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 guests
  - 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 instructions
    - Support for FICON® Express4 (4 Gbps FICON)
    - TCP/IP and guest LAN Support for HiperSockets using IPv6 protocol
    - Simplified VLAN management with support for Generic Attribute Registration Protocol (GARP) Virtual Local Area Network (VLAN) Registration Protocol (GVRP)
    - 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 series
– Support for Parallel Access Volumes (PAVs) as minidisks

• 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-use

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 (PCIIXCC) 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

• 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, 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.

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

A solution that builds on VM strengths
- Virtualization technology
- Guest operating system support
- Extensive connectivity options
- Linux server consolidation platform
- CMS interactive support
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 guests
- 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 instructions
  - Support for FICON Express4 (4 Gbps FICON)
  - TCP/IP and guest LAN Support for HiperSockets using IPv6 protocol
  - Simplified VLAN management with support for GVRP
- 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 series
- Support for Parallel Access Volumes (PAVs) as minidisks

**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 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

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

VMLINK

- User productivity enhancer for linking minidisks and SFS directories
- Rewritten for improved serviceability in z/VM
- 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
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 guests 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 SCS1 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 (co-processor 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 QDIO
  – QDIO Enhanced Buffer State Management (QEBSM) and Host Page Management Assist (HPMA)
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) QEBSM 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:
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

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

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)

---

**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)
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)

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)

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
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
• 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 is not available with z/VM V5
  (See RTM FL410 – SC24-6028 for z/VM V4)

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

VM Performance Reporting Facility (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
• PRF is not available with z/VM V5
  (See z/VM PRF FL410 – SC24-6027 for z/VM V4)

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

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/

Configurability

Partitioning Options

<table>
<thead>
<tr>
<th>Virtual</th>
<th>Logical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Images</td>
<td>Many</td>
</tr>
<tr>
<td>Performance</td>
<td>Near Native</td>
</tr>
<tr>
<td>1. I/O-assist 1 - high performance for up to 6 preferred guests</td>
<td></td>
</tr>
<tr>
<td>3. QDIO performance assists *(QEBSM, and HPMA – high performance for V=V guests using QDIO)</td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td>– Dedicated or shared processor, storage and devices</td>
</tr>
<tr>
<td>1. Dedicated or shared processor</td>
<td></td>
</tr>
<tr>
<td>2. Dynamic storage reconfiguration</td>
<td></td>
</tr>
<tr>
<td>3. Dedicated channels, CUs and devices</td>
<td></td>
</tr>
<tr>
<td>Support Requirements</td>
<td>Hardware and Software</td>
</tr>
<tr>
<td>1. Hardware and Software</td>
<td></td>
</tr>
</tbody>
</table>

1. Server-dependent (up to 15 on z900 and z800, up to 30 on the z9 BC, z990 or z890, and up to 60 on the z9 EC.
2. Channels (except parallel) may be shared on System z9, zSeries and S/390 servers using the Multiple Image Facility (MIF).
3. I/O assist is for V4.4 and is supported only on z900, z800, S390® G5/G6, and the S/390 Multiprise 3000.
4. Adapter-interruption performance assist is available only on z9 EC, z9 BC, z990, and z890 servers.
5. QEBSM and HPMA are available only on z9 EC and z9 BC

Flexible

Fixed

z/VM
A B C D E F G A B
n
z/VM
System z
LPAR mode
System z
multiprocessor
• 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.

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**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.
<table>
<thead>
<tr>
<th>VM Function</th>
<th>z/VM V3*</th>
<th>z/VM V4**</th>
<th>z/VM V5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
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</tr>
<tr>
<td>Shared File System</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Callable Services Lib.</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Cross Systems Extensions</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Virtual disk in storage</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Enhanced minidisk caching</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>370 accommodation</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>CP Exit Facility</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Java™ and NetRexx™</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Parallel Sysplex simulation</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Coupling Facility duplexing</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>HiperSockets®</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>IPv6 HiperSockets®</td>
<td>-</td>
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<tr>
<td>GVRP Support®</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Guest LAN®</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Guest LAN Sniffer</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>MPRoute Server®</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Shared tape for guests</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Accounting improvements</td>
<td>-</td>
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<td>●</td>
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<tr>
<td>Systems management APIs</td>
<td>-</td>
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</tr>
<tr>
<td>VMRM enhancements</td>
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<tr>
<td>Virtual LAN®</td>
<td>-</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Virtual swiching</td>
<td>-</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>HCM and HCD®</td>
<td>-</td>
<td>●</td>
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</tr>
<tr>
<td>MQ Interface Client</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>PCIX Cryptographic</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Coprocessor®</td>
<td>-</td>
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</tr>
<tr>
<td>CryptoExpress2®</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Improved memory management for Linux guests</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Dynamic Virtual Machine</td>
<td>-</td>
<td>-</td>
<td>●</td>
</tr>
<tr>
<td>Timeout</td>
<td>-</td>
<td>-</td>
<td>●</td>
</tr>
<tr>
<td>Storage Relief below 2 GB</td>
<td>-</td>
<td>-</td>
<td>●</td>
</tr>
<tr>
<td><strong>Central Storage</strong></td>
<td></td>
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</tr>
<tr>
<td>32 GB (z890 and z800)</td>
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<td>●</td>
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<tr>
<td>64 GB (z900)</td>
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</tr>
<tr>
<td>64 GB (z9 BC)</td>
<td>-</td>
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<tr>
<td>256 GB (z990)</td>
<td>●</td>
<td>●</td>
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</tr>
<tr>
<td>512 GB (z9 EC)</td>
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<tr>
<td><strong>Expanded Storage</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Paging</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Guest</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>VM Data Spaces</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td><strong>Virtual Machine Size</strong></td>
<td></td>
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</tr>
<tr>
<td>256 GB</td>
<td>-</td>
<td>●</td>
<td>●</td>
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<tr>
<td><strong>I/O</strong></td>
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<tr>
<td>FICON/ESCON I/O</td>
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</tr>
<tr>
<td>FICON CTCA®</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>FICON Express2</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>FICON Express4</td>
<td>-</td>
<td>●</td>
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<tr>
<td>Parallel Access Volumes</td>
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<td>-</td>
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<tr>
<td>Virtual FICON CTCA</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Cascaded FICON Directors®</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Guest use of FCP</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Guest use of SCSI FCP disks</td>
<td>-</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

**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
10. z/VM must be run in a logical partition on the z890 and z990 servers.
11. I/O - assist is not available when z/VM is running in a logical partition.
12. Adapter-interruption performance assist is available only on the z9 EC, z9 BC, z990, and z890 servers; QEBSM and HPMA are available only on z9 EC and z9 BC
13. Install, IPL, and operation of z/VM V5
14. 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
15. Withdrawn from Marketing effective 8/31/04 (EOS on 12/31/05)
16. Withdrawn from Marketing effective 3/31/06 (EOS planned for 9/30/06)
17. Supported
18. Not applicable
19. No 370 mode execution
<table>
<thead>
<tr>
<th>VM Function</th>
<th>z/VM V3</th>
<th>z/VM V4</th>
<th>z/VM V5</th>
</tr>
</thead>
<tbody>
<tr>
<td>REXX Sockets</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>31-bit CMS</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>CMS Pipelines</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>CMS multitasking</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Reusable Server Kernel</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>POSIX</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>DCE</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Binder/Loader</td>
<td>●</td>
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<tr>
<td>NFS Client</td>
<td>●</td>
<td>●</td>
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<tr>
<td>APPC</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td><strong>Shared File System</strong></td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>VM Data spaces support</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Common SFS and minidisk interface</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>POSIX Byte File System</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Automated SFS shutdown⁶</td>
<td>-</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td><strong>DFSM/VM</strong></td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Fast data mover</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Space management by policy</td>
<td>●</td>
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<td>●</td>
<td>●</td>
</tr>
<tr>
<td><strong>DB2 for VSE and VM</strong></td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>VM Data spaces</td>
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**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
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