

z/VM V6 and IBM System z

... Enhancements for zEnterprise Virtualization



Overview

The z/VM® hypervisor offers a base for customers who want to exploit IBM virtualization technology on the IBM System z10™ and IBM zEnterprise™ servers. IBM System z® servers are highly-utilized, virtualized, scalable, and optimized for consolidating workloads to help lower overall operating costs and improve energy efficiency. System z servers have advanced reliability, availability, serviceability; security, scalability, and virtualization technology that can help define a framework for the future. The System z server and its virtualization capabilities can support more virtual Linux® servers than any other platform in a single footprint. Ideally suited as the cornerstone of your new enterprise data center, this competitively-priced family of servers delivers unparalleled qualities of service to help manage growth and reduce cost and risk in your business.

When consolidating from distributed platforms onto System z you can create virtual servers on demand, achieve network savings through HiperSockets™ (internal LANs), and improve systems management of virtual servers. With System z virtualization, customers can easily create many virtual machines consisting of virtualized processors, memory, storage, I/O, and networking resources. Virtualization technology may help lower your total cost of ownership when deploying new enterprise application workloads. z/VM includes over 40 years of innovation and invention.

z/VM version 6 provides many capabilities for operating and managing your applications on System z10 servers.

(See z/VM: General Information - SC24-6193)

ibm.com/vm/

Enhancements for IBM zEnterprise 196 (z196) Virtualization and for the IBM zEnterprise Unified Resource Manager (zManager)

IBM announces enhancements to z/VM which are intended to strengthen System z virtualization technology leadership and enable customers to take advantage of the new function, performance, reliability, availability and serviceability

improvements delivered by the IBM zEnterprise System. z/VM V6.1 support for the IBM zEnterprise 196 (z196) exploits select new processor capabilities, improves z/VM internal functionality, and supports new devices. Select new function is also provided for z/VM V5.4. The PTF for APAR VM64798 provides z/VM support for the IBM zEnterprise z196 and has a planned availability date of September 2010. Additional PTFs for APARs in other components (VM64672 for VMHCD, VM64747 for VMHCM, VM64807 for EREP, VM64820 for Performance Toolkit & VM64799 for IOCP) are planned to be available in September 2010 also.

IBM System z has a rich heritage of virtualization innovation that enables exceptional qualities of service. Building on that heritage, z/VM V6 is optimized for consolidating workloads on the zEnterprise 196 and System z10 servers, helping clients build an ever more cost-effective dynamic infrastructure with exceptional levels of business resilience and speed-to-market, while providing the flexibility to expand and contract system resources to match business needs.

The IBM zEnterprise Unified Resource Manager manages System z ensembles, collections of one or more zEnterprise System nodes in which each node is comprised of a z196 and its optionally attached IBM zEnterprise BladeCenter® Extension (zBX) model 002. The resources of a zEnterprise System ensemble are managed and virtualized as a single pool of resources, integrating system and workload management across the multisystem, multi-tier, multiarchitecture environment. Virtual server lifecycle management enables directed and dynamic virtual server provisioning across all hypervisors (PR/SM™, z/VM, and PowerVM™) from a single, uniform point of control. The existing z/VM virtual server management functions available on System z10 have been extended and now permit virtual servers to be created and deleted, and allow real and virtual networking resources to be managed by the

Unified Resource Manager. Enhancements to z/VM allow full participation for life cycle management from the Unified Resource Manager when z/VM is a resource within a zEnterprise System ensemble. The PTF for APAR VM64822 provides z/VM support for the IBM zEnterprise Unified Resource Manager and System z ensembles. This APAR has a planned availability date of November 2010.

Enhancements to z/VM provide:

- *Full participation in the creation, deletion, and management of virtual server resources from the Unified Resource Manager*
- *Direct and secure access to the zEnterprise intranode management network (INMN) and intraensemble data network (IEDN)*
- *Support for the IBM zEnterprise 196*
- *Improved security with support for secure-key encryption capabilities of the CP Assist for Cryptographic Functions (CPACF), and support for the Federal Information Protection Standard (FIPS) 140-2*
- *Improved resiliency through z/VM Extended Remote Copy (XRC) time stamping which allows z/VM to participate in long distance environments that require synchronized I/O such as Geographically Dispersed Parallel Sysplex™ (GDPS®)*
- *Increased guest and system throughput with improvements to z/VM memory management scalability*

The advanced virtualization technologies available with z/VM, combined with the highly attractive economics of the secure and reliable System z servers, help clients extend the business value of the mainframe by integrating applications and data while providing exceptional levels of scalability, availability, security, and operational ease. Scalability support added in z/VM reduces system overhead and increases systems and guest throughput. Clients can now exploit enhanced security for transaction processing with protected key cryptography. The IBM zEnterprise System allows the definition of z/VM V6 guests as virtual servers within a tightly integrated and centrally managed

enterprise computing environment. The Unified Resource Manager provides end-to-end management of a heterogeneous environment that includes z/VM.

Scalability

- *Support LPARs up to 256 GB of real memory and more than 1 TB of total virtual memory in use by guests (The actual amount of usable real and virtual memory is dependent on the amount of real memory in the z/VM logical partition, the hardware server model, firmware level and configuration, and the number of guests and their workload characteristics.)*
- *Allow up to real 32 processors in a single z/VM image*
- *Provide memory management algorithms to help benefit paging workloads with large memory environments*
- *Support Collaborative Memory Management Assist (CMMA) by which host and guest exchange information to optimize their use and management of memory*
- *Provide enhanced memory utilization using Virtual Machine Resource Manager (VMRM) between z/VM and Linux®*
- *Define Discontiguous Saved Segments (DCSS) above 2047 MB in virtual storage, helping to allow many DCSSs to be used together*
- *Support System z dynamic capabilities to help reduce the need to re-IPL z/VM by dynamically configuring processors, channels, I/O, and memory to both the z/VM system itself and to individual guests*
- *Scalability enhancements within z/VM internal processing in the memory management subsystem*
 - *Configurable Settings in CP to dynamically change how page reorder processing works*
 - *Improved page release serialization to reduce the amount of resource required to manipulate guest pages*
 - *Enhanced contiguous frame coalescing to allow the hypervisor to better serve multiple contiguous pages to a guest virtual machine.*

Virtualization technology and Linux enablement

- Create virtual specialty processors allowing users to assess the operational and CPU utilization implications of configuring a z/OS® system with zIIP or zAAP processors without requiring the real specialty processors.
- Protected key CP Assist for Cryptographic functions such that z/VM now supports machine generated cryptographic wrapping keys and generates unique wrapping-key mask for each quest virtual machine. This ensures that the encrypted keys can only be used by the guest for which they were intended.
- Crypto Express3 on the System z10 and the zEnterprise 196 is supported. Initial guest clear-key support for Crypto Express3 with the PTF for APAR VM64656. Enhanced guest protected-key support for Crypto Express3 with the PTF for APAR VM64793. This support together will give
 - The ability to dedicate any available domain to a guest for clear-key cryptographic functions.
 - The ability for guests to share all available, non-dedicated domains for clear-key and protected-key cryptographic functions
 - Enhancements to the CP QUERY CRYPTO APQS command will display user information about both shared and dedicated cryptographic domains
- Virtualizes I/O devices and channels reducing or eliminating the need for the real hardware
- Create a flexible environment to test and develop on Linux while simultaneously running Linux production applications on Integrated Facility for Linux (IFL) processors
- Support for Linux on System z guests using Dynamic Storage Reconfiguration (DSR) allowing operation when running second level on z/VM to be more compatible when running directly on an LPAR
- Redistribute a CPU's share to z/VM virtual processors to help allow virtual machines to be managed more efficiently
- Define and operate Fibre Channel Protocol (FCP)-attached SCSI disks with capacities of up to approximately 1 TB

- Dump Linux on System z guests to FCP-attached SCSI disks
- Allow guests to use Modified Indirect Data Address Words (MIDAWs) to allow more flexibility and performance in certain channel programs as an alternative to data-chained channel-command words (CCWs)
- Provide a guest testing environment for z/OS Parallel Sysplex®.
- Allow guests access to the system ASCII console to facilitate recovery of the guest during an emergency

Technology exploitation

- End to end management of the heterogeneous environment of a zEnterprise System is provided by the IBM zEnterprise Unified Resource Manager. From a single point of control the Unified Resource Manager provides virtual server lifecycle management which enables directed and dynamic virtual server provisioning and also provides management of real and virtual networking resources for z/VM guest environments.
- Providing capabilities for guests to support specialty processors, allowing all processor types (CPs, IFLs, zIIPs, zAAPs, and ICFs) on a System z10 server to be defined in the same z/VM LPAR to:
 - Operate z/TPF, z/VSE™ and z/OS guests on CPs
 - Operate Linux on System z as guests on IFLs and optionally on CPs
 - Offload z/OS system software process requirements, such as DB2® workloads, on zIIPs
 - Provide an economical Java execution environment under z/OS on zAAPs
 - Operate coupling facility virtual machines in support of a Parallel Sysplex test environment on ICFs and optionally on CPs
- Guest LAN and Virtual Switch (VSWITCH) exploiting the Prefetch Data instruction to use new IBM System z10 server cache prefetch capabilities to help performance of guest-to-guest streaming workloads
- Dynamically adding and deleting LPARs using the z/VM Control Program dynamic I/O command interface and

the z/VM Hardware Configuration Definition (HCD)/ Hardware Configuration Management (HCM) support.

- Dynamically configuring processors, memory, I/O, and networking devices
- Supporting hardware assists QDIO Enhanced Buffer-State Management (QEBSM) and Host Page-Management Assist (HPMA) to allow a cooperating guest operating system to initiate QDIO operations directly to the applicable channel, without interception by z/VM, thereby helping to provide performance improvements
- Supporting HiperSockets to help enable memory-to-memory network connectivity between LPARs
- Supporting HyperSwap™ to allow virtual devices associated with one real disk to be swapped transparently to another
- Recognizing all four ports on System z10 OSA-Express3 Gigabit Ethernet (GbE) and 1000BASE-T Ethernet features on the z10 EC server and two ports on the OSA Express-3 GbE and 1000BASE-T 2P features on the z10 BC server, providing more physical connectivity to service the network and reducing the number of required resources. Includes four-port exploitation for OSA-ICC on the 1000BASE-T Ethernet feature in first quarter 2010
- Installing z/VM in an LPAR and installing both z/VM and Linux on System z in a virtual machine from the HMC DVD drive without requiring any external network setup or a physical connection between an LPAR and the HMC
- Providing I/O device information from the input/output definition file (IODF) using HCD for the World-Wide Port Name (WWPN) prediction tool
- Supporting FICON® Express8 that is designed to provide faster access to data with a link data rate of 8 gigabits per second (Gbps)
- Supporting IBM Extended Address Volumes (EAV) function of the IBM DS8000® that provides for volumes that can scale up to approximately 223 GB (262,668 cylinders) with the PTF for APAR VM64709.

- With the PTF for APAR VM64711, CMS support has been doubled, up to 65,520 cylinders, for its own use
- Supporting the IBM FlashCopy® SE feature on the IBM DS8000 designed to provide a space-efficient snapshot capability that can greatly reduce the storage capacity needed for point-in-time copies with the PTFs for APARs VM64605 and VM64684
- Supporting the IBM System Storage™ Enterprise 3592 Tape Drive Model E06 and disk-only tape configuration

Network virtualization

- Guest LANs enable users to connect virtual network adapters to an emulated local area network (LAN) segment allowing communication using the same software that would be used to communicate over an equivalent physical LAN segment
- Virtual switch (VSWITCH) support allowing virtual-QDIO connections to physical LAN segments without requiring a router
- VSWITCH exploiting Layer 2 for OSA-Express2 and OSA-Express3 providing the ability to send and receive protocol-independent traffic for both IP and non-IP applications
- Port isolation security providing the ability to restrict guest-to-guest communications within a VSWITCH by exploiting OSA-Express QDIO data connection isolation
- VSWITCH exploiting link aggregation support for OSA-Express2 and OSA-Express3 devices to help increase bandwidth
- Support of the zEnterprise System private networks that interconnect the System z processor, zBX blades, Support Element (SE), and Hardware Management Console (HMC). These new channel-path types are based on the existing OSA Direct-Express Ethernet (OSD) and are the Open Systems Adapter for intraensemble data network (IEDN) and Open Systems Adapter for intranode management network (INMN)

Security

RACF® Security Server

- Works with the z/VM Control Program to provide z/VM system access and data security controls.
- RACF is designed to help meet today's need for industrial-strength information security by providing:
 - Encrypted extended-length mixed-case passwords and password life-cycle management
 - Access Control Lists (ACLs) for z/VM system resources and networks
 - Separation of system and security administration duties
 - Authentication, authorization, and audit services to other products or servers
 - Protection of customer-defined resources
 - The ability to implement multiple security zones in a single z/VM instance
 - A detailed record of administrator and virtual server activities
 - RACF authentication and audit services available to remote hosts through the z/VM LDAP server (adapted from the IBM Tivoli® Directory Server for z/OS)
 - Authorization services available to Linux by use of the Linux LDAP pluggable authentication module (PAM)
- Licensed as an IPLA optional feature on V6.1
Note: Release-specific priced, optional feature, operating only with z/VM V6.1

(See z/VM: RACF Security Server General User's Guide — SC24-6215)

- Support for the IBM Full Disk Encryption features of the IBM DS8000
- Support for drive-based data encryption with the IBM System Storage TS1120 Tape Drive and the IBM System Storage TS1130 Tape Drive to help protect data on tape in a cost-effective way
- z/VSE guests can use DFSMS/VM™ FL221 to locate encryption-capable 3592 tape drives in an Enterprise Automated Tape Library

- z/VM SSL server
 - Facilitates security-rich and private conversations between z/VM servers and external clients
 - Supports 40-bit, 56-bit and 128-bit encryption/decryption services
 - Provides transparent support for protocols that can be encapsulated in a secure SSL session, such as HTTPS
 - Provides services to applications that need to transition from clear-text to secure-text such as TN3270, FTP, and SMTP
 - CMS-based rather than requiring a Linux distribution
 - Protection Standard (FIPS) 140-2, a government-required procedure for authenticating the security of a certificate data base that requires signing of the data base and using separate cipher suites for traffic encryption and decryption.
 - Additional enhancements have been made to the z/VM SSL server that improve the ability to provide concurrent secure connectivity by increasing its overall capacity while decreasing the amount of system resources it requires.
- IBM Tivoli zSecure Manager for RACF z/VM Combines capabilities of the most used zSecure Audit and Admin functions for the virtual machine environment to:
 - z/VM security management tasks with simple, one-step actions that can be performed without detailed knowledge of RACF command syntax
 - Quickly identify and prevent problems in RACF before they become a threat to security and compliance
 - Help ease the burden of database consolidation
 - Create comprehensive audit trails without substantial manual effort
 - Generate and view customized audit reports with flexible schedule and events elections

(See IBM Tivoli® zSecure Manager for RACF z/VM: Installation and Configuration Manual – SC23-6574)

ibm.com/software/tivoli/products/zsecure-mgr-zvm-racf/

Systems Management

Support of the zEnterprise Unified Resource Manager that manages System z ensembles. Ensembles are collections of one or more zEnterprise System nodes in which each node is comprised of a z196 and its optionally attached IBM zEnterprise BladeCenter Extension (zBX). The resources of a zEnterprise ensemble are managed and virtualized as a single pool of resources, integrating system and workload management across the multisystem, multi-tier, multiarchitecture environment.

- Support of the new IBM zEnterprise 196 internal networks that provide direct/secure access to the zBX blades.
- Systems Management enhancements through support of the Unified Resource Manager allowing ease of virtual server management from the HMC. This support will be made available via APAR VM64822 with targeted availability November 2010

Systems Management APIs (SMAPIs)

- Helps simplify the task of managing many virtual images running under a single z/VM image using a sockets-based multitasking capable server
- Additional systems management enhancements are provided by the HMC and Support Element (SE) 2.10.1 to exploit the z/VM Systems Management APIs to allow selected virtual resources to be both defined and managed
- Create new virtual images in a variety of operating environments, such as Linux on System z, z/OS, z/VM, z/VSE, z/TPF, and CMS
- Allocate and manage resources for virtual images and change a virtual image configuration
- Manage connectivity between virtual images
- Activate and deactivate individual and multiple virtual images

- Manage DASD volumes and groups
 - Update VMRM Service Virtual Machine configuration files and query data without logging onto the VMRM server
 - Support the directory manager's ability to manage subscriptions to directory updates and tag and scan functions
 - Allow creation, updating, and querying of the LOADDEV directory statement for virtual images
 - Query the time when a virtual image was activated
- (See z/VM: Systems Management Application Programming— SC24-6234)

ibm.com/vm/sysman

Hardware Management Console (HMC) and Support Element (SE)

- Exploits the SMAPIs to allow guests and selected virtual resources to be defined and managed

Hardware Configuration Manager (HCM) and Hardware Configuration Definition (HCD)

- Allows system administrators to create and manage the I/O configuration to provide a comprehensive, easy-to-use I/O configuration-management environment similar to that available with z/OS

(See z/OS and z/VM: Hardware Configuration Manager User's Guide - SC33-7989)

ibm.com/vm/related/hcm

Virtual Machine Resource Manager (VMRM)

- Provides functions to dynamically tune the z/VM system
- (See z/VM: Performance - SC24-6208)

ibm.com/vm/sysman/vmrm

Programmable Operator Facility (PROP)

- *Designed to increase the efficiency of system operation and to allow remote operation of systems in a distributed data processing environment*

(See z/VM: CMS Planning and Administration - SC24-6171)

Directory Maintenance Facility (DirMaint)

- *Provides efficient and highly-secure interactive facilities for maintaining the z/VM system directory*
- *Validate directory changes with error checking*
- *Integrates with the security management functions of the RACF Security Server*
- *Provides support for the Systems Management APIs*
- *Provides end-user authentication of password phrases, if one is defined in an external security manager (ESM)*
- *Licensed as an IPLA optional feature on V6.1*

(See DirMaint Facility Tailoring and Administration Guide – SC24-6135)

ibm.com/vm/related/Dirmaint

IBM Operations Manager for z/VM

- *Helps improve the monitoring and management of z/VM systems and virtual machines, including guests such as Linux on System z. By providing the ability to automate routine maintenance tasks and automatically respond to predictable situations that require intervention.*

(See Operations Manager for z/VM Installation and Administration Guide, SC18-9347)

ibm.com/software/sysmgmt/zvm/operations/index.html

IBM Backup and Restore Manager for z/VM

- *Provides z/VM system administrators and operators the ability to efficiently and effectively backup and restore files and data on z/VM systems, including guest operating systems, such as Linux on System z.*

(See Backup and Restore Manager for z/VM User Guide - SC18-9523)

ibm.com/software/stormgmt/zvm/backup/index.html

IBM Tape Manager for z/VM

- *Provides z/VM system administrators and operators the ability to manage, monitor, and protect tape resources on z/VM systems and helps to automate common daily tape operations and helps eliminate tedious, often error-prone, manual tasks.*

(See Tape Manager for z/VM User's Guide and Reference - SC18-9349)

ibm.com/software/stormgmt/zvm/tape/index.html

IBM Archive Manager for z/VM

- *Addresses storage and data management concerns by allowing users to archive historical or other infrequently used data to increase data availability and helps companies comply with data storage requirements mandated by fiscal or legal regulations and policies*

(See Archive Manager for z/VM User's Guide - SC18-9348)

ibm.com/software/stormgmt/zvm/archive/index.html

Performance Management

IBM Systems Director for Linux on System z

- *Delivers a simplified platform management solution that streamlines the way physical and virtual systems are managed across a multisystem environment*
- *Supports multiple operating systems and virtualization technologies across IBM and non-IBM platforms*
- *Provides consistent views for visualizing managed systems and determining how these systems relate to one another*
- *z/VM V6.1 provides the Manageability Access Point and Platform Agents for a closer integration with IBM Systems Director*

[Publib.boulder.ibm.com/infocenter/director/v6r1x/index.jsp](http://publib.boulder.ibm.com/infocenter/director/v6r1x/index.jsp)

IBM Systems Director VMControl Image Manager for Linux on System z

- *Automate the creation of a virtual server and deployment of a virtual appliance into that virtual server*
- *Decrease dependency management problems by deploying virtual appliances that contain setup and configuration requirements*
- *Capture and deploy Linux images on z/VM systems*
- *Closer integration with IBM Systems Director through the z/VM Manageability Access Point (zMAP) Agent, including the Platform Agent, previously shipped with IBM Systems Director. This is now available on z/VM V6.1. This helps simplify installation of the zMAP Agent and eliminates the need to obtain the files from the IBM Systems Director Web site.*
 - *The PTF for APAR VM64704 provides the zMAP agent for the IBM Systems Director Server V6.1.1 for Linux on System z.*
 - *The PTF for APAR VM64838 provides the zMAP agent for the IBM Systems Director Server V6.2 for Linux on System z.*
 - *The APARs must be used with the level of the IBM Systems Director Server for which the APAR is intended. Also, VM64838 should be applied only if your installation intends to use IBM Systems Director V6.2 and migrate off V6.1.1.*

publib.boulder.ibm.com/infocenter/director/v6r1x/index.jsp

Performance Toolkit for VM

- *Is updated to capture data from the IBM zEnterprise 196 processor including the OSX and OSM Channel-Paths and Ensemble Management support*
- *Supports the device enhancements by measuring z/VMs Extended Address Volume support and XRC time stamping support*
- *Measures the internal enhancements items added to z/VM to provide additional scalability*
- *Providing enhanced capabilities for a z/VM systems programmer, operator or performance analyst to monitor and report performance information and includes:*
 - *Full-screen system console for operating and managing multiple z/VM systems (local or remote)*
 - *Post-processing to produce VM history files and VM monitor data captured by the MONWRITE utility*
 - *Viewing of performance monitor data using either a Web browser or PC-based 3270 emulator graphics*
 - *Monitoring for TCP/IP for VM*
 - *Processing of Linux performance data obtained from the Resource Management Facility (RMF™) Linux performance gatherer (rmfpms)*
 - *Reporting for Linux and SCSI FCP disks*
 - *Preventing the Performance Toolkit server from being shut down and restarted when adding new z/VM systems within the enterprise for performance-data retrieval*
- *Licensed as an IPLA optional feature on V6.1*

(See z/VM: Performance - SC24-6208)

ibm.com/vm/perf

Tivoli OMEGAMON XE on z/VM and Linux

Tivoli OMEGAMON® XE on z/VM and Linux provides a wide range of information about the z/VM and Linux on System z operating systems, including information about your Linux instances running as z/VM guests and the Linux workloads, revealing how they are performing and affecting z/VM and each other. Capabilities include:

- Comparing Linux operations side by side with detailed performance metrics from other important systems
- Collecting data from the Performance Toolkit for VM (which is a prerequisite) complements data collected by the IBM Tivoli Monitoring for Linux for IBM eServer™ zSeries® agent
- Navigation between Tivoli Enterprise Portal workspaces with Dynamic Workspace Linking
- Viewing and monitoring workloads for virtual machines, groups, response times and LPAR reporting and viewing reports on z/VM and Linux usage of resources such as CPU utilization, storage, mini-disks and TCP/IP
- Helping executives understand how systems performance influences business and the bottom line with high-level views
- IT staff can more easily track complex problems that span multiple systems and platforms and share related information with granular views

(See IBM Tivoli OMEGAMON XE on z/VM and Linux User's Guide - SC32-9489)

ibm.com/software/tivoli/products/omegamon-xe-linux-zseries/index.html

Installation

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)
 - RSUs in OMA/2 format have been discontinued for all currently supported and future releases
- Installation available on 3590-formatted tapes, 3592-formatted tapes, and on DVD
- Order z/VM products and service using ShopzSeries
- Internet delivery of z/VM base, optional features, and SDO licensed products

(See z/VM:VMSES/E Introduction and Reference GC24-6243 and z/VM: Guide for Automated Installation and Service -GC24-6197)

To learn more about ShopzSeries:

ibm.com/software/ShopzSeries/

A solution that builds on z/VM hypervisor strengths

- Virtualization technology
- Guest operating system support
- Extensive connectivity options
- Linux server consolidation platform
- CMS interactive support
- Server support
- 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/zvm/library/

z/VM supports a wide range of industry standards

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

z/OS Parallel Sysplex system environments as z/VM guests

- Virtual Coupling Facility (CF) support:
- Helps provide faster deployment of new Parallel Sysplex systems through testing with virtual sysplexes
- Does not require or support real hardware coupling facilities and coupling links
- Support Coupling Facility duplexing with System z
- Allows z/VM systems hosting sysplexes to run as second-level (or higher) guests
- Helps reduce risk in running new applications for z/OS releases
- Helps reduce problems in scheduling test and production time
- Helps reduce training expense and risk to production operations through operator training with virtual configurations
- Provides additional options for disaster recovery

z/VM encompasses many uses

- Flexible, cost-effective guest environments
- Well-suited for a dynamic infrastructure
- 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 a dynamic infrastructure

- Dynamic configuration capabilities to add processors, channels, I/O devices, and memory to both the z/VM system itself and to individual guests
- Access to enterprise data and applications through TCP/IP Network File System (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

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 memory provides fast access to data in memory
- Minidisk cache boosts performance with cache in main and/or expanded storage (memory)
- VM Data Spaces allow applications in virtual machines to create additional VM data spaces of 2 GB, up to 2 TB total

Callable Services Library (CSL)

- Enhanced 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

VMLINK

- User productivity enhancer for linking minidisks and SFS directories

CMS Interactive Support

CMS Binder/Loader for z/VM

- Enhanced application affinity between CMS and z/OS
- 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 memory and executes the program
- 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

CMS Utilities Feature (CUF)

- 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/vm/related/cuf

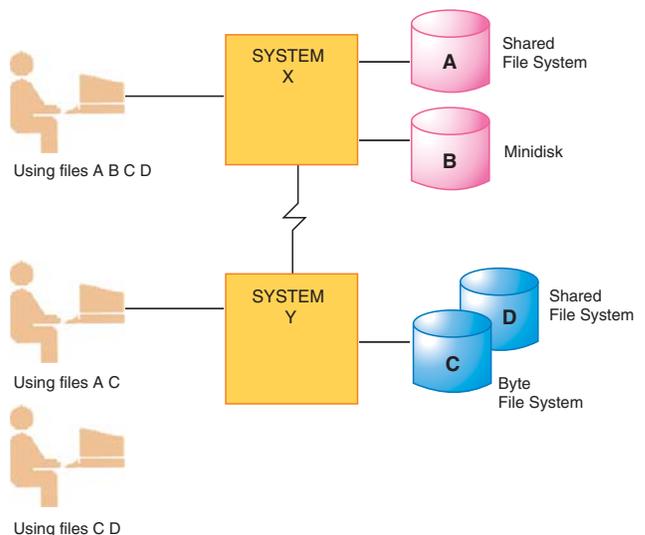
z/VM Server Support

VM Data Spaces are designed to:

- Offer capabilities unique to System z family
- Provide high speed transfer and data access between virtual machines, helping to improve 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
- Provides sharing within one system or across multiple systems
- Provides file security through authorization mechanism
- Utilizes minidisk caching in main or expanded storage memory
- Exploit VM Data Spaces



Help improve usage of disk storage devices

- Store data stored in file pools
- Provides logical vs. physical allocation of data blocks
- Make unused blocks available to any user of file pool
- Help improve productivity
 - Organize files in hierarchical directories
 - Support aliases for file names
 - Provide single application interface via CSL routines for SFS and minidisk data
- Simplify system administration
 - Provide file pool backup and file-level restore
 - Provide dynamic expansion of file space for users
 - Provide dynamic expansion of DASD to file pool
 - Allocate 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
 - Coordinate updates to multiple file pools
 - More easily develop distributed applications, with system coordination of data integrity
- Enable access to distributed data
 - Provide transparent access to remote data
- Allow CMS users and applications to access the POSIX hierarchical byte file system
- Shut down automatically when the z/VM Control Program (CP) is shutdown

DFSMS/VM is designed to:

- Provide automated data management for Shared File System (SFS), POSIX Byte File System (BFS) files, and minidisk restructuring
 - Migration, recall and expiration of active and inactive data
 - Archive/restore of SFS files to tape with Tivoli Storage Manager

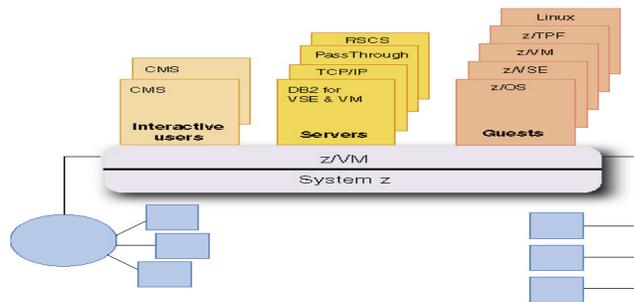
- Provide interfaces for Tivoli Storage Manager tape library usage (Tivoli Storage Manager is not supported on z/VM)
- Allow VSE/ESA™ or z/VSE guest access to automated tape libraries containing 3480, 3490, 3590, and 3592 devices
- Support for approximately 1 TB SCSI disks
- Multi-user tape support
- Tape encryption support for z/VSE guests
- Provide a high-performance data mover
- Enables fast migration to new storage devices
- Include Interactive Storage Management Facility (ISMF)
 - Provides consistent interface for VM, z/OS 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 and disk-only environments
- Provide the capability for a tape-librarian product to communicate with an automated tape library
- Provide ATL access for VSE guests
- Provide multi-user attach support allowing z/VM to be installed from 3590/3592 tapes residing in an ATL
- Provide tape Encryption support for z/VSE guest
- Orderable as a no-charge feature with the z/VM

ibm.com/vm/related/dfsms

Guest Operating System Support

The z/VM hypervisor concurrently supports many different virtual machines, each running its own operating environment (“guest” operating system) with security and isolation features. (See z/VM: Running Guest Operating Systems

- SC24-6228)



Linux on System z potential guest benefits

- Consolidation of Linux workloads on a single physical hardware server allowing multiple Linux images on a z/VM system running IFL processors without affecting IBM software charges for existing System z standard processors in the same hardware server
- Memory management algorithms to help benefit paging workloads with large memory environments
- Enhanced exploitation of real memory beyond 2 GB
- Provides additional support for Linux on System z guests using Dynamic Storage Reconfiguration – allows operation when running second level on z/VM to be more compatible with operation when running directly on an LPAR:
 - Displays configured, standby, and reserved values for each virtual storage element via the QUERY VIRTUAL STORAGE command
 - Improves z/VM handling of unexpected DSR conditions that can occur
- Support for the Collaborative Memory Management Assist (CMMA), by which host and guest exchange information to optimize their use and management of memory (Refer to ibm.com/vm/perf/reports/zvm/html/530cmm.html)
- Enhanced memory utilization using VMRM between z/VM and Linux
- Shared disk resources creating a server farm within a single machine
- More Linux images operating concurrently with reduced contention on the z/VM scheduler lock
- Redistribution of a CPU's share to z/VM virtual processors to help allow virtual machines to be managed more efficiently and Linux on System z provides new function that can automatically start and stop virtual processors based on virtual processor utilization and workload characteristics
- Remove the constraint that restricted Discontiguous Saved Segments (DCSS) being defined below 2047MB in virtual storage helps to allow many DCSSs to be used together allowing larger sizes needed for Linux filesystems and block devices and Linux on System z can expand data storage capacity more easily
- High-performance networking among virtual machines
- OSA-Express3 and OSA-Express 2 QDIO data connection isolation providing additional networking security with the required minimum MCLs
- Support for OSA-Express2 and OSA-Express3 OSA for NCP (OSN)
- Performance assists for cooperating z/VM guests using OSA-Express, FCP, and HiperSockets
- Enhanced problem determination for a guest LAN and VSWITCH
- VSWITCH support for IEEE 802.3ad link aggregation and failover support
- Guest support for Crypto Express3 on the System z10 with the PTF for APAR VM64656
- Crypto Express3 clear key and protected key support with the PTFs for APARs VM64656 and VM64793
 - Dedicated queue support for clear-key and protected-key cryptographic functions for <guest type> guest
 - Shared queue support for all available, non-dedicated domains for clear-key and protected-key cryptographic functions for <guest type> guest
- Guest support for dedicated QDIO devices (HiperSockets, OSA-Express, and FCP channels)
- Attachment of FCP-attached SCSI devices using the System z FCP feature of all FICON Express adapters
- Point-to-Point Fibre Channel links
- Dynamically-determined preferred paths for emulated FBA devices (EDEVICES) on SCSI disks in an IBM System Storage DS6000™ and devices controlled by the IBM System Storage SAN Volume Controller

- Guest IPL from FCP-attached SCSI disks Deploy a Linux server farm on z/VM using only FCP-attached SCSI disks
- Enhanced performance of z/VM Control Program (CP) use of SCSI disk I/O
- Capability to dump Linux on System z guests to FCP-attached SCSI disks
- Enhanced FCP channel utilization and sharing among guests with NPIV support
- Support for the IBM System Storage SVC Storage Engine 2145 allows Linux on System z guests of z/VM to access IBM System Storage disk subsystems, including the DS4000™ series, IBM XIV® Storage System, and OEM SCSI disk devices supported by the SVC. SCSI disk devices supported as emulated FBA devices for use by CP and guest operating systems
- 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
- Performance Toolkit provides high-level Linux reports and monitor records
- Simplified systems management using facilities provided by z/VM
- Systems management API for client applications to allocate and manage resources for virtual machines
- z/VM systems management functions to be performed from the HMC to manage guests without having to establish any external network connections or carry out complex configuration of the system
- Installation of Linux on System z as well as z/VM in a virtual machine from the HMC DVD drive without requiring any external network setup or a physical connection between an LPAR and the HMC
- 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 VSWITCH exploitation of Layer 2 support for OSA-Express2 and OSA-Express3
- Guest support for the Crypto Express2 feature (coprocessor and accelerator)
 - Dedicated-queue and shared-queue support for clear-key cryptographic functions
- Enhanced disk-access performance with minidisk cache
- Facilities to back up all Linux data providing a single backup solution for all Linux servers
- Tracing, diagnostic and debugging facilities
- Access to a large number of Linux applications
- Full support of the Unified Resource Manager to manager resources across System z ensembles (See z/VM: Getting Started with Linux on System z - SC24-6194)

z/VSE potential guest benefits

- A state-of-the-art platform for combining the best of z/VSE core applications with new workloads that exploit Linux on System z
- Outstanding operational flexibility, simplicity, and productivity:
 - Multiple specialized z/VSE guests for test, development, and release-to-release transition
 - Multiple production z/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-memory exploitation, for example, shared lock file
 - Minidisk caching in expanded and main storage (memory)
 - DB2 for z/VSE & VM data sharing for enhanced performance
 - IBM TotalStorage Virtual Tape Server 3494 automated tape library access
- Guest support for Crypto Express3 on the System z10 servers with the PTF for APAR VM64656
- Flexible support for existing Linux guests to access the IEDN and INMN networks using the a VSWITCH GRANT OSDSIM option. This will allow a Linux guest without current support to utilize ensemble management support in a secure fashion

Performance

z/OS potential guest benefits

- *Parallel Sysplex support for guests within a single VM image*
 - *Virtual Coupling Facility support allows z/VM systems to run as first or second-level, or higher guests while simulating complete z/OS coupled sysplexes*
- *Testing environment for deploying applications on simulated zAAP and zIIP specialty processors*
- *Testing environment for deploying applications on real zAAP and zIIP specialty processors*
- *Expanded guest support for specialty processors with support for z/VM-mode partitions allowing all processor types (CPs, IFLs, zIIPs, zAAPs, and ICFs) on a System z10 to be defined in the same z/VM LPAR*
- *Modified Indirect Data Address Words (MIDAWs) to allow more flexibility and performance in certain channel programs as an alternative to data-chained channel-command words*
- *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 Crypto Express2/3 feature*
 - *Dedicated-queue support for clear-key and secure key cryptographic functions for z/OS guests*
 - *Shared-queue and dedicated-queue support for clear-key cryptographic functions*
- *Guest support for Crypto Express3 on the System z10 with the PTF for APAR VM64656*
- *Crypto Express3 clear key and protected key support with the PTFs for APARs VM64656 and VM64793*
 - *Dedicated queue support for clear-key and protected-key cryptographic functions for <guest type> guest*
 - *Shared queue support for all available, non-dedicated domains for clear-key and protected-key cryptographic functions for <guest type> guest*
- *Guest support for Parallel Access Volumes (PAVs)*
- *Resiliency enhancements through z/VM XRC timestamping to facilitate synchronization of I/O operations across long distances with the PTFs for APAR VM64814 and VM64816 for z/VM 5.4 and z/VM 6.1, all of which have a planned availability date of December 2010.*

Performance

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, memory availability, and other factors.

(See z/VM: Performance - SC24-6208)

ibm.com/vm/perf/

Connectivity Options

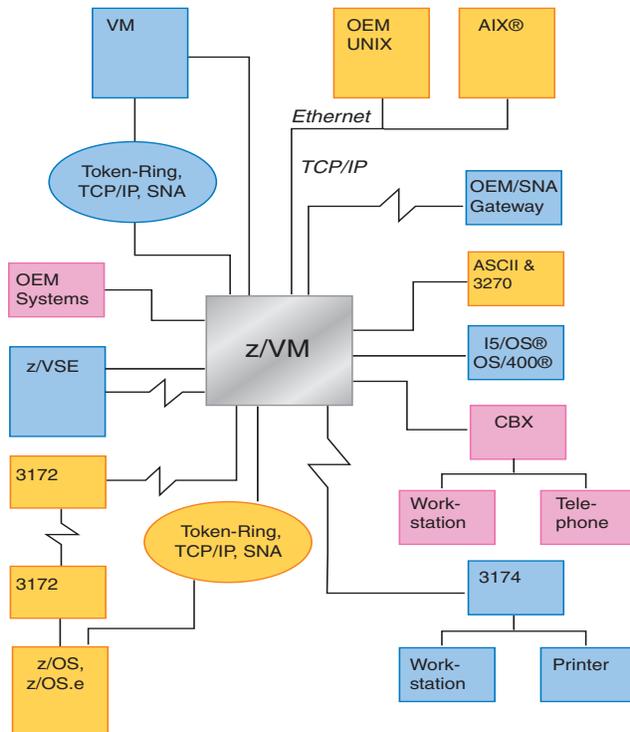
Networking options

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
- 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

Recognizes all four ports on System z10 OSA-Express3 Gigabit Ethernet (GbE) and 1000BASE-T Ethernet and two ports on the GbE and 1000BASE-T 2P features on the z10 BC server providing more physical connectivity to service the network and reducing the number of required resources (I/O slots, I/O cages, fewer CHPIDs to define and manage)

- OSA-Express3 and OSA-Express2 QDIO data connection isolation provides additional networking security with the required minimum MCLs
 - Dynamically discovers the Maximum Transmission Unit (MTU) size of a given IPv4 or IPv6 Internet/intranet path
 - Operate in Layer 2 (of the Open Systems Interface (OSI) reference model) mode
 - Enhances usability of managing virtual networks, including the z/VM virtual switch
 - Provides an IPv6-capable TELNET server and client
 - SSL server that operates in a CMS environment instead of requiring a Linux distribution
 - Ease-of-use for virtual networks
 - Failover support for IPv4 and IPv6 devices
 - Virtual IP Address (VIPA) support
 - LDAP server and associated client utilities
 - Enhanced problem determination for guest LANs and virtual switches
 - Enhanced dynamic routing capabilities with the MPRoute server
 - TCP/IP and guest LAN Support for HiperSockets
 - Simplified VLAN management with support for GVRP
- (See z/VM:TCP/IP User's Guide - SC24-6240)

ibm.com/vm/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
- Low End Networking (LEN) communications to all nodes
- Better interconnection with multivendor networks
- Increased performance for on-line transaction processing
- Enhanced 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

- RSCS capabilities provided in base z/VM at no charge:
 - Send text or postscript print files to remote TCP/IP printers using the LPR protocol
 - Send files to a remote hosts using Unsolicited File Transfer (UFT) protocol
 - Receive print files using the LPR protocol and print locally or forward to remote printers
 - Provides remote 3270-style print services on TN3270E emulators
- RSCS capabilities that require a license:
 - Processes NJE data traffic over TCP/IP, SNA, or directly-attached systems (CTCA, ESCON®and FICON)

- Print files on 3270-style printers directly connected to an IBM 3274 or 3174 control unit or via SNA
- Dynamic command authorization support eliminates the need to re-cycle RSCS when changing system and link authorizations
- Licensed as an IPLA optional feature on V6.1

(See z/VM: RSCS Networking Operation and Use - SC24-6226)

ibm.com/vm/related/rscs

VM/Pass-Through Facility

- Multisessions for CMS and dialed users
- Auto sign-on
- FICON Express8, FICON Express4, FICON Express2, FICON, ESCON, TCP/IP, APPC, IUCV, CTCA, 3088, Binary-synchronous connectivity options
- Gateway access to SNA network
- Connectivity to other z/VM, z/OS, z/VSE z/TPF, Linux on System z and AIX® systems
- Automated session operations
- Transparent, seamless solutions for end-users
- Sharing a single session among multiple workstations
- Help with 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/vm/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 Microsoft® Windows® features
- Enables database switching
- Allows multiple read-only users access to all data
- Provides VM database access from VSE system
- Recovery of databases at the table and storage pool level
- Supports VM Data Spaces
- Optional database administration feature

DB2 Server for VSE & VM V7.5

- Latest release provides an enhanced client offering to:
 - Provide bind file support for VSE and VM
 - Provide Runtime only Client edition for VSE
 - Provide Runtime only Client edition for VM
 - Convert all online phases to AMODE 31 RMODE ANY
 - Plus other additional functional enhancements

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

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

Query Management Facility (QMF) Feature

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

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

ibm.com/software/data/qmf/

Open Computing

POSIX standards

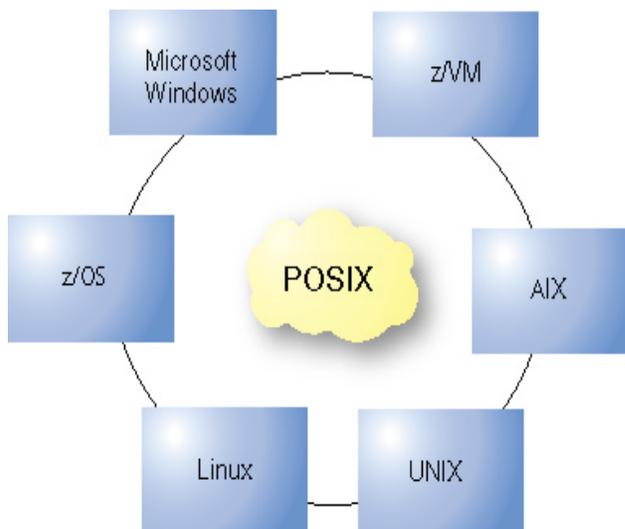
- Extend portability and provides standards-based application-development services
- Define basic operating-system interfaces and behavior
- POSIX 1003.1c threads – Provide a general set of services for developing multitasking server applications that support multiple, concurrent execution streams
 - 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.

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/vm/related/products



Configurability

Partitioning Options

Virtual	Logical
---------	---------

Number of Images

Many	30 - 60 ¹
------	----------------------

Performance

- Adapter-interruption performance assist for QDIO ³- high performance for V=V guests using QDIO (HiperSockets, OSA-Express, and FCP) Near Native
- QDIO performance assists ⁴(QEBSM, and HPMA - high performance for V=V guests using QDIO (HiperSockets, OSA-Express, and FCP)

Resources

- Dedicated or shared processors, memory and devices
- Virtual devices
- Dedicated or shared processor
- Dynamic memory reconfiguration
- Dedicated channels, CUs and devices ²

Support Requirements

Hardware and Software	Hardware
-----------------------	----------

Reliability

Hardware and Software	Hardware
-----------------------	----------

1. Server-dependent (up to 30 on the z10 BC server and up to 60 on the z10 EC server).

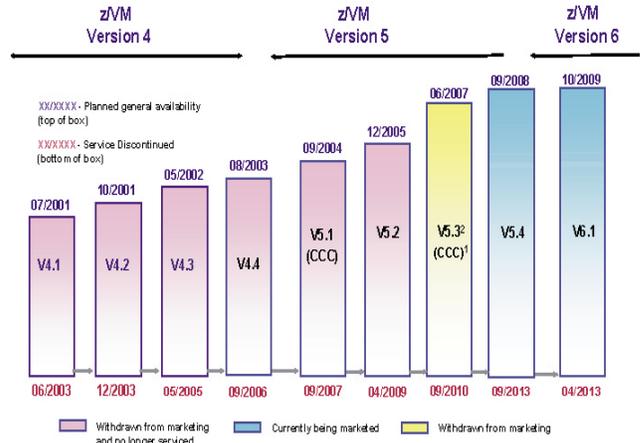
2. Channels (except parallel) may be shared on System z and S/390[®] servers using the Multiple Image Facility (MIF).

3. Adapter-interruption performance assist is available on z10 EC and z10 BC servers;

4. QEBSM and HPMA are available on System z10 servers.

z/VM Evolution

z/VM version 6 supports the z10 EC and z10 BC servers(standard, IFL, zAAP, and zIIP processors if supported on the server) in z/Architecture mode.



z/VM Operating System Comparison

VM Function	z/VM V4 ²⁶	z/VM V5	z/VM V6
Function			
Shared File System	•	•	•
Callable Services Library	•	•	•
Cross Systems Extensions	•	•	•
Virtual disk in memory	•	•	•
Enhanced minidisk cache	•	•	•
370 accommodation	•	•	•
CP Exit Facility	•	•	•
Parallel Sysplex simulation	•	•	•
Coupling Facility duplexing ⁹	•	•	•
HiperSockets ³	•	•	•
IPv6 HiperSockets ^{7,8}	-	•	•
GVRP Support ^{6,8}	-	•	•
Guest LAN ³	•	•	•
Guest LAN Sniffer ⁷	-	•	•
MPRoute Server ⁷	-	•	•
Shared tape for guests ⁴	•	•	•
Accounting enhancements	•	•	•
Systems management APIs ⁵	•	•	•
HMC integrated systems management ⁹	-	•	•
Installation of Linux from the HMC ¹⁰	-	•	•
VMRM enhancements ⁵	•	•	•
Virtual LAN ⁵	•	•	•
Virtual SWITCH (VSWITCH) ⁵	-	•	•
VSWITCH support for link aggregation ⁹	-	•	•
HCM and HCD ⁵	•	•	•
MQ Interface Client	•	•	•
PCIX Cryptographic Coprocessor ⁶	-	•	•
Crypto Express2 ⁶	-	•	•
Crypto Express3 Clear Key ⁹	-	•	•
Crypto Express3 Protected ^{10,27}	-	•	•
LDAP server and client utilities ⁹	-	•	•
Password phrases (Passphrases) ⁹	-	•	•
RACF password change logging ¹⁰	-	•	•
Dynamic Virtual Machine Timeout ⁶	-	•	•
VMRM enhancements for memory management of Linux guests ^{7,8}	-	•	•
CMMA ⁹	-	•	•
Guest ASCII console ⁹	-	•	•
Enhanced virtual network management providing SNMP data ⁹	-	•	•
CMS-based z/VM SSL server ¹⁰	-	•	•
TCP/IP Layer 2 support ¹⁰	-	•	•
Enhanced failover support for IPv4 and IPv6 devices ⁹	-	•	•
VIPA support for IPv6 ⁹	-	•	•
QDIO data connection isolation support ⁹	-	•	•
TELNET support for IPv6 ¹⁰	-	•	•
Storage Relief below 2 GB ⁷	-	•	•
Dynamic memory upgrade ¹⁰	-	•	•
Share redistribution ¹⁰	-	•	•
Dump Linux guests to SCSI disks ¹⁰	-	•	•
Linux DSR support ¹⁰	-	•	•
LPARs up to 256 GB ⁹	-	•	•
Up to 32 real processors per LPAR ⁹	-	•	•
z/VM-mode partitions ^{10,27}	-	•	•
Central Storage (Memory)²²			
32 GB (z890 and z800)	•	•	-
64 GB (z900)	•	•	-
64 GB (z9 BC)	•	•	-
248 GB (z10 BC)	-	•	•
256 GB (z990)	•	•	-
512 GB (z9 EC)	•	•	-
1520 GB (z10 EC)	-	•	•
Expanded Storage (Memory)			
Paging	•	•	•
Guest	•	•	•
VM Data Spaces	•	•	•
Virtual Machine Size			
256 GB ¹	•	•	•
1 TB (Processor dependent) ²²	-	•	•

VM Function	z/VM V4 ²⁶	z/VM V5	z/VM V6
I/O			
FICON/ESCON I/O	•	•	•
FICON CTCA ³	•	•	•
FICON Express2	•	•	•
FICON Express4	•	•	•
FICON Express8 ^{9,27}	-	•	•
PAVs as minidisks ⁵	-	•	•
Virtual FICON CTCA ⁵	•	•	•
Cascaded FICON Directors ⁵	•	•	•
Guest use of FCP ⁴	•	•	•
Guest use of emulated SCSI FCP disks ⁵	-	•	•
CP use of SCSI FCP disks ²²	-	•	•
N-Port Identifier Virtualization ²³	•	•	•
WWPN prediction tool support ^{9,27}	-	•	•
Guest use of MIDAWs ⁹	-	•	•
Logical Channel SubSystems ⁵	•	•	•
HyperSwap ⁶	-	•	•
OSA-Express2/3 OSN ⁷	-	•	•
OSA-Express3 ⁷	-	•	•
OSA-Express3 four-port exploitation ⁷	-	•	•
OSA-ICC four-port exploitation in first quarter 2010 ^{9,27}	-	•	•
Exploitation of Prefetch Data instruction	-	-	•
XRC Time Stamping ¹⁰	-	•	•
Guest Operating System			
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/Processor Units Supported			
System z10 EC/z10 BC ^{7,#}	-	•	•
System z9 EC/z9 BC ^{5,#}	•	•	-
zSeries 800/890/900/990 Servers ⁹	•	•	-
G5/G6 Servers	•	-	-
IFLs	•	•	•
zAAPs ⁹	-	•	•
zIIPs ⁹	-	•	•
zEnterprise 196	-	•	•

Legend

- 1 Pageable guests only
 - 2 The sum of memory for each of the preferred guests plus the memory 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 Supported on z/VM V5.3 and later
 - 10 Supported on z/VM V5.4 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 z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890
 - 21 Adapter-interruption performance assist is available only on z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890 servers; QEBSM and HPMA are available only on z10 EC, z10 BC, z9 EC, and z9 BC
 - 22 Supported maximum real memory per individual z/VM LPAR is 256 GB
 - 23 Supported on z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890
 - 24 For installation, IPL, and operation of z/VM V5
 - 25 z/VM V4.4 and V5 enables guest use of NPIV when FCP subchannels are dedicated to a guest. V5 provides for CP use of NPIV
 - 26 Withdrawn from Marketing
 - 27 Available only on the z10 EC, z10 BC and z196
- Supported
 - Not applicable
 # No 370-mode execution

z/VM Feature Comparison

VM Function	z/VM V4 ²²	z/VM V5	z/VM V6
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	•	•	•
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	•	•	•
Operational Enhancements			
Simplified system configuration	•	•	•
Alternate nucleus	•	•	•
Fast warm start	•	•	•
Fast spool backup (SPXTAPE)	•	•	•
GVRP support ^{6,8}	-	•	•
IPv6 HiperSockets ^{7,8}	-	•	•
Improved VMRM enhancements for memory management for Linux guests ^{7,8}	-	•	•
Support for CMMA ⁹	-	•	•
Dynamic system configuration	•	•	•
Dynamic system configuration including Coupling-over-InfiniBand (CIB) CHPID ⁹	-	•	•
Dynamic memory upgrade ¹¹	-	•	•
CPU share redistribution ¹¹	-	•	•
Linux DSR support ¹⁰	-	•	•
Support for z/VM-mode partitions ²³	-	•	•
Virtual Machine accounting enhancements ⁴	•	•	•
Systems management APIs ⁵	•	•	•
HCD and HCM ⁵	•	•	•
HMC integrated systems management ⁹	-	•	•
Hypervisor-configuration tasks performed by the HMC ¹¹	-	•	•
Installation of Linux from the HMC ¹¹	-	•	•
Automated shutdown ⁴	•	•	•
Installation from DVD	-	•	•
Guest ASCII console ⁹	-	•	•
Password phrases (Passphrases) ⁹	-	•	•
Dynamic LPAR addition/deletion	•	•	•
Coordinated DirMaint/RACF changes ⁷	-	•	•
RACF password change logging ¹¹	-	•	•
Serviceability enhancements			
VMSES/E	•	•	•
ShopzSeries	•	•	•
ESCON / FICON Architecture	•	•	•
Fibre Channel Protocol⁴	•	•	•
Device Support			
FBA DASD	•	•	•
TotalStorage ESS	•	•	•
System Storage DS4000 ⁷	-	•	•
XIV Storage System ⁷	-	•	•
Extended Address Volumes ¹¹	-	•	•
System Storage DS6000	•	•	•
System Storage DS8000	•	•	•
System Storage FlashCopy V2 ³	•	•	•
Flashcopy SE support ¹¹	-	•	•
System Storage PPRC V2 ^{3,20}	•	•	•
PAVs as minidisks ^{7,8}	-	•	•
HyperPAV ⁹	-	•	•
SVC Storage Engine 2145 ⁷	-	•	•
XRC Time Stamping ¹¹	-	•	•

VM Function	z/VM V4 ²²	z/VM V5	z/VM V6
RAMAC [®] DASD Subsystem	•	•	•
RAMAC Array Sub System	•	•	•
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 ⁵ and C06 ⁷)	•	•	•
3592 Tape Drive (J1A ⁵ , E05 ⁵ , and E06 ⁷)	•	•	•
9348 Tape	•	-	-
3995 Optical Library Dataserver	•	-	-
Minidisk Cache	•	•	•
Networking			
HiperSockets ³	•	•	•
HiperSockets using IPv6 Protocol ^{7,8}	-	•	•
QEBSM and HPMA ^{7,21}	-	•	•
Support for GVRP ^{6,8}	-	•	•
TELNET support for IPv6 ¹¹	-	•	•
CMS-based z/VM SSL server ¹¹	-	•	•
TCP/IP Layer 2 support ¹¹	-	•	•
QDIO data connection isolation support ⁹	-	•	•
Exploitation of Prefetch Data instruction	-	-	•
OSA-Express			
1000BASE-T Ethernet	•	•	-
Gigabit Ethernet (GbE)	•	•	-
Token-Ring ³	•	•	-
OSA-Express2			
1000BASE-T Ethernet	•	•	•
GbE	•	•	•
10 GbE	•	•	•
OSA-Express3 ^{7,23}			
1000BASE-T Ethernet ²⁴	-	•	•
GbE ²⁴	-	•	•
10 GbE	-	•	•
zEnterprise INMN & IEDN Networks ¹¹	-	•	•
System Management Products or Features			
HMF ²²	•	•	-
VMPAF ²²	•	•	-
PRF Feature ²²	•	-	-
RTM Feature ²²	•	-	-
Performance Toolkit for VM Feature ⁵	•	•	•
DirMaint 1.5 ²²	•	-	-
DirMaint Feature	•	-	-
RACF for VM 1.10 ²²	•	-	-
RACF Feature ^{4,10}	•	•	-
RACF Security Server Feature ⁶	-	•	•
IBM Tivoli zSecure Manager for RACF z/VM ⁴	-	•	•
IBM Tivoli OMEGAMON XE on z/VM and Linux V4.1 ⁷	-	•	•
zEnterprise Unified Resource Manager	-	-	•
Communications			
RSCS Feature ⁹	-	•	•
RSCS 3.2.0 ^{10,22}	•	•	-
ACF/VTAM V4.2	•	•	•
TCP/IP for z/VM ²	•	•	•
VM Passthrough Facility (PVM)	•	•	•
Additional Features			
OSA/SF	•	•	•
Shell & Utilities ¹	•	•	•
CMS Utilities ²	•	•	•

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 Supported on z/VM V5.3 and later
 - 10 Not supported on z/VM V5.3 or later
 - 11 Supported on z/VM V5.4 and later
 - 20 Guest use only
 - 21 Adapter-interruption performance assist is available only on z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890 servers; QEBSM and HPMA are available only on z10 EC, z10 BC, z9 EC and z9 BC
 - 22 Withdrawn from Marketing
 - 23 Available only on the z10 EC and z10 BC
 - 24 Four-port exploitation by z/VM V5.2 and later
- Supported
- Not applicable



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