

z/VM and IBM System z
... your path to success



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What is z/VM?

z/VM® offers a base for customers who want to exploit IBM® virtualization technology on one of the industry's best-of-breed server environments, the IBM System z™ family. With virtualization technology, customers can easily create many virtual machines consisting of virtualized processor, communications, storage, networking, and I/O resources. Virtualization technology may help lower your total cost of ownership when deploying new On Demand Business and enterprise application workloads. z/VM includes over 35 years of innovation and invention.

z/VM Version 5 Release 2 – Enhancements for Virtualization on System z

- *Virtualization technology and Linux® enablement:*
 - *Enhanced exploitation of real memory beyond 2 GB*
 - *Improved memory management for Linux guests¹*
 - *Improved performance of z/VM Control Program (CP) use of Small Computer System Interface (SCSI) disk I/O*
 - *QDIO efficiency improvements*
 - *Paging/spooling optimization*
 - *Improved FBA emulation, helping to reduce the number of I/O requests to the VM SCSI stack with:*
 - *CP's FBA emulation functions reading CMS I/O buffers more efficiently*
 - *More efficient FBA emulation handling Locate CCWs more efficiently*
 - *More efficient FBA emulation handling the FBA padding function more efficiently*
 - *Definition and operation of Fibre Channel Protocol (FCP)-attached SCSI disks with capacities of nearly 1 TB with the PTFs for APAR VM63700 (DirMaint™) and VM63664 (DFSMS/VM®)*
- *Secure Sockets Layer (SSL) server support for additional Linux distributions*
- *Enhanced performance assist for cooperating z/VM guests using OSA-Express, FCP, and HiperSockets™*
- *Enhanced systems management APIs for improved management of Linux and other guests*
- *Network virtualization and security:*
 - *Improved problem determination for guest LANs and virtual switches*
 - *Enhanced dynamic routing capabilities with new MPRoute server*
- *Technology exploitation:*
 - *Exploitation of selected features of the IBM System z9™ Enterprise Class (z9 EC), formerly the System z9 109 (z9-109) and the System z9 Business Class (z9 BC):*
 - *Support for new instructions²*
 - *Support for FICON® Express4 (4 Gbps FICON)*
 - *TCP/IP and guest LAN Support for HiperSockets using IPv6 protocol²*
 - *Simplified VLAN management with support for Generic Attribute Registration Protocol (GARP) Virtual Local Area Network (VLAN) Registration Protocol (GVRP)²*
 - *Crypto Express2 Accelerator for SSL acceleration*
 - *Support for OSA-Express2 OSN (OSA for NCP)*
 - *Improved FCP channel utilization and sharing among guests through N-Port ID virtualization (NPIV) support*
 - *Support for hardware capability to add and delete logical partition (LPAR) names*
 - *Support for hardware capability to provide up to 60 LPARs on the z9 EC and 30 on the z9 BC*

- Additional exploitation of IBM TotalStorage® DS6000 and IBM TotalStorage DS8000 series²
- Support for Parallel Access Volumes (PAVs) as minidisks²

- Systems management:

- Simplified user administration with the coordination of DirMaint and RACF® changes
- Improved DirMaint directory management performance
- Performance Toolkit for VM™ to support updated control blocks, new monitor data, and enhanced ease-of-use²

Note: ¹ - Requires the PTF for APAR VM63856, available June 30, 2006

² - Requires the PTF for APAR VM63952, available May 26, 2006

- To support the z9 EC and z9 BC on z/VM V4.4, V5.1, and V5.2, the PTFs for the following APARs are required:

- VM63577 - CP (V4.4)
- VM63646 - CP (V4.4, V5.1)
- VM63856 - CP (V5.2)
- VM63784 - CP (V5.1)
- PK08444 - TCP/IP (V5.1)
- VM63721 - HCD/HCM (V4.4, V5.1)
- VM63869 - HCD/HCM (V4.4, V5.1)
- VM63743 - EREP (V4.4, V5.1)
- VM63946 - EREP (V4.4, V5.1, V5.2)
- VM63744 - CP (V4.4, V5.1)
- VM63722 - CP (V4.4, V5.1)
- VM63921 - CMS IOCP (V4.4, V5.1, V5.2)
- OA15170 - OSA/SF (V4.4, V5.1)
- VM63952 - CP, CMS IOCP, TCP/IP, DirMaint, Performance Toolkit, HCD/HCM, and OSA/SF (V5.2)

Note: The PTFs for APARs VM63721, VM63743, and CP (excluding VM63952, VM VM63784, and VM63856) have been integrated into z/VM V5.2.

(See z/VM Version 5.2 General Information – GC24-6095)

z/VM Version 5 Release 1 – Enhancements for Virtualization Capabilities for Linux on System z

- Engine-based Value Unit pricing and a reduced entry price compared to V4
- Virtualization technology and Linux enablement:
 - Deployment of a Linux server farm on z/VM using only (SCSI) FCP attached disks
 - Improved performance of z/VM CP use of SCSI disk I/O reducing the number of I/O requests to the VM SCSI stack with the PTFs for APARs VM63725 and VM63534:
 - QDIO efficiency improvements
 - More efficient FBA emulation for reading CMS I/O buffers
 - More efficient FBA emulation of Locate CCWs
 - Definition and operation of FCP-attached SCSI disks with capacities of nearly 1 TB with the PTFs for APARs VM63700 (DirMaint) and VM63664 (DFSMS/VM)
 - Reduced dependence on tape with installation from DVD
 - Capability to swap from faulty disks using the new HyperSwap™ command
 - Improved cryptographic performance with PCIX Cryptographic Coprocessor (PCIXCC) support for Linux on System z and z/OS® guests
 - Improved security with Crypto Express2 guest support for Linux on System z and z/OS
 - New systems management APIs implemented using Version 2 (V2) of the RPC server

- *Network virtualization and security:*
 - *Enhanced network recovery with virtual switch failover support*
 - *More flexible data transfer with virtual switch exploitation of Layer 2 support for OSA-Express and OSA-Express2 with the PTFs for APARs VM63538 and PQ97436*
 - *Improved authorization for z/VM guest LANs and virtual switches*
- *Technology exploitation:*
 - *Support for the z9 EC and z9 BC with the PTFs for APARs VM63646, VM63721, VM63784, PK08444, VM63869, VM63743, VM63946, VM63744, VM63722, VM63921, and OA15170*
 - *Crypto Express2 Accelerator for SSL acceleration with the PTF for APAR VM63646*
 - *Support for OSA-Express2 OSN (OSA for NCP)*
 - *Improved FCP channel utilization and sharing among guests through NPIV with the PTF for APAR VM63744*
 - *Support for hardware capability to provide for up to 60 LPARs on the z9 EC and 30 on the z9 BC*
 - *Simplified VLAN management with support for GVRP with the PTFs for APARs VM63784 and PK08444*
 - *Support for the IBM eServer™ zSeries 990 (z990) and zSeries 890 (z890)*
 - *Greater scalability with up to four Logical Channel SubSystems (LCSSs) on the z990 and up to two on the z890*
 - *Transparent sharing of spanned internal and external channels across LCSSs*
 - *Support for the Open Systems Adapter (OSA)-Express Integrated Console Controller*
 - *Support for OSA-Express2 GbE and 10 GbE*
 - *Support for an increase in the number of TCP/IP stacks to provide additional connections to help enable more virtual machines to be connected to an external network with the PTFs for APARs VM63524 and PQ914215*
 - *Additional security for SCSI devices in a z/VM environment with Linux guests through support of FCP LUN access control with the PTF for APAR VM63328*
 - *Support for up to 24 processors per z/VM image on a z990 server*
 - *Improvements to Capacity Upgrade on Demand*
 - *Support for FICON Express2 that can double the channel capacity and help increase performance*
 - *Support for FICON Express4 (4 Gbps FICON)*
 - *Support for the DS8000 Series with the PTF for APAR VM63534*
 - *Support for the DS6000 Series with the PTF for APAR VM63535*
 - *Support for use of SCSI disks that support FBA disks of nearly 1 TB (2,147,483,640 512-byte blocks) for CP volumes and up to 381 GB for CMS and GCS volumes with PTFs for APARs VM63700 (DirMaint) and VM63644 (DFSMS/VM)*
 - *Capability to route IPv6 packets and develop IPv6 applications*
- *Systems management:*
 - *Enhanced Performance Toolkit for VM*
 - *Functional equivalence to the Performance Reporting Facility (PRF)*

- New reports for Linux and for SCSI FCP disks
- Support for application monitor records for Novell SUSE Linux Enterprise Server (SLES) 9 with the PTF for APAR VM63580

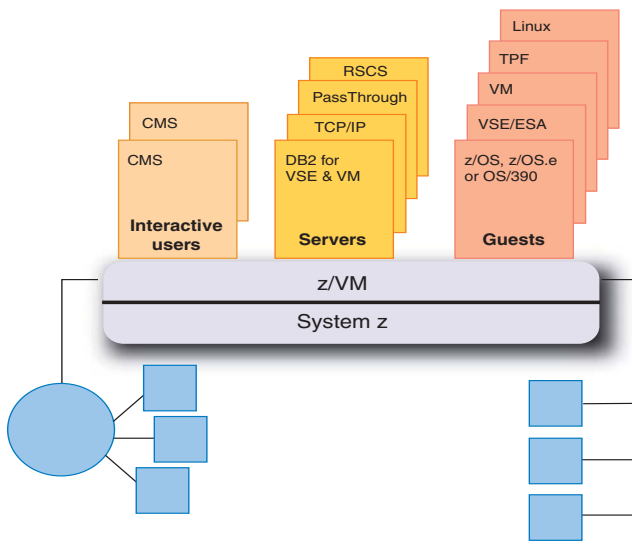
(See z/VM Version 5.1 General Information – GC24-6095)

z/VM Version 4 Release 4 - Providing Virtualization Capabilities for Linux on System z

- *Virtualization technology and Linux enablement:*
 - Reduces overhead and may improve performance of virtual machines on zSeries servers
 - Provides higher efficiency when managing large numbers of virtual machines
 - Provides high-performance virtual FICON CTCAs
 - Provides guest IPL from SCSI FCP-attached disks for Linux
 - Provides appropriate Red Hat Package Manager (RPM) packages for the SLES 8 distributions with upgraded SSL server
 - Allows VM/ESA or z/VM systems to run as second-level (or higher) guests while simulating z/OS or z/OS.e coupled sysplexes with virtual Coupling Facility (CF)
- *Network virtualization enhancements:*
 - Additional network-traffic configuration options using Virtual LANs (VLANs)
 - External IP connectivity for guest LANs through virtual switching
 - Guest-LAN support for IPv6
 - Extended HiperSockets support
- *Technology exploitation:*
 - Support for the IBM System z9 EC and z9 BC with the PTFs for APARs VM63577, VM63646, VM63721, VM63869, VM63743, VM63946, VM63744, VM63722, VM63921, and OA15170
 - Support for IBM z990 with:
 - Improved logical partitioning scalability with Logical Channel SubSystems (LCSSs)
 - Transparent sharing of HiperSockets channels across LCSSs
 - Improved capacity planning and I/O performance measurement
 - Provides support for up to 30 logical partitions (LPARs)
 - Cascaded FICON directors for enhanced and simplified connectivity
 - Support for FICON Express2 that can double the channel capacity and help increase performance
 - Support for FICON Express4 (4 Gbps FICON)
 - Support for IBM TotalStorage Enterprise Storage Server® (ESS) Peer-to-Peer Remote Copy Extended Distance (PPRC-XD) and PPRC Version 2 (V2)
 - Support for IBM ESS FlashCopy® Version 2 (V2)
 - Support for IBM TotalStorage Enterprise Tape Controller 3592 Model J70 and Tape Drive 3592 Model J1A
- *Systems management improvements :*
 - Better control, definition, and dynamic reconfiguration of hardware I/O
 - Comprehensive performance monitoring and reporting with the optional Performance Toolkit for VM feature
 - Automated shutdown of the Shared File System

- *Networking security enhancements:*
 - *Dynamic control of network access and configurability*
 - *Easier IMAP server administration with an authentication exit*
- *Application enablement:*
 - *Support for the new C/C++ for z/VM compiler (5654-A22)*

z/VM concurrently supports many different virtual machines, each running its own operating environment (as a “guest” operating system) in security and isolation.



A solution that builds on VM strengths

- *Virtualization technology*
- *Guest operating system support*
- *Extensive connectivity options*
- *Linux server consolidation platform*
- *CMS interactive support*

- *Server support*
- *Client/server workstation synergy*
- *Open distributed computing*
- *Ideal Web serving platform*
- *Wide range of environments and applications*

For a complete list of publications available, refer to the z/VM Web site at:

ibm.com/zseries/zvm/library/

z/VM supports a wide range of industry standards

- *Networking protocols and connections, languages, programming and graphical user interfaces (GUI)*
- *POSIX support*

z/VM manages the enterprise

- *Dynamic system configuration capabilities*
 - *Help reduce planned and unplanned outages*
- *DFSMS/VM provides automated data management for Shared File System (SFS), POSIX Byte File System (BFS) files, and minidisk restructuring*
 - *Provides interfaces for Tivoli Storage Manager™ (TSM) tape library usage*
 - *Allows VSE/ESA™ or z/VSE™ guest access to automated tape libraries containing 3480, 3490, 3590, and 3592 devices*
 - *Support for nearly 1 TB SCSI disks with the PTF for APAR VM63664*

z/VM embraces the latest technology

z/VM Version 5 Release 2 provides:

- *Enhanced exploitation of real memory beyond 2 GB*
- *Improved memory management for Linux guests¹*
- *Enhanced performance assist for cooperating z/VM guests using OSA-Express, FCP, and HiperSockets*
- *Definition and operation of FCP-attached SCSI disks with capacities of nearly 1 TB with the PTFs for APARs VM63700 and VM63664*
- *Exploitation of selected features of the z9 EC and z9 BC*
 - *Support for new instructions²*
 - *Support for FICON Express4 (4 Gbps FICON)*
 - *TCP/IP and guest LAN Support for HiperSockets using IPv6 protocol²*
 - *Simplified VLAN management with support for GVRP²*
 - *Crypto Express2 Accelerator for SSL acceleration*
 - *Support for OSA-Express2 OSN (OSA for NCP)*
 - *Improved FCP channel utilization and sharing among guests through NPIV support*
 - *Support for hardware capability to add and delete LPAR names*
 - *Support for hardware capability to provide up to 60 LPARs on the z9 EC and 30 on the z9 BC*
- *Additional exploitation of the IBM DS6000 and DS8000 series²*
- *Support for Parallel Access Volumes (PAVs) as minidisks²*

Notes: ¹ - Requires the PTF for APAR VM63856, available June 30, 2006

² - Requires the PTF for APAR VM63952, available May 26, 2006

z/VM Version 5 Release 1 provides:

- *Deployment of a Linux server farm on z/VM using only FCP-attached SCSI disks*
- *Definition and operation of FCP-attached SCSI disks with capacities of nearly 1 TB with the PTFs for APARs VM63700 (DirMaint) and VM63664 (DFSMS/VM)*
- *Reduced dependence on tape with installation from DVD*
- *Improved availability by swapping from faulty disks using the new HyperSwap command*
- *Improved cryptographic performance with PCIXCC support for Linux and z/OS guests*
- *Improved security with Crypto Express2 guest support for Linux on System z and z/OS*
- *Enhanced network recovery with virtual switch failover support*
- *Systems management APIs implemented using Version 2 (V2) of the RPC server*
- *Support for the z9 EC and z9 BC with the PTFs for APARs VM63646, VM63721, VM63869, VM63743, VM63946, VM63744, VM63722, VM63921, and OA15170*
 - *Crypto Express2 Accelerator for SSL acceleration with the PTF for APAR VM63646*
 - *Support for OSA-Express2 OSN (OSA for NCP) with the PTF for APAR VM63722*
 - *Improved FCP channel utilization and sharing among guests through NPIV support with the PTF for APAR VM63744*
 - *Support for hardware capability to add and delete LPAR names*
 - *Support for hardware capability to provide up to 60 LPARs on the z9 EC and 30 on the z9 BC*

- Simplified VLAN management with support for GVRP with the PTFs for VM63784 and PK08444
 - Support for the z990 and z890:
 - Up to four LCSSs on the z990 and up to two on the z890
 - Transparent sharing of spanned internal and external channels across LCSSs
 - Support for the OSA-Express Integrated Console Controller
 - More flexible data transfer with virtual switch exploitation of layer 2 support for OSA-Express and OSA-Express2 with the PTFs for APARs VM63538 and PQ97436
 - Support for OSA-Express2 GbE and 10 GbE
 - Support the increase in the number of TCP/IP stacks with the PTFs for APARs VM63524 and PQ91421
 - Provides additional connections to help enable more virtual machines to be connected to an external network with the PTFs for APARs VM63524 and PQ91421
 - Support for FICON Express2 that can double the channel capacity and help increase performance
 - Support for up to 24 processors per z/VM image on a z990 server
 - Improvements to Capacity Upgrade on Demand
 - Use of SCSI disks by guests that support FBA disks up to 361 GB in size, without requiring their own SCSI support
 - Support for the IBM DS8000 series with the PTF for APAR VM63534
 - Support for the IBM DS6000 series with the PTF for APAR VM63535
 - Capability to route IPv6 packets and develop IPv6 applications
- z/VM Version 4 Release 4 added:**
- Support for the z9 EC and z9 BC with the PTFs for APARs VM63577, VM63646, VM63721, VM63869, VM63743, VM63946, VM63744, VM63722, VM63921, and OA15170
 - Support for z990 functions are designed to provide:
 - Greater scalability with four LCSSs
 - Transparent sharing of HiperSockets channels across LCSSs
 - Facilities to extend I/O measurements
 - Twice the number of LPARs (30) compared to the z900
 - Performance assist to help boost guest performance
 - Definition and dynamic reconfiguration of hardware I/O via graphical interface
 - Increased flexibility and connectivity with support for cascaded FICON directors
 - Guest IPL from SCSI FCP disks for Linux
 - IEEE Virtual LAN (VLAN) support
 - TCP/IP broadcast support for HiperSockets and OSA-Express adapter
 - Virtual FICON CTCA support
 - Support for IBM ESS PPRC-XD and PPRC V2
 - Support for IBM ESS FlashCopy V2
 - Support for IBM Enterprise Tape Controller 3592 Model J70 and Tape Drive 3592 Model J1A
- z/VM for running Parallel Sysplex system environments**
- z/OS, and z/OS.e Parallel Sysplex[®] system environments as z/VM guests
 - Virtual Coupling Facility (CF) support:
 - Faster deployment of new Parallel Sysplex systems through testing with virtual sysplexes
 - Real hardware coupling facilities and coupling links neither required nor supported
 - Coupling facility duplexing with System z
 - Allows VM/ESA[®] or z/VM systems hosting sysplexes to run as second-level (or higher) guests
 - Help reduce risk in running new applications for z/OS or z/OS.e releases
 - Helps reduce problems in scheduling test and production time

- Helps reduce training expense and reduce risk to production operations through operator training with virtual configurations
- Additional options for disaster recovery
- z/VM V5 supports the Parallel Sysplex guest environment on all models of the IBM z9 EC, z9 BC, z990, z900, z890, and z800 servers.

z/VM encompasses many uses

- Flexible, cost-effective guest environments
- Well-suited for on demand business
- Consolidation of select UNIX® and Linux workloads onto a single physical hardware server
- Data and application serving for Internet/intranet users
- Rich application development environment

z/VM for On Demand Business

- Access to enterprise data and applications through TCP/IP NFS
- Enterprise Web serving through IBM Business Partner products working cooperatively with z/VM
- Reusable Server Kernel (RSK) for vendors and application programmers to write multithreaded server programs

VM installation and service tools

- Virtual Machine Serviceability Enhancements Staged/Extended (VMSES/E) available for:
 - Installation of z/VM, IBM Licensed Products, and vendor products in VMSES/E format
 - Allows the service disks of the z/VM components to reside in SFS
 - Application of z/VM service
 - CORrective service (COR)
 - Recommended Service Upgrades (RSU)
- z/VM installation and service available on CD-ROM (except with V5.2)

- Installation available on 3590-formatted tapes and DVD on V5.2
- Order z/VM products and service using ShopzSeries
 - Internet delivery of z/VM SDO licensed products

To learn more about ShopzSeries:

ibm.com/software/ShopzSeries/

CMS application multitasking

- Applications can be divided to handle work in parallel
- Application throughput can be improved
- POSIX exploits CMS multitasking
- CMS Pipelines support the use of CMS multitasking

CMS Pipelines

- Programmer productivity tool for simple creation of powerful, reusable REXX and Assembler programs and Common Gateway Interface (CGI) scripts for Web servers

Data-in-memory exploitation

- Virtual disk in storage provides fast access to data in memory
- Minidisk caching boosts performance with caching in central and/or expanded storage
- VM Data Spaces allow applications in virtual machines to create additional VM Data Spaces of 2 gigabytes, up to 2 terabytes total

Callable Services Library (CSL)

- Improved application development productivity
- REXX and other high-level languages can use z/VM services, such as requesting Shared File System functions
- Interfaces to use VM data spaces
- Interfaces to POSIX functions for CMS users and applications

CMS Interactive Support

CMS Binder/Loader for z/VM

- Enhanced application affinity between CMS, z/OS, or z/OS.e
- The CMS binder
 - Creates and utilizes data spaces if the user is authorized
 - Converts object or load modules, or program objects, into a program object and stores the program object in a partitioned data set extended (PDSE) program library
 - Converts object or load modules, or program objects, into a load module and stores the load module in a partitioned data set (PDS) program library
 - Converts object or load modules, or program objects, into an executable program in virtual storage and executes the program
- The CMS loader
 - Increases the services of the program fetch component by adding support for loading program objects
 - Reads both program objects and load modules into virtual storage and prepares them for execution

VMLINK

- User productivity enhancer for linking minidisks and SFS directories
- Rewritten for improved serviceability in z/VM

ibm.com/eserver/zseries/zvm

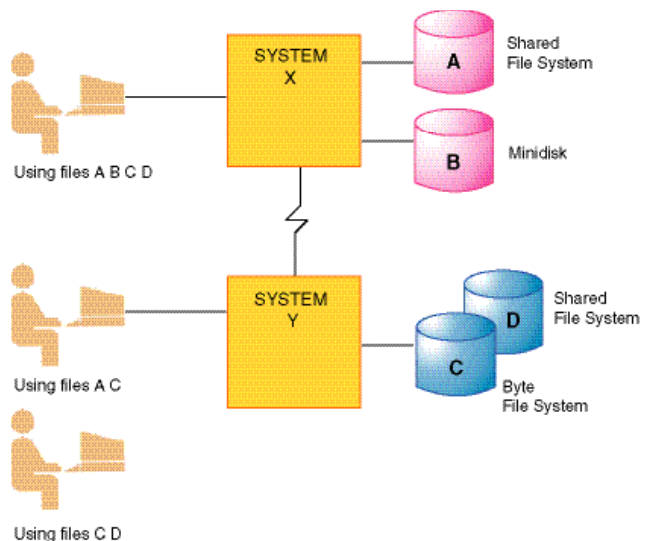
VM Server Support

VM Data Spaces are designed to:

- Offer capabilities unique to System z family
- Provide high speed transfer and data access between virtual machines, improving throughput and response times
- Allow applications to address multiple 2 GB data spaces
- Support data sharing between a server and multiple users
- Provide an application programming interface and Callable Services Library routines, exploited by DB2® for VSE and VM, SFS and FORTRAN to help
 - Enable customers and vendors to develop applications using VM Data Spaces
 - Make development process easier

z/VM Shared File System (SFS) is designed to:

- Allow read/write sharing at the file level
 - Sharable within one system or across multiple systems
 - Provides file security through authorization scheme
- Improve performance
 - Utilizes minidisk caching in main or expanded storage
 - Exploits VM Data Spaces



- *Improve usage of direct access storage devices (disk)*
 - *Data stored in file pools*
 - *Logical vs. physical allocation of data blocks*
 - *Unused blocks available to any user of file pool*
- *Improve productivity*
 - *Organizes files in hierarchical directories*
 - *Supports aliases for file names*
 - *Provides single application interface via CSL routines for SFS and minidisk data*
- *Simplify system administration*
 - *Provides file pool backup and file-level restore*
 - *Provides dynamic expansion of file space for users*
 - *Provides dynamic expansion of DASD to file pool*
 - *Allocates file pool DASD space vs. individual minidisks*
 - *Allow the same administration tools to be used for POSIX hierarchical byte file system files*
- *Use Coordinated Resource Recovery*
 - *Coordinates updates to multiple file pools*
 - *More easily developed distributed applications, with system coordination of data integrity*
- *Enable access to distributed data*
 - *Transparent access to remote data*
- *Allow CMS users and applications to access the POSIX hierarchical byte file system*
- *SFS shuts down automatically when the z/VM Control Program (CP) is shutdown*

DFSMS/VM is designed to:

- *Provide automated space management*
 - *Space management for Shared File and Byte File System files*
 - *Migration, recall and expiration of active and inactive data*
 - *Archive/restore of SFS files to tape with Tivoli® Storage Manager*
- *Provide a high-performance data mover*
 - *Enables fast migration to new storage devices*
 - *Near 1 TB SCSI disk support*
- *Include Interactive Storage Management Facility (ISMF)*
 - *Provides consistent interface for VM, z/OS or z/OS.e storage administrators*
 - *Assists in managing minidisk data*
- *Manage IBM TotalStorage Virtual Tape Server (VTS) 3494 tape libraries containing 3480, 3490, 3590, and 3592 drives*
 - *Includes support for Write Once Read Many (WORM) data cartridges*
- *Provide the capability for a tape-librarian product to communicate with an automated tape library*
- *Provide automated tape library access for VSE guests*
- *Supplied with the z/VM V4 base*
- *Orderable no-charge feature with the z/VM V5 SDO*

ibm.com/eserver/zseries/zvm/related/dfsms/

Guest Operating System Support

Linux on System z potential guest benefits

- Consolidation of Linux workloads on a single physical hardware server
 - Allows multiple Linux images on a z/VM system running IFLs engines without affecting IBM software charges for existing System z standard engines on the same hardware server
- Enhanced exploitation of real memory beyond 2 GB
- Improved memory management for Linux guests¹ of z/VM with the PTF for VM63856
- Shared disk resources creating a server farm within a single machine
- More Linux images operating concurrently with reduced contention on the VM scheduler lock for better performance
- High-performance networking among virtual machines
- Improved operation and support for additional Linux distributions with upgraded SSI server
- Support for OSA-Express2 OSN (OSA for NCP)
- Enhanced performance assists for cooperating z/VM guests using OSA-Express, FCP, and HiperSockets
- Improved problem determination for guest LANs and virtual switches
- Guest support for dedicated QDIO devices (HiperSockets, OSA-Express, and FCP channels)
- Attachment of SCSI devices using the System z FCP feature of all FICON Express adapters
 - Guest IPL from SCSI FCP disks on servers equipped with the SCSI IPL Feature Enabler
 - Deploy a Linux server farm on z/VM using only SCSI FCP disks
 - Improved performance of z/VM Control Program (CP) use of SCSI disk I/O
- Improved FCP channel utilization and sharing among guests with NPIV support
- z/VM HyperSwap function to help provide a coordinated near-continuous availability and disaster recovery solution for distributed applications, such as WebSphere®, that can span z/OS images running natively and Linux guests running under z/VM
- Publication for deploying Linux on System z with z/VM
- Performance Toolkit enhancements to add new high-level Linux reports and monitor records
- Simplified systems management using facilities provided by z/VM
- Systems management APIs for client applications to allocate and manage resources for virtual machines
- Handling of unexpected workload growth by the quick addition of Linux virtual machines as needed
- Enhanced device support, such as virtual disks and peer-to-peer remote copy for Linux systems
- More flexible data transfer with virtual switch exploitation of Layer 2 support for OSA-Express and OSA-Express2
- Increased number of TCP/IP stacks
- With corresponding function from Linux on System z, Linux guest virtual machines may benefit from:
 - Enhanced page-fault handling
 - Guest support for the IBM PCI Cryptographic Coprocessor (PCICC on the z800/z900) or the IBM PCI Cryptographic Accelerator (PCICA)
 - Shared-queue support for clear-key cryptographic functions
 - Guest support for the PCIX Cryptographic Coprocessor (PCIXCC) feature
 - Dedicated-queue and shared-queue support for clear-key cryptographic functions

- Guest support for the Crypto Express2 feature (coprocessor and accelerator)
 - Dedicated-queue and shared-queue support for clear-key cryptographic functions
- Improved disk-access performance with minidisk cache
- Facilities to back up all Linux data providing a single backup solution for all Linux servers
- Strong tracing, diagnostic and debugging facilities
- Access to a large number of Linux applications

z/VSE and VSE/ESA guest benefits

- A state-of-the-art platform for combining the best of VSE core applications with new workloads that exploit Linux on System z
- Outstanding operational flexibility, simplicity, and productivity:
 - Multiple specialized VSE guests for test, development, release-to-release transition
 - Multiple production VSE guests for system simplicity
 - Integration of VSE and Linux guests for server consolidation and new workloads, including WebSphere Application Server
- Improved performance with:
 - Virtual disk-in-storage exploitation, for example, shared lock file
 - Minidisk caching in expanded and main storage
 - DB2 for VSE & VM data sharing for improved performance
 - IBM TotalStorage Virtual Tape Server 3494 automated tape library access

z/OS and z/OS.e guest benefits

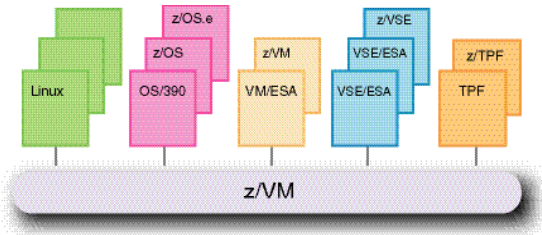
- Parallel Sysplex support for guests within a single VM image
 - Virtual Coupling Facility support to allow VM/ESA or z/VM systems to run as first or second-level, or higher guests while simulating complete z/OS and/or z/OS.e coupled sysplexes
- z/VM HyperSwap function to help provide a coordinated near-continuous availability and disaster recovery solution for distributed applications, such as WebSphere, that can span z/OS images running natively and Linux guests running under z/VM
- Guest support for the PCICA feature
 - Dedicated-queue support for clear-key cryptographic functions
- Guest support for the PCICC (z800/z900) feature
 - Dedicated-queue support for clear-key and secure-key cryptographic functions
- Guest support for the PCIXCC (z890/z990) feature
 - Dedicated-queue support for clear-key and secure-key cryptographic functions
- Guest support for the Crypto Express2 feature
 - Dedicated-queue support for clear-key and secure-key cryptographic functions
 - Guest support for Parallel Access Volumes (PAVs)

Support for z/Architecture and ESA/390-mode operating systems

- Performance assist support
 - Adapter interruption performance assist for QDIO¹
 - QDIO Enhanced Buffer State Management (QEBSM) and Host Page Management Assist (HPMA)²

Performance

- Tens to hundreds of guests for migration, testing, production and development
- Virtual device support
- Shared and dedicated resources
- Debugging and trace facilities for guest systems
- 64-bit guest operating systems including z/OS, z/OS.e and Linux on System z



Notes:

- 1) This performance assist is available only on the z9 EC, z9 BC, z990, and z890.
- 2) QEBM and HPMA are supported by z/VM V5.2 and is exclusive to z9 EC and z9 BC.

Note: z/OS.e is available only in LPAR mode on the z9 BC, z890 or z800 and must run in a logical partition, either alone or as a guest of z/VM. You may not run z/OS as a guest of a z/VM system in which z/OS.e is also a guest per licensing agreements of z/OS.e.

z/VM offers many features that can help improve performance. A number of these features work by keeping frequently used data in memory, thus significantly reducing repeated I/O for the same data. The reduction in I/O can result in faster response times, improved processor efficiency and reduced load on the I/O subsystem. Minidisk caching and virtual disk in storage are two examples of the use of data-in-memory techniques in z/VM.

The degree of benefit varies with the frequency of system workload I/O that applies to these techniques, data-reference patterns, disk configuration, storage availability, and other factors.

To learn more about z/VM performance:

ibm.com/eserver/zseries/zvm/perf/

Connectivity Options

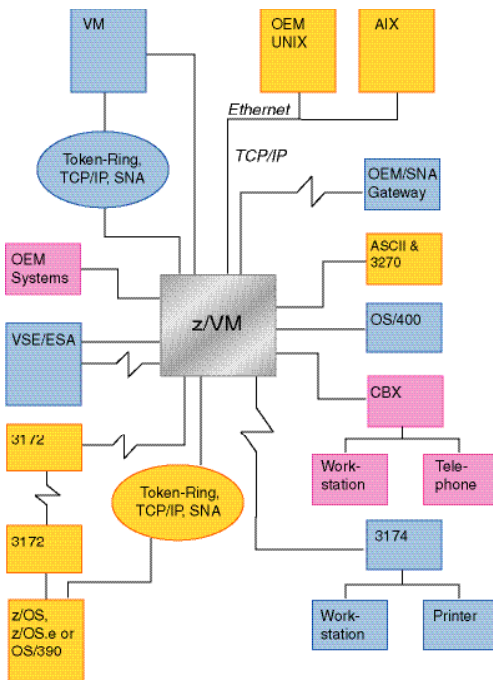
Networking options

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:

- SNA
- BSC
- TCP/IP
- X.25
- Token-Ring
- Ethernet (Gbe, 10 Gbe, and 1000BASE-T)
- X-Windows
- Network File Systems
- Simple Mail Transfer Protocol
- IP Multicast
- X.400 mail exchange protocol
- NJE

Network management

- SNA and TCP/IP networks



Communication Products

TCP/IP for z/VM V5.2 (Level 520)

- All functions available in TCP/IP for z/VM for z/VM V5.1 plus:
 - SSL server support for Red Hat and additional SUSE Linux distributions
 - Improved problem determination for guest LANs and virtual switches
 - Enhanced dynamic routing capabilities with a new MPRoute server
 - TCP/IP and guest LAN Support for HiperSockets using IPv6 protocol with the PTF for APAR VM63952
 - Simplified VLAN management with support for GVRP with the PTF for APAR VM63952

Note: Operates with z/VM V5.2

TCP/IP for z/VM V5.1 (Level 510)

- All functions available in TCP/IP for z/VM Level 440 plus:
 - Enhanced virtual switch support to provide failover support which can provide less disruptive recovery from some common network failures
 - More flexible data transfer with virtual switch exploitation of Layer 2 support for OSA-Express and OSA-Express2 with the PTFs for APARs VM63538 and PQ97436
 - Support the increase in the number of TCP/IP stacks with the PTFs for APARs VM63524 and PQ91421 to provide additional connections to enable more virtual machines to be connected to an external network
 - Enhanced authorization capabilities for z/VM guest LANs and virtual switches by RACF or any External Security Manager that supports this new authorization function.
 - IPv6 support to allow the z/VM TCP/IP stack to be configured for IPv6 networks connected through OSA-Express and OSA-Express2 operating in QDIO mode

- Simplified VLAN management with support for GVRP with the PTFs for APARs VM63784 and PK08444

Note: Operates with z/VM V5.1

(See z/VM TCP/IP User's Guide – SC24-6127)

TCP/IP for z/VM V4.4

- All functions available in TCP/IP for z/VM Level 430 plus:
 - Better performance through the use of the performance assist function of the z990 server
 - Helps enable membership in a IEEE VLAN for OSA-Express (QDIO) and HiperSockets adapters
 - Virtual IP switches acting as routers providing IPv4 connectivity to a physical LAN
 - Support to propagate broadcast frames to all TCP/IP applications using HiperSockets or OSA-Express adapters
 - Improved performance and security of the TCP/IP stack
 - IMAP user authentication exit that removes prior user ID and password length restrictions,
 - Upgraded SSL server provides appropriate Red Hat Package Manager (RPM) packages for the SUSE Linux SLES 8

Note: Operates with z/VM V4.4

(See z/VM TCP/IP User's Guide – SC24-6020-02)

To learn more about TCP/IP for z/VM:

ibm.com/eserver/zseries/zvm/related/tcpip

ACF/VTAM Version 4 Release 2 for VM/ESA

- Enhanced growth and constraint relief
- Increased number of users connected to a single VTAM® image
- Larger, more functional, less complex networks
- APPN® capability
- Provides Low End Networking (LEN) communications to all nodes
- Better interconnection with multivendor networks
- Increased performance for on-line transaction processing
- Improved client/server access
- More flexible access to applications and resources across multiple platforms

(See VTAM V4.2 for VM/ESA Release Guide – GC31-8089)

ibm.com/software/network/vtam

RSCS Version 3 Release 2

- Unsolicited File Transfer (UFT) client and daemon support
- Processes NJE data traffic over TCP/IP, SNA, Bisynchronous, or directly-attached systems (CTCA, ESCON® and FICON)
- Provides print support to TCP/IP printer daemon in text and PostScript format
- Supports ASCII printers attached to protocol converters or by TCP/IP connection
- Enables RSCS server to be the z/VM daemon to the TCP/IP world

z/VM Decision Support

- *Enables the z/VM printer daemon to access any printer attached directly or indirectly to the NJE or TCP/IP network*
- *Provides API interface to code your own device drivers for RSCS*
- *Easy to customize, maintain and use*

(See VM RSCS General Information Guide – GH24-5218)

ibm.com/eserver/zseries/zvm/related/rscs

VM/Pass-Through Facility Version 2

- *Multisession support for CMS and dialed users*
- *Auto sign-on support*
- *FICON Express4, FICON Express2, FICON, ESCON, TCP/IP, APPC, IUCV, CTCA, 3088, Bisynchronous connectivity options*
- *Gateway access to SNA network*
- *Connectivity to other VM, z/OS, z/OS.e, VSE, z/VSE and AIX® systems*
- *Provides automated session operations*
- *Transparent, seamless solutions for end-users*
- *Sharing a single session between multiple workstations*
- *Can help provide low-cost workstation support for VSE guest virtual machines*
- *Screen-capture capabilities*
- *Direct support for SDLC terminal control units*
- *Cross-system IUCV support provides communications path for applications on separate VM systems to use IUCV protocols*

(See VM/Pass-Through Facility Users Guide – SC24-5555)

ibm.com/eserver/zseries/zvm/related/pvm

VM has multiple offerings that enable the end user to transform business data into timely and accurate business decisions.

DB2 Server for VSE & VM

- *Can help improve productivity with Stored Procedures*
- *Exploits DRDA® 2 in application server for accessibility to data on local or remote systems*
- *DB2 access over a TCP/IP network from DRDA requesters*
- *Increased database availability with Incremental Archive*
- *Optional QMF™ and QMF for Microsoft® Windows® features*
- *Enables database switching*
- *Allows multiple read-only users access to all data*
- *Provides VM database access from VSE system*
- *Recovery of databases at the table and storage pool level*
- *Supports VM Data Spaces*
- *Optional database administration feature*

(See DB2 Server for VSE & VM Overview – GC09-2995)

ibm.com/software/data/db2/vse-vm/

Query Management Facility (QMF) Feature

- *Provides easy-to-use workstation GUI interfaces*
- *Powerful query and report writer for DB2 data*
- *Client/server capabilities for the workstation environment*
- *Processes both relational and non-relational data*
- *Connect to DB2 for Linux on System z as an application server*

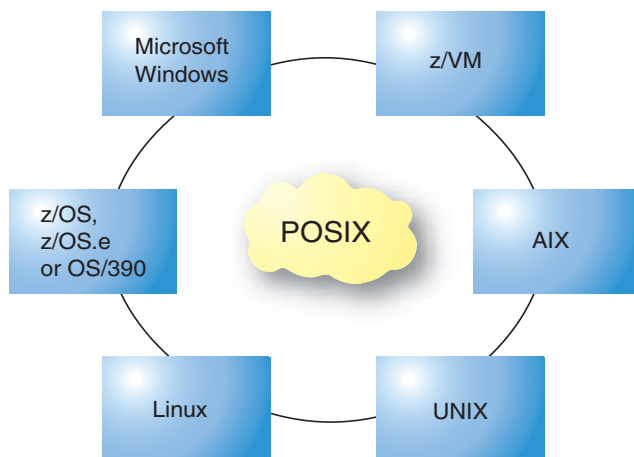
(See Using QMF 7.2 – SC27-0716, and QMF 7.2 Reference Guide – SC27-0715)

ibm.com/software/data/qmf/

POSIX standards

- Extends portability and provides standards-based application-development services
- Defines basic operating-system interfaces and behavior
- POSIX 1003.1c threads – Provide a general set of services for developing multitasking server applications that support multiple, concurrent execution streams
 - POSIX 1003.1c
 - POSIX 1003.1 and POSIX 1003.1a
 - POSIX 1003.2 – Shell and Utilities
- POSIX hierarchical byte file system support by CMS and SFS enables access by heterogeneous systems across LANs and WANs

(See z/VM OpenExtensions Users Guide — SC24-6108)



Notes:

- 1) The OpenExtensions Shell and Utilities, previously a priced optional feature of VM/ESA, is packaged with z/VM at no additional charge
- 2) DCE is not available in z/VM V4 and later

Performance Toolkit for VM optional feature of z/VM

Provides enhanced capabilities for a z/VM systems programmer, operator, or analyst to monitor and report performance data:

- Full-screen-mode system-console operation
- Management of multiple z/VM systems (local or remote)
- Post-processing of Performance Toolkit for VM history files and of VM monitor data captured by the MONWRITE utility
- Performance monitoring
- Viewing of performance monitor data using either Web browsers or PC-based 3270 emulator graphics
- TCP/IP performance reporting
- Processes Linux performance data obtained from RMF™ which can be viewed and printed similar to the way VM data is viewed and presented
- Reports for Linux and SCSI FCP disks
- With the PTF for APAR VM63952, when adding new VM systems within the enterprise for performance-data retrieval, the Performance Toolkit server does not have to be shut down and restarted
- Functional equivalence to PRF and RTM

(See z/VM: Performance Toolkit for VM - SC24-6062 for V4 or SC24-6136 for V5)

ibm.com/eserver/zseries/zvm/perf/toolkit

Directory Maintenance (DirMaint) optional feature of z/VM V5

- Provides a security-rich interactive facility for maintaining the system directory
- Simplified user administration with the coordination of DirMaint and RACF changes with z/VM V5.2
- Improved directory management performance with z/VM V5.2
- Provides distributed administration
- Provides commands and exits to support new functions
- Supports Systems Management APIs
- Supports the Shared File System
- Enables VMSES/E installation and service

(See DirMaint 1.5 General Information Manual – GC20-1836 or the DirMaint Facility Tailoring and Administration Guide – SC24-6024 for V4 or SC24-6135 for V5)

ibm.com/eserver/zseries/zvm/related/dirmaint

Resource Access Control Facility (RACF) optional feature of z/VM V5

RACF helps meet the need for security by providing:

- Flexible control of access to protected resources
- Protection of installation-defined resources
- Ability to store information for other products
- Choice of centralized or decentralized control of profiles
- Transparency to end users

(See RACF General Information — GC28-0722)

ibm.com/eserver/zseries/zos/racf/vm.html

CMS Utilities Feature (CUF)

- Integrated into z/VM Version 4 at no additional charge
- Complements the CMS interactive support
- Can increase the productivity of your local operations

- Provides tools and services that simplify and enhance the operation of CP and CMS environments for end users and application developers
- Provides fully-supported commands, EXECs and applications that would otherwise need to be created locally

ibm.com/eserver/zseries/zvm/related/cuf

Host Management Facilities/VM

- Monitors subsystems and applications to help reduce outages
- Coordinates and simplifies performance analysis
- Enables increased console automation
- Manages local and remote systems
- Enables automation of subsystem and application management
- VMSES/E installation and service enabled

(See Host Management Facilities/VM General Information Manual – SC24-5612)

ibm.com/eserver/zseries/zvm/related/hmf

RTM optional feature for z/VM V4 FL410 RealTime Monitor of z/VM systems

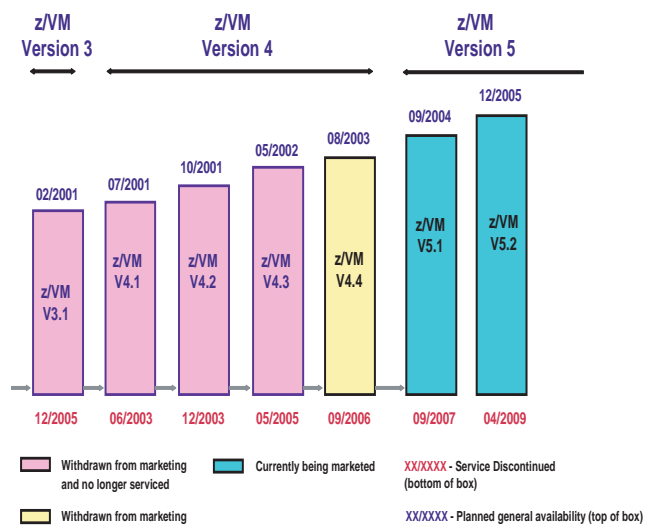
Used for performance analysis and installation - management of z/VM environments

- 31-bit enabled, allowing RTM to address storage above 16 MB
- Elimination of 370-accommodation requirement
- Improved initialization control with the availability of an external configuration file which can be used to:
 - Establish table sizes, reducing the need for local modifications and recompilations
 - Provide an initial interface for specific commands, helping to eliminate the need for RTMINIT processing

VM Evolution

- z/VM Version 4.4 supports the z9 EC, z9 BC, z990, z890, z900, and z800 (standard or IFL engines) in ESA/390 and z/Architecture mode, S/390 G5, G6, and the S/390 Multiprise 3000, and such other servers as IBM may specify.
- z/VM Version 5 supports the z9 EC, z9 BC, z990, z890, z900, and z800 (standard or IFL engines) and such other servers as IBM may specify in z/Architecture mode.

Note: For information on versions of VM prior to z/VM, refer to the z/VM Reference Guide GM13-0137-00.



VM Operating System Comparison

VM Function	z/VM V3 ²⁶	z/VM V4 ²⁷	z/VM V5
Function			
Shared File System	•	•	•
Callable Services Lib.	•	•	•
Cross Systems Extensions	•	•	•
Virtual disk in storage	•	•	•
Enhanced minidisk caching	•	•	•
370 accommodation	•	•	•
CP Exit Facility	•	•	•
Java™ and NetRexx™	•	•	-
Parallel Sysplex simulation	•	•	•
Coupling Facility duplexing ³	•	•	•
HiperSockets ³	•	•	•
IPV6 HiperSockets ^{7,8}	-	-	•
GVRP Support ^{6,8}	-	-	•
Guest LAN ⁹	•	•	•
Guest LAN Sniffer ⁷	-	-	•
MPageRoute Server ⁷	-	-	•
Shared tape for guests ⁴	•	•	•
Accounting improvements ⁴	-	•	•
Systems management APIs ⁵	-	•	•
VMMR enhancements ⁵	-	•	•
Virtual LAN ⁵	-	•	•
Virtual switching ⁵	-	•	•
HCM and HCD ⁵	-	•	•
MQ Interface Client	•	•	•
PCIX Cryptographic Coprocessor ⁶	-	-	•
Crypto Express2 ⁶	-	-	•
Improved memory management for Linux guests ^{7,9}	-	-	•
Dynamic Virtual Machine Timeout ⁶	-	-	•
Storage Relief below 2 GB ⁷	-	-	•
Central Storage			
32 GB (z890 and z800)	•	•	•
64 GB (z900)	•	•	•
64 GB (z9 BC)	-	•	•
256 GB (z990)	•	•	•
512 GB (z9 EC) ⁵	-	•	•
Expanded Storage			
Paging	•	•	•
Guest	•	•	•
VM Data Spaces	•	•	•
Virtual Machine Size			
256 GB ¹	•	•	•
I/O			
FICON/ESCON I/O	•	•	•
FICON CTCA ³	•	•	•
FICON Express2	•	•	•
FICON Express4	-	•	•
Parallel Access Volumes ^{7,8}	-	-	•
Virtual FICON CTCA ⁵	•	•	•
Cascaded FICON Directors ⁵	•	•	•
Guest use of FCP ⁴	•	•	•
Guest use of SCSI FCP disks ⁵	-	•	•

VM Function	z/VM V3 ²⁶	z/VM V4 ²⁷	z/VM V5
Logical Channel SubSystems ⁵	•	•	•
HyperSwap ⁶	-	-	•
OSA-Express OSN ⁷	-	-	•
Guest Operating System			
S/370™ architecture	•	•	•
370-XA architecture	•	•	•
ESA/390 architecture	•	•	•
z/Architecture	•	•	•
Performance Assists			
I/O Assist ^{2,20}	•	•	•
Adapter interruption performance assist for QDIOAssist ^{5,21}	-	•	•
QEBSM and HPMA ^{7,21}	-	-	•
Systems Supported			
S/390 R2x, R3x	•	-	-
G3 Servers	•	-	-
G4 Servers [#]	•	-	-
G5/G6 Servers [#]	•	•	-
zSeries 800/890/900/990 Servers [#]	•	•	•
System z9 EC/z9 BC ⁵	-	•	•
IFL processor feature	-	•	•
S/390 Multiprise 2000	•	-	-
S/390 Multiprise 3000 [#]	•	•	-
S/390 Integrated Server	•	-	-
RS/6000 ⁶ and S/390 Server-on-Board	•	-	-
PC Server S/390	•	-	-

Legend

- 1 Pageable guests only
 - 2 The sum of storage for each of the preferred guests plus the storage required for the VM Control Program cannot exceed 2 GB
 - 3 Supported on z/VM V4.2 and later
 - 4 Supported on z/VM V4.3 and later
 - 5 Supported on z/VM V4.4 and later
 - 6 Supported on z/VM V5.1 and later
 - 7 Supported on z/VM V5.2 and later
 - 8 Requires PTF for VM63952 on z/VM V5.2
 - 9 Requires PTF for VM63856 on z/VM V5.2
 - 20 I/O - assist is not available when z/VM is running in a logical partition.
z/VM must be run in a logical partition on the z890 and z990 servers.
 - 21 Adapter-interruption performance assist is available only on z9 EC, z9 BC, z990, and z890 servers; QEBSM and HPMA are available only on z9 EC and z9 BC
 - 24 Install, IPL, and operation of z/VM V5
 - 25 z/VM V4.4, V5.1, and V5.2 enable guest use of NPIV when FCP subchannels are dedicated to a guest. V5.1 and V5.2 provide for CP use of NPIV
 - 26 Withdrawn from Marketing effective 8/31/04 (EOS on 12/31/05)
 - 27 Withdrawn from Marketing effective 3/31/06 (EOS planned for 9/30/06)
- Supported
- Not applicable
No 370 mode execution

VM Feature Comparison

VM Function	z/VM V3 ²¹	z/VM V4 ²²	z/VM V5
REXX Sockets	•	•	•
31-bit CMS	•	•	•
CMS Pipelines	•	•	•
CMS multitasking	•	•	•
Reusable Server Kernel	•	•	•
POSIX	•	•	•
DCE	•	-	-
Binder/Loader	•	•	•
NFS Client	•	•	•
APPC	•	•	•
Shared File System	•	•	•
VM Data spaces support	•	•	•
Common SFS and minidisk interface	•	•	•
POSIX Byte File System	•	•	•
Automated SFS shutdown ⁵	-	•	•
DFSMS/VM			
Fast data mover	•	•	•
Space management by policy	•	•	•
Automated tape library support	•	•	•
DB2 for VSE and VM	•	•	•
VM Data spaces	•	•	•
Enhanced Move Page	•	•	•
Operational Enhancements			
Simplified system configuration	•	•	•
Alternate nucleus	•	•	•
Fast warm start	•	•	•
Fast spool backup (SPXTAPE)	•	•	•
GVRP support ^{6,8}	-	-	•
IPv6 HiperSockets ^{7,8}	-	-	•
Improved memory management for Linux guests ^{7,9}	-	-	•
Dynamic system configuration	•	•	•
Enhanced timer management ⁴	-	•	•
Virtual Machine accounting improvements ⁴	-	•	•
Systems management APIs ⁵	-	•	•
HCD and HCM ⁶	-	•	•
VM Resource Manager ⁴	-	•	•
Automated shutdown ⁴	-	•	•
Installation from DVD	-	-	•
Dynamic LPAR addition/deletion	-	•	•
Directory manager performance improvement ⁷	-	-	•
Coordinated DirMaint/RACF changes ⁷	-	-	•
Serviceability enhancements	•	•	•
VMSES/E	•	•	•
ShopzSeries	•	•	•
ESCON Architecture	•	•	•
FICON Architecture	•	•	•
Fibre Channel Protocol⁴	-	•	•
Device Support			
Internal Disk	<•	<•	-
FBA DASD	•	•	•
TotalStorage DS6000	-	•	•
TotalStorage DS8000	-	•	•
TotalStorage ESS	•	•	•
TotalStorage FlashCopy V2 ³	•	•	•
TotalStorage PPRC V2 ^{3,20}	•	•	•
Parallel Access Volumes (PAVs) as minidisks ^{7,8}	-	-	•
RAMAC ⁹ DASD Subsystem	•	•	•
RAMAC Array Subsystem	•	•	•

VM Function	z/VM V3 ²¹	z/VM V4 ²²	z/VM V5
3390 DASD	•	•	•
3990 Model 6 MPLF Support	•	•	•
9340 DASD Subsystem	•	•	•
3494 Tape Library Subsystem	•	•	•
3495 Tape Library Dataserver	•	•	•
3590 Tape Drive	•	•	•
3592 Tape Controller (J70)/ Drive (J1A) ^{4,5}	•	•	•
9348 Tape	•	•	-
3995 Optical Library Dataserver	•	•	-
Minidisk Cache	•	•	•
OSA-2	•	•	•
OSA-Express			
1000BASE-T Ethernet	•	•	•
Gigabit Ethernet (GbE)	•	•	•
Token-Ring ³	•	•	•
Layer 2	-	-	•
OSA-Express2			
1000BASE-T Ethernet	•	•	•
Gigabit Ethernet	•	•	•
10 GbE	•	•	•
Layer 2	-	-	•
Up to 640 TCP/IP Stacks	-	-	•
OSA for NCP ⁷	-	-	•
System Management Products			
HMF	•	•	•
VMPRF	•	-	-
PRF Feature ²²	-	•	-
RTM Feature ²²	-	•	-
Performance Toolkit for VM ⁵	-	•	•
DirMaint	•	-	-
DirMaint Feature	-	•	•
RACF	•	-	-
RACF Feature ⁴	-	•	•
Comminications			
RSCS V3.2.2	•	•	•
ACF/VTAM V4.2	•	•	•
TCP/IP for z/VM ²	-	•	•
TCP/IP Feature for VM	•	-	-
VM Passthrough Facility (PVM)	•	•	•
Additional Features			
LANRES	•	-	-
OSA/SF	•	•	•
Shell & Utilities ¹	•	•	•
CMS Utilities ²	•	•	•
DCE Base Services	•	-	-

Legend

- 1 Integrated in z/VM
 - 2 Integrated in z/VM V4 and later
 - 3 Supported on z/VM V4.2 and later
 - 4 Supported on z/VM V4.3 and later
 - 5 Supported on z/VM V4.4 and later
 - 6 Supported on z/VM V5.1 and later
 - 7 Supported on z/VM V5.2 and later
 - 8 Requires PTF for VM63952 for z/VM V5.2
 - 9 Requires PTF for VM63856 on z/VM V5.2
 - 20 Guest use only
 - 21 Withdrawn from Marketing effective 8/27/04 (EOS on 12/31/05)
 - 22 Withdrawn from Marketing effective 3/31/06 (EOS planned for 9/30/06)
- Supported
 - < Supported on S/390 Multiprise 2000/3000
 - Not applicable



To learn more

Visit the zSeries World Wide Web site at ibm.com/system/z/ or call IBM DIRECT at 1 800 IBM-CALL in the U.S. and Canada.

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Israel	03-6978111
Italy	167-017001
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Singapore	1800 320 1975
South Africa	0800-130130
Spain	900-100400
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