What's New in the z/VM 6.3 Hypervisor

Session 14583

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Acknowledgements

- Bill Bitner
- Brian Wade
- Alan Altmark
- Emily Hugenbruch
- Mark Lorenc
- Kevin Adams

- … and anyone else who contributed to this presentation that I may have omitted

Topics

- Scalability
  - Large Memory Support
  - Enhanced Dump Support
- HiperDispatch
- Technology Exploitation
- Virtual Networking
- Miscellaneous Enhancements

z/VM 6.3 Themes

- Reduce the number of z/VM systems you need to manage
  - Expand z/VM systems constrained by memory up to four times
    - Increase the number of Linux virtual servers in a single z/VM system
  - Exploit HiperDispatch to improve processor efficiency
    - Allow more work to be done per IFL
    - Support more virtual servers per IFL
  - Expand real memory available in a Single System Image Cluster up to 4 TB
- Improved memory management flexibility and efficiency
  - Benefits for z/VM systems of all memory sizes
  - More effective prioritization of virtual server use of real memory
  - Improved management of memory on systems with diverse virtual server processor and memory use patterns

Scalability – Large Memory Support

For more details on Large Memory Support:

Session 14686: z/VM 6.3: Changes in Memory Management
Tuesday, 3:00 PM – Platinum Ballroom Salon 1 (John Franciscovich)

Large Memory Support

- Support for up to **1TB** of real memory (increased from 256GB)
  - Proportionately increases total virtual memory
  - Individual virtual machine limit of **1TB** is unchanged
- Improved efficiency of memory over-commitment
  - Better performance for large virtual machines
  - More virtual machines can be run on a single z/VM image (depending on workload)
- Paging DASD utilization and requirements have changed
  - No longer need to double the paging space on DASD
  - Paging algorithm changes increase the need for a properly configured paging subsystem
- Recommend converting all Expanded Storage to Central Storage
  - Expanded Storage will be used if configured

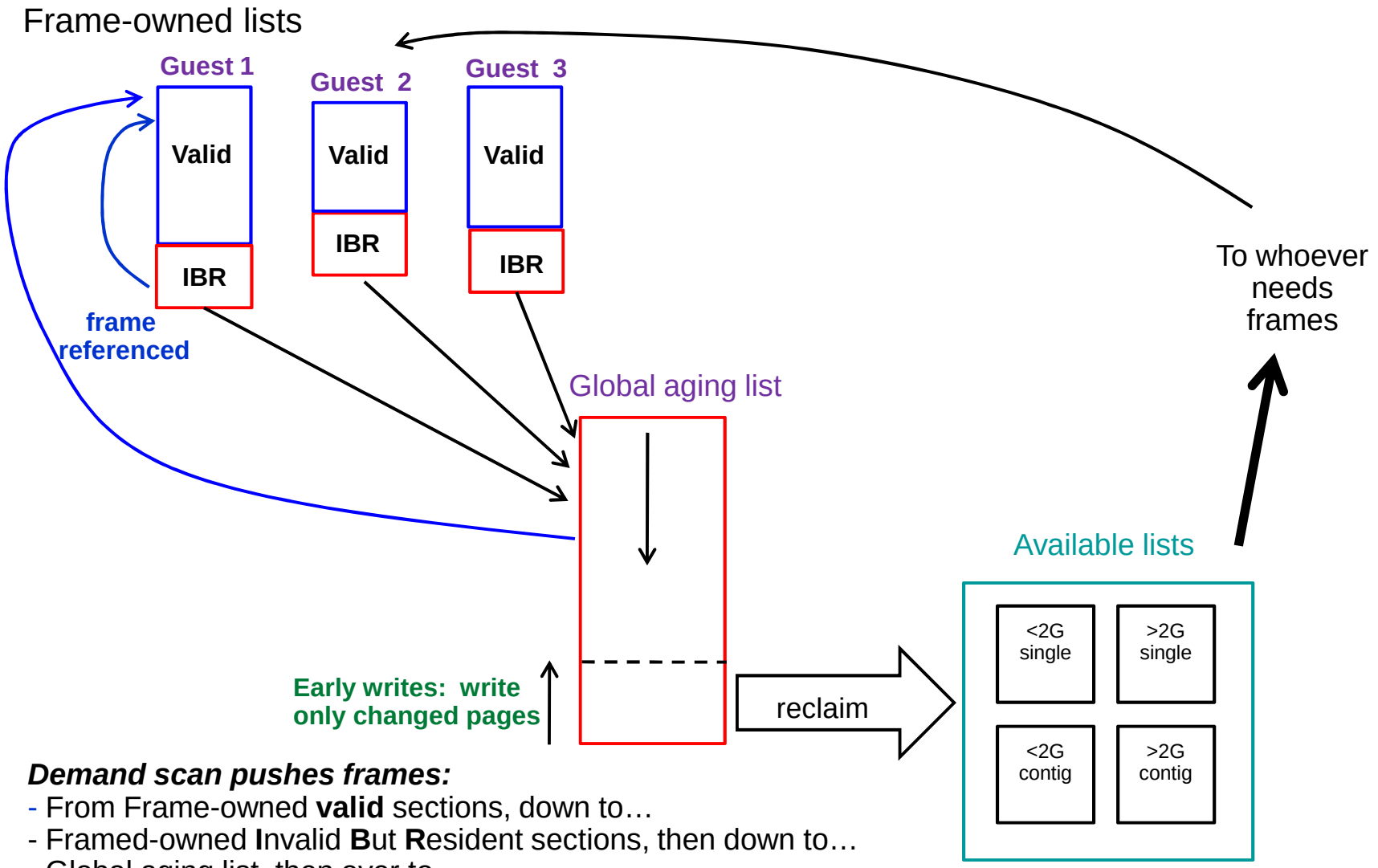
Large Memory Support: Reserved Storage

- Reserved processing is improved
  - More effective at keeping specified amount of reserved storage in memory

- Pages can be now be reserved for NSS and DCSS as well as virtual machines
  - Set ***after*** **CP SAVESYS** or **SAVESEG** of NSS or DCSS
    - Segment does not need to be loaded in order to reserve it
    - Recommend reserving monitor segment (**MONDCSS**)

- Reserved settings *do not* survive IPL
  - Recommend automating during system startup

Large Memory Support: The Big State Diagram



Demand scan pushes frames:

- From Frame-owned **valid** sections, down to…
- Framed-owned **I**nvalid **B**ut **R**esident sections, then down to…
- Global aging list, then over to…
- Available lists, from which they...
- Are used to satisfy requests for frames

Large Memory Support: Reorder

- Reorder processing has been removed
  - Could cause "stalling" of large virtual machines
  - No longer required with new paging algorithms

- Reorder commands remain for compatibility but have no impact
  - **CP SET REORDER** command gives RC=6005, “not supported”.
  - **CP QUERY REORDER** command says it’s OFF.

- Monitor data is no longer recorded for Reorder

Large Memory Support: New and Changed Commands

- New commands to **SET** and **QUERY AGELIST** attributes
  - Size
  - Early Writes

- Enhanced **SET RESERVED** command
  - Reserve pages for NSS and DCSS
  - Define ***number of frames*** or ***storage size*** to be reserved
  - Define maximum amount of storage that can be reserved for system

  - **QUERY RESERVED** command enhanced to show information about above

- **STORAGE** config statement enhanced to set AGELIST and maximum reserved storage

- **INDICATE** commands
  - New "instantiated" pages count where appropriate

Large Memory Support: Planning DASD Paging Space

- Calculate the sum of:
  - Logged-on virtual machines' primary address spaces, plus…
  - Any data spaces they create, plus…
  - Any VDISKs they use, plus…
  - Total number of shared NSS or DCSS pages, … and then …
  - Multiply this sum by 1.01 to allow for PGMBKs and friends

- Add to that sum:
  - Total number of CP directory pages (reported by DIRECTXA), plus…
  - Min (10% of central, 4 GB) to allow for system-owned virtual pages

- Then multiply by some safety factor (1.25?) to allow for growth or uncertainty

- Remember that your system will take a PGT004 if you run out of paging space
  - Consider using something that alerts on page space, such as Operations Manager for z/VM

Enhanced Dump Support

Enhanced Dump: Scalability

- Create dumps of real memory configurations up to 1 TB
  - Hard abend dump
  - SNAPDUMP
  - Stand-alone dump

- Performance improvement for hard abend dumps
  - Writes multiple pages of CP Frame Table per I/O
    - CP Frame Table accounts for significant portion of the dump
    - Previously wrote one page per I/O
  - Also improves time required for SNAPDUMPs and Stand-alone dumps

Enhanced Dump: Utilities

- New Stand-Alone Dump utility
  - Dump is written to disk – either ECKD or SCSI
    - Type of all dump disks must match IPL disk type
    - Dump disks for first level systems must be entire ECKD volumes or SCSI LUNs
    - Dump disks for second level systems may be minidisk "volumes"
  - Creates a CP hard abend format dump
    - Reduces space and time required for stand-alone dump

- **DUMPLD2** utility can now process stand-alone dumps written to disk

- VM Dump Tool supports increased memory size in dumps

Enhanced Dump: Allocating Disk Space for Dumps

- Dumps are written to disk space allocated for spool
  - Kept there until processed with DUMPLD2 (or DUMPLOAD)
- Recommend allocating enough spool space for 3 dumps
  - See ***"Allocating Space for CP Hard Abend Dumps"*** in CP Planning and Administration manual
  - Update available at www.vm.ibm.com/techinfo/
- CPOWNED statement
  - Recommend use of **DUMP** option to reserve spool volumes for dump space only
- **SET DUMP rdev**
  - Can specify up to 32 real device numbers of CP_Owned DASD
  - Order specified is the order in which they are searched for available space

Enhanced Dump: New Stand-Alone Dump Utility

- **SDINST EXEC** (new)
  - Used to create new stand-alone dump utility
  - For details:
    - Chapter 12, *"The Stand-Alone Dump Facility",* in CP Planning and Administration manual

- APAR VM65126 required to run SDINST second-level on z/VM 5.4 – 6.2 systems
  - PTF UM33687 for z/VM 5.4
  - PTF UM33688 for z/VM 6.1
  - PTF UM33689 for z/VM 6.2

Enhanced Dump: What is not Changed for Large Memory Dumps

- Old (pre-z/VM 6.3) stand-alone dump utility (HCPSADMP)
- DUMPLOAD
- VMDUMP

HiperDispatch

For more details on HiperDispatch:

Session 14686: z/VM 6.3 Hiperdispatch

Tuesday, 1:30 PM – Platinum Ballroom Salon 1 (Bill Bitner)

HiperDispatch

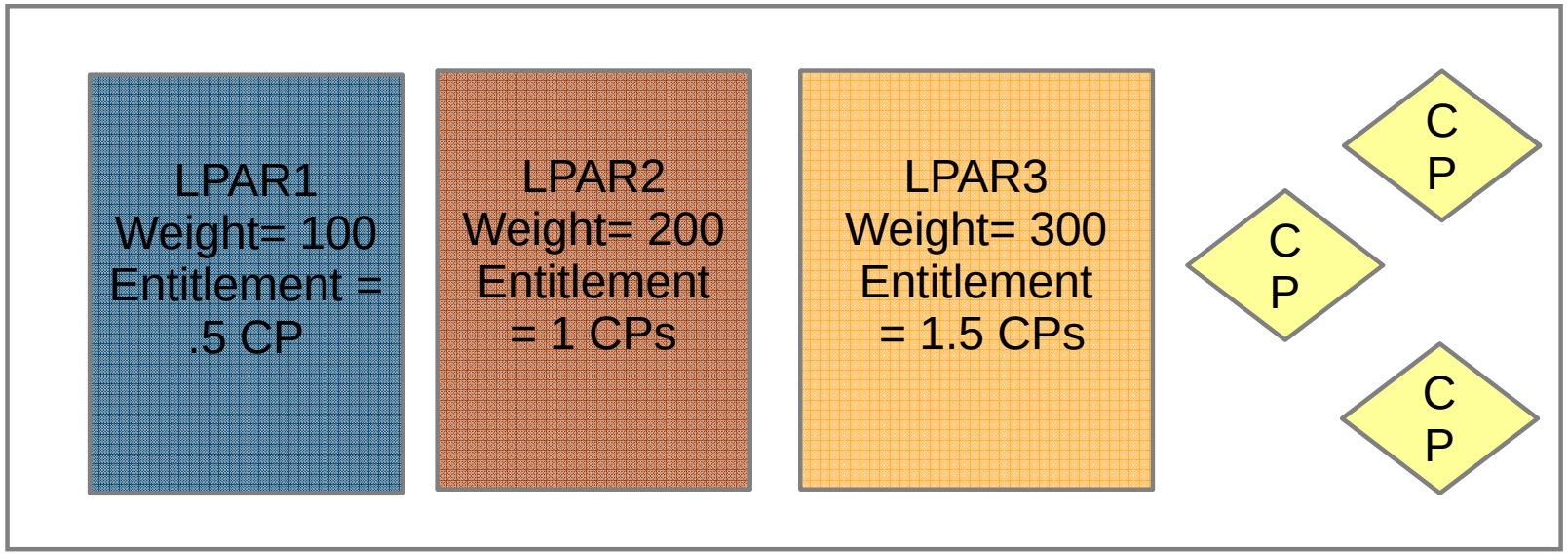
- Objective: Improve performance of guest workloads
  - z/VM 6.3 communicates with PR/SM to maintain awareness of its partition's topology
    - Partition Entitlement and excess CPU availability
    - Exploit cache-rich system design of System z10 and later machines
  - z/VM polls for topology information/changes every 2 seconds

- Two components
  - Dispatching Affinity
  - Vertical CPU Management

- For most benefit, Global Performance Data (GPD) should be on for the partition
  - Default is ON

HiperDispatch: System z Partition Entitlement

- The allotment of CPU time for a partition
- Function of
  - Partition's weight
  - Weights for all other shared partitions
  - Total number of shared CPUs
- Dedicated partitions
  - Entitlement for each logical CPU = 100% of one real CPU



HiperDispatch: Horizontal Partitions

- *Horizontal Polarization Mode*
  - Distributes a partition's entitlement evenly across all of its logical CPUs
  - Minimal effort to dispatch logical CPUs on the same (or nearby) real CPUs ("soft" affinity)
    - Affects caches
    - Increases time required to execute a set of related instructions
  - z/VM releases prior to 6.3 always run in this mode

HiperDispatch: Vertical Partitions

- *Vertical Polarization Mode*
  - Consolidates a partition's entitlement onto a subset of logical CPUs
  - Places logical CPUs topologically near one another
  - Three types of logical CPUs
    - Vertical High (Vh)
    - Vertical Medium (Vm)
    - Vertical Low (Vl)
  - z/VM 6.3 runs in vertical mode by default
    - First level only
    - Mode can be switched between vertical and horizontal
    - Dedicated CPUs are not allowed in vertical mode

HiperDispatch: Partition Entitlement vs. Logical CPU Count

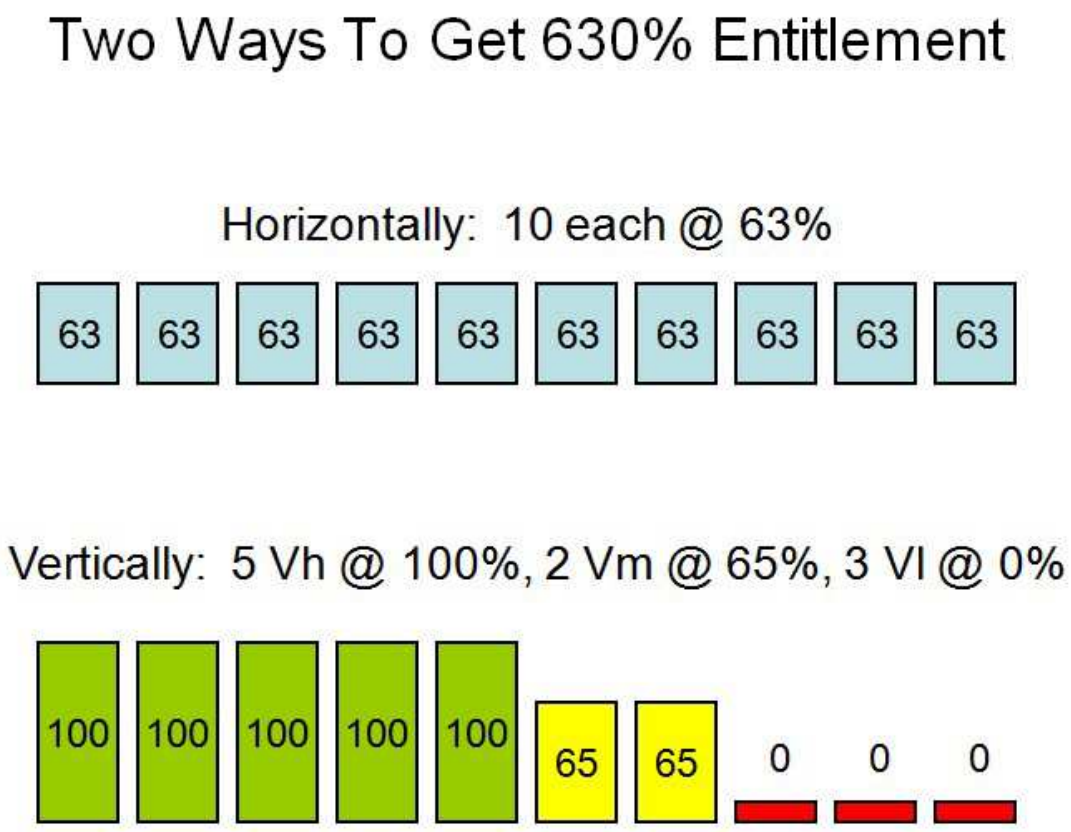
Suppose we have 10 IFLs shared by partitions FRED and BARNEY:

Partition	Weight	Weight Sum	Weight Fraction	Physical Capacity	Entitlement Calculation	Entitlement	Maximum Achievable Utilization
FRED, a logical **10-way**	**63**	100	63/100	1000%	1000% x (63/100)	**630%**	1000%
BARNEY, a logical **8-way**	**37**	100	37/100	1000%	1000% x (37/100)	**370%**	800%

For FRED to run *beyond* **630%** busy, BARNEY has to leave some of its entitlement *unconsumed.*

(CEC's excess power XP) = (total power TP) - (consumed entitled power EP).

HiperDispatch: Horizontal and Vertical Partitions



In vertical partitions:

- Entitlement is distributed unequally among LPUs.

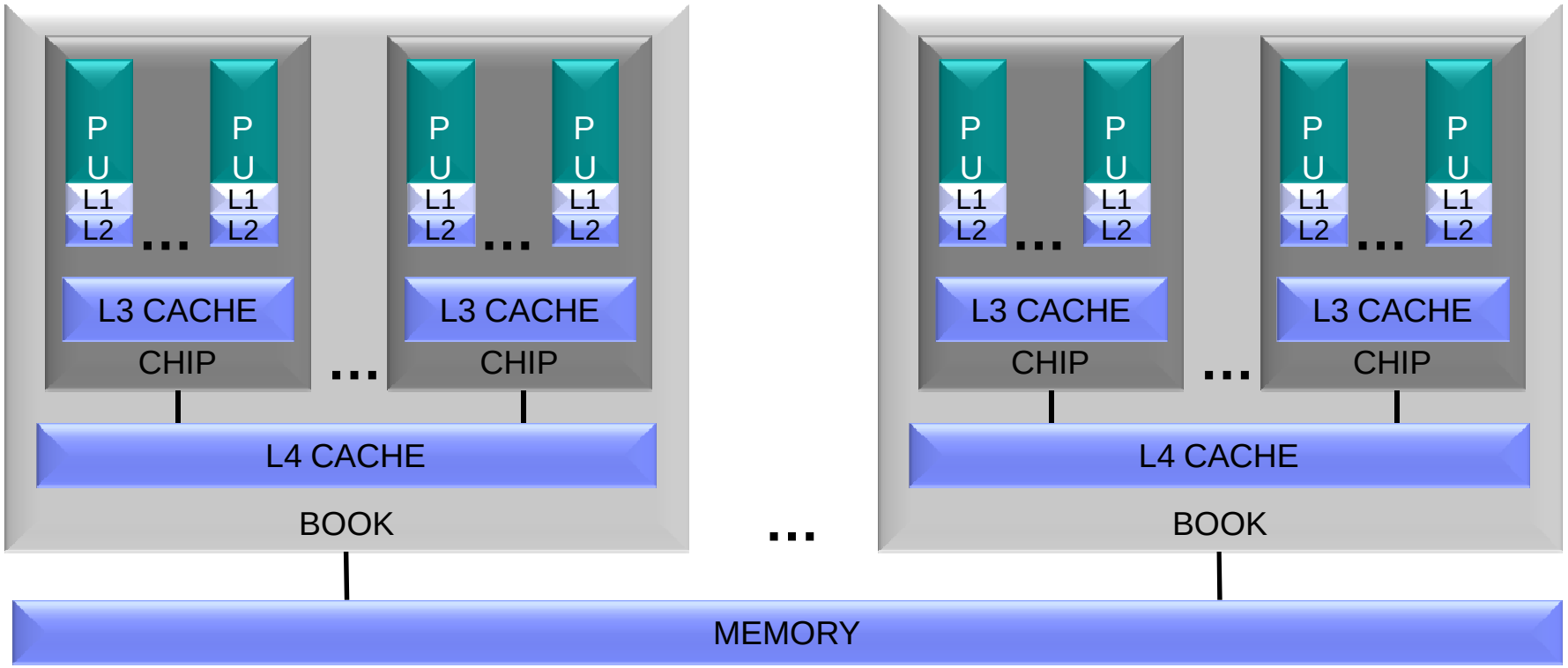
- Unentitled LPUs are useful only when other partitions are not using their entitlements.

- PR/SM tries very hard not to move Vh LPUs.

- PR/SM tries very hard to put the Vh LPUs close to one another.

- Partition consumes its XPF on its Vm and Vl LPUs.

HiperDispatch: Dispatching Affinity



- Processor cache structures have become increasingly complex and critical to performance
- z/VM 6.3 groups together the virtual CPUs of n-way guests
  - Dispatches guests on logical CPUs and in turn real CPUs that share cache
  - Goal is to re-dispatch guest CPUs on same logical CPUs to maximize cache benefits
  - Better use of cache can reduce the execution time of a set of related instructions

HiperDispatch: Parked Logical CPUs

- z/VM automatically *parks* and *unparks* logical CPUs
  - Based on usage and topology information
  - Only in vertical mode
- Parked CPUs remain in wait state
  - Still varied on
- Parking/Unparking is faster than VARY OFF/ON

HiperDispatch: Checking Parked CPUs and Topology

- **QUERY PROCESSORS** shows PARKED CPUs

```
PROCESSOR nn MASTER type
PROCESSOR nn ALTERNATE type
PROCESSOR nn PARKED type
PROCESSOR nn STANDBY type
```

- **QUERY PROCESSORS TOPOLOGY** shows the partition topology

```
q proc topology
13:14:59 TOPOLOGY
13:14:59   NESTING LEVEL: 02  ID: 01
13:14:59     NESTING LEVEL: 01  ID: 01
13:14:59       PROCESSOR 00  PARKED     CP    VH  0000
13:14:59       PROCESSOR 01  PARKED     CP    VH  0001
13:14:59       PROCESSOR 12  PARKED     CP    VH  0018
13:14:59     NESTING LEVEL: 01  ID: 02
13:14:59       PROCESSOR 0E  MASTER     CP    VH  0014
13:14:59       PROCESSOR 0F  ALTERNATE  CP    VH  0015
13:14:59       PROCESSOR 10  PARKED     CP    VH  0016
13:14:59       PROCESSOR 11  PARKED     CP    VH  0017
                      .
                      .
                      .
13:14:59   NESTING LEVEL: 02  ID: 02
13:14:59     NESTING LEVEL: 01  ID: 02
13:14:59       PROCESSOR 14  PARKED     CP    VM  0020
13:14:59     NESTING LEVEL: 01  ID: 04
13:14:59       PROCESSOR 15  PARKED     CP    VM  0021
13:14:59       PROCESSOR 16  PARKED     CP    VL  0022
13:14:59       PROCESSOR 17  PARKED     CP    VL  0023
```

HiperDispatch: New and Changed Commands

- **INDICATE LOAD**
  - AVGPROC now represents average value of the portion of a real CPU that each logical CPU has consumed

- **SET SRM** command can be used to change default settings for attributes related to HiperDispatch
  - Review monitor data and/or performance reports before changing

Technology Exploitation

Crypto Express4S

- Available on zEC12 and zBC12
- Supported for z/Architecture guests
  - Authorized in directory (CRYPTO statement)
- Shared or Dedicated access when configured as
  - IBM Common Cryptographic Architecture (CCA) coprocessor
  - Accelerator
- Dedicated access only when configured as
  - IBM Enterprise Public Key Cryptographic Standards (PKCS) #11 (EP11) coprocessor

FCP Data Router (QEBSM)

- Allows guest exploitation of the Data Router facility
  - Provides direct memory access (DMA) between an FCP adapter's SCSI interface and real memory
  - Guest must enable the Multiple Buffer Streaming Facility when establishing its QDIO queues

- **QUERY VIRTUAL FCP** command indicates whether
  - Device is eligible to use Data Router facility
    - **DATA ROUTER ELIGIBLE**
  - Guest requested use of Data Router facility when transferring data
    - **DATA ROUTER ACTIVE**

- Monitor record updated:
  - Domain 1 Record 19 – MRMTRQDC – QDIO Device Configuration Record

FICON DS8000 and MSS Support

- FICON DS8000 Series New Functions
  - Storage Controller Health message
    - New attention message from HW providing more details for conditions in past reflected as Equipment Check.
    - Intended to reduce the number of false HyperSwap events.
  - Peer-to-Peer Remote Copy (PPRC) Summary Unit Check
    - Replaces a series of state change interrupts for individual DASD volumes with a single interrupt per LSS
    - Intended to avoid timeouts in GDPS environments that resulted from the time to process a large number of state change interrupts
- Multiple Subchannel Set (MSS) support for mirrored DASD
  - Support to use MSS facility to allow use of an alternate subchannel set for Peer-to-Peer Remote Copy (PPRC) secondary volumes
  - New **QUERY MSS** command
  - New MSS support cannot be mixed with older z/VM releases in an SSI cluster

Satisfies SODs from October 12, 2011

Virtual Networking

Virtual Networking: Live Guest Relocation Enhancements

- Live Guest Relocation supports port-based virtual switches
  - New eligibility checks allow safe relocation of a guest with a port-based VSwitch interface
  - Prevents relocation of an interface that will be unable to establish proper network connectivity
  - Adjusts the destination virtual switch configuration, when possible, by inheriting virtual switch authorization from the origin

Virtual Networking: VSwitch Recovery and Stall Prevention

- Initiate controlled port change or failover to a configured OSA backup port
  - Minimal network disruption

- SET VSWITCH UPLINK **SWITCHOVER** command
  - Switch to first available configured backup device
  - Switch to specified backup device
    - Specified RDEV and port number must already be configured as a backup device
  - If backup network connection cannot be established, original connection is reestablished
  - Not valid for a link aggregation or GROUP configured uplink port

Virtual Networking: VSwitch Support for VEPA Mode

- Virtual Edge Port Aggregator (VEPA)
  - IEEE 802.1Qbg standard
  - Provides capability to send all virtual machine traffic to the network switch
  - Moves all frame switching from CP to external switch
  - Relaxes "no reflection" rule

  - Supported on OSA-Express3 and later on zEC12 and later

- Enables switch to monitor and/or control data flow

- z/VM 6.3 support
  - New **VEPA OFF/ON** operand on SET VSWITCH command

z/VM 6.3 Enhancements: Available June 27, 2014

z/VM 6.3 Enhancements: CPU Pooling

- Fine grain CPU limiting for a group of virtual machines

- Define one or more named pools in which a limit of CPU resources is set
  - No restrictions on number of pools or aggregate capacity (can overcommit)

- CPU pools coexist with individual share limits
  - More restrictive limit applies

- CPU pools in SSI clusters
  - Pool capacities are independent and enforced separately on each member
  - Live Guest Relocation
    - Destination member must have an identically named pool with same **TYPE** attribute
    - If limit is not required on destination, remove guest from pool before relocating
  - Recommend defining identical pools on all members of cluster

- Support Details
  - z/VM 6.3 with APAR VM65418 - June 27, 2014

z/VM 6.3 Enhancements: CPU Pooling

- Use the **DEFINE CPUPOOL** command to define named pools
  - **LIMITHARD** - % of system CPU resources
  - **CAPACITY** – number of CPUs
  - Define for a particular **TYPE** of CPU (**CP** or **IFL**)
- Limits can be changed with **SET CPUPOOL** command
- Assign and remove guests to/from a CPU pool with the **SCHEDULE** command

z/VM 6.3 Enhancements: Environment Information Interface

- New interface allow guest to capture execution environment
  - Configuration and Capacity information
  - Various Levels:
    - Machine, logical partition, hypervisor, virtual machine, CPU pools

- New problem statement instruction STore HYpervisor Information (STHYI)
  - Supported by z/VM 6.3
  - Tolerated by z/VM 6.2 ("function not supported")

- Foundation for future software licensing tools

- Support details:
  - z/VM 6.3 with APAR VM65419 – June 27, 2014

z/VM 6.3 Enhancements: PCIe Support

- Allows guests with PCIe drivers to access PCI "functions" (devices)
  - PCI functions can be dedicated to a guest
    - Guest must have PCI driver supporting specific function

- **DEFINE PCIFUNCTION** defines real PCI function to I/O configuration
  - PCI Function ID (PFID) used to reference a function

- Basis for support for guest exploitation of 10GbE RoCE Express feature
  - Supports z/OS's Shared Memory Communications-Remote Direct Memory Access (SMC-R) in z/OS V2.1

- Support details:
  - IBM zEC12 or zBC12 with appropriate millicode (driver 15)
  - z/VM 6.3 with APAR VM65417 – June 27, 2014
  - z/OS 1.12, z/OS 1.13, z/OS 2.1 with APAR OA43256
  - Fulfills 2013 Statement of Direction

Miscellaneous Enhancements

IPL Changes for NSS in a Linux Dump

- Allows contents of NSS to be included in dumps created by stand-alone dump tools such as Linux Disk Dump utility
  - New **NSSDATA** operand on IPL command

- **NSSDATA** can only be used if the NSS:
  - is fully contained within the first extent of guest memory
  - does not contain SW, SN or SC pages
  - is not a VMGROUP NSS

- See http://www.vm.ibm.com/perf/tips/vmdump.html for information on differences between VMDUMP and Linux Disk Dump utility

Specify RDEV for System Volumes

- Prevents wrong volume from being attached when there are multiple volumes with the same volid
- Optionally specify RDEV along with volid in system configuration file
  - **CP_OWNED** statement
  - **USER_VOLUME_RDEV** statement (new)
- If specified, disk volume must match both in order to be brought online
- No volume with specified volid is brought online when
  - Volume at RDEV address has a different volid than specified
  - There is no volume at specified RDEV address

Cross System Extensions (CSE) Withdrawn in z/VM 6.3

- Function has been replaced by z/VM Single System Image (VMSSI) feature
  - **XSPOOL …** commands no longer accepted
  - **XSPOOL_ …** configuration statements not processed (tolerated)
- CSE cross-system link function is still supported
  - **XLINK …** commands
  - **XLINK_ …** configuration statements
- CSE XLINK and SSI shared minidisk cannot be used in same cluster
- Satisfies Statement of Direction (October 12, 2011)

OVERRIDE Utility and UCR Function Withdrawn

- *"Very OLD"* method for redefining privilege classes for
  - CP Commands
  - Diagnose codes
  - other CP functions

- To redefine privilege classes, use
  - **MODIFY COMMAND** command and configuration statement
  - **MODIFY PRIV_CLASSES** command and configuration statement

- Satisfies Statement of Direction (October 12, 2011)

More Information

z/VM 6.3 resources

http://www.vm.ibm.com/zvm630/

http://www.vm.ibm.com/events/

z/VM 6.3 Performance Report

http://www.vm.ibm.com/perf/reports/zvm/html/index.html

z/VM Library

http://www.vm.ibm.com/library/

Live Virtual Classes for z/VM and Linux

http://www.vm.ibm.com/education/lvc/

Thanks!

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