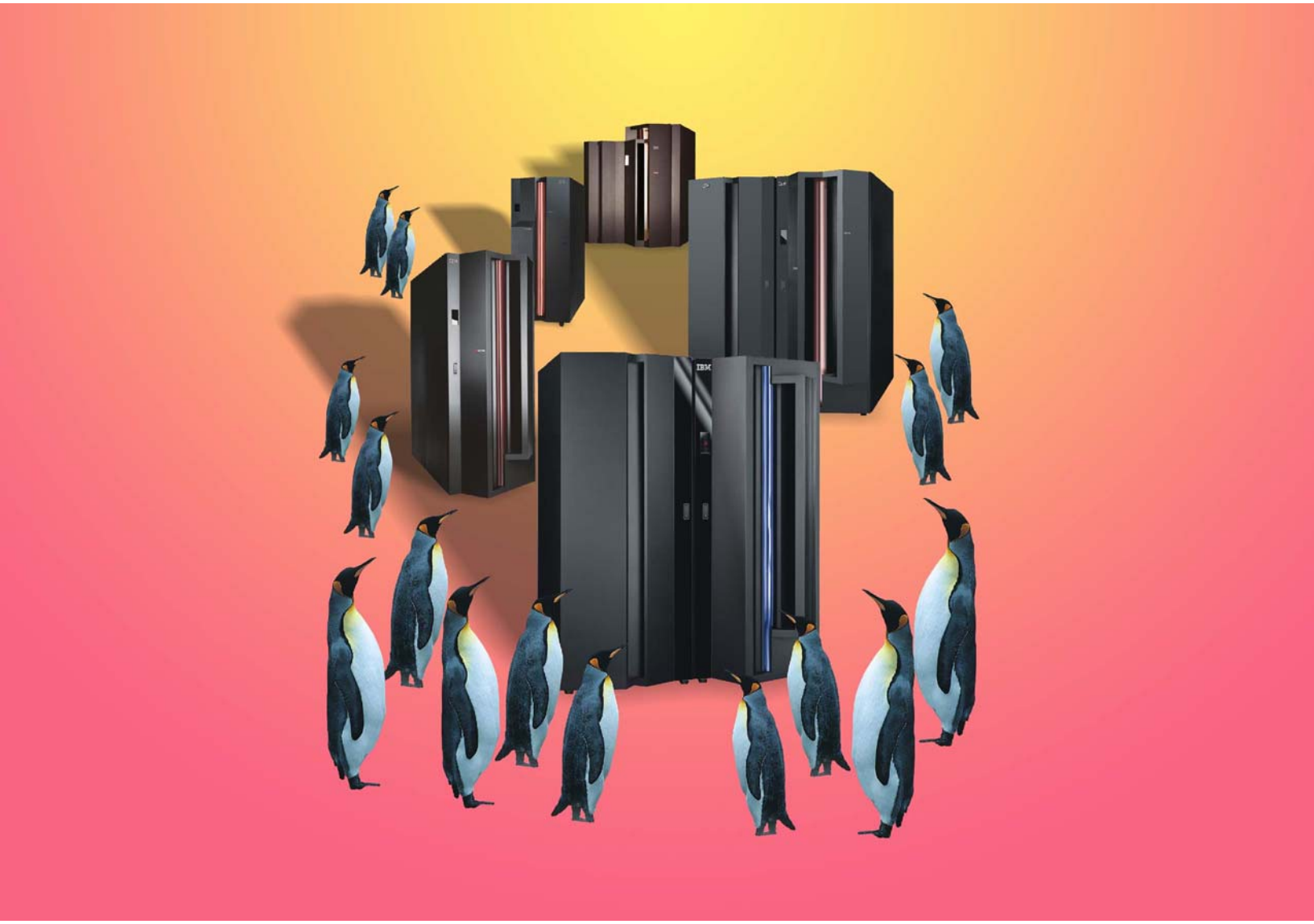
z/VM Reference Guide

IBM

z/VM and IBM System z9 and @server zSeries

... 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 z9™ or @server® zSeries® platforms. 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 – Enhancing Scalability for Virtualization on System z9 and zSeries

- *Virtualization technology and Linux® enablement:*
  - *Enhanced exploitation of real memory beyond 2 GB*
    - *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*
      - *FBA emulation handling LOCATE CCWs more efficiently*
      - *FBA emulation handling the FBA padding function more efficiently*
  - *Definition and operation of Fibre Channel Protocol (FCP)-attached SCSI disks with capacities near 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 assists for cooperating z/VM guests using OSA-Express, FCP, and HiperSockets™*
  - *Enhanced systems management APIs for improved management of Linux and other virtual images*
- *Network virtualization and security:*
  - *Improved problem determination for guest LANs and virtual switches*
  - *Enhanced dynamic routing capabilities with new MPRoute server*
- *Technology exploitation:*
  - *Support for the IBM System z9 109 (z9-109)*
    - *Crypto Express2 Accelerator for SSL acceleration*
    - *Support for OSA-Express2 OSN (OSA for NCP)*
    - *Improved FCP channel utilization and sharing among operating system images with N-Port ID Virtualization (NPIV) support*
    - *Up to 60 logical partitions*
  - *Dynamic addition and deletion of logical partition names*
  - *Support for the IBM TotalStorage® DS4000 Midrange Disk Systems*
- *Systems management:*
  - *Simplified user administration with the coordination of DirMaint and RACF® changes*
  - *Improved DirMaint directory management performance*
  - *Enhanced Performance Toolkit for VM™ to support updated control blocks and new monitor data*

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

z/VM Version 5 Release 1 – Further Enhancing Virtualization Capabilities for Linux on System z9 and zSeries

- *Engine-based Value Unit pricing and a reduced entry price*
- *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 CP's 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 near 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 z9 and zSeries and z/OS® guests*
  - *Improved security with Linux on System z9 and zSeries and z/OS guest support for Crypto Express2*
  - *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 IBM 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*
    - *Improved FCP channel utilization and sharing among operating system images with NPIV support*
    - *Support for the Open Systems Adapter (OSA)-Express Integrated Console Controller*
    - *Support for OSA-Express2 GbE and 10 GbE*
    - *Support the 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*
  - *Support for the IBM System z9 109*
    - *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 operating system images with support for NPIV and the PTF for APAR VM63744*
  - *Up to 60 logical partitions*
- *Improvements to Capacity Upgrade on Demand*
- *Support for FICON® Express2 that can double the channel capacity and help increase performance*
- *Support for the IBM TotalStorage DS8000 Series with the PTF for APAR VM63534*
- *Support for the DS6000 Series with the PTF for APAR VM63535*
- *Use of SCSI disks by guests that support FBA disks with capacities near 1 TB (2,147,483,640 512-byte blocks) for CP volumes and up to 381 Gigabytes 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*
    - *Supports application monitor records for 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 – Improving Virtualization Capabilities for Linux on zSeries

- *Virtualization technology and Linux enablement:*
  - *Helps reduce overhead and may improve performance of virtual machines on zSeries servers*
  - *Higher efficiency when managing large numbers of virtual machines*
  - *High-performance virtual FICON CTCAs*
  - *Guest IPL from FCP-attached SCSI disks for Linux when hardware function is available*
  - *Upgraded SSL server provides appropriate Red Hat Package Manager (RPM) packages for the SLES 8 distributions.*
  - *Virtual Coupling Facility (CF) support to allow VM/ESA® or z/VM systems to run as second-level (or higher) guests while simulating complete OS/390® and/or z/OS coupled sysplexes*
- *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 IBM z990 with:*
    - *Improved logical partitioning scalability with Logical Channel SubSystems (LCSSs)*
    - *Transparent sharing of HiperSockets channels across LCSSs*

  - *Improved FCP channel utilization and sharing among operating system images with NPIV support*
  - *Improved capacity planning and I/O performance measurement*
  - *Up to 30 logical partitions (LPARs)*
- *Cascaded FICON directors for enhanced and simplified connectivity*
- *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 Version 4 Release 3 – Expanding virtualization technology

- *Virtualization technology exploitation*
  - *Accounting of virtual network resources*
  - *Automated shutdown of virtual machines*
  - *Guest support for FCP channels*
  - *I/O priority queuing*
  - *Shared tape for z/OS, z/OS.e and OS/390*
- *Connectivity enhancements*
  - *Multicast support for HiperSockets*
  - *Simulation of a QDIO network adapter*
  - *Broadcast capability for QDIO*
  - *Improved TCP/IP stack security, performance, and configurability*
- *Systems management improvements*
  - *z/VM self-management to achieve guest performance goals*
  - *Enhanced timer management*
  - *Better utilization of large real storage*
  - *Additional performance monitor data*
  - *Improved accounting support for guests*
- *IBM ESS large volume support*
  - *RACF for z/VM as an optional, per-engine priced feature*

z/VM Version 4 Release 2 – Exploiting new technology

- *Technology exploitation*
  - *HiperSockets, the high speed internal TCP/IP network, and OSA-Express Token-Ring*
  - *Guest Coupling Facility duplex support*
  - *Guest support for FICON channel-to-channel adapter (CTCA) communications*
  - *Clear-key RSA support of the IBM Cryptographic Accelerator with corresponding Linux for zSeries function*

  - *Improved disk and minidisk cache access performance for 64-bit guests*
- *Connectivity enhancements*
  - *Guest LAN support*
  - *New TCP/IP server for mail accessibility using the IMAP protocol*
  - *TCP/IP stack security improvements*
- *Systems management improvements*
  - *Ease-of-use functions for managing Linux images*
  - *Move configurations and data from Virtual Image Facility™*
- *Converging VM C sockets libraries within the Language Environment®*

z/VM Version 4 Release 1 – Reducing VM costs

- *One-time charge (OTC) priced per-engine*
- *Support for the IBM Integrated Facility for Linux (IFL) processor engines*
- *Consolidation of select UNIX®, Microsoft® Windows® and Linux workloads on a single physical server*
- *Improved I/O performance for Linux guests*
- *Enhanced page fault support for Linux guests*
- *VM functions available in Version 3 except DCE, LANRES/VM, and Vector Facility*
- *RTM, PRF, and DirMaint as preinstalled optional, per engine priced features*

(See z/VM Version 4 General Information – GC24-5991)

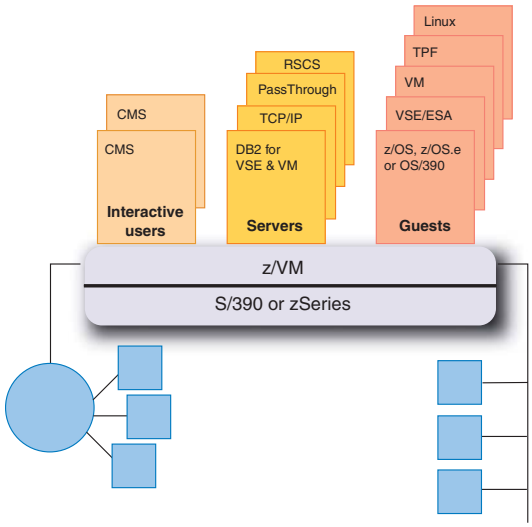
z/VM Version 3 – Exploitating z/Architecture™

- *Provides all the benefits and expands the capabilities of VM/ESA*
- *Exploits z/Architecture to support 64-bit guest operating systems and provides constraint relief when running on an IBM zSeries 990 (z990), and 890 (z890), and z900 (z900), or 800 (z800) server*
- *Provides the capability to run 64-bit and ESA/390 (31-bit) guest operating systems concurrently*
- *QDIO with OSA-Express Gigabit and 1000BASE-T Ethernet*

(See z/VM V3.1 General Information – GC24-5944)

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

Note: z/OS.e is available only in LPAR mode on the IBM @server zSeries 800 and 890 and must run in a logical partition, either alone or as a guest of z/VM. You may not run z/OS or OS/390 as a guest of a z/VM system in which z/OS.e is also a guest.



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 near 1 TB SCSI disks with the PTFs for APAR VM63664*

z/VM embraces the latest technology

z/VM Version 5 Release 2 provides:

- *Enhanced exploitation of real memory beyond 2 GB*
- *Enhanced performance assists for cooperating z/VM guests using OSA-Express, FCP, and HiperSockets*
- *Definition and operation of FCP-attached SCSI disks with capacities near 1 TB with the PTFs for APARs VM63700 (DirMaint) and (DFSMS/VM) VM63664*
- *Support for the z9-109*
  - *Crypto Express2 Accelerator for SSL acceleration*
  - *Support for OSA-Express2 OSN (OSA for NCP)*
  - *Improved FCP channel utilization and sharing among operating system images with NPIV support*
  - *Up to 60 logical partitions*
- *Dynamic addition/deletion of logical partition names*
- *Support for the IBM TotalStorage DS4000 Midrange Disk Systems*

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 near 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 Linux on System z9 and zSeries and z/OS guest support for Crypto Express2*
- *Enhanced network recovery with virtual switch failover support*
- *New Systems Management APIs implemented using Version 2 (V2) of the RPC server*

- *Support for the z9-109 with PTFs for APARs VM63646, VM63721, VM63743, VM63744, VM63722, OA11650, and VM63740*
  - *Crypto Express2 Accelerator for SSL acceleration*
  - *Support for OSA-Express2 OSN (OSA for NCP)*
  - *Improved FCP channel utilization and sharing among operating system images with NPIV support*
  - *Up to 60 logical partitions*
- *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*
  - *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*
- *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 TotalStorage DS8000 Series with the PTF for APAR VM63534*
- *Support for 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 z990 functions are designed to provide:*
  - *Greater scalability with four LCSSs*
  - *Transparent sharing of HiperSockets channels across LCSSs*
  - *Improved FCP channel utilization and sharing among operating system images with NPIV support*
  - *Facilities to extend I/O measurements*
  - *Twice the number of LPARs (30)*
  - *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 for Enterprise Storage Server (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 Version 4 Release 3 added:

- *Guest use of an FCP channel on zSeries processors connected to a fibre-channel fabric to access selected devices on SCSI controllers connected to the fabric*
- *I/O management facilities exploiting the hardware I/O Priority Queuing facility to prioritize guest and host I/O operations*
- *Virtualized automated shutdown enabling z/VM 4.3 guests to shut themselves down when signaled to do so*
- *Sharing of the same tape device among multiple z/VM guests*
- *Support for up to 32,760-cylinders on 3390 volumes on the IBM ESS*
- *Extended guest LAN implementation to support multicast transmission with HiperSockets*
- *Broadcast capability within the QDIO architecture*

z/VM Version 4 Release 2 added:

- *HiperSockets, the high-speed internal TCP/IP network, and OSA-Express Token-Ring support*
- *Guest coupling duplex support for the duplexing capabilities of the zSeries Coupling Facility*
- *Guest support for FICON CTCA communications*
- *Clear-key RSA support of the IBM PCI Cryptographic Accelerator for Linux guests*
- *Improved DASD and minidisk cache access performance for 64-bit guests*

z/VM Version 4 Release 1 provided:

- *VM function available in Version 3 except DCE, LANRES/VM, and Vector Facility*
- *Support for the IBM z900 and z800 (in z/Architecture and ESA/390 modes), the S/390® G5 and G6, and the S/390 Multiprise® 3000 servers*
- *Support for IFL engines on z990, z900, z890, and z800, the S/390 G5 and G6, and the S/390 Multiprise 3000 servers*
- *One-time charge (OTC) priced per-engine*
- *Consolidation of Linux workload on a single physical server*
- *Improved I/O performance for Linux guests*
- *Enhanced page fault support for Linux guests*

z/VM Version 3 Release 1 provided:

- *Supports all models of the IBM zSeries including the z800 (except 0LF model) and z900 in ESA/390 and z/Architecture modes, S/390 Parallel Enterprise Server™ Generation 5 (G5) and 6 (G6), and the S/390 Multiprise 3000. Also supported are the S/390 Parallel Enterprise Server R2, R3, Generation 3, and Generation 4 models, S/390 Multiprise 2000, S/390 Integrated Server, PC Server System/390®, and the RS/6000® with System/390 Server-on-Board.*
- *Extended distance and improved data rate with Enterprise Systems Connection Architecture® (ESCON®)*
- *Additional extended distance and improved data rate with FIbre Connection (FICON) architecture*
- *Enabled for Internet and intranet access*
- *Hardware data compression*
- *Support of the IBM ESS*
- *OSA-Express support*
- *Improved performance, capacity, and availability with support for IBM RAMAC® Array Family*
- *Capacity Upgrade on Demand (CUoD) architecture*
- *Multiple Preferred Guests with Processor Resource/Systems Manager™ (PR/SM™) function*

- *Extensive use of ESA/390 architecture for data in memory*
  - *High-performance, sharable virtual disk in storage*
  - *VM Data Spaces utilization for high-performance data access*
  - *Minidisk caching of CMS and guest data*
- *z/Architecture to support 64-bit guest operating systems*
- *Pageable guests up to 256 GB*
- *Native FlashCopy for the IBM TotalStorage Disks*
- *QDIO with OSA-Express Gigabit and Fast Ethernet, ATM and Token-Ring adapters*
- *Guest enhancements for the IBM TotalStorage Virtual Tape Server (VTS)*
- *Guest and native support for FICON-attached IBM TotalStorage Enterprise Tape Controller 3590 Model A60*

z/VM for running Parallel Sysplex system environments

- *OS/390, 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 z9 and zSeries*
  - *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 OS/390, 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 z9-109, z990, z900, z890, and z800 servers. In addition, z/VM V4 includes support for this environment on all models of the IBM S/390 Parallel Enterprise Server Generation 5 and 6 and S/390 Multiprise 3000 servers. z/VM V3.1 includes support for the S/390 Parallel Enterprise Server Generation 3 and 4 and the S/390 Multiprise 2000 servers.*

z/VM encompasses many uses

- *Flexible, cost-effective guest environments*
- *Ideally-suited for on demand business*
- *Consolidation of select UNIX, Windows and Linux workloads onto a single physical server*
- *Data and application serving 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 z/VM V5.2)*
- *Installation available on 3590-formatted tapes and DVD*
- *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 and OS/390, 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

- *Offers capabilities unique to zSeries family*
- *Provides high speed transfer and data access between virtual machines, improving throughput and response times*
- *Allows applications to address multiple 2 GB data spaces*
- *Supports data sharing between a server and multiple users*
- *Provides an application programming interface and Callable Services Library routines, exploited by DB2® for VSE and VM, SFS and FORTRAN*
  - *Enables customers and vendors to develop applications using VM Data Spaces*
  - *Makes development process easier*

z/VM Shared File System (SFS)

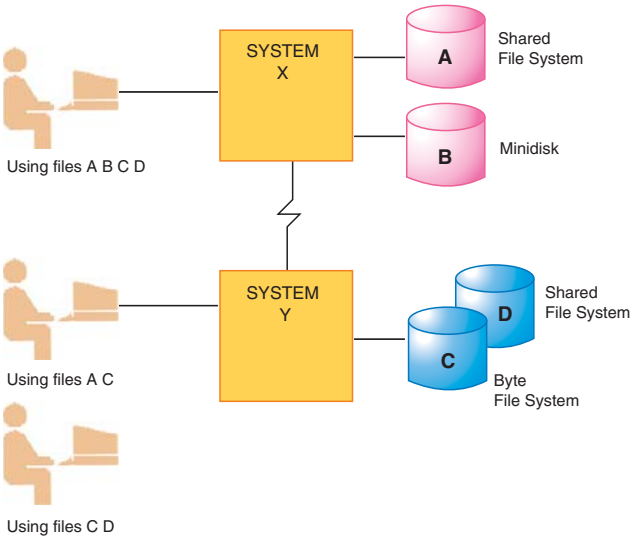
- *Allows read/write sharing at the file level*
  - *Sharable within one system or across multiple systems*
  - *Provides file security through authorization scheme*
- *Improves performance*
  - *Utilizes minidisk caching in main or expanded storage*
  - *Exploits VM Data Spaces*
- *Improves usage of direct access storage devices (DASD)*
  - *Data stored in file pools*
  - *Logical vs. physical allocation of data blocks*
  - *Unused blocks available to any user of file pool*

- *Improves productivity*
  - *Organizes files in hierarchical directories*
  - *Supports aliases for file names*
  - *Provides single application interface via CSL routines for SFS and minidisk data*
- *Simplifies 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*
  - *Allows the same administration tools to be used for POSIX hierarchical byte file system files*
- *Uses Coordinated Resource Recovery*
  - *Coordinates updates to multiple file pools*
  - *More easily developed distributed applications, with system coordination of data integrity*
- *Enables access to distributed data*
  - *Transparent access to remote data*
- *Allows 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

- *Provides 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*
- *Provides a high-performance data mover*
  - *Enables fast migration to new storage devices*
  - *1 TB SCSI disk support*
- *Includes Interactive Storage Management Facility (ISMF)*
  - *Provides consistent interface for VM, OS/390 or z/OS storage administrators*
  - *Assists in managing minidisk data*
- *Manages 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*
- *Provides the capability for a tape-librarian product to communicate with an automated tape library*
- *Provides automated tape library access for VSE guests*
- *Supplied with the z/VM V3 and V4 base*
  - *Orderable no-charge feature available with the z/VM V5 SDO*

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



Linux on System z9 and zSeries guest benefits

- *Consolidation of Linux workloads on a single physical server*
  - *Multiple Linux images on a z/VM system running IFLs without affecting IBM software charges for existing non-IFL System z9 and zSeries engines on the same physical hardware server*
- *Enhanced exploitation of real memory beyond 2 GB*
- *Shared DASD 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*
- *Upgraded SSL server for improved operation and support for additional Linux distributions*
- *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 z9 and zSeries FCP adapter*
  - *Support of FCP full fabric connectivity for shared links and improved fiber cable infrastructure utilization*
  - *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 operating system images 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 z9 and zSeries 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 z9 and zSeries, 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 DASD-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 z9 and zSeries*
- *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*

OS/390, 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 OS/390 and/or z/OS 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*

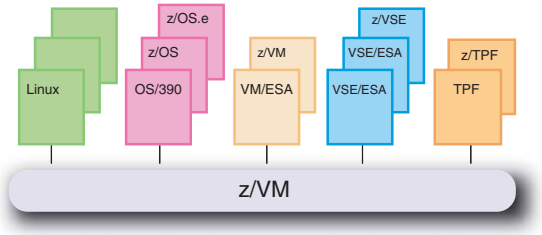
Support for z/Architecture and ESA/390-mode operating systems

- *Performance assist support*
  - *Adapter interruption performance assist for QDIO*[1]
  - *QDIO Enhanced Buffer State Management (QEBSM) and Host Page Management Assist (HPMA)*[2]
- *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 z9 and zSeries*

Notes:

1) Performance assist is available only on the z9-109, z990, and z890 servers

2) QEBSM and HPMA is supported by z/VM V5.2 and is exclusive to z9-109



Note: z/OS.e is available only in LPAR mode on the 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 or OS/390 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 be used to 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, DASD configuration, storage availability, and other factors.

To learn more about z/VM performance:

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

Connectivity Options

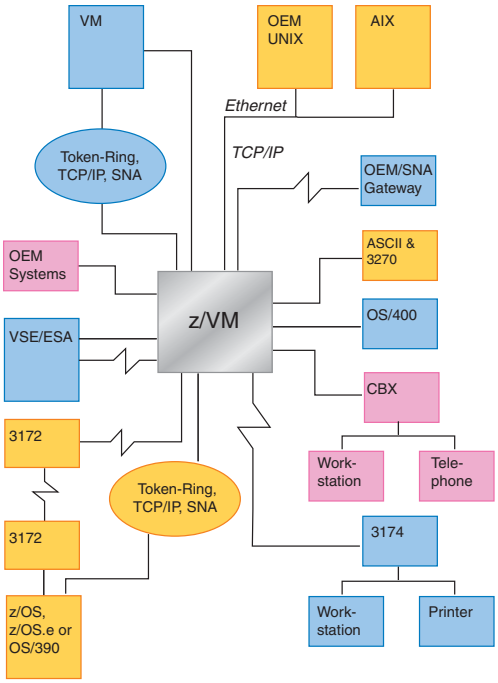
Networking options

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*

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*

Note: Operates with z/VM V5.1

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

TCP/IP for z/VM V4.4 Level 440

- *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)

TCP/IP for z/VM Level 430

- *All functions available in TCP/IP for z/VM Level 420 plus:*
  - *Guest-LAN implementation extended to support multicast transmission across HiperSockets Guest LANs*
  - *Improved performance of the TCP/IP stack by:*
    - *redesigning algorithms to reduce path-lengths*
    - *recoding procedures to optimize high-use paths*
    - *identifying and implementing performance improvement items*
  - *Additional prevention of types of DoS attacks have been implemented including Kiss of Death (KOD), KOX, Blat, SynFlood, Stream, and R4P3D*
  - *Ease-of-use enhancements include:*
    - *TCP/IP configuration wizard to automate the connection of a newly installed z/VM system to a TCP/IP-based network*
    - *dynamic configuration of TCP/IP and optional generation of syntactically-correct configuration statements*

Note: Operates with z/VM V4.3

(See z/VM TCP/IP Level 430 User's Guide – SC24-6020-01)

TCP/IP for z/VM Level 420

- *All functions available in TCP/IP for z/VM Level 3A0 plus:*
  - *Guest LAN capability designed to allow a VM guest to install a virtual HiperSockets adapter for interconnection of virtual machines*
  - *IMAP Server supporting the IMAP Version 4 Revision 1 (IMAP4rev1) mail server for storing and serving electronic mail*
  - *Improved TCP/IP stack security helps prevent some types of Denial of Service (DoS) attacks (Smurf, Fraggle, Ping-o-Death)*

Note: Operates with z/VM V4.2

(See z/VM TCP/IP Level 420 User's Guide – SC24-6020-00)

TCP/IP feature for z/VM Level 3A0 and TCP/IP for z/VM

- *All functions available in TCP/IP feature for VM/ESA FL320 plus:*
  - *Improved security with the inclusion of a Secure Sockets Layer (SSL) server*
  - *Transparent data access to remote systems data with an NFS Client*
  - *Capability and usability improvements to FTP server for Web browsers*

- *Better TCP/IP efficiency with the MPROUTE server*
- *Reduced load on hosts with support for IP Multicasting*
- *Improved data transfer performance with QDIO supporting Gigabit Ethernet, Fast Ethernet, and 155 ATM (Ethernet LAN Emulation)*

Note: Operates with z/VM V3.1 and V4.1

(See z/VM TCP/IP User's Guide – SC24-5982-00)

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*
- *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*
- *ESCON, FICON, FICON Express2, TCP/IP, APPC, IUCV, CTCA, 3088, Bisynchronous connectivity options*
- *Gateway access to SNA network*
- *Connectivity to other VM, z/OS, z/OS.e,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

z/VM Decision Support

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 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 z9 and zSeries as an application server*

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

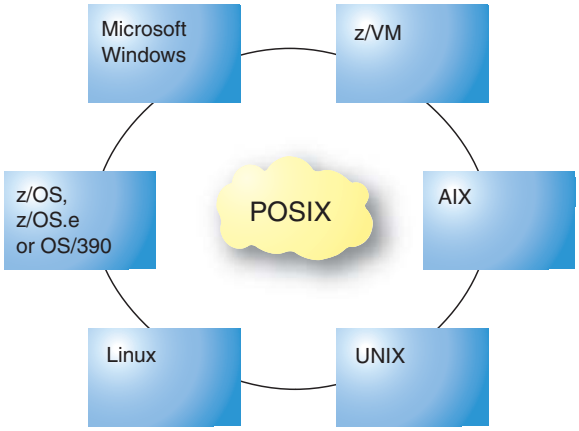
ibm.com/software/data/qmf/

Open Computing

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

3) 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*
- *New reports for Linux and SCSI FCP disks,*
- *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) for VM Version 1 Release 5 and the DirMaint optional feature of z/VM V4 or 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 V4 or 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 VM/ESA Version 1 Release 5.3 and the RTM optional feature for z/VM V4 FL410 RealTime Monitor of z/VM systems, including 64-bit architecture support

- *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*
- *Query command updated to provide:*
  - *Service level of executable RTM parts using the new LEVEL operand*
  - *Storage addresses of dynamically-allocated tables using the new TABLES operand*
  - *System information, such as the CP and CMS levels, hardware level, and installed features using the new ENVIRON operand*
- *RTM Version 1 Release 5.3 operates on on V3.1 but not on V4 or V5*
- *RTM is not available with z/VM V5.1*

(See RTM VM/ESA Program Description/Operations – SH26-7000 for z/VM 3.1 or the RTM FL410 – SC24-6028 for z/VM V4)

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

VM Performance Reporting Facility (VMPRF) Version 1 Release 2 and the PRF optional feature of z/VM V4 FL410

- *Produces performance reports and historical files through processing of monitor data*
- *Provides analysis and tuning aids for z/VM systems*

- *VMPRF operates on V3.1 but not on V4 or V5*
- *PRF is not available with z/VM V5.1*

(See VM Performance Reporting Facility User's Guide – SC23-0460 for z/VM 3.1 or the z/VM PRF FL410 – SC24-6027 for z/VM V4)

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

Performance Analysis Facility/VM (VMPAF)

- *Offers rapid visualization of system performance via a graphical interface*
- *Aids in identifying and resolving performance problems and performing capacity management*

(See PAF/VM General Information Manual – GC23-0566)

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

Display Management System for CMS (DMS/CMS)

- *Provides a convenient mechanism for generating panels and menus for 3270 display terminals*
- *Provides the ability to utilize the designed screens with any application program*

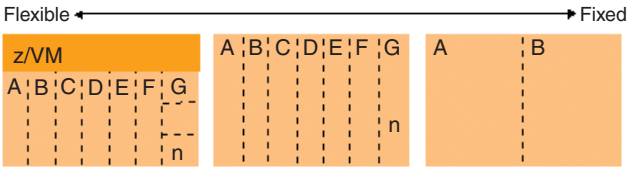
Additional Product Information

For additional information on the many z/VM technology-related products from IBM and independent software vendors, visit the z/VM Web site at:

ibm.com/zseries/zvm/products/

Partitioning Options	
Virtual	**Logical**
Number of Images	
Many	15 - 60[1]
Performance	
– I/O-assist[3] - high performance for up to 6 preferred guests – Adapter interruption performance assist[4] for QDIO[3]- high performance for V=V guests (pageable guests) using QDIO	Near Native
– QDIO performance assists[3]: adapter-interruption passthrough, QEBSM, and HPMA - high performance for V=V guests using QDIO	
Resources	
– Dedicated or shared processors, storage and devices – Virtual devices	– Dedicated or shared processor – Dynamic storage reconfiguration – Dedicated channels, CUs and devices[2]
Support Requirements	
Hardware and Software	Hardware
Reliability	
Hardware and Software	Hardware

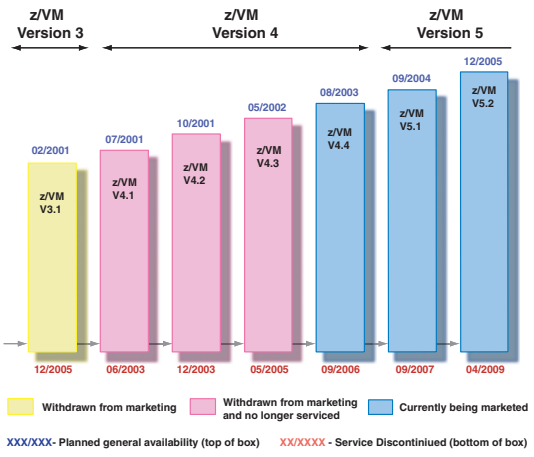
1. Server-dependent (up to 15 on z900 and z800, up to 30 on the z990 or z890, and up to 60 on the z9-109.
2. Channels (except parallel) may be shared on System z9, zSeries and S/390 servers using the Multiple Image Facility (MIF).
3.Adapter-interruption passthrough is available only on z9-109, z990, and z890 servers; QEBSM and HPMA are available only on z9-109
4. Performance assist is available only on the z9-109, z990, or z890 server.



z/VM | System z9 and zSeries LPAR mode | System z9 and zSeries multiprocessor

VM Evolution

- *z/VM Version 3 supports all models of the IBM zSeries including the IBM z800 (except 0LF model) and z900 in ESA/390 and z/Architecture modes, S/390 G5, G6, and the S/390 Multiprise 3000. Also supported are the S/390 G3, G4 and the R2 and R3 models, S/390 Multiprise 2000, S/390 Integrated Server, PC Server System/390, and the RS/6000 with System/390 Server-on-Board, or equivalent servers. z/VM V3.1 has been withdrawn from marketing effective August 27, 2004.*
- *z/VM Version 4 supports the z9-109, z990, z890, z900, and z800 in ESA/390 and z/Architecture mode, S/390 G5, G6, and the S/390 Multiprise 3000, or equivalent servers.*
- *z/VM Version 4 supports the Integrated Facility for Linux (IFL) engines of the z9-109, z990, z890, z900, z800, S/390 G5, G6, and the S/390 Multiprise 3000, or equivalent servers.*
- *z/VM Version 3.1 and 4.3 support the z990 and z890 server, or equivalent servers, in ESA/390, z/Architecture, and compatibility mode.*
- *z/VM Version 5 supports the z9-109, z990, z890, z900, and z800 (standard or IFL engines), or equivalent servers in z/Architecture mode.*



VM Operating System Comparison

VM Function	z/VM V3	z/VM V4	z/VM V5
Function			
APPC/VM	•	•	•
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]	•	•	•
Guest LAN[3]	•	•	•
Guest LAN Sniffer[7]	-	-	•
New MPRoute Server [7]	-	-	•
Shared tape for guests[4]	•	•	•
Accounting improvements[4]	-	•	•
Systems Management APIs[5]	-	•	•
VMRM enhancements[5]	-	•	•
Virtual LAN[5]	-	•	•
Virtual swiching[5]	-	•	•
HCM and HCD[5]	-	•	•
MQ Interface Client	•	•	•
PCIX Cryptographic Coprocessor[6]	-	-	•
Crypto Express2[6]	-	-	•
Dynamic Virtual Machine Timeout[6]	-	-	•
Storage Relief below 2 GB [7]	-	-	•
Central Storage			
32 GB (z890 and z800)	•	•	•
64 GB (z900)	•	•	•
256 GB (z990)	•	•	•
512 GB (z9-109)[c]	-	•	•
Expanded Storage			
Paging	•	•	•
Guest	•	•	•
VM Data Spaces	•	•	•
Virtual Machine Size			
256 GB[1]	•	•	•
I/O			
FICON/ESCON I/O	•	•	•
FICON CTCA[3]	•	•	•
FICON Express2	•	•	•
Virtual FICON CTCA[5]	•	•	•
Cascaded FICON Directors[5]	•	•	•
Guest use of FCP[4]	•	•	•
Guest use of SCSI FCP disks[5]	-	•	•
CP use of SCSI FCP disks[6, 24]	-	-	•
N-Port Identifier Virtualization [25]	-	•	•
Logical Channel SubSystems[5]	•	•	•

VM Function	z/VM V3	z/VM V4	z/VM V5
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 Servers[#]	•	•	-
G6 Servers[#]	•	•	-
zSeries 800/890/900/990 Servers[#]	•	•	•
System z9 109[#,5]	-	•	•
IFL processor feature	-	•	•
S/390 Multiprise 2000	•	-	-
S/390 Multiprise 3000[#]	•	•	-
S/390 Integrated Server	•	-	-
RS/6000 and S/390 Server-on-Board	•	-	-
PC Server S/390	•	-	-

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

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
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 passthrough is available only on z9-109, z990, and z890 servers; QEBSM and HPMA are available only on z9-109
22 Maximum channels on z890
23 Maximum channels on z990
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 sub-channels are dedicated to a guest. V5.1 and V5.2 provide for CP use of NPIV

• Supported
– Not applicable
No 370 mode execution

VM Feature Comparison

VM Function	z/VM V3	z/VM V4	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)	•	•	•
Dynamic system configuration	•	•	•
Enhanced timer management[4]	-	•	•
Virtual Machine accounting improvements[4]	-	•	•
Systems management APIs[5]	-	•	•
HCD and HCM[5]	-	•	•
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 Protocol[4]	-	•	•
Device Support			
ESS	•	•	•
ESS Large Volume	•	•	•
ESS Peer-to-Peer Remote Copy - XD	•	•	•
ESS FlashCopy V2[3]	•	•	•
ESS PPRC V2[3, 20]	•	•	•
FBA DASD	•	•	•
DS4000 [7]	-	-	•
DS6000	-	•	•
DS8000	-	•	•
Internal Disk	<•	<•	-
RAMAC DASD Subsystem	•	•	•
RAMAC Array Subsystem	•	•	•

VM Function	z/VM V	z/VM V4	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	•	-	-
VMPAF	•	•	•
RTM 1.5.3	-	-	-
PRF Feature	-	•	-
RTM Feature	-	•	-
Performance Toolkit for VM[5]	-	•	•
DirMaint	•	-	-
DirMaint Feature	-	•	•
RACF	•	-	-
RACF Feature[4]	-	•	•
Commincations			
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	•	-	-

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

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
20 Guest use only
21 Withdrawn from Marketing effective August 27, 2004 (EOS announced for 12/2005)
• Supported
< Supported on S/390 Multiprise 2000/3000
– Not applicable

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