IBM z/VM

Virtualization for extreme security, scalability, agility, and efficiency on IBM Z and IBM LinuxONE

Highlights

- Foundation for infrastructure as a service (IaaS)
- Host many virtual servers running different operating systems on IBM Z® and IBM LinuxONE™
- Virtualize and share system resources with very high levels of utilization
- Extends business value of IBM Z and LinuxONE technology across the enterprise
- IBM z/VM V7.1 Continuous Delivery model enables faster benefit

IBM z/VM® provides high levels of extreme security, scalability, agility, and efficiency, creating opportunities for cost savings while providing a robust foundation for cloud computing. z/VM virtualization technology is designed to run hundreds to thousands of Linux servers on a single Z or LinuxONE server with the highest degrees of efficiency, elasticity, and security.

Its ability to support numerous machine images and solution's architectures provides a highly flexible production and test environment for Z and LinuxONE operating systems. That simplifies migration from one release to another, facilitates the transition to newer applications, provides a test environment whenever one is needed, and deploys/consolidates several systems onto one physical server.

New with z/VM V7.1

The introduction of the z/VM Continuous Delivery model provides a new way to deliver z/VM capabilities, allowing for a faster adoption and benefit to the client. New z/VM capabilities will be delivered in the service stream of the current release as Small Programming Enhancements, thus providing the flexibility of selecting and deploying new capabilities immediately, along with moving from one release to another release in the new two-year cadence.

Clients will continue to receive the same world-class support and assistance that they are accustomed to from IBM. The support is included in the standard Software Subscription and Support (S&S) charges. A website provides details on new functions delivered via the z/VM continuous delivery model and allows for subscribing to be alerted when they have been made available: www.vm.ibm.com/newfunction
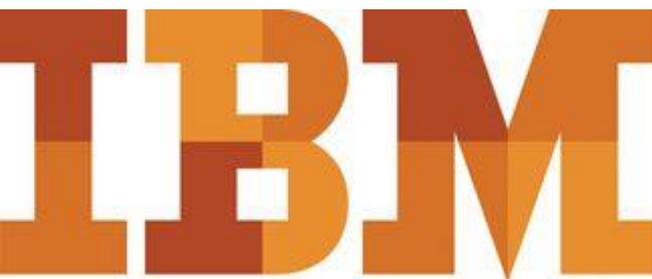
Continuous operation is extended with z/VM V7.1, since it includes the Single System Image feature as part of the z/VM V7.1 base at no additional cost, which offers Live Guest Relocation. This helps continuous deployment of new capabilities as the new delivery model is adopted by enabling continuous availability of Linux applications while implementing new functions provided for z/VM.

Additional enhancements delivered with z/VM V7.1, including enhancements planned for Continuous Delivery:
Improvements to the z/VM Dump process, reducing the time required to create, process, and transmit data from SNAPDUMP and Hard Abend dumps. The increased efficiency can help save time, resources, and makes the deployment of z/VM configurations with large amounts of memory more feasible. The PTF for APAR VM66176 further reduces the time required to create a SNAPDUMP or Hard Abend dump.

Two enhancements are delivered in support of an external security manager (ESM). First, some commands can use the current dynamic command protection setting of the LINK command when validating the required LINK authorizations, and second, programs can use the ESM for all SMAPI authorization decisions at the same granularity used with the SMAPI existing authorization mechanism.

With the dynamic memory downgrade capability, planned to be available with the PTF for APAR VM66173 in December 2018, z/VM memory management allows for the dynamic removal of real memory from a running z/VM system; dynamic memory downgrade requires a z14, Emperor II or Rockhopper II.

The z/VM TLS/SSL server will be enhanced to improve security through the enablement of Elliptic Curve Cryptography cipher suites, planned to be available in December 2018 with the PTF for APAR PI99184, providing a faster, more secure mechanism for asymmetric encryption than standard RSA or DSS algorithms.

RSCS Query System Service capabilities will be enhanced to provide a means to query the service level of each part that is included within the RSCS LOADLIB. This is planned to be available in December 2018 with the PTF for APAR VM66174. A new RSCS parameter will return the highest level PTF that is applied to each part within the running RSCS server, eliminating ambiguity on what service is applied.

z/VM V7.1 and z/VM V6.4 capabilities

Both releases, z/VM V7.1 and z/VM V6.4, provide support for all IBM z14™ (z14), IBM z13™ (z13), IBM z13s™ (z13s), IBM zEnterprise EC12 (zEC12), IBM zEnterprise BC12 (zBC12) and LinuxONE servers, as well as for Linux distributions from Canonical, Red Hat and SUSE, and IBM Z operating systems: z/OS, z/VSE and z/TPF.

Sub-Capacity pricing is available with z/VM V7.1 and z/VM V6.4. It allows for software pricing at less than full machine capacity and can provide more flexibility and improved cost of computing as a client manages the volatility and growth of new workloads.
For more information read: Sub-Capacity for z/VM.

z/VM Support for z14, Emperor II and Rockhopper II

z/VM V7.1 and V6.4 enable guest use of the new instructions and capabilities available on z14, Emperor II and Rockhopper II with the PTFs[1] for APARs VM65942 and PI73016. In addition, guest exploitation support is provided for the Crypto Express6S, the RoCE Express2, the OSA-Express6S and the FICON Express16S+ adapters. The PTF for APAR VM65639 is also required for Rockhopper II[2].

Encrypted paging support:
Ciphering will occur as data moves between active memory and a paging volume owned by CP. z/VM provides support for encrypted paging, in support of the philosophy of encrypting all data in flight and at rest with the PTF[1] for APAR VM65993. Included in the support is the ability to dynamically control whether a running z/VM system is encrypting this data.

Guest exploitation support for the Instruction Execution Protection Facility:
The IBM Instruction Execution Protection Facility provides functionality to improve the security of programs running on IBM Z and LinuxONE by allowing virtual memory elements to be identified as containing only data. If an attempt is made to fetch an instruction from an address in such an element or if an address in such an element is the target of an execute-type instruction, a Protection Exception will occur. z/VM provides support for guest exploitation of the Instruction Execution Protection Facility with the PTF[1] for APAR VM65986.

Guest exploitation support for Pause-Less Garbage Collection:
The guarded storage facility is designed to improve the performance of garbage-collection processing by various languages, in particular Java™. z/VM 6.4 provides guest support for the guarded storage facility with the PTF[1] for APAR VM65987.

Efficiency and Scalability

z/VM real memory and guest virtual support
The maximum amount of real memory that z/VM exploits is 2 TB. The maximum supported virtual memory for a single guest is 1 TB. When configured with 2 TB of real storage and keeping the same over-commitment ratio for virtual-to-real memory, this can double the amount of virtual memory that can be efficiently used compared to older z/VM releases.

HyperPAV technology exploitation
z/VM exploits the ability for an IBM DS8000 device to execute concurrent I/O requests to an ECKD™ paging volume. In HyperPAV mode, if the base volume is busy, z/VM selects a free alias device from a pool, binds the alias to the base device, and starts the I/O. When the I/O completes, the alias device is returned to the pool to be used for another I/O to the same logical subsystem (LSS). The primary benefit of exploiting HyperPAV is to improve paging throughput during periods of high-volume disk I/O, which will increase the efficiency of z/VM memory management for memory over-committed workloads. HyperPAV paging also enables the management of fewer and larger CPOWNED volumes.

With HyperPAV paging taking advantage of DS8000® features the bandwidth for paging eases to manage dozens of page volumes rather than 100s and allows for more efficient memory management of over-committed workloads.

HyperPAV is exploited by the z/VM hypervisor not only for paging but also for:
● The SYSRES volume, and volumes containing checkpoint and warm start data
● Volumes used for spooling, and the z/VM user directory
● Minidisk pools, as defined by a guest's use of MAPMDISK IDENTIFY

Support for the Enhanced-DAT facility
z/VM provides support for the Enhanced-DAT facility, which allows a guest to exploit large (1 MB) pages. A larger page size decreases the amount of guest memory needed for dynamic address translation (DAT) tables and also decreases the hardware overhead required to perform address translation. In all cases, guest memory is mapped into 4 KB pages at the host level. With Guest Large Page support, Linux on Z, z/VSE® and z/OS® virtual machines can benefit from reduced memory footprints and address translation times, which in turn can decrease overhead and improved throughput.

Guest Transaction Execution (TX) support
z/VM supports guest exploitation of the Transactional Execution (TX) facility on supported machines. The TX facility allows a program to issue multiple instructions that appear to operate atomically, offering an alternative to a costlier mutual-exclusion mechanism such as software locks. This support can improve the efficiency and scalability of multithreaded software such as Java or guest operating systems.

Dump Processing Enhancements
The amount of time it takes for z/VM to write a Hard Abend or snap dump to 3390 DASD may be reduced with the PTF[1] for APAR VM65989. The improvements were achieved via changes to the I/O channel program used to write central memory to z/VM spool space located on 3390 DASD.

Processor Scalability Efficiency Improvements
The z/VM hypervisor has been enhanced to more efficiently manage internal spinlocks and thereby reduce system overhead with the PTF[1] for APAR VM65988. This enhancement contributes to improved performance and throughput for large n-way configurations and thereby helps to improve overall system capacity by allowing additional work to be performed. These improvements are greatest for workloads experiencing significant Scheduler Lock contention. Larger n-way configurations will tend to see greater benefit.

Extended Address Volume (EAV) Minidisk Support
Enhanced EAV support for 3390-A DASD devices is provided with the PTFs[1] for APARs VM65943 and VM65945. This support allows non-full pack minidisks to reside anywhere on the volume, including beyond the current restriction of the 64K cylinder boundary (0-65519), and up to the one terabyte limit currently supported.

Virtual Switch Enhanced Load Balancing
z/VM supports exclusive and shared Multi-VSwitch Link Aggregation configurations to improve load balancing to leverage both horizontal and vertical growth in single and cross virtual switch networking configurations with the PTF[1] for APAR VM65918. With this improvement, a VSwitch can utilize more fully the capacity of the OSA devices used for link aggregation whether that is a single VSwitch growing vertically or a Multi-VSwitch growing horizontally.

System Ease of Use Enhancements

z/VM Control Program environment variables enhancement
This enhancement allows automation procedures to adapt more easily to changes in operating environments to help simplify the control and testing of a system setup. For example, an operator can indicate at IPL time that the system is running in a disaster recovery or test environment, which in turn enables automation routines to modify the devices used and alter the choice and sequence in which virtual machines are activated, as well as perform other environment-dependent functions.

z/VM Query Shutdown command
The new QUERY SHUTDOWN command enables a z/VM system programmer or a guest virtual machine to determine whether a system shutdown is in progress and obtain additional information about the shutdown. This can help automate an orderly shutdown of the z/VM system and its virtual servers. This function can be of particular value to virtual machines that coordinate the shutdown of other virtual machines. These coordinating virtual machines can receive the signal that the system is shutting down, issue the new QUERY command to get additional information, and take actions appropriate for an orderly shutdown.

SCSI enhancements for z/VM
Improved Small Computer System Interface (SCSI) support for guest attachment of disk and other peripherals to IBM Z and LinuxONE servers to:
- Enable ease of use with enhanced management for SCSI devices to provide information needed about device configuration characteristics.
- Enhance interoperability between the SCSI driver and SAN Volume Controller (SVC) and devices incorporating SVC technology such as the IBM Storwize® V7000 and IBM FlashSystem™ V840 and V9000.
- A z/VM storage administrator can use FlashSystem storage as a z/VM-system-attached disk without the need for an intermediate SAN Volume Controller (SVC). Previously, while FlashSystem could be used by a Linux virtual machine without an SVC, to use it for z/VM system volumes or EDEVs for virtual machines, an external or internal SVC was required.
- Improve reliability when SCSI disk devices are attached to the z/VM hypervisor for system use, without the need to be attached behind an SVC.
- With the available PTF[1] for APAR VM65929, the z/VM SCSI container enables multiple I/O requests to be issued concurrently to EDEVICEs.

SCSI management queries support provides enhancements to the commands for EDEVICEs within z/VM to improve the usability and problem diagnosis for EDEV-intensive environments and provide a clearer end-to-end view of the storage configuration. This simplifies the process of verifying that the storage configuration is consistent between z/VM and the disk storage subsystem.

The following updates are designed to further enhance the reliability of SCSI devices:

- The CP missing interrupt handler is disabled for EDEVICEs, allowing the SCSI driver to manage its outstanding requests in a more appropriate manner.
- The SCSI driver is updated to provide additional path recovery.
- Debug facilities within the SCSI driver are enhanced, allowing IBM support teams to more quickly diagnose and debug issues in the field.
- Guidelines for multi-path configuration are provided for SVC and devices incorporating SVC technology to ensure path recovery is optimal.
- Concurrent code loads on the SVC and devices incorporating SVC technology are now supported without quiescing EDEVICE I/O. This was previously, and continues to be, restricted on releases prior to z/VM V6.4.

z/VM CMS Pipeline Update
Integration of new CMS Pipelines functionality, which previously was not formally incorporated in the z/VM product, provides a much more inclusive set of tools for application developers. This upgrade addresses client concerns with using downloaded code, includes fixes not previously integrated into the z/VM product, broadens the ecosystem, enables innovation for clients and ISVs, and includes additional functionality.

DirMaint RACF connector been modernized with z/VM
The DirMaint™ RACF® connector is modernized with a collection of functional enhancements that improve how z/VM security is handled in a managed environment. The Connector allows appropriate security policy changes to be passed directly to RACF. This allows a z/VM environment managed by IBM Wave for z/VM or via an OpenStack environment to function properly with RACF installed on the system.

z/VM RACF automate control of access list authority
The ADDCREATOR and NOADDCREATOR options on the RACF SETROPTS command determine whether the creator of a RACF profile is automatically added to its access control list. This enhancement removes the need for manual intervention in RACF resource

configuration and eliminates a point of potential human error from security policy management.

z/VM Performance Toolkit enhancements
Performance Toolkit for VM function exploits z/Architecture® and its expanded set of instructions. Consequently, the PERFSVM virtual machine must run on z/Architecture CMS (z/CMS).

The PTF[1] for APAR VM66085 provides new and updated performance reports within the Performance Toolkit Feature in support of HyperPAV Paging. These new reports include information that will help clients tune the z/VM HyperPAV Paging Subsystem.

z/VM Cloud Connector
The z/VM Cloud Connector is a development toolkit that manages z/VM host and virtual machines. It provides a set of RESTful APIs to operate z/VM resources. Upper layer cloud management solutions can consume these RESTful APIs directly to manage z/VM. For additional information, see the z/VM Cloud Connector web page.

Hardware Currency

z/VM supported using IBM Dynamic Partition Manager
IBM z/VM is a supported environment using IBM Dynamic Partition Manager (DPM) for Linux-only servers with SCSI storage. DPM 3.1 will provide support for ECKD DASD in August 2018. This simplifies system administration tasks for a more positive experience with IBM Z or LinuxONE.
IBM Wave for z/VM is an intuitive virtualization management tool that provides management, automation, administration and provisioning of virtual servers, enabling automation of Linux virtual servers in a z/VM environment.

z-Thin Provisioning
Support for DS8880 z-Thin Provisioning and Extent Space-Efficient (ESE) volumes is provided with the PTFs for APARs VM66098 and VM66108[1]. This enables guest support for thin-provisioned volumes and allows CPOWNED volumes be defined on thin-provisioned volumes.

Dynamic Simultaneous Multithreading Level support for z/VM
Support for Simultaneous Multithreading (SMT) is enhanced with the addition of the SET MULTITHREAD command. Once z/VM has been IPLed with multithreading enabled in the system configuration file, this command can be used to switch non-disruptively between one and two activated threads per IFL core. Performance of a system and workload with one active thread per core is comparable to that of the same system and workload with multithreading disabled. Thus, the Dynamic SMT Level capability allows the benefit of multithreading to be evaluated for a workload without requiring an outage to enable or disable SMT. The SET MULTITHREAD command is allowed only when the system has been enabled for multithreading in the system configuration file, which can specify activating either one or two threads per core. It is not possible to revert to a non-SMT configuration without an IPL. SMT-enabled configurations are restricted to thirty-two cores even when operating in single-threaded mode due to the logical processor addressing limit.

z/VM supports I/O architecture enhancements on the z13 (Driver D27) and z13s
With the PTF[1] for APAR VM65865, a UID (user defined identifier) can be assigned to a real PCI function to more accurately indicate equivalent functions between different LPARs and for exploitation by guest operating systems, and Linux in particular. z/VM supports dynamic I/O and guest use for PCIe UID support.

Shared Memory Communications
Shared Memory Communications Direct (SMC-D) protocol support is the latest networking innovation for the z13 family of processors and provides support for fast, low-latency LPAR-to-LPAR TCP/IP traffic using Direct Memory Access over firmware-provided Internal Shared Memory (ISM) devices. Supported for z/VM guest exploitation, SMC-D and ISM are designed to use shared memory areas to provide low-latency, high-bandwidth, cross-LPAR connections for applications. This support is intended to provide application-transparent DMA communications to TCP endpoints for sockets-based connections. SMC-D is expected to provide substantial performance, throughput, response

time, and CPU consumption benefits compared with standard TCP/IP communications over HiperSockets™. z/VM supports dynamic I/O and guest use of the Internal Shared Memory (ISM) PCI function type. See the z/OS subset within the 2964DEVICE or 2965DEVICE PSP bucket for z/OS service required in support of SMC-D connectivity.

Installation Enhancements and Improvements

z/VM enhanced functions and processes to improve the installation, migration, and serviceability of z/VM
- Enhanced upgrade in place. The z/VM upgrade in place process allows upgrading an existing system to a new release of z/VM with minimal impact to the running system. The upgrade in place process has been extended to allow upgrade from z/VM V6.2 or V6.3 to z/VM V6.4 and positions a system for releases beyond z/VM V6.4. Upgrade in place is supported for a member of a z/VM SSI cluster as well as for a non-clustered z/VM system. The only release supported for upgrading to z/VM V7.1 is V6.4.
- Determine installed service. Enhancements to CP and VMSES/E enable you to determine if specific CP service is built into the CP nucleus (load module). The new CPSERVICE option on the CP QUERY command allows queries based on APAR, PTF, or local modification identifiers of the nucleus that is currently running.
- 3590 and 3592 tape formats not supported for the installation of z/VM. z/VM V6.4 is not available in 3590 or 3592 tape format. z/VM is available on DVD and electronic delivery. In addition, z/VM service for all releases will no longer be orderable in 3590 or 3592 tape format.
- Installing z/VM V6.4 on a z14 requires updated installation media available since August 25, 2017.
- Dump to tape is no longer supported with z/VM V7.1

Additional Enhancements and Improvements

- Network Security Enhancement. The NICDEF Security Controls introduces Directory Network Authorization capability with which each virtual NIC can be configured and authorized entirely within the user directory. This eliminates the need to use SET VSWITCH and COUPLE commands in applicable scenarios.
- Encryption of TCPNJE connections. RSCS TCPNJE traffic can be encrypted by directing the flow through an SSL server. The secure TCP/IP protocols that were previously implemented to support VMCF clients and servers are extended for IUCV clients and servers.
- Architecture level set (ALS). z/VM V7.1 includes an Architecture Level Set (ALS) and requires IBM zEnterprise EC12 or BC12 or later systems. z/VM V6.4 includes an ALS and requires IBM zEnterprise® 196 (z196) and IBM zEnterprise 114 (z114) and later systems. See the appropriate preventive service planning (PSP) bucket for the minimum microcode level (MCL) and any required updates.
- ESA/390 removal. z/VM V6.4 enhancements enable hypervisor initialization and termination, the Stand-Alone Program Loader (SAPL), DDR, Stand-Alone Dump, and stand-alone utilities to run entirely in z/Architecture mode.

For more information

To learn more about the IBM z/VM offering, please contact your IBM representative or IBM Business Partner, or visit the following website:
ibm.com/it-infrastructure/z/zvm

To keep informed and about the latest z/VM capabilities and news visit:
www.vm.ibm.com/newfunction

[1] *The PTF is required to get this capability with z/VM V6.4. It is in the base of z/VM V7.1.*

[2] *Please see the information at:*
www.vm.ibm.com/service/vmreqz14.html

ZSD03045-USEN-03