2 (ML2) function of DFSMS/VM, ADSTAR Distributed Storage Manager (5648-020), Tivoli ADSM for VM (5697-VM3), or Tivoli Storage Manager for VM (5697-TSM, 5697-TS9, or 5698-TSM) is required
- TCP/IP Feature for z/VM Level 3A0 to access the 3495 Tape Library Dataserver for processors capable of 3490/3490E tape I/O but incapable of 3495 Tape Library Data Server control
- Program Development Facility (PDF) Version 3 (5684-123) Release 2.0 or CMS Utilities Feature to use the BROWSE and EDIT functions
- Remote Spooling Communications Subsystem Networking (RSCS) Version 3 (5684-096) Release 2.0 or later for remote operations
- IBM Compiler for REXX/370 (5695-013) and IBM Library for REXX/370 (5695-014) if the compiled REXX installation-wide exit or a compiled ACS REXX exit is desired

DFSMS/VM APAR VM61214 is required for Year 2000 support.

OSA/SF Program Requirements

OSA/SF can be accessed by a CMS user ID, by a REXX call to the OSA/SF API, and at the OSA/SF graphical user interface (GUI).

Access at the OSA/SF GUI requires one of the following:

- Microsoft Windows 95 4.00.950B (OSR2)
- Microsoft Windows NT 4.0 with Service Pack 3
- IBM OS/2 Warp Version 4.0 fixpack 6

Access at the OSA/SF GUI also requires one of the following communications protocols:

- EHLLAPI (3270), which requires either Personal Communications/3270 Version 4 (5871-AAA) Release 2 or ACF/VTAM®
- APPC (CPI-C), which requires ACF/VTAM OS/2 on the workstation
- TCP/IP, which requires TCP/IP on the workstation and TCP/IP running on the host

To support an OSA in its TCP/IP Passthru mode in a z/VM environment, OSA/SF requires TCP/IP Feature for z/VM Level 3A0. OSA/SF is required in TCP/IP Passthru mode when sharing OSA ports among logical partitions or for defining the emulated/logical ports of a 155 ATM feature.

Language Environment Program Requirements

To do Language Environment customization, or to compile assembler routines included in mixed-language user applications, you need the following licensed program:

- IBM High Level Assembler Version 1 (5696-234) Release 2.0 or later

CMS Utilities Feature Program Requirements

To enable the DIRMAP utility of the CMS Utilities Feature to process directory statements that are continued across multiple records, such as the statements for POSIX support (POSIXOPT, POSIXINFO, POSIXGLIST, and POSIXGROUP), APAR VM58937 must be applied.

Note: This function is now provided in Directory Maintenance VM/ESA (DirMaint) Version 1 (5798-XE4) Release 5.0.

APAR VM60540 is required for Year 2000 support.

TCP/IP Feature for z/VM Program Requirements

TCP/IP Feature for z/VM Level 3A0 requires z/VM 3.1.0 and the Language Environment supplied with z/VM 3.1.0. Previous levels of CP, CMS, and Language Environment cannot be used.

TCP/IP Feature for z/VM has the following additional program requirements:

- If a primary or secondary domain name server is to be run (not a caching-only name server), or the Network Data Base server is to be run:
 - IBM DB2 Server for VSE & VM Version 6 (5648-A70) or IBM DB2 Server for VSE & VM Version 7 (5697-F42)
- For SNALink LU0 interface support:
 - ACF/VTAM for VM/ESA Version 4 (5654-010)
- For X.25 interface support:
 - X.25 NCP Packet Switching Interface (NPSI) Version 3 (5688-035) Release 4 or later for 3745 or 3720
 - X.25 NPSI Version 2 (5668-719) Release 1 for 3725
 - Corresponding levels of ACF/VTAM and ACF/NCP that support NPSI
- If programs are developed in C:
 - IBM C for VM/ESA Version 3 (5654-033) Release 1
- If programs are developed in Pascal:
 - IBM VS Pascal Version 1 (5668-767) Release 2 Compiler and Library

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For more information about program requirements for the TCP/IP Feature for z/VM, see *z/VM: TCP/IP Level 3A0 Planning and Customization*.

OpenEdition DCE Feature for VM/ESA Program Requirements

The OpenEdition DCE Feature for VM/ESA requires the following:

- TCP/IP Feature for z/VM Level 3A0
- IBM C for VM/ESA Version 3 (5654-033) Release 1.0

LANRES/VM Feature Program Requirements

The LANRES/VM feature has the following programming requirements:

- On the NetWare server:
 - One of the following:
 - NetWare Version 3.11 from IBM
 - NetWare Version 3.12 from IBM
 - NetWare Version 4.01 from IBM
 - NetWare Version 4.02 from IBM
 - NetWare v3.11J from IBM
 - NetWare 3.12J/V from IBM
 - Novell NetWare Version 3.11
 - Novell NetWare Version 3.12
 - Novell NetWare Version 4.01
 - Novell NetWare Version 4.02

Notes:

1. NetWare v3.11J from IBM and NetWare 3.12J/V from IBM run only on the PS/55 platform.
 2. You will also need any software required by NetWare.
- Depending on what type of clients you have on your NetWare LAN, you may need this additional software:
 - To use Macintosh client support, you need one of the following on the server:
 - When using NetWare Version 3.11:
 - NetWare for Macintosh Version 3.01, or later
 - NetWare for Macintosh from IBM Version 3.01, or later
 - When using NetWare Version 3.12:
 - NetWare for Macintosh Version 3.12, or later
 - NetWare for Macintosh from IBM Version 3.12, or later
 - When using NetWare Version 4.01 or 4.02:
 - NetWare for Macintosh Version 4.0, or later
 - NetWare for Macintosh from IBM Version 4.0, or later
 - When using NetWare v3.11J from IBM:
 - NetWare for Macintosh v3.011J from IBM
 - When using NetWare 3.12J/V from IBM:
 - NetWare for Macintosh 5-Users, which is bundled to NetWare 3.12J/V from IBM

Note: Product numbers vary based on the number of sessions. See your IBM representative for more information.

- To use NetWare NFS client support, you need one of the following on the server:
 - When using NetWare Version 3.11 or Version 3.12:
 - NetWare NFS Version 1.1, or later

- NetWare NFS from IBM Version 1.1, or later
- When using NetWare Version 4.01 or Version 4.02:
 - NetWare NFS Version 1.2b with patch NFS153.EXE, or later
 - NetWare NFS from IBM Version 1.2b with patch NFS153.EXE, or later
- When using NetWare v3.11J from IBM:
 - NetWare NFS v1.2J from IBM
- When using NetWare 3.12J/V from IBM:
 - NetWare NFS v1.2J from IBM (Version 1.2C)

Note: Versions previous to Version 1.2C are not supported. These users should get an update kit from IBM.

- Additional connectivity requirements:
 - To use the NetWare for SAA channel driver connection between the host processor and the NetWare server, you need:
 - On the host, ACF/VTAM Version 4.2.0 for VM/ESA (5654-010)
 - On the channel-attached NetWare server, you will need one of the following:
 - NetWare 3.12, NetWare 4.01, or NetWare 4.02 with NetWare for SAA Version 1.3B
 - NetWare 3.12J/V from IBM with NetWare for SAA 1.3B from IBM (Japanese Version)

Notes:

1. NetWare for SAA Version 1.3B must be at service level 1.3.59 or later.
 2. With NetWare for SAA Version 1.3B, the NetWare Communication Executive must be at service level 1.3.46, or later.
 3. NetWare 4.01 must have fix DSPAT.EXE.
- To use SNA LU 6.2 communications between the VM host and the NetWare server, you need:
 - ACF/VTAM Version 4.2.0 for VM/ESA (5654-010)
 - One of the following installed on the NetWare server:
 - NetWare for SAA from IBM Version 1.2
 - NetWare for SAA from IBM Version 1.3B
 - NetWare for SAA 1.3B from IBM (Japanese Version) -- this is required if you are using NetWare 3.12J/V from IBM
 - NetWare for SAA Version 1.2
 - NetWare for SAA Version 1.3B

Product numbers vary based on the number of sessions. See your IBM representative or the appropriate NetWare for SAA Administration Guide for more information.

- To use TCP/IP protocols between the z/VM host and the NetWare server, you will also need:
 - TCP/IP Feature for z/VM Level 3A0
 - IBM C/370™ Library Version 2 (5688-188)
- Additional print serving requirements:
 - To use the ASCII ES/9000® support, you need:
 - RSCS Version 3 (5684-096) Release 1.1 or later
 - To use printers supported by the Print Services Facility™ (PSF), you need:
 - PSF/VM Version 2 (5684-141) Release 1.1 or later

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- To print PostScript files, you need:
 - IBM Publishing Systems PostScript Interpreter for Advanced Function Printing™ (5688-104)
 - PSF/VM Version 2 (5684-141) Release 1.1 or later

Note: LANRES/VM does not support importing Encapsulated PostScript files into other PostScript language files.

- To send client data to the reader of a host virtual machine, you need:
 - RSCS Version 3 (5684-096) Release 1.1 or later

Program Requirements for VM Related Products

The following VM related products require the specified APARs to run on z/VM 3.1.0:

- Directory Maintenance VM/ESA (DirMaint) Version 1 (5748-XE4) Release 5.0 — VM62609
- Pass-Through Facility (PVM) Version 2 (5684-100) Release 1.1 — VM61373
- Host Management Facility (HMF) Version 1 (5684-157) Release 1.1 — VM62632

Online Books Program Requirements

Online books are available in two formats: Adobe Portable Document Format (PDF) and IBM BookManager®.

Portable Document Format (PDF)

The Adobe Acrobat Reader is required to open and view PDF books on your workstation. You can also use the Adobe Acrobat Reader to print PDF books or sections of PDF books. The Adobe Acrobat Reader is available free from the Adobe home page (<http://www.adobe.com>).

IBM BookManager

IBM BookManager READ/VM (5684-062) Release 3 or later is required to view BookManager books loaded on the z/VM system. This program has the following prerequisite licensed programs:

- GDDM/VMXA Version 2 (5684-007) Release 3 or later
- C/370 Library Version 2 (5688-188) Release 2 or later
- IBM Compiler and Library for REXX/370 (5695-013) or IBM Library for REXX/370 (5695-014)

BookManager APAR GC05366 is required for READ/VM Public Library to run in a non-370 mode virtual machine.

Special versions of the BookManager READ programs for Windows, OS/2, and DOS are included on the *IBM Online Library Omnibus Edition: VM Collection* CD-ROM. Also included is the IBM Bookshelf Upload Program, which allows you to upload books to a VM, OS/390, or MVS® host.

Note: The IBM Library Reader™ programs for Windows, OS/2, and DOS have been revised to read all books in BookManager format (IBM and non-IBM). The BookManager files supplied with z/VM will work only with the new readers. Library Reader programs provided prior to VM/ESA 2.4.0 will not read these BookManager files. To read these files using a Library Reader program on your workstation, you must use one of the Library Reader programs provided on the July 1999 or later CD-ROM or download the revised program from the IBM BookManager Web site (<http://booksrv1.raleigh.ibm.com/homepage/ilrserv.html>).

Operating Systems Supported as Guests

For a list of operating systems and versions of operating systems supported as guests of z/VM, see “Appendix B. IBM Operating Systems Supported as Guests of VM” on page 81.

Other Programs Supported on z/VM

The following documents contain information about other programs supported on z/VM:

- *Licensed Products Migration Matrix for VM* lists IBM licensed programs. It is available at:
<http://www.ibm.com/servers/eserver/zseries/zvm/related>
- *Software Vendors' Products That Will Run on VM* lists non-IBM programs. It is available at:
<http://www.ibm.com/servers/eserver/zseries/zvm/vendor>

Another source of information about supported products is the *IBM Global Solutions Directory*:

<http://www8.software.ibm.com/solutions/isv/igssg.nsf/>

National Language Support (NLS)

z/VM provides National Language Support (NLS) for several of its components, facilities, and features. End users can selectively (through commands) receive messages and HELP in their national language. Any of the languages can be set as the system default language. Each session on the same system can select a language that is different from another session, as long as the language selected has been installed on that system. For example, user A can be using German while user B is using Japanese.

z/VM Base

The available languages and the components that are translated are:

Language	Translated Components
German	CP, CMS, and REXX/VM
Japanese	CP, CMS, and REXX/VM

In addition, IBM provides uppercase American English on the z/VM System DDR.

CP lets virtual machines write Double-Byte Character Set (DBCS) display data to display devices (in line mode) while CP manages the display screen.

DFSMS/VM

DFSMS/VM is enabled for NLS for panels and messages. DFSMS/VM is translated to Japanese (KANJI) as well as mixed-case American English (AMENG) and uppercase American English (UCENG).

In addition to supporting these languages, DFSMS/VM also supports multiple active languages at the same time. For example, a user could have their virtual machine set to upper-case English, enter a DFSMS MIGRATE command, and the reader file returned to the user would be in upper-case English. Also, another user

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could have their virtual machine set to Japanese, enter the same command at the same time the other user issued the command, and the reader file returned to this user would be in Japanese.

CMS Utilities Feature

CMS Utilities Feature is enabled for NLS for panels and messages. CMS Utilities Feature is provided in uppercase American English, but it is also available in German and Japanese.

Packaging and Ordering Information

To order z/VM, order program number 5654-A17.

z/VM is distributed as a multivolume system DASD Dump Restore (DDR) image on 3480 or 3490 tape cartridges, 4mm tape cartridges, or CD-ROM disks. The system DDR image is available for the 3380, 3390 (except 3390-9), 9345, and FBA (9336) DASD devices supported for installation.

The system DDR contains:

- CP
- CMS
- REXX/VM
- VMSES/E
- GCS (preinstalled on minidisks)
- AVS (preinstalled on minidisks)
- TSAF (preinstalled on minidisks)
- SFS and CRR file pools
- Dump Viewing Facility
- ICKDSF for VM Release 16 (includes ICKDSF Standalone Release 16)
- DASD Dump Restore (DDR) Program
- Environmental Record Editing and Printing (EREP/VM) Version 3 Release 5
- Translated CP and CMS message repositories
- 3800 Printer Image Library object code
- 3800 Printer Image Library source
- Language Environment
- OSA/SF V2R1
- TCP/IP Base Feature for z/VM (Level 3A0)
- TCP/IP Network File System (NFS) Feature
- Translated HELP files

Notes:

1. ICKDSF for VM (5684-042) and EREP/VM (5654-260) are not part of z/VM. They are separate licensed programs that are prerequisites of z/VM, and they are shipped on the z/VM system DDR for convenience. You must already be licensed for these programs or you must place separate orders for them to establish a license.
2. Although shipped on the z/VM system DDR, the TCP/IP Base Feature for z/VM and the TCP/IP NFS Feature are separately-orderable priced features of z/VM.
3. For convenience only, the following licensed programs are also shipped on the z/VM system DDR. If you decide to use these programs, you must place separate orders for them.
 - RSCS Version 3 (5684-096) Release 2.0
 - Tivoli Storage Manager for VM Version 4 (5698-TSM) Release 1.0

If you order z/VM on tape, the base product ships with the following additional feature tapes (on the product medium):

- DFSMS/VM Function Level 221
- REXX/EXEC Migration Tool for VM/ESA
- PLX source
- Stacked recommended service upgrade (RSU)

The following feature tapes are separately-orderable:

- CMS Utilities Feature (CUF)
- LANRES/VM Feature
- OpenEdition DCE Feature for VM/ESA, Base Services Feature
- OpenEdition DCE Feature for VM/ESA, User Data Privacy Feature
- Restricted Source
- TCP/IP Source Feature
- VM BookManager Library Feature

If you order z/VM on CD-ROM, you receive all of the items listed above *except* the following, which must be ordered separately:

- CMS Utilities Feature (CUF)
- OpenEdition DCE Feature for VM/ESA, Base Services Feature
- OpenEdition DCE Feature for VM/ESA, User Data Privacy Feature

Object Code Only and Limited Source Availability

Some z/VM components, facilities, and features are distributed in object code only (OCO) form. No source program materials are available for the following:

- AVS
- Dump Viewing Facility
- DFSMS/VM
- OpenEdition DCE Feature for VM/ESA
- SSL server included with the TCP/IP Feature for z/VM

CP and CMS are distributed partially in OCO form, which means that some modules will not have source program materials available but others will.

Restrictions

z/VM does *not* support reconfiguration of partitionable processors, either by z/VM itself or by guests running on z/VM.

General Restrictions for z/VM Virtual Machines

z/VM virtual machines have the following general restrictions:

- Dynamically modified channel programs cannot run in a virtual machine unless one of the following is true:
 - The virtual machine uses the V=R performance option
 - The channel program modification facility that the DIAGNOSE interface provides can be used to ensure correct operation of such channel programs.
- Channel command support is limited to basic device support; therefore, z/VM does not support the Speed Matching Buffer. Performance degradation occurs when a DASD attached to a 3880 Control Unit with a Speed Matching Buffer is used as a CP-owned device in low speed mode.
- VSE requires the following:
 - Operation in a virtual machine with a minimum size of 1MB
 - System generation with options appropriate to virtual machine operation.

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- If operating systems running in virtual machines under z/VM control use separate master and logon consoles, the consoles should be placed on different control units; otherwise, console lockout may occur.
- z/VM does not support alternate tracking on 3340 and 3344 devices for virtual machines.
- When CP is running in a logical partition, you cannot run V=F guests. (They are converted into V=V guests during logon.)
- The CPUID that appears in most EREP records is not the same as the CPUID of the physical processor on which the error occurred (because there is more than one partition per physical processor in LPAR mode).

Integrity and Security of z/VM

This section discusses facilities of z/VM that deal with the security and integrity of the system.

Data Integrity for Guests

Operating system failures that occur in virtual machines do not normally affect the z/VM operating system running on the real processor. If the error is isolated to a virtual machine, only that virtual machine fails, and the user can re-IPL without affecting the testing and production work running in other virtual machines.

System Integrity Statement for z/VM

System integrity is an important characteristic of z/VM. This statement extends IBM's previous statements on system integrity to the z/VM environment.

IBM has implemented specific design and coding guidelines for maintaining system integrity in the development of z/VM. Procedures have also been established to make the application of these design and coding guidelines a formal part of the design and development process.

However, because it is not possible to certify that any system has perfect integrity, IBM will accept APARs that describe exposures to the system integrity of z/VM or that describe problems encountered when a program running in a virtual machine not authorized by a mechanism under the customer's control introduces an exposure to the system integrity of z/VM, as defined in the following "z/VM System Integrity Definition" section.

IBM will continue its efforts to enhance the integrity of z/VM and to respond promptly when exposures are identified in z/VM and any subsequent releases.

z/VM System Integrity Definition

The z/VM control program system integrity is the inability of any program running in a virtual machine not authorized by a z/VM control program mechanism under the customer's control or a guest operating system mechanism under the customer's control to:

- Circumvent or disable the control program real or auxiliary storage protection.
- Access a resource protected by RACF. Resources protected by RACF include virtual machines, minidisks, and terminals.
- Access a control program password-protected resource.
- Obtain control in real supervisor state or with privilege class authority or directory capabilities greater than those it was assigned.

- Circumvent the system integrity of any guest operating system that itself has system integrity as the result of an operation by any z/VM control program facility.

Real storage protection refers to the isolation of one virtual machine from another. CP accomplishes this by hardware dynamic address translation, start interpretive-execution guest storage extent limitation, and the Set Address Limit facility.

Auxiliary storage protection refers to the disk extent isolation implemented for minidisks/virtual disks through channel program translation.

Password-protected resource refers to a resource protected by CP logon passwords and minidisk passwords.

Guest operating system refers to a control program that operates under the z/VM control program.

Directory capabilities refer to those directory options that control functions intended to be restricted by specific assignment, such as those that permit system integrity controls to be bypassed or those not intended to be generally granted to users.

Customer Responsibilities: While protection of the customer's data remains the customer's responsibility, data security continues to be an area of vital importance to IBM. IBM's commitment to the system integrity of the z/VM environment, as described in this statement, represents a further significant step to help customers protect their data.

Product documentation, subject to change, describes the actions that must be taken and the facilities that must be restricted to complement the system integrity support provided by z/VM. Such actions and restrictions may vary depending on the system, configuration, or environment. The customer is responsible for the selection, application, adequacy, and implementation of these actions and restrictions, and for appropriate application controls.

Security, Auditability, and Control

z/VM includes several facilities to enhance or improve the security and integrity of the system:

- Each guest and CMS user runs in a unique virtual machine definition which, in combination with hardware features, prohibits one user from accessing another's data in storage (unless specifically allowed through shared segments, communication vehicles such as IUCV and APPC/VM, or ESA/XC data sharing services).
- z/VM, in combination with hardware features, provides protection against channel programs accessing another user's virtual addresses.
- A password facility provides minidisk security to control both read-only and read-write access.
- Both user ID and password checking are provided to minimize unauthorized system access.
- User class restructure provides customers with the ability to control access to commands and DIAGNOSE codes more precisely through customer-defined classes.

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- Journaling is supported on z/VM. In addition, RACF provides customers with many of these facilities, as well as other security capabilities.
- The NOVF parameter on the OPTION directory control statement lets z/VM restrict the use of the Vector Facility by the virtual machine.
- Directory control statements and system configuration file statements provide controls for certain POSIX-related functions, such as the ability to change another virtual machine's POSIX security values.
- TCP/IP Feature for z/VM offers:
 - Kerberos authentication service
 - Secure Socket Layer (SSL) support

CMS File Pool Security

CMS file pools include the following features to aid data security for SFS data and BFS data stored in them:

- To access a file pool, you must be authorized (enrolled) by someone with administrator authority for that file pool, or PUBLIC must be enrolled.
- If an administrator gives you an SFS file space in a file pool, you are the only one (other than an administrator) who can create files in that file space, unless you specifically grant this authority to another user.
- You can control access to your SFS files and directories by granting and revoking authority to other users.
- Only the owner of an SFS directory or an administrator can delete the directory.
- Implicit and explicit locks prevent simultaneous updates.
- An auditing facility is available that documents:
 - Attempts to access file pool resources
 - Use of CRR recovery server operator commands and file pool server operator commands, which erase CRR and SFS log data in the intervention of CRR activity.

In addition, an external security manager can replace file pool authorizations for those objects protected by the external security manager.

File pools can exploit external security manager services through documented interfaces including the use of the RACROUTE programming interface.

User management is responsible for evaluation, selection and implementation of these features, for administrative procedures, and for appropriate controls in application systems and communications facilities.

RACF Support

The Resource Access Control Facility (RACF) licensed program is a strategic security facility that provides comprehensive security capabilities. RACF controls user access to the system, checks authorization for use of system resources, and audits the use of system resources.

In the z/VM environment, RACF verifies logon passwords and checks access to minidisks, data in spool files, and RSCS nodes. You can use RACF commands to audit security-relevant events and prevent users from entering the CP DIAL and MSG commands before they log on. The events you can audit include:

- Any CP command or DIAGNOSE code (including privileged commands and DIAGNOSE codes)
- The creation, opening, and deletion of spool files

- The dumping and loading of spool files through the SPXTAPE and SPTAPE commands
- IUCV CONNECT and SEVER operations and certain VMCF functions
- APPC/VM CONNECT and SEVER operations
- The creation and deletion of logical devices.

Chapter 4. z/VM Base Components

This chapter describes the base components of z/VM:

- “Control Program (CP)”
- “Conversational Monitor System (CMS)” on page 40
- “REXX/VM” on page 43
- “Group Control System (GCS)” on page 44
- “Transparent Services Access Facility (TSAF)” on page 44
- “APPC/VM VTAM Support (AVS)” on page 44
- “Virtual Machine Serviceability Enhancements Staged/Extended (VMSES/E)” on page 45
- “Dump Viewing Facility” on page 45

Control Program (CP)

CP is primarily a real-machine resource manager. CP provides each user with an individual working environment known as a *virtual machine*. Each virtual machine is a functional equivalent of a real system, sharing the real processor function, storage, console, and input/output (I/O) device resources.

When you first log on to z/VM, CP controls the working environment. Many of the facilities of z/VM are immediately available to you. For example, you can use CP commands to do various system management tasks. However, most of the work done on z/VM requires the CMS component or another operating system, such as z/OS, to help with data processing tasks and to manage work flow.

CP also provides connectivity support that allows application programs to exchange information with each other and to access resources residing on the same VM system or on different VM systems.

For National Language Support information, see “z/VM Base” on page 27.

CP Image

z/VM provides both a 64-bit CP image and a 32-bit CP image. You can IPL the 64-bit CP image only on a z/Architecture processor. You can IPL the 32-bit CP image on a z/Architecture or ESA/390 architecture processor.

z/VM also provides a dual-image CP. If the dual-image CP is installed, it automatically determines at IPL if the processor is capable of running z/Architecture. If it is, the 64-bit CP image is loaded; otherwise, the 32-bit CP image is loaded.

z/VM Virtual Machines

z/VM supports 370, XA, ESA, and XC virtual machines:

- 370 virtual machines process according to System/370™ architecture. They are supported for compatibility with previous versions of VM, but only on older ESA/390 processors (see “Appendix A. IBM Processors Supported by VM” on page 77).
- XA virtual machines are functionally equivalent to ESA virtual machines. The XA designation is supported for compatibility with previous versions of VM.

Base Components

- ESA virtual machines processing according to ESA/390 architecture and may also be capable of processing according to z/Architecture, depending on the processor on which z/VM is installed and the CP image that is loaded.
- XC virtual machines process according to ESA/XC architecture.

Notes:

1. CMS will not run in a 370 virtual machine. Applications developed for the 370 virtual machine should use the 370 Accommodation Facility and, if necessary, the CMS SET GEN370 OFF command to run in a non-370 virtual machine.
2. Some CMS applications may check the virtual machine designation and may require CMS to be running in an XA virtual machine.

Table 2 shows the different virtual machine designations and their resulting architecture modes.

Table 2. Virtual Machine Architecture Modes

Virtual Machine Designation	Resulting Virtual Machine Architecture on an ESA/390 Processor	Resulting Virtual Machine Architecture on a z/Architecture Processor
370	System/370 ¹	n/a
XA ² , ESA	ESA/390	ESA/390 or z/Architecture ³
XC	ESA/XC	ESA/XC
Notes: <ol style="list-style-type: none">1. System/370 mode is supported only on older ESA/390 processors. The IBM S/390 Parallel Enterprise Server™ G4 and later do not support System/370 mode even for guests.2. The XA designation is supported for compatibility. An XA virtual machine is functionally equivalent to an ESA virtual machine.3. An ESA virtual machine processes according to ESA/390 architecture on the 32-bit CP image on a z/Architecture processor. On the 64-bit CP image on a z/Architecture processor, an ESA virtual machine is capable of processing according to either ESA/390 architecture (390 mode) or z/Architecture (z-mode), as determined by the program that is loaded into the virtual machine.		

z/VM also provides three types of virtual machines, which are defined by their storage configurations:

V=R machine

Virtual=Real machine. This virtual machine has a fixed, contiguous area of host real storage starting at location 0. CP does not page this storage, so guest real storage maps to host real storage. CP provides performance benefits for this virtual machine (compared to V=V machines) and an automatic recovery mechanism.

V=F machine

Virtual=Fixed machine. This virtual machine also has a fixed, contiguous area of host real storage, but the area does not start at real location 0. CP does not page this storage, so guest real storage maps to host real storage. CP also provides performance benefits for this virtual machine (compared to V=V machines).

V=V machine

Virtual=Virtual machine. This virtual machine's guest real storage does not permanently map to host real storage. Rather, CP pages the guest real storage of a V=V machine into and out of host real storage.

Because V=R and V=F machines receive preference in terms of storage and performance, these virtual machines are called preferred virtual machines.

For more information about the types of virtual machines, see *z/VM: Running Guest Operating Systems*.

Guest Support

Guests that exploit features of System/370 architecture, 370-XA architecture, ESA/370 architecture, ESA/390 architecture, or z/Architecture can operate in virtual machines on z/VM, depending on the processor on which z/VM is installed and the CP image that is loaded.

System/370 guests are supported in 370 virtual machines only when z/VM is installed on the IBM Parallel Enterprise Server R2/R3 or the IBM S/390 Parallel Enterprise Server G3, because later processors do not support 370 virtual machines. However, the 370 Accommodation Facility allows many CMS applications written for 370 virtual machines to run in ESA, XA, and XC virtual machines on newer processors. For more information about the 370 Accommodation Facility, see *z/VM: CP Programming Services*.

Because ESA/370 is upwardly compatible from 370-XA, and ESA/390 is upwardly compatible from ESA/370, in most cases 370-XA and ESA/370 guests can run in ESA/390 virtual machines. CP does not distinguish between the 370-XA, ESA/370, and ESA/390 architectures.

If z/VM is installed on a z/Architecture processor, and the 64-bit CP image is loaded, z/Architecture guests can use z/Architecture facilities (such as 64-bit arithmetic and addressing).

ESA/XC Architecture

z/VM uses extensions to the interpretive-execution facility to provide the Extended Configuration (ESA/XC) virtual machine architecture. ESA/XC is an architecture unique to virtual machines. Because it exists mainly to provide services to application programs in virtual machines, ESA/XC architecture does not have a basic-mode or native-mode equivalent.

ESA/XC architecture lets virtual machines share multiple data spaces. An XC machine can access one or more data spaces of another virtual machine if so authorized. This is extremely useful for applications that require one or more virtual machines to serve many users.

Cross-System Extensions (CSE)

CSE is a function of z/VM that allows multiple systems running z/VM or VM/ESA to be coupled together in a complex that provides cross-system functions:

- Cross-system link, which extends the existing CP minidisk access protocols (for minidisk linking) across the CSE complex
- Cross-system spool, which extends CP spooling
- Cross-system message, query, and other commands
- Support for printer spooling

See “Cross-System Extensions Hardware Requirements” on page 16 and “Cross-System Extensions Program Requirements” on page 21.

Base Components

Inter-System Facility for Communications (ISFC)

ISFC is a function of CP that enables communication between programs written to the APPC/VM, CPI Communications, or IUCV programming interfaces. A group of interconnected VM systems that use ISFC to communicate with each other is known as a Communication Services (CS) collection. Programs on systems in the CS collection can use ISFC to access, manage, and share resources defined in the collection. ISFC also enables programs in a CS collection to communicate with APPC programs on systems in the SNA network.

VM Dump Tool

The VM Dump Tool assists in analyzing dump data from a dump file created by the DUMpload utility. The VM Dump Tool provides a variety of subcommands and macros that allow you to display, locate, and format dump data interactively. This tool can process CP stand-alone dumps, CP ABEND dumps, and virtual machine dumps of a CP system.

For more information, see *z/VM: VM Dump Tool*.

The Dump Viewing Facility component interactively diagnoses virtual machine dumps. See “Dump Viewing Facility” on page 45.

Support for Hardware Architectures and Facilities

CP is the component of z/VM that provides support for hardware architectures and facilities, some of which are described here. Note that in many cases this support is available only to guests.

Asynchronous Data Mover Facility (ADMF)

CP provides guest support for ADMF. ADMF provides an extension to the existing channel subsystem which is capable of off-loading page move activity onto the I/O processor, freeing the instruction processor for other work while the page movement is performed. No external control or intervention is necessary. ADMF is available for guest use automatically at LOGON if:

- z/VM is running in basic mode (not in an LPAR)
- The PR/SM feature is available
- The guest is a preferred guest (V=R, V=F)

Concurrent-Sense Facility

CP provides guest support for the concurrent-sense facility, which is designed for use on channel paths that support the ESCON I/O interface. This facility allows the channel subsystem to present I/O status information and sense information together, in one I/O operation. This eliminates the wait for sense information whenever status information is received.

Cryptographic Facility

CP supports guest use of a cryptographic facility. The cryptographic facility provides cryptographic capability to transaction processing environments. Cryptography is an effective means of protecting data in computer and communication systems from unauthorized disclosure. It involves the process of transforming plaintext into cyphertext (encipherment) and the reverse process of transforming ciphertext into plaintext (decipherment).

Enterprise Systems Connection Architecture® (ESCON)

ESCON is built around fiber optic transmission technology. Fiber optic cables reduce cable bulk, allow for increased distance between the processor and attached devices, and improve data transfer rates. ESCON I/O devices can be attached to

the processor at distances up to 9 kilometers (5.5 miles) using LED technology and 60 kilometers (37.2 miles) using laser technology.

Expanded Storage

Expanded Storage is an optional integrated high-speed storage facility, available on certain processors, that allows for the rapid transfer of 4KB blocks between itself and real storage.

Extended-TOD-Clock Facility

The Extended-TOD-clock facility is a hardware facility available on certain processors which provides a 128-bit Time of Day (TOD) clock. CP supports the use of the Extended-TOD-clock facility from XA, ESA, and XC virtual machines.

Fibre Connection (FICON™) Channels

FICON is a fiber-optic I/O architecture that coexists with and exploits existing ESCON equipment and infrastructure, but offers improved link performance and enhanced distance connectivity. Each FICON channel provides the equivalent of eight ESCON channels.

Flash Copy

A native CP user can initiate the Flash Copy function to make an instant copy of a disk or data set from a source device to a target device on an IBM Enterprise Storage Server™ or other virtual DASD subsystem.

IEEE Floating Point

CP supports guest use of the IEEE Floating Point hardware on the IBM @server zSeries 900 and on the IBM S/390 Enterprise Server G5 and later. This support allows multiple levels of guests to use basic floating point extensions, floating point support extensions, hexadecimal floating point extensions, and binary floating point.

Move-Page Facility

CP provides support for V=V guest use of the Move-Page Facility. A page of data can be moved from main storage to main storage, from main storage to expanded storage, or from expanded storage to main storage.

Guest Move-Page support is *not* available to:

- Guest virtual machines when z/VM is running in a logical partition
- A z/VM or VM/ESA guest of z/VM

Parallel Access Volumes

CP provides guest support for the Parallel Access Volumes feature of the IBM Enterprise Storage Server. This feature allows you to configure base and alias DASD volumes. The alias volumes are logical volumes that map the physical space occupied by the base. However, each alias volume has a unique subchannel ID, which allows concurrent I/O to a base volume and all of its associated alias volumes.

Processor Resource/Systems Manager (PR/SM)

CP supports both basic mode and logically partitioned (LPAR) mode on processors with the PR/SM feature installed.

PR/SM Support of Multiple Preferred Guests: When the processor operates in basic mode, CP supports up to six preferred guests. Two configurations are supported: one V=R guest and up to five V=F guests, or no V=R guest and up to six V=F guests. Note that on a physically partitioned multiprocessor, running two copies of z/VM supports up to 12 preferred guests.

Base Components

With multiple preferred guest support, you can simultaneously support many CMS users, test multiple guest systems, and support multiple production guests.

PR/SM Support of Logical Partitioning: When the processor operates in LPAR mode, it provides flexible partitioning of processor resources across multiple logical partitions. Each logical partition contains some portion of the processor, storage, and channel path resources and, if available, some portion of the Expanded Storage and Vector Facility resources of the processor.

CP supports logical path measurement in an ESCON Multiple Image Facility (EMIF) environment.

Queued-Direct I/O (QDIO) Facility

CP supports guest use of the QDIO Facility. The QDIO Facility allows a program running on a z/Architecture or ESA/390 processor to directly exchange data with an I/O device without performing traditional I/O instructions. To exchange data, both the I/O device and the program reference main storage directly through a set of data queues.

Vector Facility

The Vector Facility processor feature improves the performance of vector processing for numerically intensive applications. CMS and guest operating systems can use the Vector Facility.

Conversational Monitor System (CMS)

CMS provides a high-capacity environment that supports large numbers of interactive users. CMS can help you perform a wide variety of tasks:

- Write, test, and debug application programs for use on CMS or guest systems
- Run application programs developed on CMS or guest systems
- Create and edit data files
- Process jobs in batch mode
- Share data between CMS and guest systems
- Communicate with other system users

For National Language Support information, see “z/VM Base” on page 27.

For general information about CMS, see the *z/VM: CMS User's Guide*.

CMS Application Programming

CMS supports a wide range of high-level languages and application environments. CMS also provides many application programming facilities, including:

- Extended architecture (XC) support
- CMS Pipelines
- Multitasking services
- Callable services library (CSL)
- OpenExtensions
- Reusable Server Kernel
- Assembler macros and functions
- OS/MVS simulation
- DOS/VSE support

For more information, see the following books:

- *z/VM: CMS Application Development Guide*
- *z/VM: CMS Application Development Guide for Assembler*

Shared File System (SFS)

SFS is an extension of the CMS file system that offers you additional file management and file sharing functions:

- Files are stored in file pools.
- A user can be given an amount of file space in a file pool.
- The files in a file space are organized in directories.
- A file can be placed in more than one directory.
- Users can grant each other authorities on files or directories.
- Multiple users can have concurrent access to the same file or directory.
- Locks on files and directories ensure data integrity among multiple users.
- You can share files and directories with users in other systems.

A file pool is a collection of minidisks assigned to a single virtual machine called a *file pool server machine*. Because the minidisks in the file pool are shared by many users, using SFS can save DASD space. Certain SFS directories can be placed into VM data spaces, providing an additional DASD savings.

DFSMS/VM provides storage management functions for file pools. It erases expired files and migrates low activity files to auxiliary storage, which enables better utilization of high performance DASD.

For more information, see *z/VM: CMS File Pool Planning, Administration, and Operation*.

CMS Pipelines

CMS Pipelines provides a rich and efficient set of functions that you can use to solve large problems by breaking them up into smaller, less complex programs. These smaller programs are called *stages*. Many stages are included with CMS Pipelines. Some stages read data from system sources, such as disk files, tape files, or the results of VM commands. Other stages filter and refine that data in some way. You can combine many stages within a single *pipeline* to create the results you need. You can also write your own stages.

For more information, see the *z/VM: CMS Pipelines User's Guide*.

CMS Application Multitasking

CMS application multitasking services provide an execution environment for high-performance applications and servers. With CMS multitasking, an application can divide itself into multiple units of execution and provide the ability for these units, called threads, to run on multiple CPUs simultaneously. The multitasking facilities are available only at the application programming level. The CMS user still runs one application at a time, but these applications can split themselves into multiple execution units, or threads. These multitasking facilities allow applications to harness the power of the underlying multiprocessor complex and to overlap operations to achieve high performance.

For more information, see *z/VM: CMS Application Multitasking*.

OpenExtensions

OpenExtensions consists of three parts:

- OpenExtensions Services
- OpenExtensions Shell and Utilities
- OpenEdition DCE Feature for VM/ESA

Base Components

OpenExtensions Services and OpenExtensions Shell and Utilities are provided in CMS. OpenEdition DCE Feature for VM/ESA is optional.

OpenExtensions Services is the VM implementation of three POSIX standards:

- POSIX 1003.1 (known as POSIX.1) - System Interfaces
- POSIX 1003.1a (known as POSIX.1a) - Extensions to POSIX.1
- POSIX 1003.1c (known as POSIX.1c) - Threads

The POSIX.1, POSIX.1a, and POSIX.1c interfaces are provided as C library routines in the C for VM/ESA (C/VM™) run-time library. For programs written in other languages, a language-neutral version of the POSIX functions is provided as a set of callable services library (CSL) routines in z/VM known as the OpenExtensions callable services. These CSL routines are called by the C POSIX library routines to provide the functions, but are also available to other applications. The CSL routines can be invoked as REXX functions through a REXX subcommand environment, ADDRESS OPENVM.

Included in the OpenExtensions Services is a POSIX.1 compliant file system known as the Byte File System (BFS). BFS is a companion to the CMS Shared File System (SFS) that provides a byte-stream view of files. BFS allows data to be organized and used in a UNIX style and format.

Like SFS files, BFS files are organized in a hierarchical directory structure and stored in CMS file pools. While supporting the POSIX file system functions and rules, BFS also takes advantage of administration and system management facilities that it shares with SFS. These include space allocation, backup, and DFSMS/VM file migration, as well as other administrative functions.

CMS provides a set of commands, known as the OPENVM commands, that allow users to manage their BFS directories and files and control their related permission and ownership attributes. CMS Pipelines additionally provides the ability to use BFS from pipeline programs.

OpenExtensions Shell and Utilities provides application development tools and an interactive environment in support of the POSIX application environment. OpenExtensions Shell and Utilities is the VM implementation of the POSIX 1003.2 Shell and Utilities standard (known as POSIX.2). Each of the POSIX.2 utilities additionally conforms to the X/Open Portability Guide, issue 4 (XPG4) for Commands and Utilities.

OpenExtensions Shell and Utilities provides a large set of utilities that aid in program development and in porting applications from other open systems. It also provides a UNIX-like interactive user environment. Users of the shell environment have access to both the shell commands set (built-in commands and utilities) and the full CP and CMS command set, as well as both OpenExtensions and non-OpenExtensions applications.

See “OpenExtensions Program Requirements” on page 21.

For more information about OpenExtensions, see the following books:

- *z/VM: CMS Application Development Guide*
- *z/VM: OpenExtensions POSIX Conformance Document*
- *z/VM: OpenExtensions Callable Services Reference*
- *z/VM: OpenExtensions User's Guide*

For information about the OpenEdition DCE Feature for VM/ESA, see “OpenEdition DCE Feature for VM/ESA” on page 52.

Reusable Server Kernel

The reusable server kernel enables vendors and application programmers to write multithreaded server programs that are heavily exploitive of VM technologies. These servers can be constructed without knowledge of data transport mechanisms, multithreaded APIs, or I/O performance boosters and without reinventing API suites necessary in one server after another.

The reusable server kernel is an “empty” server program that server writers can use as a starting point for developing and executing server programs on CMS. The reusable server kernel consists of a text library of routines and a macro library of function prototypes and constant definitions. To construct an actual server program, the server author attaches application-specific code to a set of interfaces in the reusable server kernel.

For more information, see the *z/VM: Reusable Server Kernel Programmer's Guide and Reference*.

XEDIT

XEDIT is a full-screen editing facility that runs under CMS. XEDIT creates and modifies CMS files and BFS files. System macros and user-written procedures are performed from the XEDIT environment.

For more information, see the *z/VM: XEDIT User's Guide*.

CMS HELP Facility

The CMS HELP Facility provides online assistance for various z/VM functions in the form of menus and panels. HELP information is available for:

- Tasks
- Commands and options
- Subcommands
- REXX statements
- Callable routines
- Pipelines stages
- Assembler language macros
- Messages

Additional facilities and features of z/VM, as well as other licensed programs that run on CMS, may provide HELP information for display through the CMS HELP Facility. You can also write your own HELP information.

For more information, see the *z/VM: CMS User's Guide*.

REXX/VM

The REXX/VM component contains the REXX/VM Interpreter, which processes the English-like programming language, REstructured eXtended eXecutor (REXX). It also contains the VM implementation of the SAA REXX programming language. REXX/VM provides a single source base for the REXX/VM Interpreter in the CMS and GCS components. The REXX/VM Interpreter exploits 31-bit addressing.

Base Components

The REXX/VM Interpreter helps improve the productivity of your organization. Using REXX, you can write customized application programs and command procedures, tailor CMS commands, and create new XEDIT macros.

For more information, see the *z/VM: REXX/VM User's Guide*.

Group Control System (GCS)

GCS runs in a virtual machine (XA or XC mode) in place of CMS. It is a virtual machine supervisor, providing multitasking services that allow numerous tasks to remain active in the virtual machine at one time. The specific function of GCS is to support a native Systems Network Architecture (SNA) network. The SNA network relies on ACF/VTAM, VTAM® SNA Console Support (VSCS), and other network applications to manage its collection of links between terminals, controllers, and processors. GCS provides services for ACF/VTAM, VSCS, and the others, which eliminates your need for VTAM Communications Network Application (VM/VCNA) and a second operating system like VS1 or VSE.

Installation of GCS is optional.

For more information, see:

- *VM/ESA: Connectivity Planning, Administration, and Operation*
- *z/VM: Group Control System*

Transparent Services Access Facility (TSAF)

TSAF provides communication services within a collection of VM systems without using VTAM. TSAF runs in a CMS virtual machine. A group of up to eight VM systems that each have TSAF installed and running can form a TSAF collection. APPC/VM programs on one VM system in the TSAF collection can communicate with other APPC/VM programs on the other VM systems in the collection. The routing is transparent to the application programs. Communications between the applications proceed as if the applications were running on the same system.

Installation of TSAF is optional.

For more information, see *VM/ESA: Connectivity Planning, Administration, and Operation*.

APPC/VM VTAM Support (AVS)

AVS is a VTAM application that provides communication services between VM and non-VM systems in an SNA network. AVS and VTAM run in the same GCS group on a z/VM system. Together, AVS and VTAM enable APPC/VM application programs in a TSAF or CS collection to communicate with:

- Other APPC/VM applications residing in other VM systems within the SNA network
- APPC applications residing in non-VM systems in the SNA network

Installation of AVS is optional.

For more information, see *VM/ESA: Connectivity Planning, Administration, and Operation*.

Virtual Machine Serviceability Enhancements Staged/Extended (VMSES/E)

VMSES/E helps you install z/VM and other VMSES/E-enabled products and apply code changes that correct or circumvent reported problems. VMSES/E handles both source code and object code.

VMSES/E also helps you define, build, and manage saved segments. The VMFSGMAP EXEC provides a saved segment mapping interface that lets you modify saved segment definitions and view saved segment layouts prior to actually building them on your system.

For more information, see *z/VM: VMSES/E Introduction and Reference*.

Dump Viewing Facility

The Dump Viewing Facility helps you interactively diagnose system problems. Using this facility, you can display, format, and print data interactively from virtual machine dumps, as well as display and format recorded trace data. The BLOCKDEF utility lets you display, format, and print control block information. The VIEWSYM command lets you display symptom records, making it easier to identify duplicate problems when they occur.

For more information, see *z/VM: Dump Viewing Facility*.

The VM Dump Tool interactively analyzes CP stand-alone dumps, CP ABEND dumps, and virtual machine dumps of a CP system. See “VM Dump Tool” on page 38.

Chapter 5. Additional Facilities Supplied with z/VM

This chapter describes the additional facilities supplied with z/VM:

- “DFSMS/VM”
- “Language Environment”
- “Open Systems Adapter Support Facility (OSA/SF)” on page 48

DFSMS/VM

DFSMS/VM is a storage management system that allows you to control your data and storage resources more efficiently. DFSMS/VM provides:

- ***Space Management***

DFSMS/VM improves DASD utilization by automatically managing space in SFS file pools. As the SFS administrator, DFSMS/VM allows you to:

- Convert SFS storage to DFSMS-managed storage by assigning *management classes* to files and directories. Each management class tells DFSMS/VM how to treat its members in the course of its management of the file pool.
- Automatically manage files based on the criteria in each management class. This management may consist of deletion of files, automatic migration of files, or both.
- *Migrate* (or move) files from DFSMS-managed storage to DFSMS-owned storage by using the assigned *management class*. This function also compresses the data. The files can be automatically recalled when referenced (opened and browsed), or they can be explicitly recalled.

- ***Minidisk Management***

Using DFSMS/VM for minidisk management allows you to check the integrity of CMS minidisks and move them from one location to another. DFSMS/VM helps you migrate CMS minidisks to new DASD quickly, efficiently, and with minimal impact to users.

- ***Interactive Storage Management Facility (ISMF)***

DFSMS/VM uses the ISMF to provide a consistent user interface for storage management tasks.

- ***IBM 3495 Tape Library Dataserver Support***

DFSMS/VM provides native VM support for the IBM 3495 Tape Library Dataserver.

See “DFSMS/VM[®] Program Requirements” on page 22. For National Language Support information, see “DFSMS/VM” on page 27.

For more information, see the *VM/ESA: DFSMS/VM Function Level 221 Planning Guide*.

Language Environment

Language Environment provides the run-time environment for programs generated with participating high-level languages. Language Environment helps you create mixed-language applications and gives you a consistent method of accessing common, frequently-used services.

Language Environment consists of:

Additional Facilities

- Basic routines that support starting and stopping programs, allocating storage, communicating with programs written in different languages, and indicating and handling conditions.
- Common library services, such as math services and date and time services, that are commonly needed by programs running on the system. These functions are supported through a library of callable services.
- Language-specific portions of the run-time library. Because many language-specific routines call Language Environment services, behavior is consistent across languages.

See “Language Environment Program Requirements” on page 23.

For more information, see the following books:

- *Language Environment for OS/390 & VM: Concepts Guide*
- *C for VM/ESA: Library Reference*

Open Systems Adapter Support Facility (OSA/SF)

The IBM S/390 Open Systems Adapter (OSA) is an integrated hardware feature that allows the S/390 platform to provide industry-standard connectivity directly to clients on local area networks (LANs) and wide area networks (WANs). The Open Systems Adapter Support Facility (OSA/SF) is a host-based tool supplied with z/VM that allows you to customize an OSA's modes of operation. You can access OSA/SF by a CMS user ID, by a REXX call to the OSA/SF API, or through the OSA/SF Windows 95, Windows NT, or OS/2 graphical user interface (GUI).

See “OSA and OSA/SF Hardware Requirements” on page 17 and “OSA/SF Program Requirements” on page 22.

For more information, see the following books:

- *S/390: Planning for the S/390 Open Systems Adapter (OSA-1, OSA-2) Feature*
- *VM/ESA: Open Systems Adapter Support Facility User's Guide for OSA-2*
- *S/390: Open Systems Adapter-Express Customer's Guide and Reference*

Chapter 6. z/VM Optional Features

This chapter describes the optional features of z/VM:

- “CMS Utilities Feature”
- “TCP/IP Feature for z/VM” on page 50
- “OpenEdition DCE Feature for VM/ESA” on page 52
- “LAN Resource Extension and Services/VM (LANRES/VM)” on page 52

CMS Utilities Feature

The CMS Utilities Feature complements CMS by providing tools and services that add enriched function to the CP and CMS environments for end users and application developers. The following programs are included in the CMS Utilities Feature:

Program	Description
ACCOUNT	Processes z/VM accounting records
AUDITOR	Monitors service virtual machines
BROWSE	Lets you view a file or library member
CLRSCRN	Clears the terminal screen
DCSSBKUP	Saves CMS saved segments
DCSSRSV	Restores CMS saved segments
DEPRINT	Writes printer files to a disk
DEVTYPE	Displays device characteristics
DIRMAP	Maps minidisk space in the CP directory
FILESTCK	Transfers data from the program stack to a file
FINDSTAK	Transfers data from a file to the program stack
FLIST	Displays a full-screen list of files
GETFMADR	Finds a free file mode and address
OPTIMISE	Optimizes the performance of EXEC 2 execs
QSYSOWN	Queries system disk space
REPRINT	Transfers files from a virtual reader to a printer
SADT	Stacks minidisk and file directory information
SETKEYX	Sets storage keys for saved segments
SFPURGER	Performs spool file maintenance
SHRLDR	Loads saved segments
STAG	Stacks reader tag information
SYSWATCH	Monitors system data on multiple systems
USERID	Stacks user ID information
VMSIZE	Displays the virtual storage size as a CMS return code
WAKEUP	Controls event-driven virtual machines
XRDR	Displays reader file information
YDISK	Provides a modified CMS DISK LOAD command

Optional Features

See “CMS Utilities Feature Program Requirements” on page 23. For National Language Support information, see “CMS Utilities Feature” on page 28.

For more information, see *VM/ESA: CMS Utilities Feature*.

TCP/IP Feature for z/VM

The TCP/IP Feature for z/VM brings the power and resources of your IBM z/Architecture or S/390 server to the internet. Using the TCP/IP protocol suite of the TCP/IP Feature for z/VM, you can reach open multivendor networking environments from your z/VM system. With the TCP/IP Feature, z/VM systems can act as peers of other central computers in TCP/IP open networks. Applications can be shared transparently across VM, UNIX, VAX, and other environments. As shown in Figure 1, users can send messages, transfer files, share printers, and access remote resources across a broad range of systems from multiple vendors.

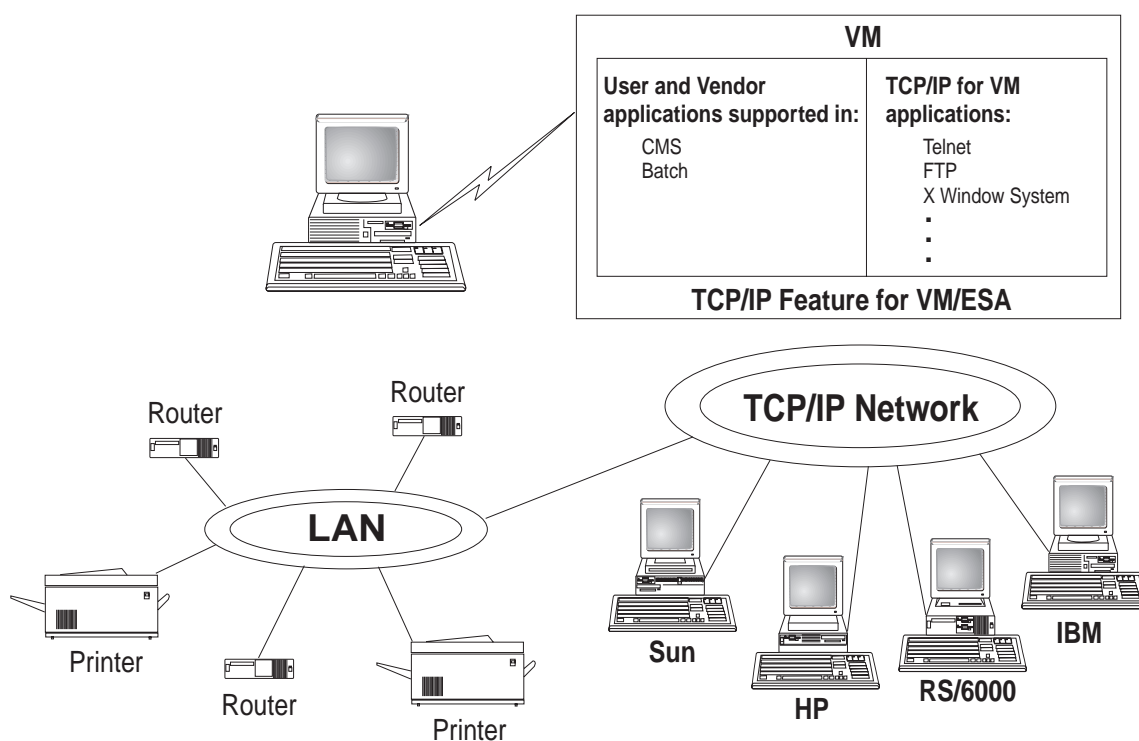


Figure 1. TCP/IP Feature for z/VM as Part of a Multivendor Network

TCP/IP can be characterized as belonging to one of the following categories:

- Connectivity and gateway functions, which handle the physical interfaces and routing of data.
- Server functions, which provide a service to a client (that is, send or transfer a file).
- Client functions, which request a certain service from a server anywhere in the network.
- Network status/management functions, which detect and solve network problems.
- Application Programming interfaces, which allow you to write your own client/server applications.

Transport Protocols

The transport layer of TCP/IP consists of transport protocols, which allow communication between application programs. This section describes the transport protocols in TCP/IP.

Transmission Control Protocol (TCP)

The Transmission Control Protocol (TCP) provides a reliable vehicle for delivering packets between hosts on an internet. TCP takes a stream of data, breaks it into datagrams, sends each one individually using IP, and reassembles the datagrams at the destination node. If any datagrams are lost or damaged during transmission, TCP detects this and resends the missing datagrams. The received data stream is a reliable copy of the transmitted data stream.

User Datagram Protocol (UDP)

The User Datagram Protocol (UDP) provides an unreliable mode of communication between source and destination hosts. UDP is a datagram-level protocol built directly on the IP layer. UDP is used for application-to-application programs between TCP/IP hosts.

Like IP, UDP does not offer a guarantee of datagram delivery or duplication protection. UDP does provide checksums for both the header and data portions of a datagram. However, applications that require reliable delivery of streams of data should use TCP.

Applications and Protocols

Applications are provided with the TCP/IP feature that allow users to use network services. These applications are included in the application layer of TCP/IP. The application layer is built on the services of the transport layer. The following applications and protocols are included in TCP/IP:

- Telnet Protocol
- File Transfer Protocol (FTP)
- Trivial File Transfer Protocol (TFTP)
- Simple Mail Transfer Protocol (SMTP)
- Domain Name System (DNS)
- Simple Network Management Protocol (SNMP)
- Kerberos Authentication System
- Remote Printing (LPR and LPD)
- Dynamic Routing (RouteD)
- X Window System
- GDDMXD
- Remote Procedure Call (RPC)
- Network File System (NFS)
- Remote Execution Protocol (REXEC)
- Bootstrap Protocol (BOOTP)
- Dynamic Host Configuration Protocol (DHCP)
- Network Database System (NDB)
- Multiple Protocol Route (MPROUTE)
- Open Shortest Path First (OSPF)
- Secure Socket Layer (SSL)
- Socket Interfaces

For More Information

See “TCP/IP Feature for z/VM Hardware Requirements” on page 17 and “TCP/IP Feature for z/VM Program Requirements” on page 23.

Optional Features

For more information, see the following books:

- *z/VM: TCP/IP Level 3A0 Planning and Customization*
- *z/VM: TCP/IP Level 3A0 User's Guide*

OpenEdition DCE Feature for VM/ESA

The OpenEdition DCE Feature for VM/ESA facilitates the development of Distributed Computing Environment (DCE) applications and significantly enhances the interoperability characteristics of the VM system in heterogeneous multivendor computing environments.

VM support for DCE consists of the following DCE components:

- ***DCE Remote Procedure Call (RPC)***

VM provides the complete structure for connection-less RPC. RPC provides a facility for calling a procedure on a remote system as if it were a procedure on the local system. RPC also provides a high level programming model which masks the application from the underlying details of the communication network.

- ***DCE Threads***

VM provides support for the DCE Threads application program interface (API). The DCE Threads service allows a user to create and control multiple threads of execution within a single process. The user threads library implementation is based on IEEE POSIX 1003.4a draft 4.

- ***DCE Cell Directory Service (CDS) Client***

The DCE CDS Client provides access to the DCE CDS Server on another system in the DCE Cell. The DCE Directory Services provide consistent naming throughout the distributed environment. This allows users to identify resources such as RPC based servers, files, or print queues by name and gain access to them without needing to know their location in the network.

- ***DCE Security Service Client***

The DCE Security Service Client provides the API to access the DCE Security Server on another system in the DCE Cell. The DCE Security Service enables clients and servers to prove their identities to each other. It offers integrity and privacy of communications and supports controlled access to resources. In addition, it provides user registration, authorization and authentication services for distributed applications.

See “OpenEdition DCE Feature for VM/ESA Program Requirements” on page 24.

For more information, see the following books:

- *OpenEdition DCE for VM/ESA: Introducing the OpenEdition Distributed Computing Environment*
- *OpenEdition DCE for VM/ESA: Planning*

LAN Resource Extension and Services/VM (LANRES/VM)

LANRES/VM establishes a server environment on z/VM to allow NetWare clients transparent access to mainframe resources. With LANRES/VM, a single Netware server can communicate with VM, MVS, and OS/400® hosts at the same time.

LANRES/VM services include:

- ***Disk Serving***

Using LANRES/VM disk services, NetWare workstation users can transparently store files on VM DASD. VM DASD can be configured for use by NetWare servers and subsequently by NetWare clients. Multiple NetWare servers connected to a single VM host can share disks stored on VM in read-only mode. To a NetWare user, there is no difference between files stored on DASD on the host and files stored on hard drives on the NetWare server. Each NetWare volume can be mapped to a disk drive letter in the client. The client can access a combination of local disk drives, drives on the NetWare server, and disk drives on the host.

- ***Print Serving***

LANRES/VM provides a print serving capability for NetWare that lets NetWare workstation users route print jobs through NetWare to VM for printing. In addition, VM users can route print jobs to NetWare for printing on LAN-attached printers.

- ***Data Distribution***

The data distribution function of LANRES/VM allows authorized VM users to manipulate files and directories controlled by NetWare. The volumes containing these files may be on the NetWare server or on a LANRES/VM host disk. This function implements a central data distribution capability.

- ***LAN Administration***

The LAN administration function of LANRES/VM allows an authorized VM administrator to add, delete, and rename users on the LAN. The administrator can also set passwords and password restrictions, limit space utilization, control file and directory access, and perform other administration functions. A VM administrator can function as the LAN administrator for an almost unlimited number of LANs connected by LANRES/VM.

See “LANRES/VM Feature Hardware Requirements” on page 17 and “LANRES/VM Feature Program Requirements” on page 24.

For more information, see the following book:

- *LAN Resource Extension and Services/VM: General Information*

Optional Features

Chapter 7. z/VM Library Guide

This chapter provides information about the z/VM product documentation. It contains the following sections:

- “Library Structure”
- “Basic (Automatically Shipped) z/VM Library” on page 56
- “Abstracts of Books in the z/VM Base Library” on page 56
- “Abstracts of Books for z/VM Additional Facilities” on page 65
- “Abstracts of Books for z/VM Optional Features” on page 67
- “Editions and Formats of VM Books” on page 70

Library Structure

This section explains how the z/VM library is organized.

Base Library Task Groups

The z/VM base library is organized according to the main tasks that computer users perform. These main tasks are:

Task	Definition
Evaluation	Deciding if z/VM meets your installation's needs.
Installation and Service	Generating and maintaining z/VM.
Planning and Administration	Making fundamental decisions about the options z/VM offers. Planning is an iterative task in that many of the decisions are made before installation, continually evaluated after installation, and revised as appropriate. The administration task involves defining the characteristics of data processing resources to z/VM. The resources can be data files, databases, programs, users, and so forth.
Customization	Extending or enhancing z/VM.
Operation	Starting z/VM, monitoring it to keep it running, and shutting it down if required.
Application Programming	Designing, coding, compiling, running, debugging, and maintaining application programs to do specific functions.
End Use	Performing user tasks.
Diagnosis	Identifying the source of a programming problem, describing the problem, comparing it to similar known problems, reporting a new problem, and correcting the problem.

Other Groups of Books

Also included in the z/VM library are groups of books for the following additional facilities and optional z/VM features:

- DFSMS/VM
- Language Environment
- OSA/SF

Library Guide

- CMS Utilities Feature
- TCP/IP Feature for z/VM
- OpenEdition DCE Feature for VM/ESA
- LANRES/VM

For a list of all the books in the z/VM library, see “Editions and Formats of VM Books” on page 70.

Basic (Automatically Shipped) z/VM Library

The basic z/VM library is shipped automatically with the z/VM product at no additional cost. The basic library consists of:

- One copy of the *Online Library Omnibus Edition: VM Collection*

This CD-ROM contains all the IBM libraries that are available in IBM BookManager format for current VM system products and IBM licensed programs that run on z/VM. It also contains Adobe Portable Document Format (PDF) versions of most z/VM base, additional facility, and optional feature books.

Note: Only unlicensed books are included.

IBM Library Reader programs for Windows, OS/2, and DOS are included on the CD-ROM so you can make immediate use of the BookManager libraries on a workstation. Also included is the IBM Bookshelf Upload Program, which allows you to upload books to a VM, OS/390, or MVS host.

- One printed copy of each of the following books:
 - *z/VM: Licensed Program Specifications*
 - *z/VM: Planning and Administration*
 - *z/VM: Installation Guide*
 - *z/VM: Service Guide*
 - *z/VM: System Messages and Codes*
 - *z/VM: TCP/IP Level 3A0 Planning and Customization*

Note: The latest printed version of each book is shipped. However, a later PDF edition may be available on the VM home page.

- If the optional no-cost z/VM BookManager Library Feature is ordered, a set of z/VM base, additional facility, and optional feature books in BookManager format on a feature tape.

Abstracts of Books in the z/VM Base Library

The following abstracts describe the contents of the books in the z/VM base library. Each book is listed under its task group. The title of the book is followed by its form number.

For abstracts of the other books in the z/VM library, see:

- “Abstracts of Books for z/VM Additional Facilities” on page 65
- “Abstracts of Books for z/VM Optional Features” on page 67

Evaluation: Deciding If z/VM Meets Your Needs

z/VM: Licensed Program Specifications, GC24-5943

This document provides information on the warranted functions of z/VM, the specified operating environment, and the supplemental terms.

z/VM: General Information, GC24-5944

This book provides general information about z/VM. It contains:

- An introduction to z/VM
- An overview of the functions that are new or changed for the current release
- Hardware and software requirements and packaging information
- Descriptions of the z/VM components, additional facilities supplied with z/VM, and optional z/VM features
- A library guide that explains the structure and content of the z/VM publications library
- A list of the IBM processors that VM supports
- A list of the IBM operating systems supported as guests of VM
- A list of the IBM devices that VM supports

Installation and Service: Generating and Maintaining z/VM**z/VM: Installation Guide, GC24-5945**

This book guides a system programmer step-by-step through the z/VM installation procedures. The procedures feature an automated installation process using an INSTALL exec with a panel interface to load a prebuilt z/VM system packaged in DASD Dump Restore (DDR) image format.

This book also offers reference material to be used while you install z/VM. For example, some aspects of z/VM installation must be preplanned using the installation work sheets provided for you in the introductory chapter.

Note: *z/VM Installation and Service Sample Files* is an informal document packaged directly with z/VM. These hardcopy files are identical to the sample system definition files found on the z/VM system DDR tapes or CD-ROM.

z/VM: Service Guide, GC24-5946

This book provides step-by-step procedures for receiving and applying service and rebuilding serviced parts of your z/VM system.

This book is intended for system programmers and anyone responsible for servicing (maintaining and updating) z/VM. This book should be used in conjunction with the *z/VM: VMSES/E Introduction and Reference*.

z/VM: VMSES/E Introduction and Reference, GC24-5947

This book provides an overview of the Virtual Machine Serviceability Enhancements Staged/Extended (VMSES/E) component of z/VM. It describes how to use the VMSES/E Installation/Service Tool (VMSES/E) to install, migrate, build, service, and delete program products from a more general, less z/VM-specific, point of view than the *z/VM: Installation Guide* and the *z/VM: Service Guide*. This book discusses the Software Inventory and how you can use it to manage the products on your system. Reference information on the product parameter file, Software Inventory tables, VMSES/E execs, and other related execs is also provided.

Planning and Administration: Making Decisions and Defining Resources for z/VM**z/VM: Planning and Administration, SC24-5948**

This book describes how to plan and administer a z/VM system. It describes the following tasks:

- System planning and administration
- User planning and administration

Library Guide

- Storage planning and administration
- Saved segment planning and administration
- CMS planning and administration
- I/O configuration planning and administration

This book is the primary source of information about the system configuration file and the user directory.

z/VM: CMS File Pool Planning, Administration, and Operation, SC24-5949

This book provides guidance and reference information on planning for, administering, and operating CMS file pools. It provides information about using file pools as repositories for Shared File System (SFS) and OpenExtensions Byte File System (BFS) data. It also provides information about using file pool server machines for Coordinated Resource Recovery (CRR) and FIFO functions. The book includes a reference section that contains descriptions of file pool start-up parameters and file pool administration and server commands.

z/VM: Migration Guide, GC24-5928

This book provides information to help system programmers and other system support personnel migrate to the new z/VM release from a VM/ESA 2.1.0 or later system. It is also intended for application programmers who use VM commands, macros, routines, and other externals in their programs. The book contains the following information:

- An introduction to migration
- Descriptions of VM system changes and enhancements that you should be aware of before migrating
- Identification of VM external interfaces that have changed since VM/ESA 2.1.0
- Guidance for some migration tasks you might need to perform

Note: For users planning to migrate from a release prior to VM/ESA 2.1.0, this book indicates what other books (not included in the current z/VM library) you should obtain for additional information.

VM/ESA: REXX/EXEC Migration Tool for VM/ESA, GC24-5752

This book describes how to use the REXX/EXEC Migration Tool for VM/ESA (VM/ESA MIGR) to help you migrate REXX, EXEC 2, DMKRIO/HCPRIO, and DMKSYS/HCPSYS source files to **VM/ESA Version 2 Release 4.0** from any of the following VM releases:

- VM/SP Release 5
- VM/SP HPO Release 5
- VM/XA SP Release 2.0 or 2.1
- VM/ESA Version 1 (all releases)
- VM/ESA Version 2 (all releases)

VM/ESA MIGR can give you assistance in estimating the migration effort and identifying the changes that have to be made in your programs. VM/ESA MIGR also creates an interactive XEDIT environment in which you can make the changes it identifies. However, VM/ESA MIGR does not change any files.

z/VM: Performance, SC24-5952

This book contains information about the planning, managing, measuring, and tuning considerations needed to obtain optimum z/VM system performance.

This book is intended for system programmers and others involved in the performance, monitoring, and tuning activities of z/VM.

Note: The CP monitor records are packaged directly with the z/VM product in a file called MONITOR LIST1403.

z/VM: Running Guest Operating Systems, SC24-5950

This book helps the reader to run *guest* operating systems under the supervision of z/VM. It contains specific information on running such guest operating systems as VSE/ESA, OS/390, MVS/ESA, VM/ESA, and z/VM in a virtual machine.

VM/ESA: Connectivity Planning, Administration, and Operation, SC24-5756

This book describes the VM components and facilities that enable communications between programs that run on VM and non-VM systems. This book presents basic connectivity concepts and planning considerations. It also provides information to help you use the Transparent Services Access Facility (TSAF), APPC/VM VTAM Support (AVS), and Inter-System Facility for Communications (ISFC) on your VM system.

z/VM: Group Control System, SC24-5951

This book provides detailed information on planning for the GCS component of z/VM. It also describes the purpose and use of GCS commands and macroinstructions.

This book is intended for anyone writing programs that run in GCS, including system and application programmers in both customer and IBM development environments.

Customization: Extending or Enhancing z/VM

z/VM: CP Exit Customization, SC24-5953

This book describes how to customize a z/VM system using CP exit points, both IBM-defined and customer-written. It describes the following:

- Creating, controlling, and calling CP exit points
- Creating, controlling, and overriding CP commands
- Creating, controlling, and overriding DIAGNOSE codes
- Creating, controlling, and using local message repositories
- Dynamically loading into and unloading from CP storage
- Using dynamic CP exits

Operation: Starting, Running, and Shutting Down z/VM

z/VM: System Operation, SC24-5954

This book explains how to operate z/VM on a z/Architecture or S/390 processor.

z/VM: Virtual Machine Operation, SC24-5955

This book explains how to operate a z/VM virtual machine, particularly how to run an operating system in a virtual machine.

Application Programming: Creating and Using Application Programs on z/VM

z/VM: CP Programming Services, SC24-5956

This book describes application programming services and facilities available in the CP component. These services and facilities include:

- DIAGNOSE instruction
- Inter-User-Communications Vehicle (IUCV)
- Advanced Program-to-Program Communications/VM (APPC/VM)

Library Guide

- CP System Services
- ESA/XC address-space management macros
- Symptom record reporting

z/VM: CMS Application Development Guide, SC24-5957

This book provides information about developing an application program in CMS. The development process includes planning, designing, writing, compiling, debugging, executing, and updating.

This book also describes what CMS services are available and how you can use these CMS services to develop an application. These CMS services include:

- Shared File System (SFS)
- OpenExtensions Services, including the Byte File System (BFS)
- OpenExtensions Shell and Utilities
- Common Programming Interface (CPI) Communications
- Coordinated Resource Recovery (CRR) Facility
- VM Data Space Support
- CMS libraries
- CMS Batch Facility
- Parsing Facility
- Message repositories

z/VM: CMS Application Development Guide for Assembler, SC24-5958

This book provides assembler language programmers with information to help them:

- Understand CMS programming interfaces and virtual machine architecture
- Use CMS services to:
 - Handle interrupts
 - Obtain free storage
 - Perform I/O
 - Process abnormal ends
- Manage CMS programs using CMS services to build, load, run, and package assembler programs
- Develop OS/MVS and VSE applications under CMS
- Use Access Methods Services and VSAM under CMS and CMS/DOS

z/VM: CMS Callable Services Reference, SC24-5959

This book describes the basic set of CMS callable services library (CSL) routines included in the VMLIB callable services library. These CSL routines primarily perform functions related to CMS file system management and CMS file pool administration.

z/VM: CMS Macros and Functions Reference, SC24-5960

This book describes the preferred CMS macroinstructions and functions. It also describes the CMS macros and functions supported only for compatibility (because they do not support 31-bit addressing).

z/VM: CMS Application Multitasking, SC24-5961

This book describes how you can use CMS multitasking to develop and run multitasking application programs written in C (C for VM/ESA or C/370 Version 2), assembler, or REXX/VM. The book provides introductory and tutorial information as well as detailed reference material.

VM/ESA: REXX/VM Primer, SC24-5598

This book introduces you to programming using the REstructured eXtended eXecutor language (REXX). This book is intended to help you get started with writing and running programs, commonly called execs, using the REXX language.

z/VM: REXX/VM User's Guide, SC24-5962

This book provides step-by-step instructions for using the REstructured eXtended eXecutor language (REXX), a powerful interpretive command and macrolanguage. It is intended for users with some knowledge of VM, editors, and terminals, but previous programming experience is not needed. However, users with no programming experience should read the *VM/ESA: REXX/VM Primer* before reading this book.

z/VM: REXX/VM Reference, SC24-5963

This book provides reference information about REXX statements and their use, including:

- Error messages
- Instructions
- Functions
- Debugging aids
- Parsing
- System interfaces
- Syntax descriptions

This book includes the description of the REXX Sockets API.

z/VM: OpenExtensions POSIX Conformance Document, GC24-5976

This book describes the VM implementation of those areas of the IEEE POSIX.1 and POSIX.2 standards that were declared to be optional or implementation-defined.

z/VM: OpenExtensions Callable Services Reference, SC24-5980

This book describes the OpenExtensions callable services, which are interfaces between VM and the functions specified in the IEEE POSIX.1 standard. These functions are used by IBM C for VM/ESA (C/VM™) POSIX support in VM. This book also describes callable services that are not related to the standards.

z/VM: OpenExtensions User's Guide, SC24-5977

This book describes the OpenExtensions Byte File System (BFS) and provides information for using the shell commands in the OpenExtensions Shell and Utilities.

z/VM: OpenExtensions Command Reference, SC24-5978

This book describes the commands and utilities in the OpenExtensions Shell and Utilities. It also describes CMS commands for using OpenExtensions services.

z/VM: OpenExtensions Advanced Application Programming Tools, SC24-5979

This book provides advanced information for using the **lex**, **yacc**, and **make** utilities in the OpenExtensions Shell and Utilities.

z/VM: Reusable Server Kernel Programmer's Guide and Reference, SC24-5964

This book describes how you can use the reusable server kernel supplied with z/VM to develop and run server programs in the CMS environment.

This book covers advanced material in server construction and is not intended for beginning programmers.

External Security Interface (RACROUTE) Macro Reference for MVS and VM, GC28-1366

This book provides a description of the full function RACROUTE external security interface for MVS and VM, the requests that can be called by it, their respective syntax, and related information. Also included in the book are certain data area fields and parameter lists.

VM/ESA: Programmer's Guide to the Server-Requester Programming Interface for VM, SC24-5455

This book provides application programmers with information on how to write and install IBM Enhanced Connectivity Facilities services in a VM system. For workstation users, the book also offers information on how to start IBM Enhanced Connectivity Facilities communications on VM.

VM/ESA: CPI Communications User's Guide, SC24-5595

This book provides step-by-step instructions for using Systems Application Architecture® (SAA) Common Programming Interface (CPI) communications to write communications programs to run in the CMS environment. Sample programs written in REXX/VM show how to use SAA CPI Communications calls and the CMS extensions to CPI Communications.

This book is intended for programmers who want to learn how to write communications programs but are not familiar with communications programming.

Common Programming Interface Communications Reference, SC26-4399

This book describes Systems Application Architecture (SAA) Common Programming Interface (CPI) Communications in detail, including scenarios and individual routines.

This book is intended for anyone writing an application program that communicates with another program using the APPC protocol. The communications occur within a single TSAF collection, across many TSAF collections, or between a TSAF collection and a SNA network.

Common Programming Interface Resource Recovery Reference, SC31-6821

This book describes the System Application Architecture (SAA) Common Programming Interface resource recovery interface in detail, including scenarios and individual routines.

This book is intended for programmers who want to write applications that use the SAA resource recovery interface. The SAA resource recovery interface lets programs coordinate exchanges of data and updates to databases and other resources. This coordination ensures that either all changes become permanent or all are undone.

z/VM: Enterprise Systems Architecture/Extended Configuration Principles of Operation, SC24-5965

This book provides a detailed description of the Enterprise System Architecture/Extended Configuration (ESA/XC) virtual machine architecture. It describes how ESA/XC operates as compared to Enterprise Systems

Architecture/390® (ESA/390), upon which ESA/XC is based. It is intended as a reference for programmers who write or debug programs that run in ESA/XC virtual machines.

C for VM/ESA: Library Reference, SC23-3908

This book describes the C/VM language header files, library functions, language extensions, and macros that operate with z/VM and Language Environment.

Note: This book is part of the library for the C for VM/ESA licensed product, but is also included in the z/VM library.

z/VM: Program Management Binder for CMS, SC24-5934

This book provides information about the Program Management Binder and Loader for CMS. It describes only the differences in usage and behavior from the DFSMS/MVS® Binder and Loader, as documented in *OS/390: DFSMS Program Management*.

OS/390: DFSMS Program Management, SC27-0806

This book documents the program management services provided by DFSMS/MVS. These services include the program management binder, the program management loader, the linkage editor, and the batch loader. This book describes how to use these services to create, modify, execute, and maintain programs in an MVS environment.

Debug Tool User's Guide and Reference, SC09-2137

This book is intended for application programmers using the Debug Tool to debug High Level Languages with Language Environment.

End Use: Performing z/VM User Tasks

z/VM: CP Command and Utility Reference, SC24-5967

This book provides detailed reference information on Control Program (CP) commands and utilities for users of every privilege class.

VM/ESA: CMS Primer, SC24-5458

This book provides information on basic CMS tasks and commands. It presents, through examples, only a portion of the functions and commands available with CMS, with the primary emphasis on:

- Logging on
- Editing and working with notes and files
- Using the Shared File System (SFS)

z/VM: CMS User's Guide, SC24-5968

This book describes how to:

- Manage your file system
- Create and maintain an Online Help Facility
- Use windowing commands and full-screen CMS
- Modify and run execs and programs

This book is intended for users with a general understanding of CMS, who want to use CMS at a more advanced level. Users with no CMS knowledge should read the *VM/ESA: CMS Primer* before reading this book.

z/VM: CMS Command Reference, SC24-5969

This book provides detailed reference information on all general-use CMS commands and VM Help Facility format words.

z/VM: CMS Pipelines User's Guide, SC24-5970

This book describes the general concepts of CMS Pipelines and how to use CMS Pipelines. This information includes:

- Writing a pipeline
- Using filters, host command interfaces, and device drivers
- Writing a stage command
- Writing a multistream pipeline
- Using pipelines in exec procedures and XEDIT macros
- Storing user-written stage commands in a filter package
- Migrating to CMS Pipelines

z/VM: CMS Pipelines Reference, SC24-5971

This book provides reference information on the CMS PIPE command and CMS Pipelines stages, subcommands, and assembler macros.

CMS/TSO Pipelines: Author's Edition, SL26-0018

This book provides information on CMS/TSO Pipelines from its author. (CMS/TSO Pipelines evolved from the CMS Pipelines PRPQ.) In addition to a description of CMS/TSO Pipelines terms and concepts, this book includes reference information on the PIPE command and Pipelines stages, commands, and messages.

This book contains additional information not found in the *z/VM: CMS Pipelines Reference* and also provides information intended for the advanced Pipelines user.

z/VM: XEDIT User's Guide, SC24-5972

This book provides a working knowledge of the z/VM system editor, XEDIT. XEDIT provides a wide range of functions for text processing and programming development. Because it is both a full-screen and a line-mode editor, XEDIT can be used on display and on typewriter terminals.

z/VM: XEDIT Command and Macro Reference, SC24-5973

This book provides detailed reference information on the XEDIT command, subcommands, and macros.

Users should read the *z/VM: XEDIT User's Guide* before reading this book.

z/VM: Quick Reference, SC24-5986

This book provides an alphabetical listing of z/VM commands, utilities, and REXX and EXEC 2 statements. It shows the syntax of each function and indicates the reference book where you can find detailed information.

Diagnosis: Identifying, Describing, Reporting, and Correcting Problems in z/VM

z/VM: System Messages and Codes, GC24-5974

This book describes the messages and codes generated by z/VM. It explains the conditions that cause each message or code, describes the resulting system action, and suggests the proper user, operator, or programmer response.

z/VM: Diagnosis Guide, GC24-5975

This book provides diagnostic guidance information to help you identify, report, solve, and collect information about problems in z/VM.

z/VM: VM Dump Tool, GC24-5887

This book describes how to use the VM Dump Tool, which assists in analyzing dump data from a dump file created by the DUMpload utility. The tool can

process CP stand-alone dumps, CP ABEND dumps, and virtual machine dumps of a CP system. This book describes the VM Dump Tool subcommands and macros that allow you to display, locate, and format dump data interactively.

z/VM: Dump Viewing Facility, GC24-5966

This book provides information for using the z/VM Dump Viewing Facility for problem determination and problem source identification.

Abstracts of Books for z/VM Additional Facilities

This section describes the books for the additional facilities supplied with z/VM. The title of the book is followed by its form number.

DFSMS/VM Function Level 221

VM/ESA: DFSMS/VM Function Level 221 Planning Guide, GC35-0121

This book is a guide for system programmers and storage administrators who need to plan for the installation and use of DFSMS/VM.

VM/ESA: DFSMS/VM Function Level 221 Installation and Customization, SC26-4704

This book is for system programmers responsible for installing, customizing, and servicing DFSMS/VM.

VM/ESA: DFSMS/VM Function Level 221 Storage Administration Guide and Reference, SH35-0111

This book provides instructions for performing DFSMS/VM tasks and related reference information.

VM/ESA: DFSMS/VM Function Level 221 Removable Media Services User's Guide and Reference, SC35-0141

This book provides information about planning for, installing, and using the DFSMS/VM Removable Media Services (RMS) subsystem.

VM/ESA: DFSMS/VM Function Level 221 Messages and Codes, SC26-4707

This book contains explanations and suggested actions for messages and codes issued by DFSMS/VM.

VM/ESA: DFSMS/VM Function Level 221 Diagnosis Guide, LY27-9589

This book provides information about diagnosing and reporting DFSMS/VM errors.

Open Systems Adapter Support Facility (OSA/SF)

S/390: Planning for the S/390 Open Systems Adapter (OSA-1, OSA-2) Feature, GC23-3870

This book provides planning information for all the hardware and programming platforms on which an Open Systems Adapter (OSA) can be run, including VM. An OSA is an integrated hardware feature that allows the S/390 platform to provide industry-standard connectivity directly to clients on local area networks (LANs) and wide area networks (WANs). This book addresses OSA channel and attached device definitions in the hardware I/O configuration, host programming considerations, and considerations for using the Open Systems Adapter Support Facility (OSA/SF).

VM/ESA: Open Systems Adapter Support Facility User's Guide for OSA-2, SC28-1992

This book provides step-by-step instructions for setting up and using OSA/SF, a host-based tool for configuring and managing OSAs. You communicate with OSA/SF through the OSA/SF graphical user interface (GUI) or from CMS using OSA/SF commands.

S/390: Open Systems Adapter-Express Customer's Guide and Reference, SA22-7403

This book describes the Open Systems Adapter-Express (OSA-Express) Gigabit Ethernet (GbE) feature. It provides guidelines for using OSA/SF with the OSA-Express.

Language Environment

Language Environment for OS/390 & VM: Concepts Guide, GC28-1945

This book provides information on evaluating and planning for Language Environment.

Language Environment for OS/390 & VM: Programming Guide, SC28-1939

This book contains information about linking, running, and using services within the Language Environment. It also contains the Language Environment program management model and provides language- and operating system-specific information, where applicable.

Language Environment for OS/390 & VM: Programming Reference, SC28-1940

This book provides application programmers with a detailed description of each Language Environment run-time option and callable service, as well as information on how to use them. It also provides programming examples that illustrate how each callable service can be used in routines written in Language Environment-conforming high-level languages (HLLs) and assembler language.

Language Environment for OS/390 & VM: Writing Interlanguage Communication Applications, SC28-1943

This book contains information on creating and running interlanguage communication (ILC) applications under the Language Environment.

Language Environment for OS/390 & VM: Debugging Guide and Run-Time Messages, SC28-1942

This book provides assistance in detecting and locating programming errors that occur during run-time under the Language Environment. The book can help you establish a debugging process to analyze data and narrow the scope and location of where an error might have occurred. You can read about how to prepare a routine for debugging, how to classify errors, and how to use the debugging facilities that Language Environment provides. Also included are chapters on debugging HLL-specific routines and routines that run under CICS®.

Language Environment for OS/390 & VM: Migration Guide, SC28-1944

This book provides an overview of the steps that customers must take to migrate applications for use with the Language Environment. These customers may not necessarily be migrating to a new language compiler. This book is written for

application developers. Familiarity with the run-time libraries of the different languages, and an understanding of the basics of linking and running applications, are assumed.

The information in this book is designed to help you create a broad migration strategy. This book will help you identify which modules can be migrated first, and which will require relinking or recompiling. It also explains how to use Language Environment run-time options to achieve behavior that is compatible with your old modules. For more detailed information about migration topics such as upgrading source code and load module compatibility, see one of the following manuals:

- *C for VM/ESA: Compiler and Run-Time Migration Guide*, SC09-2147
- *COBOL for OS/390 & VM Compiler and Run-Time Migration Guide*, GC26-4764
- *PL/I for MVS & VM Compiler and Run-Time Migration Guide*, SC26-3118
- *FORTTRAN Run-Time Migration Guide*, SC26-8499

Abstracts of Books for z/VM Optional Features

This section describes the books for the optional features of z/VM. The title of the book is followed by its form number.

CMS Utilities Feature

VM/ESA: CMS Utilities Feature, SC24-5535

This book describes the tools and services provided in the CMS Utilities Feature. These tools and services make the CP and CMS environments less complex for end users and application developers by reducing the number of commands you must remember and enter to do certain tasks, or by providing useful execs and applications that you might otherwise have to generate yourself.

TCP/IP Feature for z/VM

z/VM: TCP/IP Level 3A0 Planning and Customization, SC24-5981

This book is intended to help system administrators plan for TCP/IP networks on a z/VM host and customize TCP/IP to their systems.

z/VM: TCP/IP Level 3A0 Messages and Codes, GC24-5984

This book is intended for use by system programmers in diagnosing TCP/IP problems. The book lists TCP/IP messages and codes by category.

z/VM: TCP/IP Level 3A0 User's Guide, SC24-5982

This book is intended for the end user and describes how to use TCP/IP after it has been installed and customized on your network. The book explains how to use the applications available in TCP/IP. These applications include:

- Transferring files
- Sending electronic mail
- Logging on to a foreign host
- Monitoring the network
- Authenticating network users
- Remote printing
- Managing network resources
- Using the Domain Name System

z/VM: TCP/IP Level 3A0 Programmer's Reference, SC24-5983

This book is intended for users and programmers who are familiar with z/VM and its CP and CMS components. The book contains information about the following application program interfaces (APIs):

- C sockets
- IUCV sockets
- Pascal
- Virtual Machine Communication Facility (VMCF)
- Remote Procedure Calls (RPCs)
- X Window System
- Kerberos Authentication System
- Simple Network Management Protocol (SNMP) agent distributed program interface
- Network Computing System (NCS)
- CMS command interface to the name server
- Simple Mail Transfer Protocol (SMTP)

z/VM: TCP/IP Level 3A0 Diagnosis Guide, GC24-5985

This book is intended for system programmers who want to diagnose and report problems that can occur in TCP/IP networks.

OpenEdition DCE Feature for VM/ESA

OpenEdition DCE for VM/ESA: Introducing the OpenEdition Distributed Computing Environment, SC24-5735

This book introduces you to OpenEdition DCE for VM/ESA. Whether you are a system manager, technical planner, VM system programmer, or application programmer, it will help you understand the Distributed Computing Environment (DCE).

OpenEdition DCE for VM/ESA: Planning, SC24-5737

This book will help you plan for the organization and installation of OpenEdition DCE for VM/ESA. It discusses the benefits of distributed computing in general, and describes how to develop plans for a distributed system in an OpenEdition z/VM environment.

OpenEdition DCE for VM/ESA: Configuring and Getting Started, SC24-5734

This book will help system and network administrators who understand the basic concepts of the Distributed Computing Environment (DCE) configure OpenEdition components. This publication should be used after the successful installation of OpenEdition DCE for VM/ESA which is described in the Program Directory.

OpenEdition DCE for VM/ESA: Administration Guide, SC24-5730

This book provides information to help system and network administrators understand and administer OpenEdition DCE for VM/ESA. It provides guidance information on managing all supported DCE components on the z/VM platform. A knowledge of TCP/IP communications and the UNIX operating system can help administrators use this publication more effectively.

OpenEdition DCE for VM/ESA: Administration Reference, SC24-5731

This book provides detailed reference information on commands that system and network administrators use when working with the OpenEdition DCE feature. This reference publication includes:

- DCE Configuration and Process Control Commands
- Remote Procedure Call Administration Commands
- Cell Directory Administration
- Security Services Administration Commands

OpenEdition DCE for VM/ESA: Application Development Guide, SC24-5732

This book provides detailed information to assist the programmer with designing, writing, compiling, linking, and running distributed applications on the z/VM operating system. The information includes:

- Steps necessary to develop a distributed application using DCE services and application programming interfaces
- Development considerations and tools that you need to consider when developing your distributed applications using OpenEdition DCE for VM/ESA

OpenEdition DCE for VM/ESA: Application Development Reference, SC24-5733

This book explains in detail the Distributed Computing Environment (DCE) Application Program Interfaces (APIs) that a programmer will need to know when writing Distributed applications on the z/VM platform.

OpenEdition DCE for VM/ESA: User's Guide, SC24-5738

This book describes how to do the following tasks in OpenEdition DCE for VM/ESA and is intended for anyone who uses a DCE application to:

- Work with your user account
- View namespace entries
- Control access to DCE objects that you own

OpenEdition DCE for VM/ESA: Messages and Codes, SC24-5736

This book provides detailed explanations and recovery actions for the messages, status codes, and exception codes issued by OpenEdition DCE for VM/ESA.

LAN Resource Extension and Services/VM (LANRES/VM)

LAN Resource Extension and Services/VM: Licensed Program Specifications, GC24-5617

This document provides information on the warranted functions of LANRES/VM, the specified operating environment, and the supplemental terms.

LAN Resource Extension and Services/VM: General Information, GC24-5618

This book provides an introduction to LANRES/VM and what it can do for you. This book also identifies the hardware, software, and storage requirements for installing and using LANRES/VM.

Note: For updated hardware and software requirements, see “LANRES/VM Feature Hardware Requirements” on page 17 and “LANRES/VM Feature Program Requirements” on page 24.

LAN Resource Extension and Services/VM: Guide and Reference, SC24-5622

This book tells how to set up, install, start, and use LANRES/VM. Although it is intended for system programmers responsible for installing and maintaining LANRES/VM, it also contains general user information. This book describes the LANRES/VM commands and messages.

Editions and Formats of VM Books

The tables in this section identify the current edition and available formats for each book in the z/VM library, including the books for z/VM additional facilities and z/VM optional features. The current edition (form number suffix) of a book is indicated in the **Edition** column of the table. A book that is new in the VM library is indicated by **NEW** following the title. A new edition of a book in the library is indicated by **NEW** following the form number suffix. Most z/VM books are available as Adobe Portable Document Format (PDF) files and IBM BookManager files. Some books may also be available as printed books.

PDF Books

Books that are available as PDF files are indicated by “Yes” in the **PDF** column of the tables. PDF books are available from one or more of the following sources:

- *Online Library Omnibus Edition: VM Collection* CD-ROM, supplied free with z/VM
- z/VM publications web page:
<http://www.ibm.com/servers/eserver/zseries/zvm/pubs>
- IBM Resource Link™:
<http://www.ibm.com/servers/resource link>
- IBM Publication Ordering System:
<http://www.elink.ibm link.ibm.com/public/applications/pbl/cgibin/pbl.cgi>

You can view a PDF file using the Adobe Acrobat Reader, which is available free from the Adobe home page (www.adobe.com). PDF files look just like printed books on your workstation monitor. They provide topic linking similar to IBM BookManager files. You can also print a PDF file — either the whole book or selected portions.

BookManager Books

Books that are available in BookManager files are indicated by “Yes” in the **BookMgr** column of the tables. BookManager books are available from one or more of the following sources:

- *Online Library Omnibus Edition: VM Collection* CD-ROM.
IBM Library Reader programs for Windows, OS/2, and DOS are included on the CD-ROM.
- z/VM publications web page:
<http://www.ibm.com/servers/eserver/zseries/zvm/pubs>
- IBM Publication Ordering System:
<http://www.elink.ibm link.ibm.com/public/applications/pbl/cgibin/pbl.cgi>
- Optional z/VM BookManager Library Feature available with the z/VM product

Note: See “Online Books Program Requirements” on page 26.

Printed Books

Books that are available as printed books are indicated by either “Basic” or “Extra” in the **Printed** column of the tables. A basic book is supplied free with z/VM (see “Basic (Automatically Shipped) z/VM Library” on page 56). An extra book is not available with the z/VM product, but you can order it separately for a fee through the IBM Publication Ordering System. If the **Printed** column is blank, there is no printed version of the current edition of the book. However, you can obtain a printed copy of the current edition by printing the PDF file.

Current Editions and Available Formats of z/VM Base Books

Table 3. Current Editions and Available Formats of z/VM Base Books

Book Title	Number	Edition	PDF	BookMgr	Printed
z/VM: CMS Application Development Guide	SC24-5957	-00 NEW	Yes	Yes	
z/VM: CMS Application Development Guide for Assembler	SC24-5958	-00 NEW	Yes	Yes	
VM/ESA: CMS Application Development Reference ¹					
VM/ESA: CMS Application Development Reference for Assembler ¹					
z/VM: CMS Application Multitasking	SC24-5961	-00 NEW	Yes	Yes	
z/VM: CMS Callable Services Reference	SC24-5959	-00 NEW	Yes	Yes	
z/VM: CMS Command Reference	SC24-5969	-00 NEW	Yes	Yes	
VM/ESA: CMS Data Areas and Control Blocks ²					
VM/ESA: CMS Diagnosis Reference	SC24-5857	-00 ³		Yes	Extra
z/VM: CMS File Pool Planning, Administration, and Operation	SC24-5949	-00 NEW	Yes	Yes	
z/VM: CMS Macros and Functions Reference	SC24-5960	-00 NEW	Yes	Yes	
z/VM: CMS Pipelines Reference	SC24-5971	-00 NEW	Yes	Yes	
z/VM: CMS Pipelines User's Guide	SC24-5970	-00 NEW	Yes	Yes	
CMS/TSO Pipelines: Author's Edition	SL26-0018	-00		Yes	Extra
VM/ESA: CMS Primer	SC24-5458	-02		Yes	Extra
z/VM: CMS User's Guide	SC24-5968	-00 NEW	Yes	Yes	
VM/ESA: Connectivity Planning, Administration, and Operation	SC24-5756	-00		Yes	Extra
VM/ESA: Conversion Guide and Notebook	GC24-5839	-01 ⁴	Yes	Yes	Extra
z/VM: CP Command and Utility Reference	SC24-5967	-00 NEW	Yes	Yes	
VM/ESA: CP Data Areas and Control Blocks ²					
VM/ESA: CP Diagnosis Reference	SC24-5855	-00 ⁵		Yes	Extra
VM/ESA: CP Diagnosis Reference Summary ⁵					
z/VM: CP Exit Customization	SC24-5953	-00 NEW	Yes	Yes	

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Table 3. Current Editions and Available Formats of z/VM Base Books (continued)

Book Title	Number	Edition	PDF	BookMgr	Printed
z/VM: CP Programming Services	SC24-5956	-00 NEW	Yes	Yes	
VM/ESA: CPI Communications User's Guide	SC24-5595	-01		Yes	Extra
z/VM: Diagnosis Guide	GC24-5975	-00 NEW	Yes	Yes	
VM/ESA: Distributed Graphical User Interface Toolkit	SC24-5724	-02 ⁶		Yes	Extra
z/VM: Dump Viewing Facility	GC24-5966	-00 NEW	Yes	Yes	
z/VM: Enterprise Systems Architecture/Extended Configuration Principles of Operation	SC24-5965	-00 NEW	Yes	Yes	
z/VM: General Information	GC24-5944	-01 NEW	Yes	Yes	
VM/ESA: Graphical User Interface Facility	SC24-5789	-03 ⁶	Yes	Yes	
z/VM: Group Control System	SC24-5951	-00 NEW	Yes	Yes	
z/VM: Installation Guide	GC24-5945	-00 NEW	Yes ⁷		Basic
z/VM: Licensed Program Specifications	GC24-5943	-00 NEW	Yes	Yes	Basic
z/VM: Migration Guide NEW	GC24-5928	-00	Yes	Yes	
z/VM: OpenExtensions Advanced Application Programming Tools ⁸	SC24-5979	-00 NEW	Yes	Yes	
z/VM: OpenExtensions Callable Services Reference ⁸	SC24-5980	-00 NEW	Yes	Yes	
z/VM: OpenExtensions Command Reference ⁸	SC24-5978	-00 NEW	Yes	Yes	
z/VM: OpenExtensions POSIX Conformance Document ⁸	GC24-5976	-00 NEW	Yes	Yes	
z/VM: OpenExtensions User's Guide ⁸	SC24-5977	-00 NEW	Yes	Yes	
z/VM: Performance	SC24-5952	-00 NEW	Yes	Yes	
z/VM: Planning and Administration	SC24-5948	-05 NEW	Yes	Yes	Basic
VM/ESA: Planning Dynamic I/O Configuration ⁹					
z/VM: Program Management Binder for CMS NEW	SC24-5934	-00	Yes	Yes	
VM/ESA: Programmer's Guide to the Server-Requester Programming Interface for VM	SC24-5455	-01		Yes	Extra
z/VM: Quick Reference	SC24-5986	-00 NEW	Yes	Yes	
VM/ESA: REXX/EXEC Migration Tool for VM/ESA	GC24-5752	-03 ¹⁰	Yes	Yes	Extra
VM/ESA: REXX/VM Primer	SC24-5598	-01		Yes	Extra
z/VM: REXX/VM Reference	SC24-5963	-00 NEW	Yes	Yes	
z/VM: REXX/VM User's Guide	SC24-5962	-00 NEW	Yes	Yes	
z/VM: Running Guest Operating Systems	SC24-5950	-00 NEW	Yes	Yes	
z/VM: Reusable Server Kernel Programmer's Guide and Reference	SC24-5964	-00 NEW	Yes	Yes	

Table 3. Current Editions and Available Formats of z/VM Base Books (continued)

Book Title	Number	Edition	PDF	BookMgr	Printed
z/VM: Service Guide	GC24-5946	-00 NEW	Yes	Yes	Basic
z/VM: System Messages and Codes	GC24-5974	-00 NEW	Yes	Yes	Basic
z/VM: System Operation	SC24-5954	-00 NEW	Yes	Yes	
z/VM: Virtual Machine Operation	SC24-5955	-00 NEW	Yes	Yes	
z/VM: VM Dump Tool NEW	GC24-5887	-00	Yes	Yes	
z/VM: VMSES/E Introduction and Reference	GC24-5947	-00 NEW	Yes	Yes	
z/VM: XEDIT Command and Macro Reference	SC24-5973	-00 NEW	Yes	Yes	
z/VM: XEDIT User's Guide	SC24-5972	-00 NEW	Yes	Yes	
C for VM/ESA: Library Reference	SC23-3908	-02		Yes	
Common Programming Interface Communications Reference	SC26-4399	-09	Yes		Extra
Common Programming Interface Resource Recovery Reference	SC31-6821	-01		Yes	Extra
Debug Tool User's Guide and Reference	SC09-2137	-05 NEW	Yes	Yes	
OS/390: DFSMS Program Management NEW	SC27-0806	-03	Yes	Yes	Extra
External Security Interface (RACROUTE) Macro Reference for MVS and VM	GC28-1366	-07		Yes	Extra

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Table 3. Current Editions and Available Formats of z/VM Base Books (continued)

Book Title	Number	Edition	PDF	BookMgr	Printed
Notes on the z/VM Base:					
<ol style="list-style-type: none"> 1. The <i>VM/ESA: CMS Application Development Reference</i> has been renamed to the <i>z/VM: CMS Callable Services Reference</i>. The <i>VM/ESA: CMS Application Development Reference for Assembler</i> has been renamed to the <i>z/VM: CMS Macros and Functions Reference</i>. 2. CP and CMS control block information is no longer provided in book form. This information is available on the VM publications Web page (http://www.ibm.com/servers/eserver/zseries/zvm/pubs), or you can use the BLOCKDEF utility against control blocks on your system to get the most current data. 3. The <i>VM/ESA: CMS Diagnosis Reference</i> has not been updated for z/VM and is not included in the z/VM library. The last VM/ESA edition is still available from the publication sources. 4. The <i>VM/ESA: Conversion Guide and Notebook</i> has not been updated for z/VM and is not included in the z/VM library. This edition, which is still available from the publication sources, contains updates only through VM/ESA 2.4.0. For migration considerations after VM/ESA 2.4.0, see the <i>VM/ESA: Migration Guide</i>. 5. The <i>VM/ESA: CP Diagnosis Reference</i> and <i>VM/ESA: CP Diagnosis Reference Summary</i> have been not been updated for z/VM and are not included in the z/VM library. The CP trace codes table has been moved to the <i>z/VM: Diagnosis Guide</i>. The internal DIAGNOSE codes (DIAGNOSE codes NOT intended for use as programming interfaces by customers) have been moved to <i>z/VM: CP Programming Services</i>. The last VM/ESA edition of the <i>VM/ESA: CP Diagnosis Reference</i> is still available from the publication sources. 6. The VM/ESA Graphical User Interface Facility is not shipped with the z/VM product; the code is available from the VM Download Library. The <i>VM/ESA: Graphical User Interface Facility</i> and <i>VM/ESA: Distributed Graphical User Interface Facility Toolkit</i> books have not been updated for for z/VM and are not included in the z/VM library. The last VM/ESA editions of these books are still available from the publication sources. 7. The PDF version of the <i>z/VM: Installation Guide</i> is not included on the <i>Online Library Omnibus Edition: VM Collection</i> CD-ROM. 8. OpenEdition for VM/ESA Services and the OpenEdition Shell and Utilities Feature for VM/ESA have been renamed to OpenExtensions Services and OpenExtensions Shell and Utilities, respectively, and are now included in CMS. 9. The <i>VM/ESA: Planning Dynamic I/O Configuration</i> book has been deleted from the VM library. The information is now included in <i>z/VM: Planning and Administration</i>. 10. The <i>VM/ESA: REXX/EXEC Migration Tool for VM/ESA</i> has not been updated for z/VM. However, the last VM/ESA edition, which contains updates through VM/ESA 2.4.0, is still included in the z/VM library. 					

Current Editions and Available Formats of Books for z/VM Additional Facilities

Table 4. Current Editions and Available Formats of z/VM Additional Facility Books

Facility / Book Title	Number	Edition	PDF	BookMgr	Printed
DFSMS/VM					
VM/ESA: DFSMS/VM Function Level 221 Diagnosis Guide	LY27-9589	-00			Extra
VM/ESA: DFSMS/VM Function Level 221 Installation and Customization	SC26-4704	-03		Yes	Extra
VM/ESA: DFSMS/VM Function Level 221 Messages and Codes	SC26-4707	-03		Yes	Extra
VM/ESA: DFSMS/VM Function Level 221 Planning Guide	GC35-0121	-01		Yes	Extra
VM/ESA: DFSMS/VM Function Level 221 Removable Media Services User's Guide and Reference	SC35-0141	-01		Yes	Extra

Table 4. Current Editions and Available Formats of z/VM Additional Facility Books (continued)

Facility / Book Title	Number	Edition	PDF	BookMgr	Printed
VM/ESA: DFSMS/VM Function Level 221 Storage Administration Guide and Reference	SH35-0111	-01		Yes	Extra
Language Environment					
Language Environment for OS/390 & VM: Concepts Guide	GC28-1945	-09 NEW	Yes	Yes	Extra
Language Environment for OS/390 & VM: Debugging Guide and Run-Time Messages	SC28-1942	-09 NEW	Yes	Yes	Extra
Language Environment for OS/390 & VM: Migration Guide	SC28-1944	-09 NEW	Yes	Yes	Extra
Language Environment for OS/390 & VM: Programming Guide	SC28-1939	-09 NEW	Yes	Yes	Extra
Language Environment for OS/390 & VM: Programming Reference	SC28-1940	-09 NEW	Yes	Yes	Extra
Language Environment for OS/390 & VM: Writing Interlanguage Communication Applications	SC28-1943	-09 NEW	Yes	Yes	Extra
OSA/SF					
VM/ESA: Open Systems Adapter Support Facility User's Guide for OSA-2	SC28-1992	-03		Yes	Extra
S/390: Open Systems Adapter-Express Customer's Guide and Reference	SA22-7403	-02	Yes	Yes	Extra
S/390: Planning for the S/390 Open Systems Adapter (OSA-1, OSA-2) Feature	GC23-3870	-08	Yes	Yes	Extra

Current Editions and Available Formats of Books for z/VM Optional Features

Table 5. Current Editions and Available Formats of z/VM Optional Feature Books

Feature / Book Title	Number	Edition	PDF	BookMgr	Printed
CMS Utilities Feature					
VM/ESA: CMS Utilities Feature	SC24-5535	-01		Yes	Extra
TCP/IP Feature					
z/VM: TCP/IP Level 3A0 Diagnosis Guide	GC24-5985	-00 NEW	Yes	Yes	
z/VM: TCP/IP Level 3A0 Messages and Codes	GC24-5984	-00 NEW	Yes	Yes	
z/VM: TCP/IP Level 3A0 Planning and Customization	SC24-5981	-00 NEW	Yes	Yes	Basic
z/VM: TCP/IP Level 3A0 Programmer's Reference	SC24-5983	-00 NEW	Yes	Yes	
z/VM: TCP/IP Level 3A0 User's Guide	SC24-5982	-00 NEW	Yes	Yes	
OpenEdition DCE Feature					
OpenEdition DCE for VM/ESA: Administration Guide	SC24-5730	-00		Yes	Extra

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Table 5. Current Editions and Available Formats of z/VM Optional Feature Books (continued)

Feature / Book Title	Number	Edition	PDF	BookMgr	Printed
OpenEdition DCE for VM/ESA: Administration Reference	SC24-5731	-00		Yes	Extra
OpenEdition DCE for VM/ESA: Application Development Guide	SC24-5732	-00		Yes	Extra
OpenEdition DCE for VM/ESA: Application Development Reference	SC24-5733	-00		Yes	Extra
OpenEdition DCE for VM/ESA: Configuring and Getting Started	SC24-5734	-00		Yes	Extra
OpenEdition DCE for VM/ESA: Introducing the OpenEdition Distributed Computing Environment	SC24-5735	-00		Yes	Extra
OpenEdition DCE for VM/ESA: Messages and Codes	SC24-5736	-00		Yes	Extra
OpenEdition DCE for VM/ESA: Planning	SC24-5737	-00		Yes	Extra
OpenEdition DCE for VM/ESA: User's Guide	SC24-5738	-00		Yes	Extra
LANRES/VM					
LAN Resource Extension and Services/VM: General Information	GC24-5618	-04		Yes	Extra
LAN Resource Extension and Services/VM: Guide and Reference	SC24-5622	-03		Yes	Extra
LAN Resource Extension and Services/VM: Licensed Program Specifications	GC24-5617	-05		Yes	Extra

Appendix A. IBM Processors Supported by VM

This appendix provides information about the IBM processors supported by current VM operating systems. It addresses VM operating systems running first level on the hardware or in an LPAR. For guest considerations, see “Appendix B. IBM Operating Systems Supported as Guests of VM” on page 81.

The following terms are used in the processor support matrix:

Term	Meaning
PR/SM	Processor Resource/Systems Manager. A hardware feature that supports LPAR mode and MPG capability.
LPAR	Logically Partitioned. On a processor with PR/SM operating in LPAR mode, processor resources are divided across up to fifteen logical partitions, depending on the processor model.
MPG	Multiple Preferred Guests. On a processor with PR/SM operating in basic mode, a VM host operating system supports up to six preferred (high performance) guests.
VM Data Spaces	A facility of all listed VM releases that allows an XC virtual machine to access as many as 1022 data spaces of 2GB (gigabytes) each. (An XC virtual machine requires an ESA/390 architecture or z/Architecture processor.)
S/370™	System/370 architecture
ESA/370	ESA/370 architecture
ESA/390	ESA/390 architecture
VM220	VM/ESA Version 2 Release 2.0
VM230	VM/ESA Version 2 Release 3.0
VM240	VM/ESA Version 2 Release 4.0
VM310	z/VM Version 3 Release 1.0

The following general notes apply to the matrix:

- All listed VM releases can exploit the ESCON Multiple Image Facility (EMIF) when running in a logical partition.
- The inclusion of a processor in this matrix does not imply the processor is available in all countries.

Table 6. VM Processor Support Matrix

Processor	Mode	Current VM Support
ES/4381™-9x (1)	S/370	
	ESA/370	VM220, VM230, VM240

Processor Support

Table 6. VM Processor Support Matrix (continued)

Processor	Mode	Current VM Support
Notes on ES/4381-9x:		
(1) Storage Key Facility (SKF) and VM Data Spaces facility are not available on this processor.		
ES/3090™ E/S	S/370	
	ESA/370	VM220 (1), VM230 (1), VM240 (1)
	LPAR	VM220 (1,2), VM230 (1,2), VM240 (1,2)
Notes on ES/3090 E/S:		
(1) VM Data Spaces facility is not available.		
(2) On the ES/3090 E, CMS guest environments on a VM host running in an LPAR are supported for test and development only. On the ES/3090 S, RPQ 8P1367 is required to support production CMS guest environments on a VM host running in an LPAR.		
ES/3090 J	S/370	
	ESA/370	VM220 (1), VM230 (1), VM240 (1)
	LPAR	VM220 (1), VM230 (1), VM240 (1)
Notes on ES/3090 J:		
(1) VM Data Spaces facility is not available.		
ES/3090 9000T	S/370	
	ESA/370	VM220 (1), VM230 (1), VM240 (1)
	LPAR	VM220 (1), VM230 (1), VM240 (1)
Notes on ES/3090 9000T:		
(1) VM Data Spaces facility is not available.		
ES/9000 9221	S/370	
	ESA/390	VM220, VM230, VM240
	LPAR	VM220, VM230, VM240
ES/9000 9121	ESA/390	VM220, VM230, VM240
	LPAR	VM220, VM230, VM240
ES/9000 9021	ESA/390	VM220, VM230, VM240
	LPAR	VM220, VM230, VM240
Notes on ES/9000 9221, 9121, and 9021:		
For specific service levels required, contact your IBM representative.		
S/390 Multiprise 2000	Basic	VM220 (1), VM230, VM240, VM310
	LPAR	VM220 (1), VM230, VM240, VM310
Notes on Multiprise 2000:		
For specific service levels required, contact your IBM representative.		
(1) VM220 does not support VM guest coupling simulation.		

Table 6. VM Processor Support Matrix (continued)

Processor	Mode	Current VM Support
S/390 Multiprise 3000 Enterprise Server	Basic	VM220 (1,2), VM230 (1), VM240 (1), VM310
	LPAR	VM220 (1,2), VM230 (1), VM240 (1), VM310
Notes on Multiprise 3000: For specific service levels required, contact your IBM representative. (1) APAR VM62180 is required. (2) VM220 does not support VM guest coupling simulation.		
Parallel Enterprise Server R2/R3	Basic	VM220, VM230, VM240, VM310
	LPAR	VM220, VM230, VM240, VM310
Notes on R2/R3: For specific service levels required, contact your IBM representative.		
S/390 Parallel Enterprise Server G3	Basic	VM220 (1,2), VM230 (1), VM240 (1), VM310 (1)
	LPAR	VM220 (1,2), VM230 (1), VM240 (1), VM310 (1)
Notes on G3: For specific service levels required, contact your IBM representative. (1) VM220 and VM230 do not support the CMOS Cryptographic Coprocessor. Moreover, APAR VM61244 is required to run these releases on a machine with the CMOS Cryptographic Processor installed. VM240 and later support the CMOS Cryptographic Processor for use by guests. (2) VM220 does not support VM guest coupling simulation.		
S/390 Parallel Enterprise Server G4	Basic	VM220 (1,2,3), VM230 (1,2), VM240 (1,2), VM310 (1,2)
	LPAR	VM220 (1,2,3), VM230 (1,2), VM240 (1,2), VM310 (1,2)
Notes on G4: For specific service levels required, contact your IBM representative. (1) 370-mode operating systems will not run as guests of VM on this server. (2) VM220 and VM230 do not support the CMOS Cryptographic Coprocessor. Moreover, APAR VM61244 is required to run these releases on a machine with the CMOS Cryptographic Processor installed. VM240 and later support the CMOS Cryptographic Processor for use by guests. (3) VM220 does not support VM guest coupling simulation.		
S/390 Parallel Enterprise Server G5	Basic	VM220 (1,2,3,4), VM230 (1,2,4), VM240 (1,2), VM310 (1,2)
	LPAR	VM220 (1,2,3,4), VM230 (1,2,4), VM240 (1,2), VM310 (1,2)

Processor Support

Table 6. VM Processor Support Matrix (continued)

Processor	Mode	Current VM Support
Notes on G5: For specific service levels required, contact your IBM representative.		
(1) 370-mode operating systems will not run as guests of VM on this server. (2) VM220 and VM230 do not support the CMOS Cryptographic Coprocessor. Moreover, APAR VM61244 is required to run these releases on a machine with the CMOS Cryptographic Processor installed. VM240 and later support the CMOS Cryptographic Processor for use by guests. (3) VM220 does not support VM guest coupling simulation. (4) VM220 does not support IEEE Floating Point. VM230 requires APAR VM61762 to support IEEE Floating Point.		
S/390 Parallel Enterprise Server G6	Basic	VM220 (1,2,3,4), VM230 (1,2,4), VM240 (1,2), VM310 (1,2)
	LPAR	VM220 (1,2,3,4), VM230 (1,2,4), VM240 (1,2), VM310 (1,2)
Notes on G6: For specific service levels required, contact your IBM representative.		
(1) 370-mode operating systems will not run as guests of VM on this server. (2) VM220 and VM230 do not support the CMOS Cryptographic Coprocessor. Moreover, APAR VM61244 is required to run these releases on a machine with the CMOS Cryptographic Processor installed. VM240 and later support the CMOS Cryptographic Processor for use by guests. (3) VM220 does not support VM guest coupling simulation. (4) VM220 does not support IEEE Floating Point. VM230 requires APAR VM61762 to support IEEE Floating Point.		
@server zSeries 900	Basic	VM230 (1,2,3,4), VM240 (1,2,4), VM310 (1,2)
	LPAR	VM230 (1,2,3,4), VM240 (1,2,4), VM310 (1,2)
Notes on z900: For specific service levels required, contact your IBM representative.		
(1) 370-mode operating systems will not run as guests of VM on this server. (2) VM230 does not support the CMOS Cryptographic Coprocessor. Moreover, APAR VM61244 is required to run this release on a machine with the CMOS Cryptographic Processor installed. VM240 and later support the CMOS Cryptographic Processor for use by guests. (3) VM230 requires APAR VM61762 to support IEEE Floating Point. (4) VM230 and VM240 do not support the z/Architecture (64-bit) capabilities of the z900.		

Appendix B. IBM Operating Systems Supported as Guests of VM

This appendix provides information about the IBM operating systems supported as guests of current VM releases.

In general, an operating system is supported as a guest of VM only on hardware (processors, DASD, and other devices) for which support has been announced for that operating system to run native, in an LPAR, or as a guest of VM.

This appendix is not intended to completely cover the complex issues involved in hardware support. For processor considerations, see “Appendix A. IBM Processors Supported by VM” on page 77.

VM may be run in a logical partition (LPAR), which offers production level performance for V=V workloads, including a mix of CMS and full-function operating systems. For example, when OS/390 or VSE/ESA runs as a V=V guest of a VM image in turn running in an LPAR, it will experience performance comparable to running as a guest of a VM system running natively.

Several hardware assists available to VM running native are not available to VM in an LPAR.

When VM is run in an LPAR, V=F guests are not supported and I/O passthrough is not available to the V=R guest.

For more details, consult the *PR/SM Planning Guide*, GA22-7123, and documentation for the applicable processor.

The following symbols and abbreviations are used in the “Support” column of the matrix to indicate the level of support:

Symbol	Meaning
—	Guest is not supported
V	Guest is supported in V=V virtual machine
R	Either of the following: <ol style="list-style-type: none">1. Guest is supported in V=R virtual machine2. Guest is also supported in V=F virtual machine if the real hardware has the PR/SM feature installed
U	Guest may be UP (uniprocessor)
A	Guest may be AP (attached processor)
M	Guest may be MP (multiprocessor)
370	Guest runs in a 370 virtual machine
XA	Guest runs in an XA virtual machine
ESA	Guest runs in an ESA virtual machine

If a guest is supported in both XA and ESA virtual machines, ESA is preferred.

Guest Support

Table 7. VM Guest Support Matrix

Guest	Host	Support
LINUX for S/390	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA (1) VR UM ESA (1) VR UM ESA (1) VR UM ESA (1)
Notes for LINUX for S/390 Guests: (1) The VM host must be running on one of the following processors: IBM S/390 Multiprise 2000, IBM S/390 Multiprise 3000 Enterprise Server, IBM Parallel Enterprise Server R2/R3, IBM S/390 Parallel Enterprise Server G3 or later, or an IBM z/Architecture server.		
LINUX for zSeries	z/VM 3.1.0	VR UM ESA (1)
Notes for LINUX for zSeries Guests: (1) The z/VM host must be running on an IBM z/Architecture server and the 64-bit CP image must be loaded.		
MVS/ESA 5.2.2 (1)	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA VR UM ESA VR UM ESA VR UM ESA
Notes for MVS/ESA Guests: (1) Exploitation of hardware function by MVS may require specific levels of VM. For details, see the following books: <ul style="list-style-type: none"> • <i>MVS/ESA SP V5 Planning: Installation and Migration with JES2</i>, GC28-1428 • <i>MVS/ESA SP V5 Planning: Installation and Migration with JES3</i>, GC28-1429 		
OS/390 V2R6 or later (1)	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA (2) VR UM ESA (2,3) VR UM ESA (2,3) VR UM ESA (2,3)
Notes for OS/390 Guests: (1) Exploitation of hardware function by OS/390 may require specific levels of VM. For details, see <i>OS/390: Planning for Installation</i> , GC28-1726. (2) VM does not support external coupling facilities or real coupling links. (3) VM supports guest-coupling simulation on IBM S/390 Multiprise 2000, IBM S/390 Multiprise 3000 Enterprise Server, IBM S/390 Parallel Enterprise Server G3 or later, and IBM z/Architecture servers. An entire sysplex environment can be defined on a single VM image. VM guest coupling simulation is intended for test and development environments only, not for production.		
z/OS (1)	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA (2,4) VR UM ESA (2,4,5) VR UM ESA (2,4,5) VR UM ESA (3,4,5)

Table 7. VM Guest Support Matrix (continued)

Guest	Host	Support
Notes for z/OS Guests:		
(1)	Exploitation of hardware function by z/OS may require specific levels of VM. For details, see <i>z/OS: Planning for Installation</i> , GA22-7504.	
(2)	The VM/ESA host must be running on an IBM S/390 Multiprise 3000 Enterprise Server or IBM S/390 Parallel Enterprise Server G5 or G6. The z/OS guest runs only in 31-bit mode.	
(3)	The z/VM host must be running on an IBM S/390 Multiprise 3000 Enterprise Server, IBM S/390 Parallel Enterprise Server G5 or G6, or IBM z/Architecture server: <ul style="list-style-type: none"> On an IBM S/390 Multiprise 3000 Enterprise Server or IBM S/390 Parallel Enterprise Server G5 or G6, the z/OS guest runs only in 31-bit mode. On an IBM z/Architecture server, the z/OS guest must run in 64-bit mode on the 64-bit CP image. 	
(4)	VM does not support external coupling facilities or real coupling links.	
(5)	VM supports guest-coupling simulation. An entire sysplex environment can be defined on a single VM image. VM guest coupling simulation is intended for test and development environments only, not for production.	
VM/ESA 2.2.0	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA (1,2) VR UM ESA (1,2) VR UM ESA (1,2) VR UM ESA (2)
VM/ESA 2.3.0	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA (1,2,3) VR UM ESA (1,2,3) VR UM ESA (1,2,3) VR UM ESA (2,3)
VM/ESA 2.4.0	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA (1,2,3,4) VR UM ESA (1,2,3,4) VR UM ESA (1,2,3) VR UM ESA (2,3)
z/VM 3.1.0	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM ESA (2,3,4,5,6) VR UM ESA (2,3,4,5,6) VR UM ESA (2,3,5,6) VR UM ESA (2,3,5,7)
Notes for VM Guests:		
(1)	ESA/390 SIE extensions required for VM Data Spaces are not available to guests on ESA/370 processors.	
(2)	V=R recovery is not supported for a V=R guest.	
(3)	VM Guest Coupling Simulation will not work in the VM guest.	
(4)	Extended-TOD-clock facility is not available.	
(5)	A z/VM guest is supported only on processors that z/VM supports natively. See “Appendix A. IBM Processors Supported by VM” on page 77.	
(6)	The z/VM guest runs only in 32-bit mode.	
(7)	The z/Architecture (64-bit) capabilities of the z/VM guest are supported only on the 64-bit CP image on an IBM z/Architecture server.	
VSE/ESA 1.4.3	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR U 370 XA ESA (1) VR U 370 XA ESA (1) VR U 370 XA ESA (1) VR U 370 XA ESA (1)

Guest Support

Table 7. VM Guest Support Matrix (continued)

Guest	Host	Support
VSE/ESA Version 2	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM XA ESA VR UM XA ESA VR UM XA ESA VR UM XA ESA
Notes for VSE/ESA Guests: (1) VSE/ESA ESA and VM modes supported in both XA and ESA virtual machines.		
TPF Version 4.1 (1)	VM/ESA 2.2.0 VM/ESA 2.3.0 VM/ESA 2.4.0 z/VM 3.1.0	VR UM XA ESA VR UM XA ESA VR UM XA ESA VR UM XA ESA
Notes for TPF Guests: (1) TPF is supported as a guest of VM in environments where TPF-specific processor and DASD control unit RPQs are not required. If in a V=V virtual machine, use of Emulation Program for 37xx communication controllers is not supported.		

Appendix C. IBM Devices Supported by VM

This appendix provides information about the IBM devices supported by current VM operating systems.

The device support matrix is intended to provide a quick reference for support of various devices on VM. You should also check the hardware device support list for your processor to be sure the hardware supports a particular device. Other devices not found in the device support matrix may be supported; consult device announcements and publications for this information.

Device support might not be in the base release of any system shown, but may have been delivered through the service stream by an APAR.

Devices are fully supported by VM unless otherwise indicated. VM supports devices at any of the following three levels of function:

1. **Full support:** VM uses the device itself and makes it available to guests. VM will usually manage the device on behalf of all users.
2. **Dedicated to a guest or virtual machine:** VM does not use the device itself but enables operating systems or applications in virtual machines to use the device. There are usually no restrictions on the use of the device by a virtual machine operating system or application, except that the device may not be dedicated to more than one virtual machine at a time.
3. **Dedicated to a guest or virtual machine as an unsupported device:** VM does not use the device itself but will allow a full function guest or application in a virtual machine to use it. The guest or virtual machine application is completely responsible for the management and use of the device. Usage restrictions may apply; the major common usage restriction for this type of support is that the device cannot be used as the guest's IPL device.

The device support matrix may show that support for a device was not provided after a particular VM release. The following clarifications on the meaning of the programming support withdrawal may be helpful:

- Where programming support for a *real* device has been withdrawn as of some VM release, the corresponding *virtual* device remains supported in the same or later VM releases.
- There are some device types which can be defined as, or use many of the device attributes of, the real devices for which programming support is being terminated. VM's support for these currently supported devices remains unchanged.

Additional device restrictions may apply. There may be exceptions to supported devices and releases depending on your specific configuration. See the CP planning book for your release and hardware announcements for additional information.

It is sometimes possible to define a device differently depending on whether the definition is done using HCPRIO or CP Configurability support. For instance, a 3725 Communications Controller would be defined as a 3705 Communications Controller using HCPRIO or a 3725 Communications Controller using dynamic system configuration. For specific details, see *z/VM: Planning and Administration*.

Device Support

VM does not support 7-track tapes.

The following terms are used in the device support matrix:

Term	Meaning
VM220	VM/ESA Version 2 Release 2.0
VM230	VM/ESA Version 2 Release 3.0
VM240	VM/ESA Version 2 Release 4.0
VM310	z/VM Version 3 Release 1.0

Direct Access Storage Devices (DASD)

Table 8. Device Support List—DASD

Device	VM Releases Providing Support	Support Notes
3370 Model A01, B01, A02, B02	VM220, VM230, VM240, VM310	
3375 Model A1, B1, D1	VM220, VM230, VM240, VM310	
3380 Model A04, AA4, B04, AD4, BD4, AE4, BE4, AJ4, BJ4, AK4, BK4	VM220, VM230, VM240, VM310	Although it was previously announced that support for models A04, AA4, and B04 was withdrawn after VM/ESA 1.1.1, support has been extended on these models.
3380 Model CJ2	VM220, VM230, VM240, VM310	
3390 Model A14, A18, B14, B18, B1C, A24, A28, B24, B28, B2C	VM220, VM230, VM240, VM310	Supported in 3390 mode (native mode) with VSE/VSAM 2.1.0 or later.
3390 Model A34, A38, B34, B38, B3C	VM220, VM230, VM240, VM310	Supported in 3390 mode (native mode) with VSE/VSAM 2.1.0 or later.
3390 Model A94, A98, B94, B98, B9C	VM220, VM230, VM240, VM310	3380 Track Compatibility Mode is not supported. Minidisks used with VSE/VSAM or CMS/VSAM are limited to 65,536 tracks (4369 cylinders). Intended as a mass-storage device. Should not be used for system data or for data for applications that require high performance DASD.
3995 Model 131, 132 Optical Library Dataserver	VM220, VM230, VM240, VM310	Dedicated to a guest as a 3088.
3995 Model 151, 111 Optical Library Dataserver	VM220, VM230, VM240, VM310	Must be defined as a 3390. Intended as a mass-storage device. Should not be used for system data or for data for applications that require high performance DASD.
3995 Model 153, 113 Optical Library Dataserver	VM220, VM230, VM240, VM310	Must be defined as a 3390. Intended as a mass-storage device. Should not be used for system data or for data for applications that require high performance DASD.
9332 Model 400, 402, 600, 602	VM220, VM230, VM240, VM310	
9335 Model B01	VM220, VM230, VM240, VM310	
9336 Model 010, 020, 025	VM220, VM230, VM240, VM310	

Table 8. Device Support List—DASD (continued)

Device	VM Releases Providing Support	Support Notes
9340 Direct Access Storage Subsystem: 9345 Model B12, B22	VM220, VM230, VM240, VM310	
RAMAC [®] Array DASD: 9391 Model A10 Rack with 9392 Model B13 Drawers	VM220, VM230, VM240, VM310	Must be defined as a 3390. Attaches to 3990 Model 3 or Model 6 Storage Control.
RAMAC Virtual Array Subsystem: 9393 Model 002, T42, or T82	VM220, VM230, VM240, VM310	Emulates a 3990 Model 3 Storage Control with 3390 Models 1, 2, and 3 DASD or 3380 Models J and K DASD.
RAMAC Array Subsystem: 9394 Model 001, 002, or 003 Cluster Array Controller with 9395 Model B13 or B23 Drawers	VM220, VM230, VM240, VM310	Emulates a 3990 Model 2 Storage Control with 3390 Model 3 DASD or 3380 Model K DASD.
Internal Disk (for Multiprise 2000)	VM220, VM230, VM240, VM310	<p>This device is a feature of the S/390 Multiprise 2000 server.</p> <p>Emulates a 3990 Model 2 Storage Control with 3390 Models 1, 2, 3, and 9 DASD or 3380 Models E, J, and K DASD.</p> <p>On VM220, APAR VM60844 is required to enable CP Monitor to gather cache statistics for Internal Disk.</p> <p>On VM220, IOCP APAR VM61197 and Mirroring Status APAR VM61266 are required.</p>
Internal Disk (for Multiprise 3000)	VM220, VM230, VM240, VM310	<p>This device is a feature of the S/390 Multiprise 3000 Enterprise Server.</p> <p>Emulates a 3990 Model 2 Storage Control with 3390 Models 1, 2, 3, and 9 DASD or 3380 Models E, J, and K DASD.</p> <p>On VM220, VM230, or VM240, APAR VM62180 is required.</p> <p>On VM230 or later, the performance-oriented track level commands are supported for guest use only.</p> <p>IOCP APAR VM62312 is required.</p> <p>ICKDSF APAR PQ26800 is required.</p>

Device Support

Table 8. Device Support List—DASD (continued)

Device	VM Releases Providing Support	Support Notes
Enterprise Storage Server (2105 DASD Subsystem)	VM220, VM230, VM240, VM310	<p>Supported only in emulation mode. Must be defined as 3990 Model 3 or 6 Storage Control with either of the following:</p> <ul style="list-style-type: none"> 3990 Models 2, 3, or 9 DASD 3990 Models 2 or 3 DASD in 3380 track compatibility mode <p>On VM220, VM230, or VM240, APAR VM62111 is required.</p> <p>On VM230 or later, the performance-oriented track level commands are supported for guest use only.</p> <p>On VM220 or VM230, the Parallel Access Volumes feature is not supported. To use this feature on VM240 or later, the device must be dedicated to a guest. On VM240, APAR VM62295 is required.</p> <p>On VM240, APAR VM62416 is required to support guest Flash Copy (dedicated DASD or fullpack minidisk). On VM310, guest and native Flash Copy are supported.</p> <p>ICKDSF APAR PQ26800 is required.</p>

DASD Control Units and Storage Controls

Table 9. Device Support List—DASD Control Units and Storage Controls

Device	VMESA Releases Providing Support	Support Notes
3830 Model 2	VM220, VM230, VM240, VM310	
3880 Model 1, 3, 4	VM220, VM230, VM240, VM310	
3880 Model E21, G21, H21, J21, D23, E23, G23, H23, J23	VM220, VM230, VM240, VM310	
3990 Model 1, 2	VM220, VM230, VM240, VM310	
3990 Model 3	VM220, VM230, VM240, VM310	Concurrent Copy function supported for guest use only.
3990 Model 6	VM220, VM230, VM240, VM310	<p>All functions of former 3990 models supported plus increased cache, System Clock Support, and the Control Unit Initiated Reconfiguration feature (CUIR).</p> <p>Concurrent Copy and Extended Remote Copy functions are supported for guest use only.</p>
9221 DASD/Tape Subsystem Control	VM220, VM230, VM240, VM310	

Table 9. Device Support List—DASD Control Units and Storage Controls (continued)

Device	VMESA Releases Providing Support	Support Notes
9335 Model A01	VM220, VM230, VM240, VM310	
9340 Direct Access Storage Subsystem: 9341 Model A02 9343 Model C02, C04	VM220, VM230, VM240, VM310	
9340 Direct Access Storage Subsystem: 9343 Model D04	VM220, VM230, VM240, VM310	ESCON-attached only.
9340 Direct Access Storage Subsystem: 9343 Model CC2, CC4	VM220, VM230, VM240, VM310	Models CC2 and CC4 are cache models (basic caching only). The cache function is not visible to or controllable by software. No additional VM support is required.
9340 Direct Access Storage Subsystem: 9343 Model DC4	VM220, VM230, VM240, VM310	ESCON-attached only. Model DC4 is a cache model (basic caching only). The cache function is not visible to or controllable by software. No additional VM support is required.

Tape Units and Tape Libraries

Table 10. Device Support List—Tape Units and Tape Libraries

Device	VM Releases Providing Support	Support Notes
2440	VM220, VM230, VM240, VM310	Must be defined as a 3420 Model 4.
3420 Model 3, 4, 5, 6, 7, 8	VM220, VM230, VM240, VM310	
3422 Tape Unit and Control	VM220, VM230, VM240, VM310	
3424 Tape Subsystem	VM220, VM230, VM240, VM310	For Brazil only.
3430	VM220, VM230, VM240, VM310	
3480 Tape Subsystem	VM220, VM230, VM240, VM310	
3490 Tape Subsystem	VM220, VM230, VM240, VM310	
3490E (Enhanced Capability Model) Tape Subsystem	VM220, VM230, VM240, VM310	
3494 Tape Library Dataserver and Virtual Tape Server	VM220, VM230, VM240, VM310	Native support is provided in conjunction with DFSMS/VM. VM310 supports Peer-to-Peer VTS and VTS Import/Export feature for guests.
3495 Tape Library Dataserver	VM220, VM230, VM240, VM310	Native support is provided in conjunction with DFSMS/VM.
3590 High Performance Tape Subsystem	VM220, VM230, VM240, VM310	Native support is for ESCON-attached only. VM310 supports FICON attachment of 3590 A60 tape controller for guests that support FICON attachment natively.
9348 Model 11, 12	VM220, VM230, VM240, VM310	

Tape Control Units

Table 11. Device Support List—Tape Control Units

Device	VM Releases Providing Support	Support Notes
3803 Model 1, 2	VM220, VM230, VM240, VM310	
9221 DASD/Tape Subsystem Control	VM220, VM230, VM240	

Printers

Table 12. Device Support List—Printers

Device	VM Releases Providing Support	Support Notes
3203 Model 5	VM220, VM230, VM240, VM310	
3262	VM220, VM230, VM240, VM310	
3268 Model 2, 2C	VM220, VM230, VM240, VM310	Supported if defined as a 3287.
3287 Model 1, 1C, 2, 2C, 4	VM220, VM230, VM240, VM310	
3289 Model 1, 3, 4, 8	VM220, VM230, VM240, VM310	
3800 Model 1	VM220, VM230, VM240, VM310	
3800 Model 3, 6, 8	VM220, VM230, VM240, VM310	Full support in Model 1 compatibility mode or using Advanced Function Printing (AFP [™]) licensed programs.
3812	VM220, VM230, VM240, VM310	Full support through RSCS 3.1.1 or later, using Advanced Function Printing licensed programs; downloading of fonts is not supported. Loading of fonts requires Print Services Facility/VM (PSF/VM) licensed program (program number 5684-141).
3816 Model 01D, 01S	VM220, VM230, VM240, VM310	Full support through RSCS 3.1.1 or later, using AFP licensed programs; downloading of fonts is not supported. Loading of fonts requires PSF/VM licensed program.
3820	VM220, VM230, VM240, VM310	Full support through VM/VTAM, using AFP licensed programs.
3825	VM220, VM230, VM240, VM310	Full support using AFP licensed programs.
3827	VM220, VM230, VM240, VM310	Full support using AFP licensed programs.
3835	VM220, VM230, VM240, VM310	Full support using AFP licensed programs.
3900	VM220, VM230, VM240, VM310	Supported if defined as a 3800.
4245 Model 1	VM220, VM230, VM240, VM310	Supported as a 4245 or in 3262 compatibility mode.
4245 Model 12, 20	VM220, VM230, VM240, VM310	
4248 Model 1, 2	VM220, VM230, VM240, VM310	Supported as a 4248 or in 3211 compatibility mode.
6262 Model 14, 22	VM220, VM230, VM240, VM310	Must be defined as a 4248 Model 1.

Card Readers and Card Punches

Table 13. Device Support List—Card Readers and Card Punches

Device	VM Releases Providing Support	Support Notes
3505 Model B1, B2	VM220, VM230, VM240, VM310	
3525 Model P1, P2, P3	VM220, VM230, VM240, VM310	

Terminals/Displays/Consoles

Most terminals are supported as a virtual machine console (in 3215 emulation mode or 3270 mode). 3270-family displays can be defined generically (for example, as 3270s) with dynamic computation of screen size based on information returned from the device.

Display Printers

Most display printers are supported using Advanced Function Printing (AFP) licensed programs through RSCS.

Display Control Units

Table 14. Device Support List—Display Control Units

Device	VM Releases Providing Support	Support Notes
2074 Console Support Controller	VM220, VM230, VM240, VM310	
3174	VM220, VM230, VM240, VM310	
3272 Model 2	VM220, VM230, VM240, VM310	
3274	VM220, VM230, VM240, VM310	
3276 Display/Control Unit	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device.

Communications Controllers

Table 15. Device Support List—Communications Controllers

Device	VM Releases Providing Support	Support Notes
3705	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device.
3720	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device. Must be defined as a 3705, unless you are using dynamic system configuration.
3725	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device. Must be defined as a 3705, unless you are using dynamic system configuration.
3745	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device. Must be defined as a 3705, unless you are using dynamic system configuration.

Device Support

Table 15. Device Support List—Communications Controllers (continued)

Device	VM Releases Providing Support	Support Notes
9221 Integrated Communications Attachment	VM220, VM230, VM240, VM310	

Enterprise Systems Connection Architecture (ESCON) Devices

Table 16. Device Support List—Enterprise Systems Connection Architecture (ESCON) Devices

Device	VM Releases Providing Support	Support Notes
9032 ESCON Director Model 2	VM220, VM230, VM240, VM310	
9032 ESCON Director Model 3	VM220, VM230, VM240, VM310	
9032 ESCON Director Model 5	VM220, VM230, VM240, VM310	
9033 ESCON Director Model 1	VM220, VM230, VM240, VM310	
9033 ESCON Director Model 4	VM220, VM230, VM240, VM310	
9034 ESCON Converter Model 1	VM220, VM230, VM240, VM310	
9035 ESCON Converter Model 2	VM220, VM230, VM240, VM310	
ESCON Channel-to-Channel Adapter (CTCA)	VM220, VM230, VM240, VM310	Extended mode operation only.

Note: VM supports ESCON channels, ESCON-attached control units, and the ESCON Director (ESCD) on all IBM z/Architecture servers, IBM S/390 Parallel Enterprise Servers, IBM S/390 Multiprise servers, and IBM ES/9000 processors, plus those IBM ES/3090 processors on which the ESCON hardware is supported.

Control units and I/O devices with parallel channels can be attached to ESCON channels through the ESCON Converter Model 1. (See your IBM representative for a list of parallel devices that the ESCON Converter Model 1 supports.) Conversely, the ESCON Converter Model 2 allows ESCON devices to be attached to processors that have parallel channels.

For more information about ESCON architecture, see *Introducing Enterprise Systems Connection*, GA23-0383.

Miscellaneous Devices

Table 17. Device Support List—Miscellaneous Devices

Device	VM Releases Providing Support	Support Notes
CTCA	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device.
OSA-2	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device. OSA/SF is required to customize the OSA Express modes. OSA/SF can be running either in an LPAR in the same system complex or as a VM guest. OSA/SF for VM can be run as a CMS application. OSA-2 is recognized as TYPE=OSA.

Table 17. Device Support List—Miscellaneous Devices (continued)

Device	VM Releases Providing Support	Support Notes
OSA Express	VM220, VM230, VM240, VM310	<p>On VM220 and VM230, APAR VM62184 is required.</p> <p>Dedicated to a virtual machine as a supported device.</p> <p>OSA/SF is required to customize the OSA Express modes. OSA/SF can be running either in an LPAR in the same system complex or as a VM guest. OSA/SF for VM can be run as a CMS application.</p> <p>OSA Express is recognized as TYPE=OSE for the OSA Express Fast Ethernet and OSA Express 155 ATM modes.</p> <p>On VM240 and later, OSA Express is recognized as TYPE=OSD for the OSA Express Gigabit Ethernet mode.</p>
3088	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device.
3088 Model 61 PSCA Card (common link access to workstations)	VM220, VM230, VM240, VM310	
3172 Model 1, 2, 3	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device.
3174 Model 12L, 22L	VM220, VM230, VM240, VM310	
3737 Remote Channel-to-Channel Unit Model 2	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device. Must be defined as a CTCA.
3890™	VM220, VM230, VM240, VM310	Dedicated to a guest as a supported device.
4753 Network Security Processor	VM220, VM230, VM240, VM310	Dedicated to a guest as a supported device.
7171 Device Attachment Control Unit	VM220, VM230, VM240, VM310	The 7171 ASCII Device Attachment Control Unit (DACU) allows the attachment of ASCII terminals locally or (through Start-Stop communication line) remotely. The ASCII terminals appear to the host as 3277s, 3278s, and 3279s, with the DACU itself appearing as a 3274 control unit.
8232 LAN Channel Station	VM220, VM230, VM240, VM310	Dedicated to a virtual machine as a supported device. Supported by TCP/IP for VM and the TCP/IP Feature for z/VM.

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DB2	Processor Resource/Systems Manager
DFSMS/MVS	PS/2
DFSMS/VM	RACF
Distributed Relational Database Architecture	RAMAC
DRDA	Resource Link
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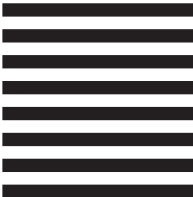
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