Using New CP Features in z/VM 5.4

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Agenda

- z/VM® Evolution
- z/VM Version 5 Release 3 (V5.3) Service
- z/VM Evaluation Edition
- z/VM Version 5 Release 4 (V5.4) Enhancements
  - Enhanced scalability and constraint relief
  - Virtualization technology and Linux enablement
  - Network virtualization
  - Miscellaneous
- Statement of Direction
z/VM Evolution

Expand your opportunities with z/VM

Version 3
- 02/2001: z/VM V3.1
- 07/2001: z/VM V4.1
- 10/2001: z/VM V4.2
- 05/2002: z/VM V4.3
- 08/2003: z/VM V4.4

Version 4
- 12/2005: z/VM V5.1 (CCC)
- 06/2007: z/VM V5.2 (CCC)
- 09/2008: z/VM V5.4

Version 5
- 09/2007: z/VM V5.1 (CCC)
- 12/2005: z/VM V5.2 (CCC)
- 06/2007: z/VM V5.3 (CCC)
- 09/2010: z/VM V5.4
- 09/2011: z/VM V5.5

Legend:
- Purple: Withdrawn from marketing and no longer serviced
- Blue: Currently being marketed and serviced
- Yellow: Withdrawn from marketing
- Green: On the horizon
- Orange: XX/XXXX – General Availability (top of box)
- Pink: XX/XXXX – Service Discontinued (bottom of box)
z/VM Version 5 Terms and Conditions

- **International Program License Agreement (IPLA)**
  - Program Use License
    - One-time charge (OTC) for standard or IFL processors
      - Engine-based Value Units
    - Can be transferred within an enterprise
    - Service by mail, fax, and e-mail only under basic warranty
  - Subscription and Support (S&S)
    - Comparable service to traditional ICA products
    - Not required but highly recommended
    - Must decline when ordering if not desired
    - Annual renewable charge per processor
    - Adds telephone support
    - No additional charges for updates, new versions and releases

- **SoftwareXcel available for an additional charge**

- **IPLA applies to z/VM base code and the optional features**
  - DirMaint, RSCS, RACF Security Server for z/VM, and the Performance Toolkit for VM

- **No-charge upgrade to the Performance Toolkit for VM for:**
  - Customers who purchased z/VM V4 S&S for the RTM, PRF, or Performance Toolkit for VM features
  - Customers who purchased the FCON/ESA program (5788-LGA)
z/VM V5.3 Service

- **System z10 Processor Compatibility (VM64180, UM32277/32278)**
  - Guest support for Execute-Extensions Facility
- **System z10 IOP Subchannel Recovery (VM64242, UM32285/32286)**
- **Memory Management Improvement (VM64349, UM32250/32251)**
- **Encryption Re-Key Support – z/VM 5.3 only (VM64260, UM32221)**
  - SET TAPE REKEY
- **Virtual Switch Port Isolation (VM64281, UM32269/32270)**
  - Isolate guests on VLAN-unaware virtual switch (DROP or FORWARD inter-guest traffic)
- **System z10 Performance Toolkit OMEGAMON Enhancements (VM64337, UM32233/32234)**
- **System z10 Performance Toolkit Enhancements (VM64369, UM32257/32258)**
- **System z10 IOCP Support (VM64302, UM32279/32280)**
- **Missing adapter interruption detection (VM64398, UM32371/UM32372)**

- DVD-RAM containing z/VM 5.3 (also available via Web download)
  - Boot loader
  - z/VM 5.3 Nucleus
  - RAMdisk – one-pack system
    - CP
    - CMS
    - DIRMAINT
    - Performance Toolkit

- Insert in HMC DVD drive and IPL (“Load from CD-ROM or server”)
  - Requires 3GB or larger logical partition on System z10
  - Automatic invocation of customization script

- Save customizations on DVD
  - New guest definitions
  - Additional DASD allocations
  - System configuration changes

www.vm.ibm.com/eval
z/VM V5.4 CP Enhancements (GA: Sept 12, 2008)

- **Enhanced scalability and constraint relief**
  - System z10 processor instruction exploitation
  - Dynamic memory upgrade
  - DAT Table performance enhancements

- **Virtualization enhancements for Linux and other guests**
  - Virtual CPU SHARE redistribution
  - Mixed-engine partition enhancements
  - Dynamic memory upgrade virtualization
  - Guest FCP dump
  - DCSS above 2GB

- **Network virtualization**
  - Multi-port OSA
  - Virtual switch networking management

- **Miscellaneous**
  - SHUTDOWN verification
  - OSA, FCP, and Hipersockets MIH support
  - Logical volume expansion compatibility
  - Enable PerfKit Diagnose 4 independence
  - Virtual Switch port isolation
Enhanced Scalability and Constraint Relief

- System z10 processor instruction exploitation
- Dynamic memory upgrade
- DAT Table performance enhancements
System z10 New Instruction Support

- **Execute-Extensions facility**
  - Execute Relative long (EXRL)

- **General-Instruction-Extension Facility**
  - 71 new instructions, 4 new instruction formats, 7-character mnemonics

- **Parsing-Enhancement Facility**
  - Translate and Test Extended, Translate and Test Reverse Extended
Dynamic Memory Upgrade

- **Allow z/VM to dynamically increase amount of real memory**
  - Define partition with Initial and Reserved amounts
  - Enable portion of Reserved amount to be brought online
  - Appropriate planning can enable memory growth to meet demand

- **Does not allow storage to be deconfigured dynamically**
  - Difficult technical challenge
  - May not meet some customer needs

- **Complements existing ability to add processors and I/O resources non-disruptively**
Dynamic Memory Upgrade ...

![Image of Dynamic Memory Upgrade settings](image-url)
Dynamic Memory Upgrade …

- Storage defined in increments
- Increment size determines multiples in which storage can be added
- Increment size
  - Is a function of potential storage size (Initial + Reserved)
  - Is expressed in megabytes
  - Must be a power of 2
- Cannot be more than 512 increments

<table>
<thead>
<tr>
<th>Storage Size (s)</th>
<th>Increment Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>s ≤ 512M</td>
<td>1M</td>
</tr>
<tr>
<td>512M ≤ s ≤ 1G</td>
<td>2M</td>
</tr>
<tr>
<td>1G ≤ s ≤ 2G</td>
<td>4M</td>
</tr>
<tr>
<td>2G ≤ s ≤ 4G</td>
<td>8M</td>
</tr>
<tr>
<td>4G ≤ s ≤ 8G</td>
<td>16M</td>
</tr>
<tr>
<td>8G ≤ s ≤ 16G</td>
<td>32M</td>
</tr>
<tr>
<td>16G ≤ s ≤ 32G</td>
<td>64M</td>
</tr>
<tr>
<td>32G ≤ s ≤ 64G</td>
<td>128M</td>
</tr>
<tr>
<td>64G ≤ s ≤ 128G</td>
<td>256M</td>
</tr>
<tr>
<td>128G ≤ s ≤ 256G</td>
<td>512M</td>
</tr>
</tbody>
</table>
Dynamic Memory Upgrade …
Dynamic Memory Upgrade …

- QUERY STORAGE reports additional information
  
  STORAGE = d  CONFIGURED = c  INC = i  STANDBY = s  RESERVED = r

- Initialization of dynamically added storage above 2G is lazy
  - Immediate if demand exists (may be partial)
  - When idle otherwise

- Monitor records
  - MRMTRMCC (Event) created when partition memory configuration changes
  - MRMTRMEM (Sample) includes standby and reserved storage sizes
  - MRSTOADD (Event) created when memory added via SET STORAGE
DAT Table Performance Enhancements

- **Support 64-bit host Control Registers**
  - CR 1 (Primary Space)
  - CR 7 (Secondary Space)
  - CR 13 (Home Space)

- **Enables Region and Segment tables that describe guest storage to reside above 2G**

- **Mitigates “needle in haystack” problem**
  - Upper-level DAT tables may require multiple contiguous frames
  - Can be difficult to find in constrained below-2G storage
Virtualization Technology and Linux Enablement

- Virtual CPU SHARE redistribution
- Mixed-engine partition enhancements
- Dynamic memory upgrade virtualization
- Guest FCP dump
- DCSS above 2GB
Virtual CPU Share Redistribution

- SHARE distributed evenly among guest virtual CPUs
- Prevents dynamic accommodation of changes in multiprogramming need

```
<table>
<thead>
<tr>
<th>CPU 0</th>
<th>CPU 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHARE: 50</td>
<td>SHARE: 50</td>
</tr>
<tr>
<td>Guest SHARE=100</td>
<td></td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>CPU 0</th>
<th>CPU 1</th>
<th>CPU 2</th>
<th>CPU 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guest SHARE=100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

- Cannot reduce number of virtual CPUs with DETACH because of associated virtual system reset
- However, guest can start and stop virtual CPUs to control its multiprogramming level
Virtual CPU Share Redistribution …

- Virtual CPU SHARE redistribution eliminates need for DETACH by not distributing SHARE to stopped virtual CPUs

<table>
<thead>
<tr>
<th>CPU 0</th>
<th>CPU 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHARE: 100</td>
<td>STOPPED</td>
</tr>
<tr>
<td>SHARE: 0</td>
<td></td>
</tr>
<tr>
<td>Guest SHARE=100</td>
<td></td>
</tr>
</tbody>
</table>

Start second virtual CPU due to load increase

<table>
<thead>
<tr>
<th>CPU 0</th>
<th>CPU 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHARE: 50</td>
<td>SHARE: 50</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Guest SHARE=100</td>
<td></td>
</tr>
</tbody>
</table>

More active virtual CPUs with same resources

- Linux CPU hotplug daemon starts/stops CPUs based on Load Average
- Monitor records
  - MRMTRUSR, MRUSEACT, MRUSEINT – Added number of virtual processor starts/stops
Mixed-Engine Partition Enhancements

- System z10 introduced “z/VM-mode” partitions
- Allow CPUs, IFLs, zIIPs, zAAPs, and ICFs in a single partition
- z/VM manages guest dispatch appropriately

Add Linux on IFLs
Add z/OS on CPs
Mixed-Engine Partition Enhancements …

- Consolidate partitions
  - Reduce systems management effort
  - Improve processor, memory and I/O utilization
  - Simplify connectivity (Guest LAN, Virtual Switch)

- Run IPLA products on IFLs
- Run MLC products on CPs
- Exploit spare ICF capacity
- Also fully virtualized
Mixed-Engine Partition Enhancements …

- QUERY PROCESSORS EXPANDED reports partition mode
  - ESA/390, LINUX-ONLY, or z/VM

- SET SHARE allows different share settings for each processor type
  - Only applicable if CPUAFFINITY ON
Mixed-Engine Partition Enhancements ...

- Set SHARE userid
  - Type
    - ALL
    - CP
    - ZIIP
    - ZAAP
    - IFL
    - ICF

- Set VCONFIG MODE
  - ESA390
    - LINUX
    - VM

- Query VCONFIG
Mixed-Engine Partition Enhancements …

- **Monitor records**
  - MRUSEINT – Virtual configuration mode
  - MRMTRSYS – Real configuration mode
  - MRMTRUSR, MRSCLADL, MRSCLAEL, MRSCLDDL, MRSCLSHR, MRUSELOF, MRUSELON – CPU SHARE settings
  - MRMTRUSR, MRSCLSHR, MRUSEACT, MRUSEATE, MRUSELOF, MRUSELON – Per-CPU type SHARE settings
  - MRMTRUSR – Number of virtual ICFs
  - MRMTRPRP, MRPRCPRP, MRPRCVON, MRSTORSP, MRSTOSXP, MRSYTCOM, MRSYTPRP, MRSYTRSP, MRSYTSCP, MRSYTSXP, MRSYTSYP, MRSYTXSP, MRUSEDFC, MRUSEDTC, MRUSEINT, MRUSEITE, MRUSELOF, MRUSERDC, MRUSETRE – New engine type code for ICF
  - MRSYTUWT – Dispatch list counts for ICFs
Dynamic Memory Upgrade Virtualization

- **Virtualized dynamic storage reconfiguration architecture**
  - Enables guests to dynamically increase or decrease memory
  - Limited by maximum storage size in User Directory

- **Supported by z/OS and z/VM guests**

- **Linux guest exploitation anticipated**
Dynamic Memory Upgrade Virtualization ...
Dynamic Memory Upgrade Virtualization …

- QUERY VIRTUAL STORAGE response enhanced
  - STORAGE = d  MAX = m  INC = i  STANDBY = s  RESERVED = r
- Increment rules same as for real storage
- Initial reserved storage size limited to maximum-defined
Guest FCP Dump

- Enable guest to dump to SCSI device
  - Capacity
  - Performance

- Supported by Linux and z/VSE
Guest FCP Dump ...

- Set-DUMPDEV
  - CLEAR
  - PORTname
    - hhhhhhhhh
    - hhhhhhhhh
    - LUN
      - hhhhhhhhh
      - hhhhhhhhh
    - BOOTprog
      - bootprog
      - number
    - BR_LBA
      - hhhhhhhhh
      - hhhhhhhhh
      - APPend
      - SCPdata
        - NEW
        - offset
        - HEX
        - 'text'
        - text

- Ipl
  - ...fcp_vdev...
    - DUMP
DCSS Above 2G

- Problem exploiting DCSS support (e.g., with XIP)
  - DCSS below 2G limited machine size and complicated configuration
  - DCSS ≤ 2047M limited size of shared memory

- Enabling 2047M DCSS above 2G addresses both problems
  - Some added complexity for exploiters (Linux)
  - New 64-bit interfaces to Diagnose 64
DCSS Above 2G …

- DEFSEG allows page ranges up to X’7FFFFFFF’ (512 GB)
  - SPACE, SECURE, and SC ranges not allowed

- Number of page ranges for DEFSYS and DEFSEG reduced to 64 from 128

- QUERY NSS MAP response changed for segments above 2G

```
FILE FILENAME FILETYPE BEGPAG ENDPAG TYPE CL #USERS
spid fn          DCSSG   nnnnnnnnnnnnn nnnnnnnnnnnnn type c  nnnnn
```

- New Diagnose X’64’ subcodes
  - X’20’ (LOADSHR), X’24’ (LOADNSHR), X’2C’ (FINDSEG), X’38’ (SEGEXT)
  - Correspond to existing (31-bit) subcodes X’00’, X’04’, X’0C’, and X’18’
  - Subcodes X’20’, X’24’, and X’2C’ produce 64-bit addresses
  - New output area formats for subcode X’38’ accommodate 64-bit addresses
Network Virtualization

- Multi-port OSA
- Virtual switch networking management
Multi-Port OSA

- System z10 OSA-Express3 support
  - Multiple ports per adapter on one CHPID
- Allow port numbers to be specified for Virtual Switch real devices
- Virtualization enables any single port number to be used
- Report port number in QUERY VSWITCH, QUERY PORT, QUERY LAN, QUERY NIC
Multi-Port OSA ...

►►DEFine-VSWITCH-name— RDEV-nnnn.Pnn—

►►Set-VSWITCH-name— RDEV-nnnn.Pnn—

►►Set-PORT GROup-groupname— JOIN nnnn— LEAve nnnn.Pnn—

►►MODify-PORT GROup-groupname— JOIN nnnn.Pnn—
Multi-Port OSA …

- Report port number in QUERY VSWITCH, QUERY PORT, QUERY LAN, QUERY NIC
- Monitor records
  - Add port number to MRIODVSW, MRIODVSF, and MRIODVSR
- Diagnose X’26C’ Subcode X’20’
  - Add real port number to output
Virtual Switch Management Improvements

- Record Virtual Switch activity counters at either individual VLAN or entire network level
- Improve Virtual Switch/Guest LAN Query selectivity
- Recognize failures of Virtual Switch backup OSA
  - Detect and correct problems when the happen
  - Avoid problems when failover occurs
Virtual Switch Management Improvements ...

- `Set-VSWITCH-switchname...-VLAN_counters ON OFF`

- `MODify-VSWITCH-switchname...-VLAN_counters ON OFF`

- `Query-LAN-lanname... VLAN ANY VLAN-vlanid VLAN-NONE USERid-userid`

- `Query-VSWITCH-switchname... VLAN ANY VLAN-vlanid VLAN-NONE USERid-userid RDEV-nnnn`
Miscellaneous

- SHUTDOWN verification
- Adapter MIH support
- Logical volume expansion compatibility
- Enable Performance Toolkit Diagnose 4 independence
- Virtual Switch port isolation
SHUTDOWN Verification

- System configuration option to require system name on SHUTDOWN command
- May prevent inadvertent SHUTDOWN of first-level system
  - Better to not give second-level guest Class A privileges
SHUTDOWN Verification ...

```
SHUTDOWN... [SYSTEM systemid]

FEATURES... [DISABLE] [ENABLE] [VALIDATE_SHUTDOWN]
```
Adapter MIH Support

- Detect and attempt to correct missing interruptions on OSA, FCP, and Hipersockets adapters
- Allow reasonable period of time (five seconds) for expected interruptions to be presented
- Attempt to recover up to ten times
- APAR VM64398 for z/VM 5.2 and 5.3
Adapter MIH Support …

- **New Operator message issued**
  
  HCPVAP2154E Missing adapter interruption

- **Monitor data**
  
  - New fields in MRSYTSYG
    
    - Number of missing adapter interruptions detected
    - Number of unrecoverable missing adapter interruptions
Logical Volume Expansion Compatibility

- **DS8000 added support to allow volumes to be expanded dynamically**
  - ECKD: 3390-3 and 3390-9, SCSI
  - Up to 65,520 cylinders

- **z/VM compatible with this feature**
  - Recognizes when expansion has occurred
    - Dedicated: Reflects interrupt to guest
      - Non-dedicated: Prevents use of expanded area until device varied off/on
    - Device model number may change
      - Expand 3390-3 beyond 3339 cylinders => 3390-9

- **APAR VM64305 (PE: VM64354)**
Logical Volume Expansion Compatibility …

- QUERY DASD DETAILS reports pending expansion
  PENDING EXPANSION DETAILS: DEVTYPE = 3390–0C, CYLS = 65535

- QUERY EDEVICE DETAILS reports pending expansion
  PENDING EXPANSION NUMBER OF BLOCKS: 147483640
Enable PerfKit Diagnose 4 Independence

- Performance Toolkit used Diagnose 4 to obtain fields not in Monitor Data
- Monitor data enhanced to eliminate that dependency
  - MRPRCPRP – CPU operating state
  - MRSTOXSG – Additional page migration counters
  - MRSYTPRP – Additional fast-path function counters
  - MRSYTXSG – Additional Minidisk Cache counters
  - MRUSEACT – Number of Minidisk Cache inserts
Virtual Switch Port Isolation

- Prevent CP from switching packets between guests on same Virtual Switch
  - Allows sharing of OSA(s) without enabling inter-guest communication
  - Can drop packets or forward through OSA for disposition (e.g., by firewall)
Virtual Switch Port Isolation ...

- Set-VSWITCH-switchname...-ISOLation OFF...
  - DROP
  - FORWARD

- MODIFY-VSWITCH-switchname...-ISOLation OFF...
  - DROP
  - FORWARD
Statement of Direction

- MMC (Mainframe to Micro Channel) card
  IBM intends to withdraw support in a future z/VM release for the MMC card, which enabled communication between the PS/2 (PWSCS) and VM (PWSCF or ISFC).

- z/VM Flashcopy enhancements
  IBM intends to enhance z/VM FlashCopy capabilities to support the FlashCopy SE function of the IBM DS8000 with the PTF for APAR VM64449 in fourth quarter 2008. FlashCopy SE offers a space-efficient snapshot capability that reduces the storage capacity needed for point-in-time copies. This function is especially useful for short-lived testing or backups, such as flash to intermediate volume for backup to tape.
Questions?