2007 System z Summit

DESTINATION z

IBM System z: The Ultimate Virtualization Platform

Reed Mullen
Product Manager, System z Virtualization Technology

Trademarks

The following are trademarks of the International Business Machines Corporation in the United States and/or other countries.

IBM	NetView*	System I	z/OS*
IBM logo	OMEGAMON*	System p	z/VSE
AIX*	PR/SM	System x	z/VM*
AS/400*	Processor Resource/System Manager	System z	
CICS*	RACF*	Systems Storage	
DB2*	Rational*	System z9	
ECKD	REXX	Tivoli*	
eServer	S/360	VM/ESA	
FICON*	S/370	WebSphere*	
GDPS*	s/390*	zSeries*	
HiperSockets			
Hyperswap			

* Registered trademarks of IBM Corporation

The following are trademarks or registered trademarks of other companies.

Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation in the United States, other countries, or both.

Java and all Java-based trademarks and logos are trademarks of Sun Microsystems, Inc., in the United States, other countries or both.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Microsoft, Windows, Windows NT and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

Red Hat, the Red Hat "Shadow Man" logo, and all Red Hat-based trademarks and logos are trademarks or registered trademarks of Red Hat, Inc., in the United States and other countries.

SET and Secure Electronic Transaction are trademarks owned by SET Secure Electronic Transaction LLC.

* All other products may be trademarks or registered trademarks of their respective companies.

Notes:

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

IBM hardware products are manufactured from new parts, or new and serviceable used parts. Regardless, our warranty terms apply.

All customer examples cited or described in this presentation are presented as illustrations of the manner in which some customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics will vary depending on individual customer configurations and conditions.

This publication was produced in the United States. IBM may not offer the products, services or features discussed in this document in other countries, and the information may be subject to change without notice. Consult your local IBM business contact for information on the product or services available in your area.

All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

Information about non-IBM products is obtained from the manufacturers of those products or their published announcements. IBM has not tested those products and cannot confirm the performance, compatibility, or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Prices subject to change without notice. Contact your IBM representative or Business Partner for the most current pricing in your geography.

IBM System z: The Ultimate Virtualization Platform

- ***Virtualize* everything with up to 100% utilization rates**
  - CPU, memory, network, I/O, cryptographic features, coupling facility, ...

  Consolidate all types of workloads

- ***Massively scale* your workload on a single IBM System z™ mainframe**
  - The Linux® -on-z/VM® record is 97,943 virtual machines
  - Each virtual machine on z/VM can access up to 24,576 devices

  Smart economics: start small and grow big in the same box

- ***Security* for everything**
  - Highest security classification for general purpose servers in the world
  - System z LPAR technology is EAL 5 certified

  Secure your virtual servers and reduce business risk

- ***Non-disruptively add* anything**
  - 54x CPU scalability per mainframe, 32x CPU scalability per z/VM LPAR
  - z/VM is designed to support up to 8 TB of active virtual memory

  Rapidly respond to workload spikes

- ***Optimize and integrate* it all with the IBM software portfolio**

  Increase staff productivity and virtualize the enterprise

System z Virtualization: a Multidimensional Solution
Virtualization Support is Built In, Not Added On

With coordinated investments in the virtualization technology stack

- **Application support layer**
  - Open, reliable operating system
  - Virtual server awareness infrastructure
  - Enterprise applications

- **Hypervisor layer (z/VM)**
  - Shared-memory based virtualization model
  - Highly granular resource sharing and simulation
  - Flexible virtual networking
  - Resource control and accounting
  - Server operation continuity (failover)
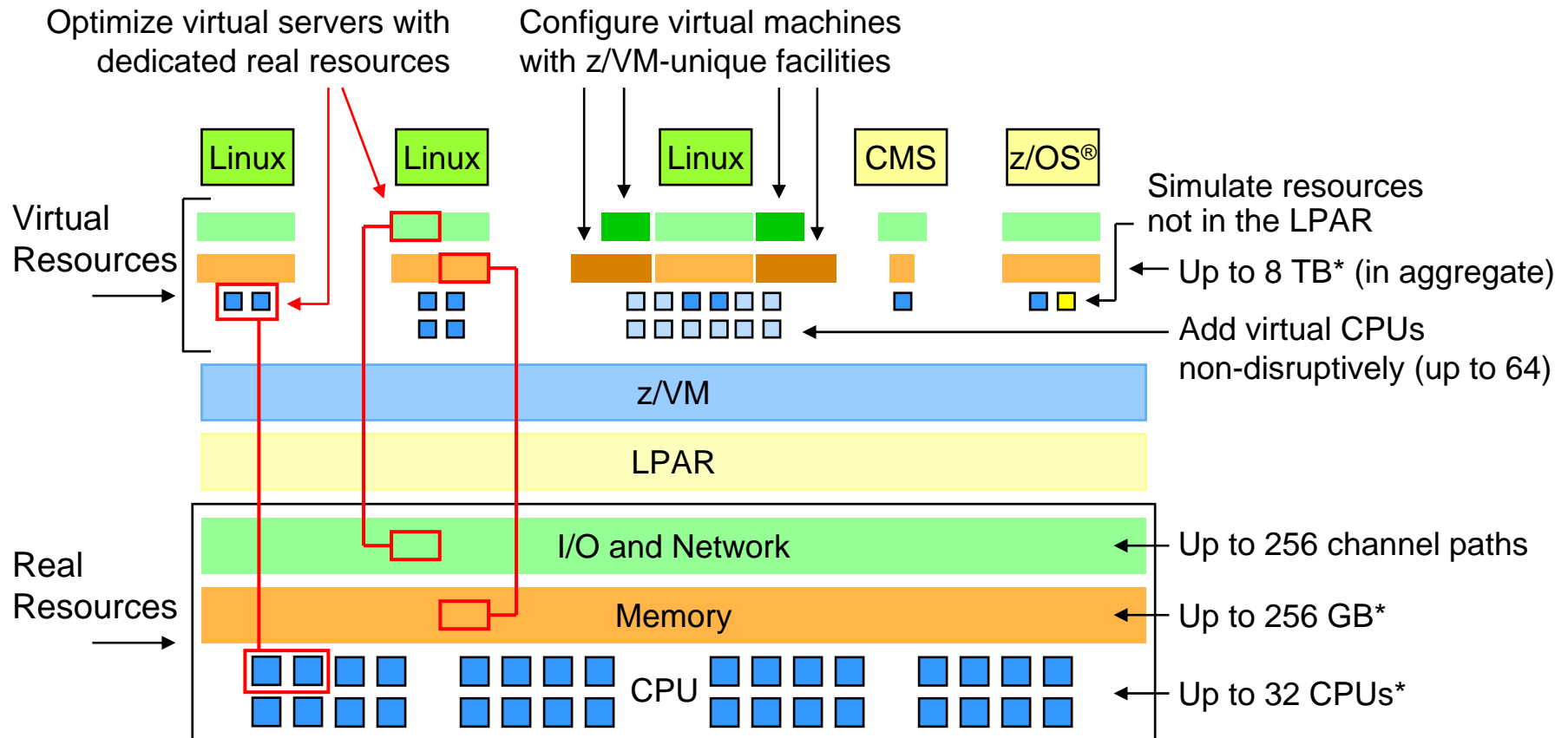 - Server maintenance tools and utilities

- **Hardware layer**
  - Legendary reliability, scalability, availability, security
  - Logical partitioning (LPAR)
  - Processor and peripheral sharing
  - Interpartition communication
  - Virtualization support at the hardware instruction level

Application Support

Hypervisor

Hardware
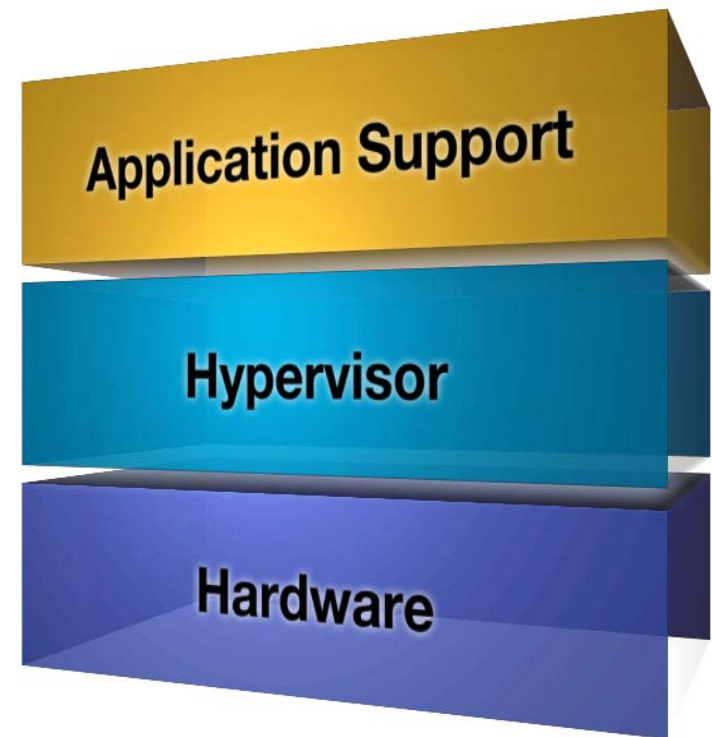
Extreme Virtualization with z/VM V5.3

*z/VM can provision virtual machines with a mix of real and virtual resources with exceptional levels of scalability, availability and security*

Optimize virtual servers with dedicated real resources

Configure virtual machines with z/VM-unique facilities

Linux Linux Linux CMS z/OS®

Virtual Resources

Simulate resources not in the LPAR

Up to 8 TB* (in aggregate)

Add virtual CPUs non-disruptively (up to 64)

z/VM

LPAR

Real Resources

I/O and Network — Up to 256 channel paths

Memory — Up to 256 GB*

CPU — Up to 32 CPUs*

* z/VM V5.3 maximums

z/VM Virtual Switch Link Aggregation Support
Enhanced Networking Bandwidth and Business Continuance

Up to 8 OSA ports per VSWITCH
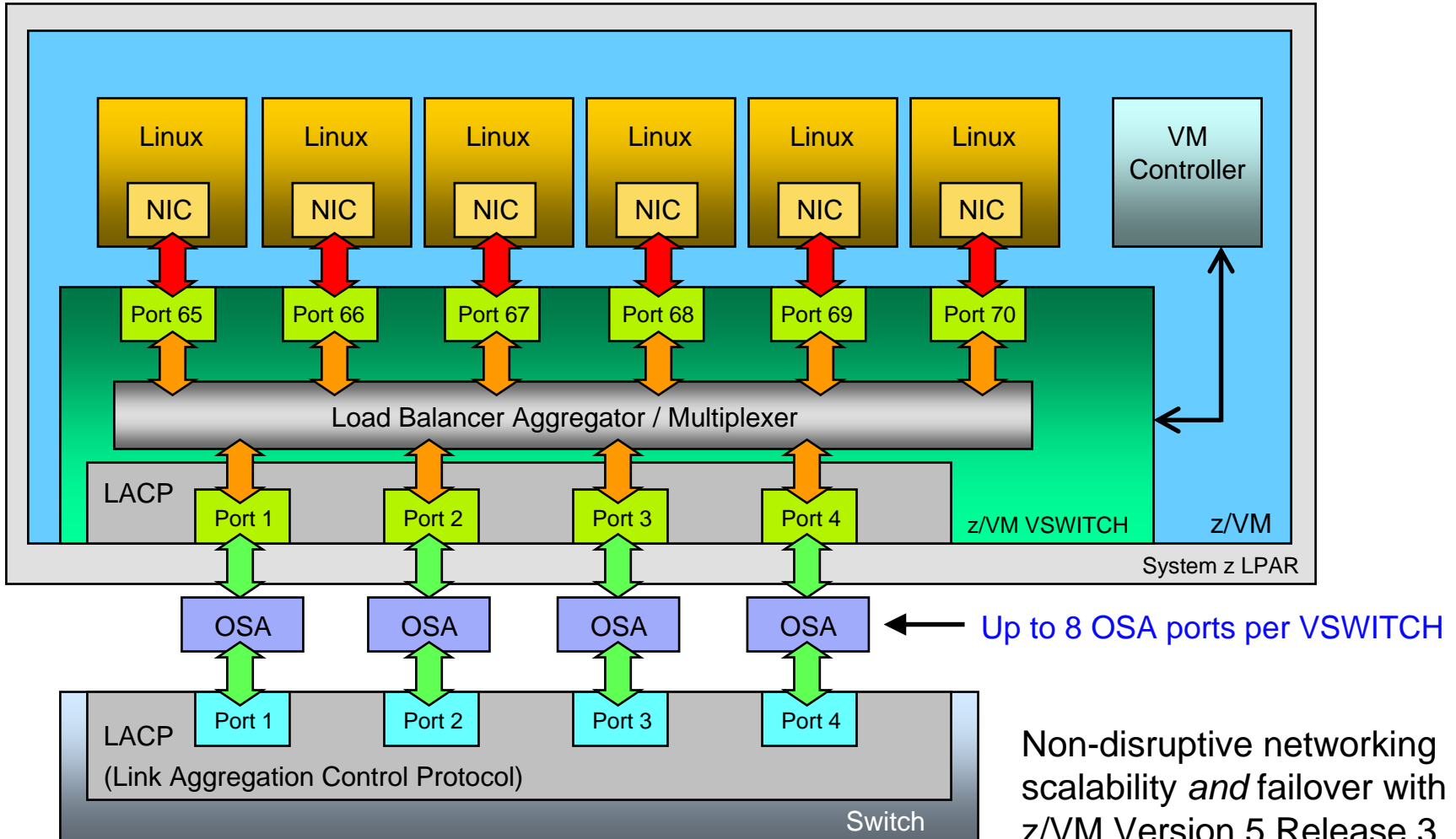
Non-disruptive networking scalability *and* failover with z/VM Version 5 Release 3

Note: Requires OSA-Express2 support available with IBM System z9 servers

z/VM Virtualization Leadership
The Value of Scaling on a Single Hypervisor

- **Grow virtual server workloads without linearly growing energy costs**

- **Enhance staff productivity with a single point of control at the hypervisor level**

- **Dynamically add and remove physical resources in a single machine to optimize business results**

- **Exploit hypervisor automation tools with higher degrees of integration and optimization**

Functional Comparison of z/VM and VMware ESX

Attribute	z/VM V5.3	VMware ESX 3	System z Value
Supported operating systems	Linux, z/OS, z/VSE, z/TPF, z/VM itself	Linux, Windows, Netware, Solaris 10	z/VM-on-z/VM = added flexibility
Scalability and Performance			
Hypervisor scalability	Up to 32 CPUs, 256 GB of memory, 8 TB of "active virtual memory"	Up to 32 CPUs, 64 GB of memory	Cost-saving, extreme scalability of virtual server environment
Virtual Machine (VM) scalability	Up to 64 CPUs, 1 TB of memory, extensive I/O bandwidth	Up to 4 CPUs, 16 GB of memory, modest I/O bandwidth	Virtualizes servers on z/VM that cannot run on VMware
CPU sharing	No limit	Up to 8 VMs per CPU	Add servers without adding HW
Architected (practical) VM limit	Thousands (hundreds) per copy of z/VM	128 (singles) per copy of VMware	Avoid real server sprawl
CPU capacity on demand	Yes, non-disruptively	No	Fast, easy capacity growth
In-memory support	Minidisk cache; Virtual Disks in Storage; DCSS (shared program executables)	Shared virtual memory pages (detected via background operation)	Enhanced resource utilization
Logical Partition (LPAR) support	Yes	No	Secure Linux access to z/OS
Flexible Operations			
Resource over-commitment support (memory, CPU, network, I/O)	Extensive	Modest	Absorb workload spikes; add more servers to a "full" system
Reconfiguration of Virtual Machines	Non-disruptive re-config for CPU, I/O, networking; VM re-boot for memory	VM reboot required for re-config of CPU, memory, ethernet, disk	Higher server and application availability; staff productivity
Command and control, monitoring, automation infrastructure	Extensive, robust, time-tested	Modest	Cost-optimized systems management support
Virtual Machine mobility support	No; single-image scalability of z/VM does not require mobility for mgmt	Yes; essential for workload mgmt across multiple copies of VMware	Can dynamically add or remove resources to meet demand
Integrity and Security			
Fault isolation / hypervisor security	Hardware-assisted isolation*; CAPP/EAL 3+	No I/O virtualization separation; CAPP/EAL 2	Helps to avoid security breaches; data security and integrity
Run multiple copies of hypervisor on single server	Yes; share CPU, I/O, and networking resources among z/VM systems	No	Workload isolation; lower-cost failover (using same hardware)

* z/VM runs in System z LPARs, which have achieved EAL 5 certification; System z HiperSockets provide high-speed, secure connectivity among LPARs.

Provisioning Linux Virtual Machines on System z
Using IBM Director for Linux on System z with z/VM Center

Provisioning Software in System z Virtual Linux Servers
Using IBM Tivoli Provisioning Manager

Tivoli® Provisioning Manager deployment scope:

Operating systems like Linux, AIX®, Microsoft™ Windows™

Middleware like DB2® and WebSphere® Application Server

Monitoring System z Virtual Linux Servers
Using IBM Tivoli OMEGAMON® XE for z/VM and Linux

- **Combined product offering that monitors z/VM and Linux for System z**

- **Provides work spaces that display:**

  - Overall system health

  - Workload metrics for logged-in users

  - Individual device metrics

  - LPAR Data

- **Provides composite views of Linux running on z/VM**

IBM Systems Director
End-to-End Management For the Enterprise

IBM Tivoli
(and other selected enterprise management tools)

IBM Systems Director
Physical and Virtual platforms
Server, Storage, Networking

Foundation

| Deployment | Health |
| Configuration | Maintain |

Extension Groups

| Virtualization | Optimization |
| Advanced Monitoring | Replication |

Platform-specific Capabilities

| IBM System x™, i™, z, p™ | IBM System Storage™ | Other |

3rd Party, Custom

Managed Environments

Operating systems

Virtualization software

IBM TotalStorage
SAN Volume Controller
Advanced POWER Virtualization
z/VM

Hardware

Extreme Virtualization with System z
Understanding the Value Proposition

- **Business pain points addressed by server virtualization:**
  - Underutilized IT assets
  - Environmental costs
  - Linear software costs per server image
  - Staff inefficiencies managing multiple real servers
  - Spiraling people costs

- **x86 virtualization pain points addressed by System z**
  - Virtual server workload management
  - Reliable high-bandwidth I/O virtualization
  - Virtual server and total system performance reporting and planning
  - Virtual server reconfiguration outages
  - Virtual machine security and integrity
  - Server sprawl with added complexity

> **Clients need to develop an enterprise-wide virtualization strategy that leverages the strengths of mainframe virtualization**

Nationwide Saves $15M
with System z

TCO: $15M savings over 3 years

80% reduction in data center floor space needs; power conservation

50% reduction in hardware and OS support efforts

70% average CPU utilization

Dynamic allocation of compute power

Capacity on Demand

Tested 22 times the capacity for 2006 Super Bowl Ad blitz traffic

Source: Guru Vasudeva, AVP & Chief Architect, Nationwide Insurance LinuxWorld August 2006 presentation

Nexxar

"The company you trust to send money worldwide"

Advanced virtualization capabilities to quickly create a secure, custom-tailored computing environment for each "private label" relationship

Key Benefits (Value Proposition)

- ✓ An architecture that suits requirements for security, manageability, reliability, availability, scalability, extensibility and flexibility
- ✓ The ability to help Nexxar's growth-by-acquisition business while staying within the same platform
- ✓ Consolidation of more than 80 x86 servers onto an IBM System z9™ Business Class (BC) machine
- ✓ *A 75% reduction of headcount required to maintain the operating environment in comparison with x86 systems previously on the floor*

Business Need

An IT infrastructure that provides very high (24x7) availability and is able to sustain significant business growth

NEXXAR GROUP

Solution

- ❑ Hardware: IBM System Storage
- ❑ Software: z/OS, DB2, z/VM, Linux
  WebSphere Application Server
  Tivoli OMEGAMON
  Rational®
- ❑ Services: GTS Infrastructure & Systems Management Services

Client Deploys Additional Workloads on System z

BALDOR

***Computerworld* published a story comparing two "growing midsize companies" ***

Baldor Electric consolidated several UNIX-based servers onto one IBM eServer™ zSeries® 990, deploying all of its SAP Enterprise Portal, Supply, and Business Warehouse solutions on zSeries and Linux.

Both have "... similar size IT departments"; Both "... use packaged ERP applications ... and want complete alignment with the business." ***However*, "when it comes to the hardware running these systems, the companies are polar opposites"**

	Baldor Electric implemented SAP using Linux on System z, z/VM, & DB2 on z/OS & is spending less than 1% of sales on I/T.	Welch's Food implemented Oracle ERP on Dell using VMware, Oracle DB, and Linux and is spending 2.5% of sales on I/T.
Supplier	**IBM**	**Dell**
Moved from:	3 Mainframes and 8 UNIX Servers	S/390® and AS/400®
Moved to:	1 z990 + Integrated Facility for Linux (IFLs)	100 Intel® Servers
Solution	DB2 database runs on IBM z/OS and SAP applications run in 24 Linux virtual machines on the same server	Oracle ERP on Dell using VMWare, and Oracle DB using Linux
Decision-to-Completion Time	Approximately 6 months	Started sometime before June 2005, project will continue into 2007
IT Staff	Down to 38	50
IT Spending	1.2% of Sales in first year of implementation	About 2.5% of Sales

Computerworld, August 15, 2005

System z Virtualization Leadership
Offering Virtual Server Solutions the IT Industry Demands

- **Highly scalable, granular, and efficient virtual server hosting**
  - Capable of running thousands of virtual servers on a single mainframe
  - Designed to run memory-rich and I/O-intensive (disk and network) workloads with data integrity
  - Able to achieve extremely high levels of physical CPU, memory, networking, and disk resource sharing
  - Allows significant over commitment of real resources, resulting in higher utilization while processing peak business demands and maintaining service levels – "doing more with less"

- **Infrastructure simplification and flexible operations**
  - Can improve the efficiency of your IT staff with robust and powerful systems management capabilities, allowing staff to quickly provision and manage more virtual servers
  - Provides non-disruptively adding and removing of physical resources to satisfy virtual server requirements in response to changing business demands
  - Can host Linux applications side-by-side LPARs on the same mainframe with fast and secure connectivity, leveraging z/TPF, z/VSE™, and z/OS secure data serving

- **Virtual server integrity and security**
  - For decades z/VM and the mainframe have been architected for secure processing, offering high levels of integrity and security
  - System z servers have achieved EAL 5 certification; z/VM has achieved EAL 3+ certification and intends to pursue EAL 4 certification, offering system solutions that have been methodically designed, tested, and reviewed for secure operations
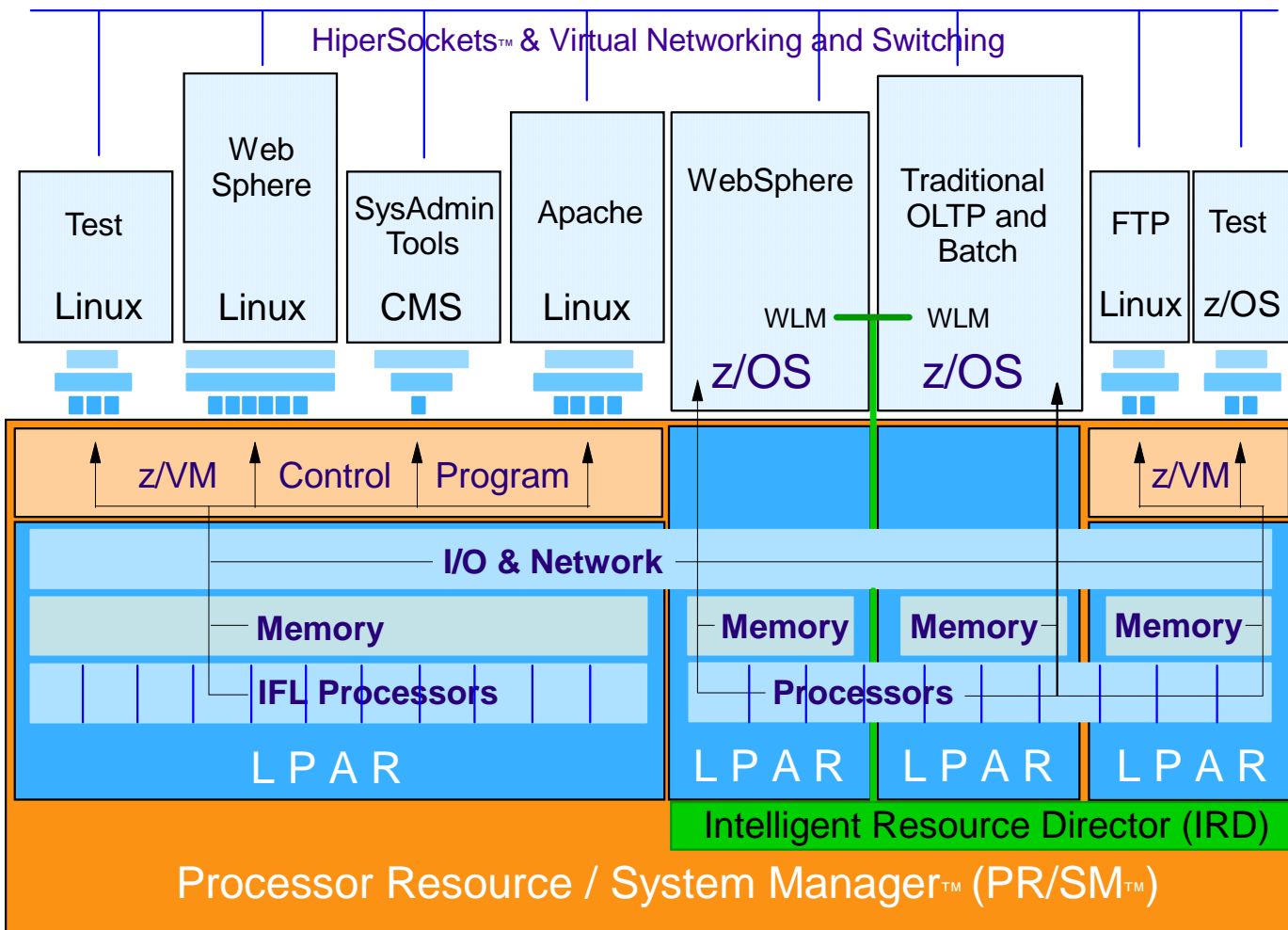
Questions?

Backup Material

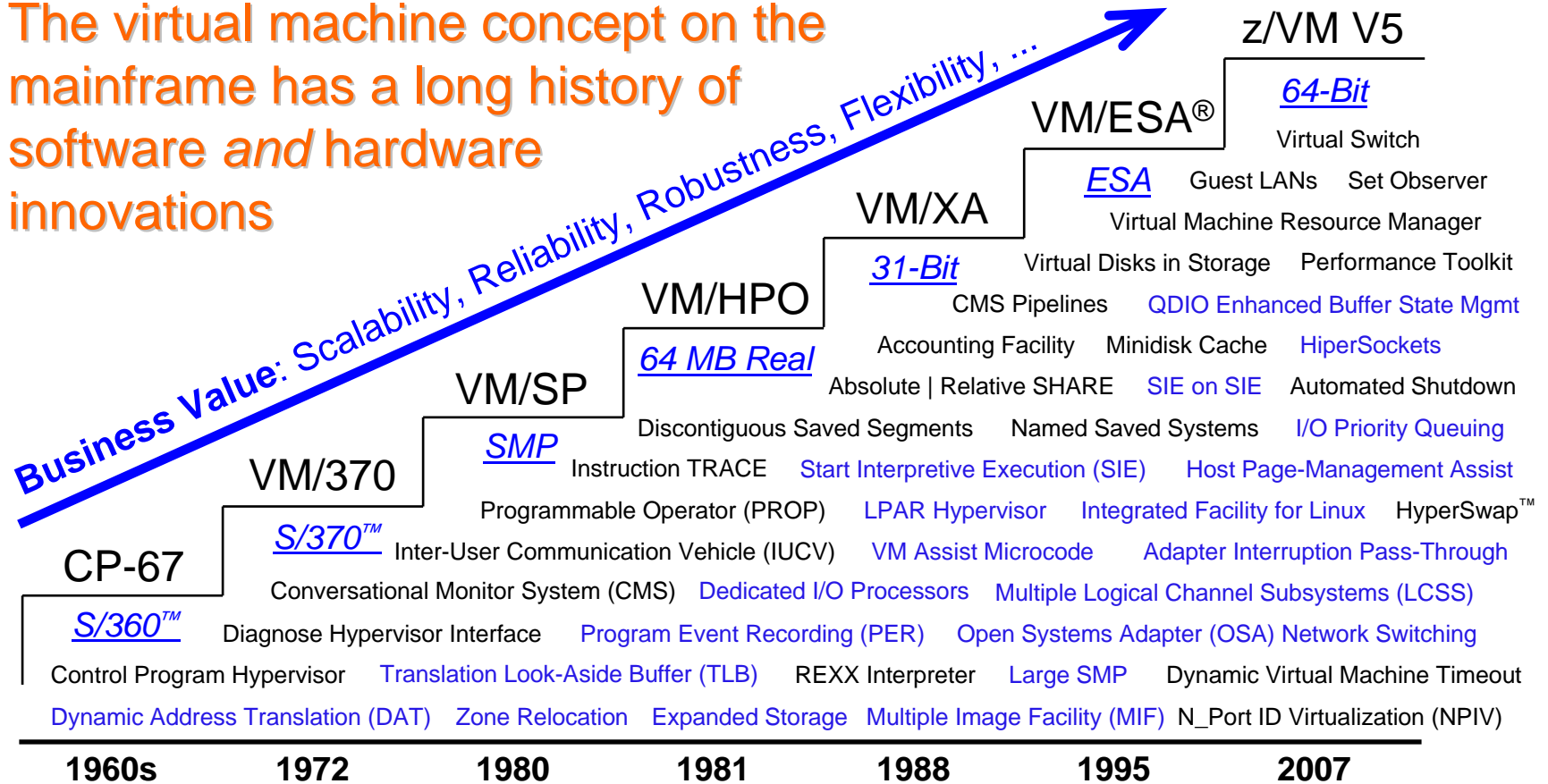# IBM System z Virtualization Architecture

HiperSockets™ & Virtual Networking and Switching

Test Linux | Web Sphere Linux | SysAdmin Tools CMS | Apache Linux | WebSphere WLM z/OS | Traditional OLTP and Batch WLM z/OS | FTP Linux | Test z/OS

z/VM Control Program

I/O & Network

Memory

IFL Processors

LPAR | LPAR | LPAR | LPAR

Memory | Memory | Memory

Processors

z/VM

Intelligent Resource Director (IRD)

Processor Resource / System Manager™ (PR/SM™)

- **Multi-dimensional virtualization technology**
  - System z provides logical (LPAR) and software (z/VM) partitioning
  - PR/SM enables highly scalable virtual server hosting for LPAR _and_ z/VM virtual machine environments
  - IRD coordinates allocation of CPU and I/O resources among z/OS and non-z/OS LPARs*

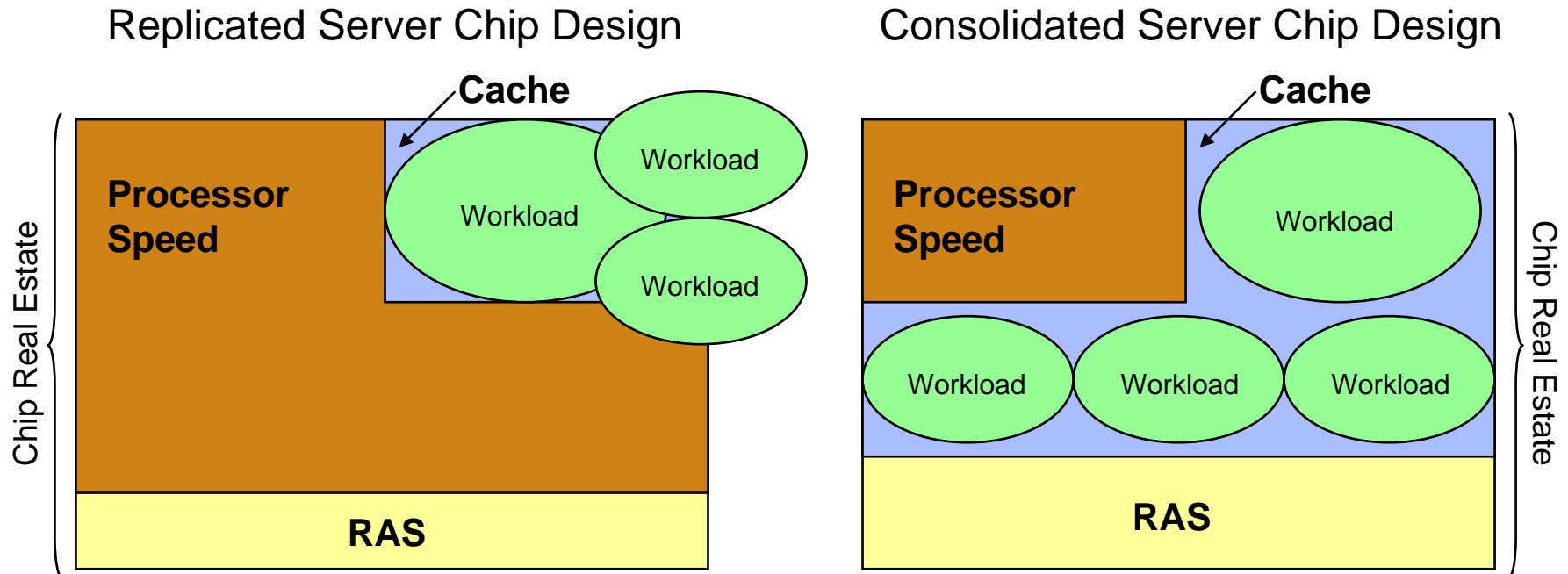* Excluding non-shared resources like Integrated Facility for Linux processors

IBM System z Virtualization Genetics

The virtual machine concept on the mainframe has a long history of software *and* hardware innovations

Business Value: Scalability, Reliability, Robustness, Flexibility, ...

z/VM V5

64-Bit
Virtual Switch

VM/ESA®

ESA   Guest LANs   Set Observer

Virtual Machine Resource Manager

VM/XA

31-Bit   Virtual Disks in Storage   Performance Toolkit

CMS Pipelines   QDIO Enhanced Buffer State Mgmt

VM/HPO

64 MB Real   Accounting Facility   Minidisk Cache   HiperSockets

Absolute | Relative SHARE   SIE on SIE   Automated Shutdown

VM/SP

Discontiguous Saved Segments   Named Saved Systems   I/O Priority Queuing

SMP   Instruction TRACE   Start Interpretive Execution (SIE)   Host Page-Management Assist

VM/370

Programmable Operator (PROP)   LPAR Hypervisor   Integrated Facility for Linux   HyperSwap™

S/370™   Inter-User Communication Vehicle (IUCV)   VM Assist Microcode   Adapter Interruption Pass-Through

CP-67

Conversational Monitor System (CMS)   Dedicated I/O Processors   Multiple Logical Channel Subsystems (LCSS)

S/360™   Diagnose Hypervisor Interface   Program Event Recording (PER)   Open Systems Adapter (OSA) Network Switching

Control Program Hypervisor   Translation Look-Aside Buffer (TLB)   REXX Interpreter   Large SMP   Dynamic Virtual Machine Timeout

Dynamic Address Translation (DAT)   Zone Relocation   Expanded Storage   Multiple Image Facility (MIF)   N_Port ID Virtualization (NPIV)

| **1960s** | **1972** | **1980** | **1981** | **1988** | **1995** | **2007** |

System z virtualization starts on the chip; an integration of hardware, firmware, and software functionality

Chip Design Affects Virtualization Capabilities

Replicated Server Chip Design

Cache

Processor Speed

Workload

Workload

Workload

RAS

Chip Real Estate

Consolidated Server Chip Design

Cache

Processor Speed

Workload

Workload

Workload

Workload

RAS

Chip Real Estate

- Mixed workloads stress cache usage, requiring more context switches
- Working sets may be too large to fit in cache
- "Fast" processor speed is not fully realized due to cache misses

- System z cache is able to contain more working sets
- Processor speed is optimized by increased cache usage
- Additional RAS function is beneficial for mixed workloads

System Design Affects Virtualization Capabilities

System z packs a lot of compute power into a single box
➲ With TCO-friendly pricing

Up to 54-way SMP
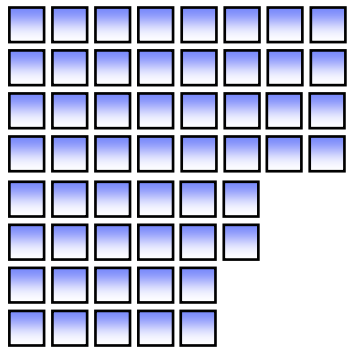
Share up to 54 processors with up to 60 LPARs

Configure these processors as CPs, IFLs, zAAPs*, zIIPs*, or ICFs*

* No software license fees

Up to 10 System Assist Processors
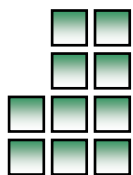
Offload system processing to dedicated CPUs with no impact to software license fees

Plus up to 336 I/O Processors
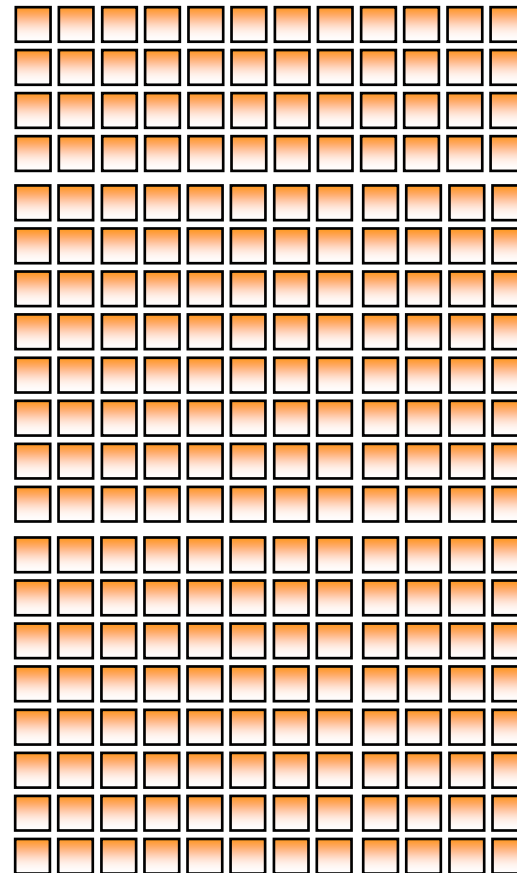
No additional charge for these processors

Sample z/VM IFL Configuration

IBM System z Server

z/OS	z/OS	z/OS
LPAR1	LPAR2	LPAR3

CP1 CP2 CP3 CP4 CP5 CP6

Production Systems

Linux

Devmt and Test Systems

Linux

z/VM

LPAR4

IFL1 IFL2 IFL3
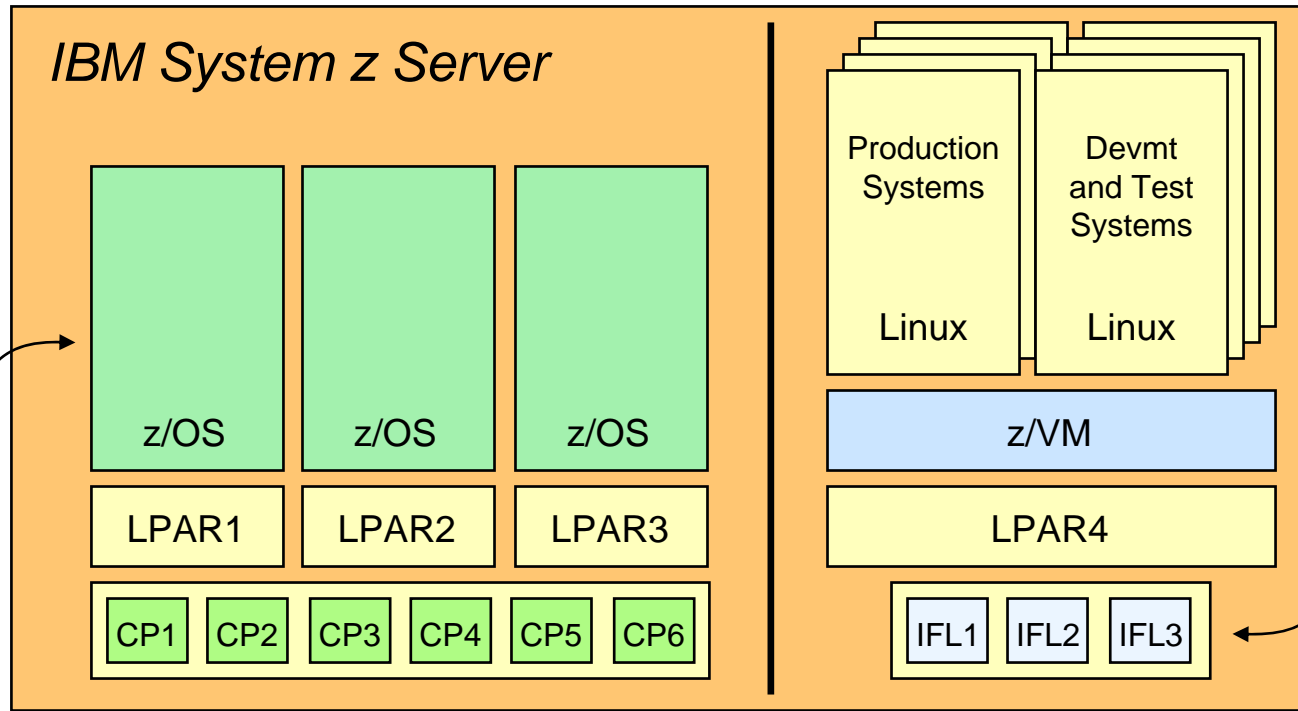
z/VM and most Linux software fees are priced on <u>real</u> <u>engine</u> capacity...

IFL engines have no impact on z/OS license fees

...another source of cost savings attributed to z/VM's ability to over-commit CPU capacity

3-engine z/VM V5 license charges*

Year 1:	$84,390	OTC plus S&S
Year 2:	$16,890	S&S only
Year 3:	$16,890	S&S only
3-Year Total:	$118,170	

*U.S. prices as of 1 June 2007

z/VM CPU Resource Controls
Highly Granular Sharing of System Resources

- **Allocate system resources per guest image using SHARE command**
  - This is a highly flexible and self-managed function of the z/VM Control Program
  - Reserve CPU capacity for peak usage
    - Use it when needed
    - Relinquish the processor cycles for other servers when not needed
  - "Absolute guests" receive top priority
  - The Virtual Machine Resource Manager can be used to monitor and adjust remaining capacity allocated to "Relative guests"

z/VM Directory Entries (or "on-the-fly" commands)

```
SHARE Lin1 ABSOLUTE 40% ABSOLUTE 60% LIMITSOFT
SHARE Lin2 ABSOLUTE 20% ABSOLUTE 30% LIMITHARD

SHARE Lin3 RELATIVE 200 RELATIVE 300 LIMITHARD
SHARE Lin4 RELATIVE 100 RELATIVE 200 LIMITSOFT
SHARE Lin5 RELATIVE 100 RELATIVE 200 LIMITSOFT
```
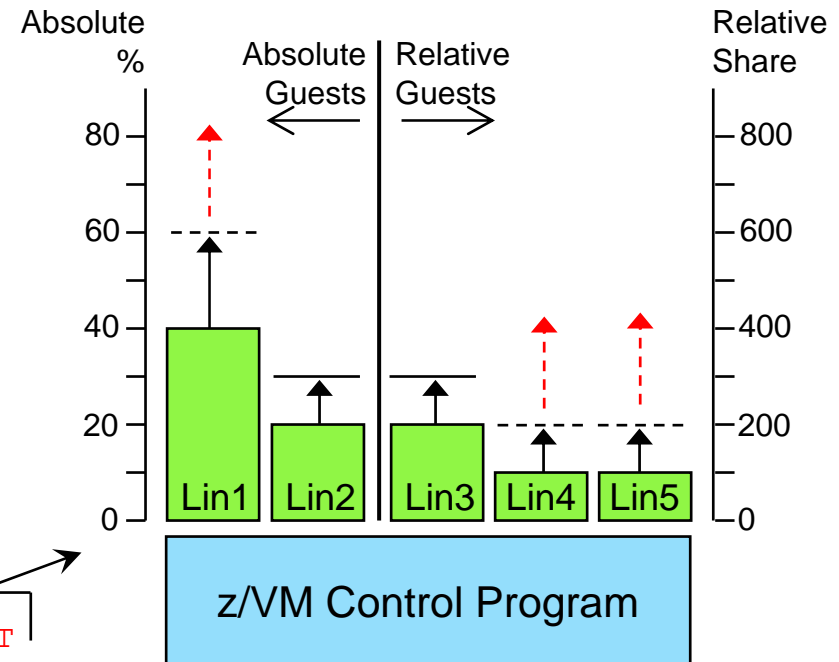

Notes:
- - - - - = limit can be exceeded if unused capacity is available (LIMITSOFT)

———— = limit will not be exceeded (LIMITHARD)

PR/SM High-Performance I/O Sharing (MIF)
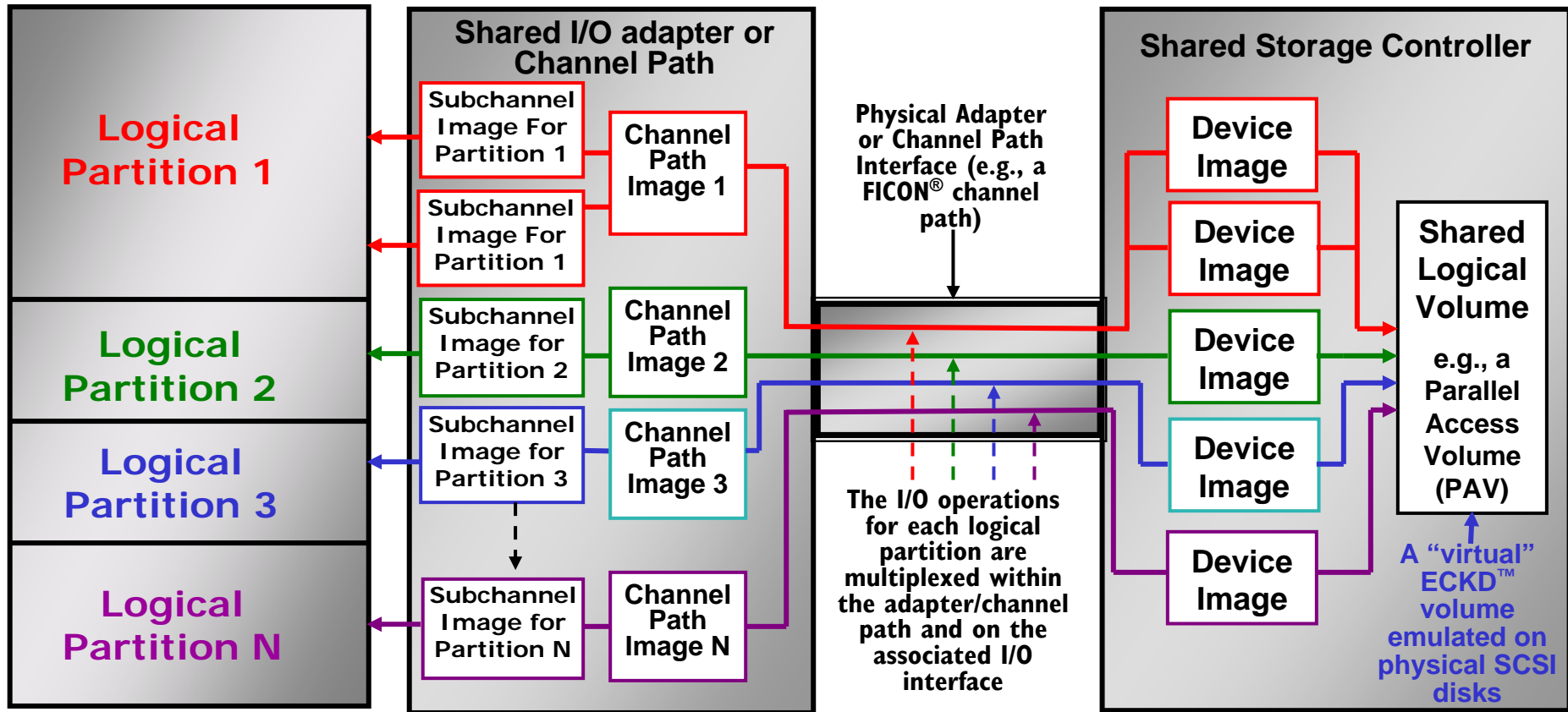
- **The I/O infrastructure (adapters/channels, their transmission links, and attached I/O resources) are shared by logical partitions at native speeds (without hypervisor involvement)**
  - I/O requests, their associated data transfers and I/O interruptions flow between each logical partition OS instance and the shared I/O components just as if the I/O components were physically dedicated to a single logical partition
  - Dynamic paths enables up to 8 physical channels (either dedicated or shared) to process the I/O requests to the shared devices; reduces possibility of I/O queuing delays at the channels or at the shared storage controller

System z and N_Port ID Virtualization (NPIV)

Without N_Port ID Virtualization

Linux3 Linux4

Linux1 Linux2 z/VM

No NPIV:
Hosted Linux images can access all the LUNs that are accessible to the real hardware channels.
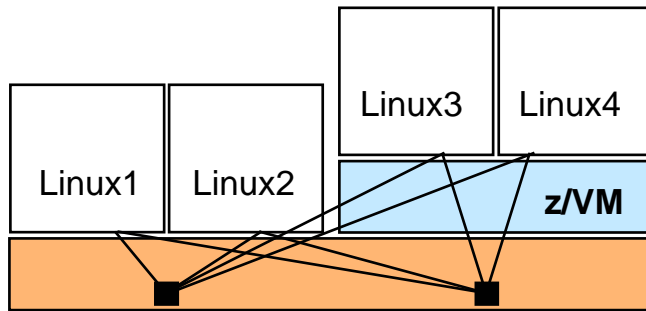
Linux1	Linux1	Linux1	Linux1
Linux2	Linux2	Linux2	Linux2
Linux3	Linux3	Linux3	Linux3
Linux4	Linux4	Linux4	Linux4

Problem!

With N_Port ID Virtualization

Linux3 Linux4

Linux1 Linux2 z/VM

With NPIV:
Each Linux image is separately authorized via zoning and LUN-masking with a unique WWPN for each subchannel or virtual host-bus adapter.

Linux1	Linux2	Linux3	Linux4
Linux2			
Linux3			
Linux4			
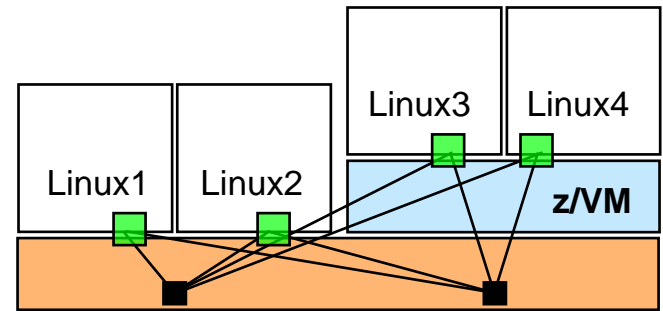
■ = virtual Worldwide Port Name (WWPN)

Linux and z/VM Technology Exploitation
Cooperative Memory Management (CMM)

- **Problem scenario: virtual memory utilization far exceeds real memory availability**

- **z/VM Control Program paging operations become excessive**

- **Overall system performance and guest throughput suffers**
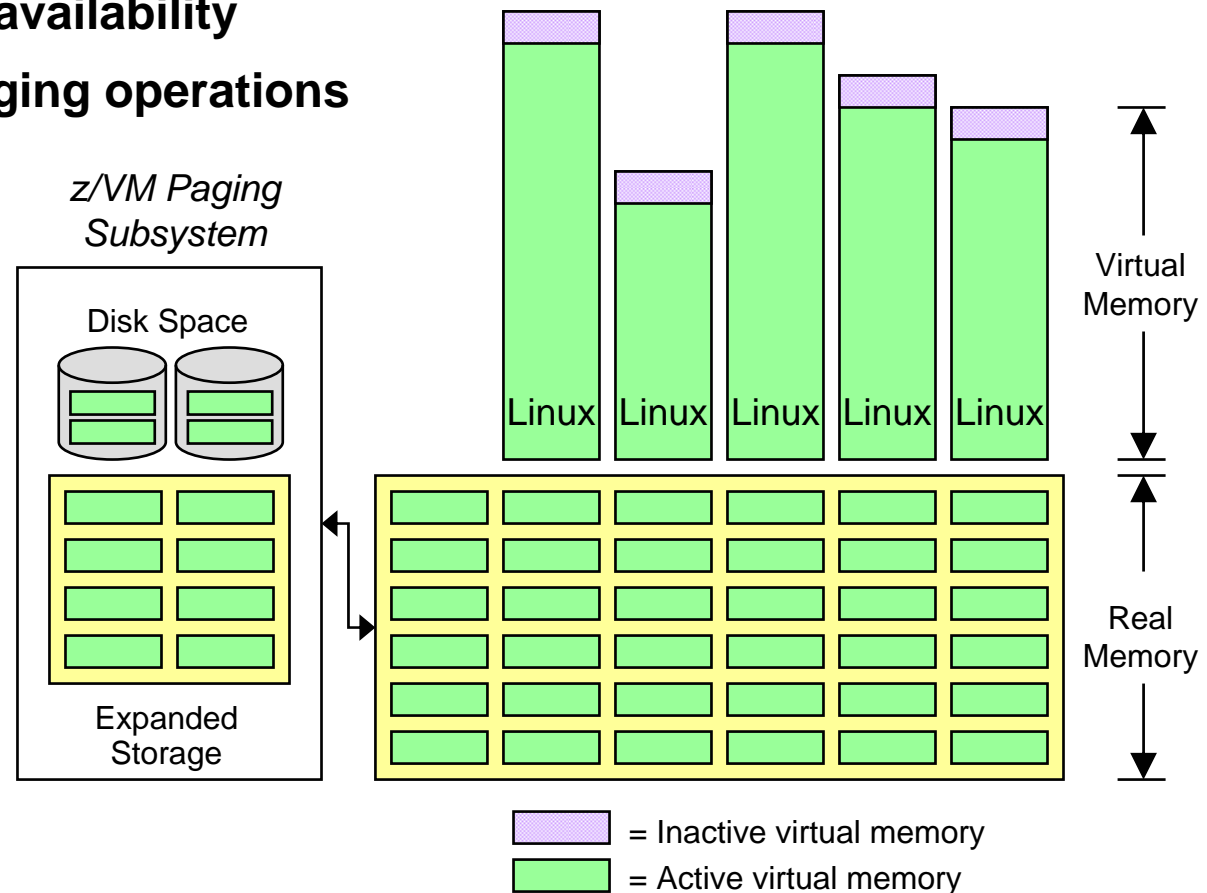
z/VM Paging Subsystem

Disk Space

Expanded Storage

Linux Linux Linux Linux Linux

Virtual Memory

Real Memory

▢ = Inactive virtual memory

▢ = Active virtual memory

Linux and z/VM Technology Exploitation
Cooperative Memory Management (CMM)

- **Solution: real memory constraint detected by z/VM *Virtual Machine Resource Manager***

- **Linux images signaled to reduce virtual memory consumption**

- **Linux memory pages are released**

- **Demand on real memory and z/VM paging subsystem is reduced**

- **Helps improve overall system performance and guest image throughput**
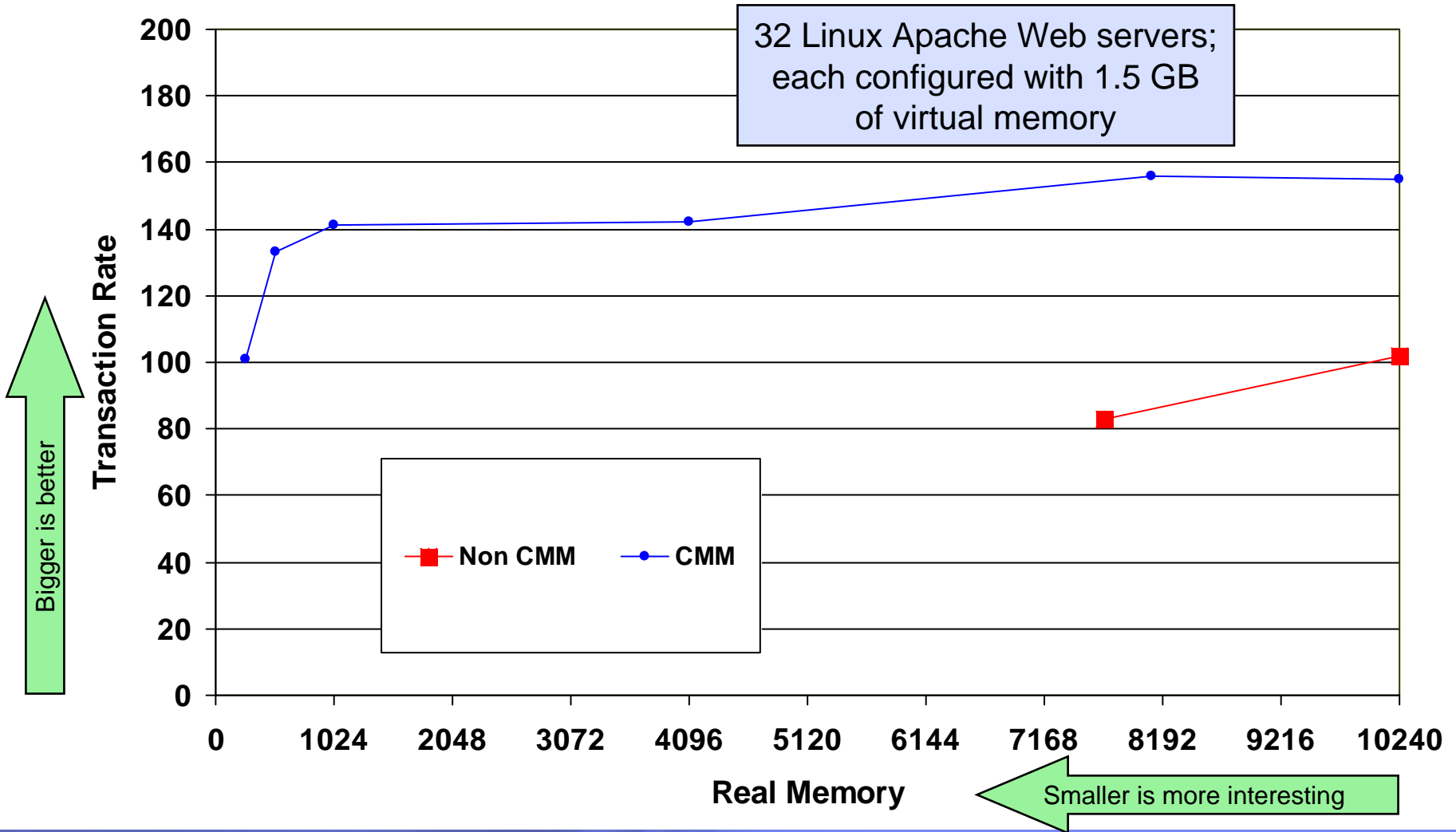
Learn more at:
ibm.com/servers/eserver/zseries/zvm/sysman/vmrm/vmrmcmm.html

z/VM Paging Subsystem

Disk Space

Expanded Storage

Virtual Machine Resource Manager

Linux | Linux | Linux | Linux | Linux

Virtual Memory

Real Memory

▨ = Inactive virtual memory

▩ = Active virtual memory

Linux and z/VM Technology Exploitation
Cooperative Memory Management (CMM)

- **Solution: real memory constraint detected by z/VM *Virtual Machine Resource Manager***

- **Linux images signaled to reduce virtual memory consumption**

- **Linux memory pages are released**

- **Demand on real memory and z/VM paging subsystem is reduced**

- **Helps improve overall system performance and guest image throughput**

z/VM Paging Subsystem

Disk Space

Expanded Storage

Virtual Machine Resource Manager

Linux   Linux   Linux   Linux   Linux

Virtual Memory

Real Memory

▨ = Inactive virtual memory

▨ = Active virtual memory
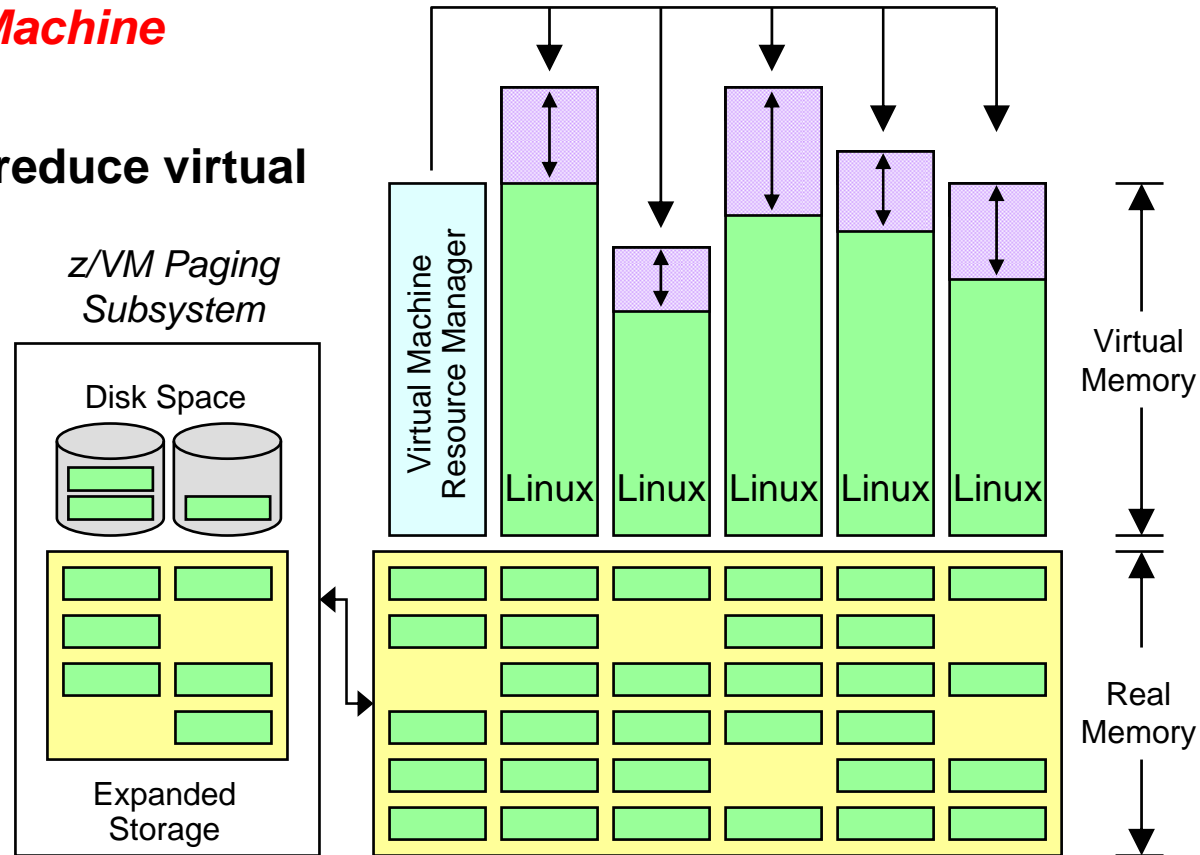
Learn more at:
ibm.com/servers/eserver/zseries/zvm/sysman/vmrm/vmrmcmm.html

Cooperative Memory Management with Linux on z/VM
Apache Web Serving Example

32 Linux Apache Web servers; each configured with 1.5 GB of virtual memory

Bigger is better

Transaction Rate

Non CMM   CMM

Real Memory   Smaller is more interesting

Linux and z/VM Technology Exploitation
Collaborative Memory Management Assist (CMMA)

- **Extends coordination of memory and paging between Linux and z/VM to the level of individual pages using a new hardware assist (*CMMA*)**

- **z/VM knows when a Linux application has released a page of memory**

- **Host Page-Management Assist (*HPMA*), in conjunction with CMMA, further reduces z/VM processing needed to resolve page faults**

- **Can help z/VM host more virtual servers in the same amount of memory**

- **Supported by System z9 and z/VM V5.3**

- **IBM is working with its Linux distribution partners for exploitation support**

z/VM Paging Subsystem

Disk Space

Expanded Storage

Linux | Linux | Linux | Linux | Linux

Virtual Memory

Real Memory

= Unused
= Stable
= Volatile
= Volatile discarded
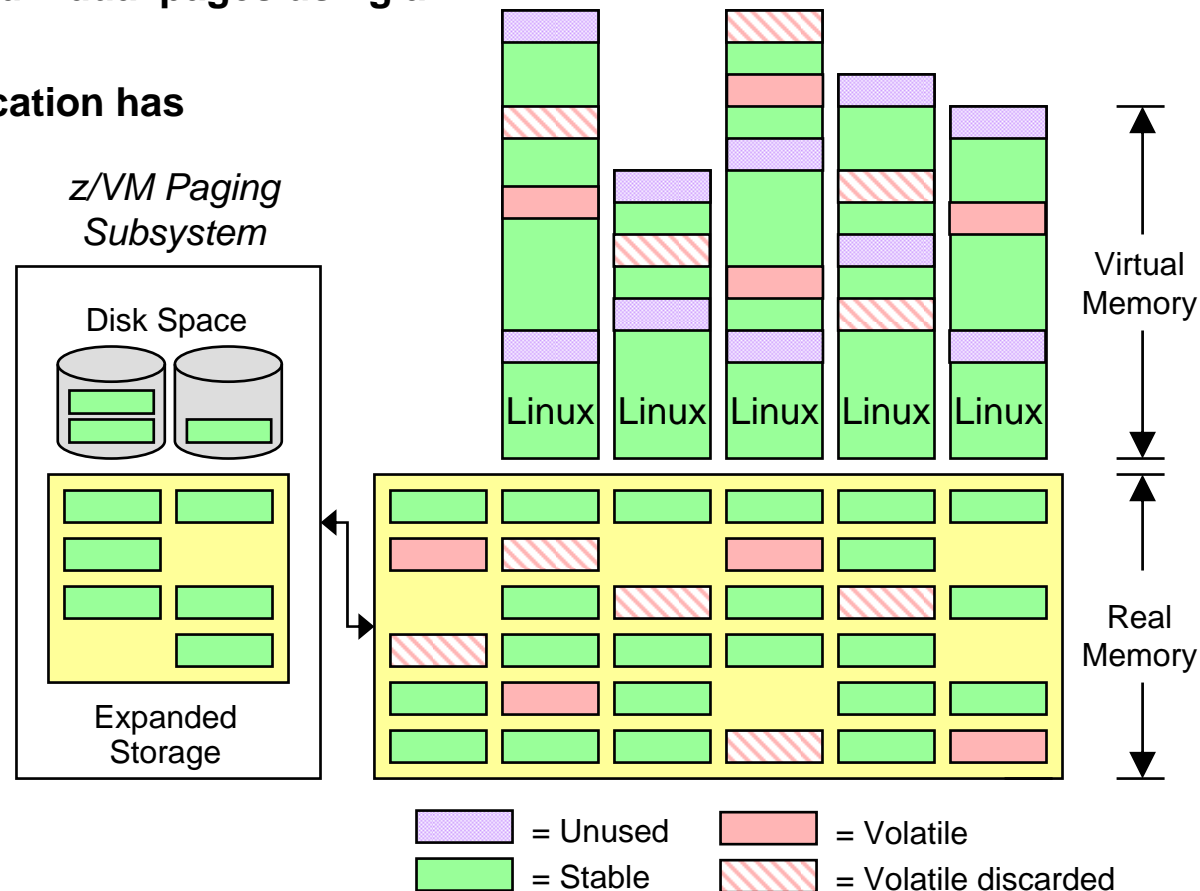
Linux and z/VM Technology Exploitation
Linux Exploitation of z/VM Discontiguous Saved Segments (DCSS)

- **DCSS support is Data-in-Memory technology**
  - Share a single, real memory location among multiple virtual machines
  - High-performance data access
  - Can reduce real memory utilization
- **Linux exploitation: shared program executables**
  - Program executables are stored in an execute-in-place file system, then loaded into a DCSS
  - DCSS memory locations can reside outside the defined virtual machine configuration
  - Access to file system is at memory speeds; executables are invoked directly out of the file system (no data movement required)
  - Avoids duplication of virtual memory and data stored on disks
  - Helps enhance overall system performance and scalability

Virtual Memory

Real Memory
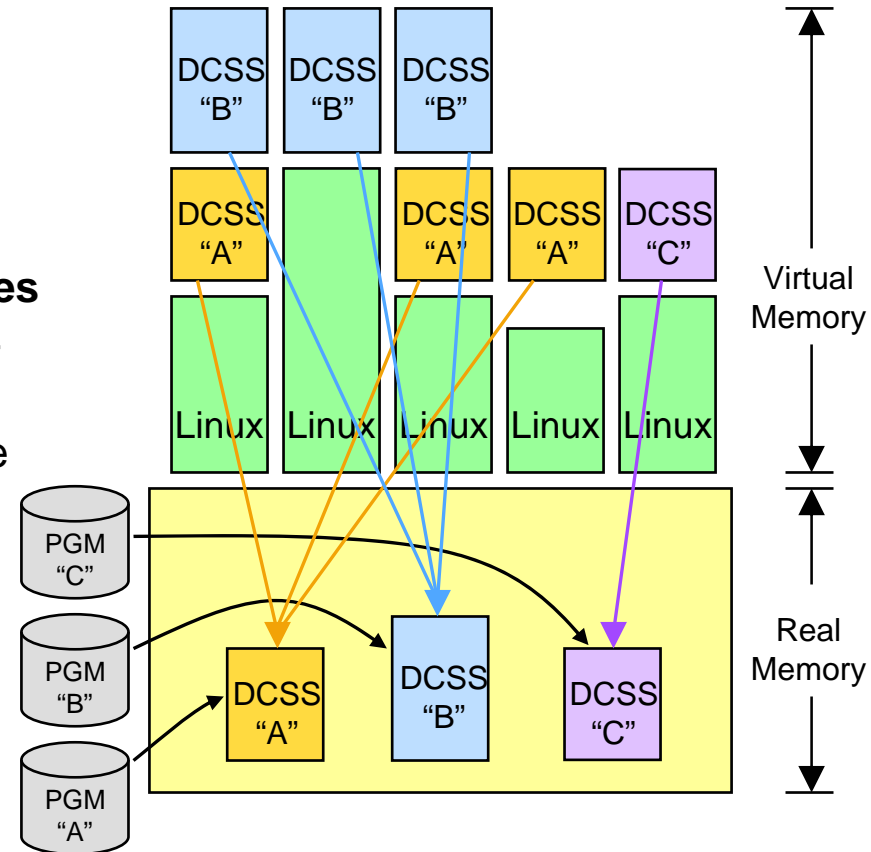
Learn more:
"Using DCSS/XIP with Oracle 10g on Linux for System z"
www.redbooks.**ibm.com**/redpieces/abstracts/sg247285.html

© 2007 IBM Corporation

Linux and z/VM Technology Exploitation
Linux Exploitation of z/VM Virtual Disks in Storage (VDISK)

- **VDISK support is Data-in-Memory technology**
  - Simulate a disk device using real memory
  - Achieve memory speeds on disk I/O operations
  - VDISKs can be shared among virtual machines

- **Linux exploitation: high-speed swap device**
  - Use VDISKs for Linux swap devices instead of real disk volumes
  - Reduces demand on I/O subsystem
  - Helps reduce the performance penalty normally associated with swapping operations
  - An excellent configuration tool that helps clients minimize the memory footprint required for virtual Linux servers
  - Helps improve the efficiency of sharing real resources among virtual machines
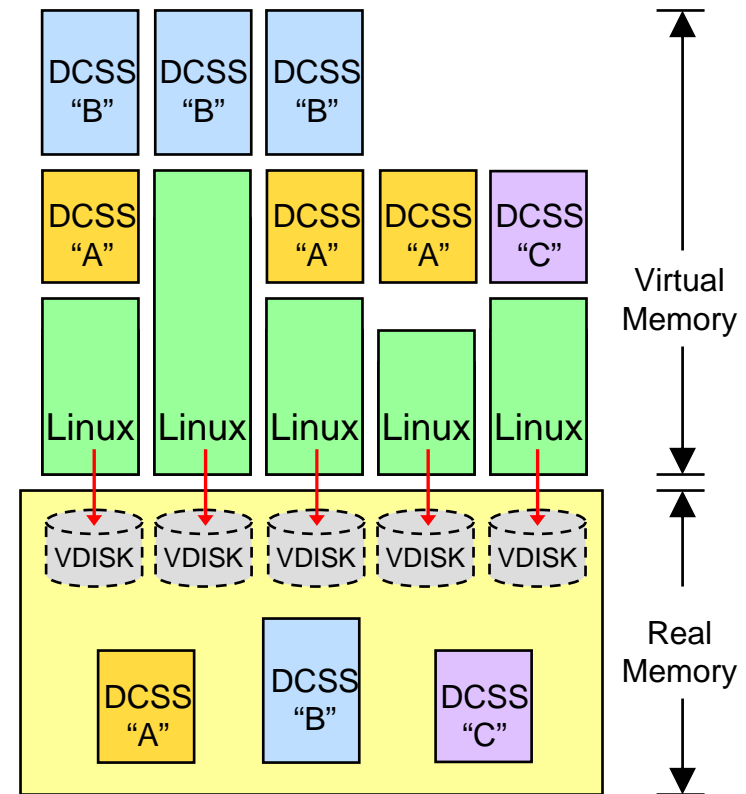
z/VM Technology – Command and Control Infrastructure
Leveraging the IBM Software Portfolio

1. Send all Linux console output to a single CMS virtual machine.

Virtual Servers

2. Use PROP and REXX™ to interrogate console messages.

PROP REXX

CMS

Virtual Console

Linux

3. Initiate hypervisor commands on behalf of Linux servers.

On-the-fly debug

CP

Hypervisor Operations

CP Monitor

Performance Toolkit for VM

CMS

Realtime Graphs

Reports, Historical Data
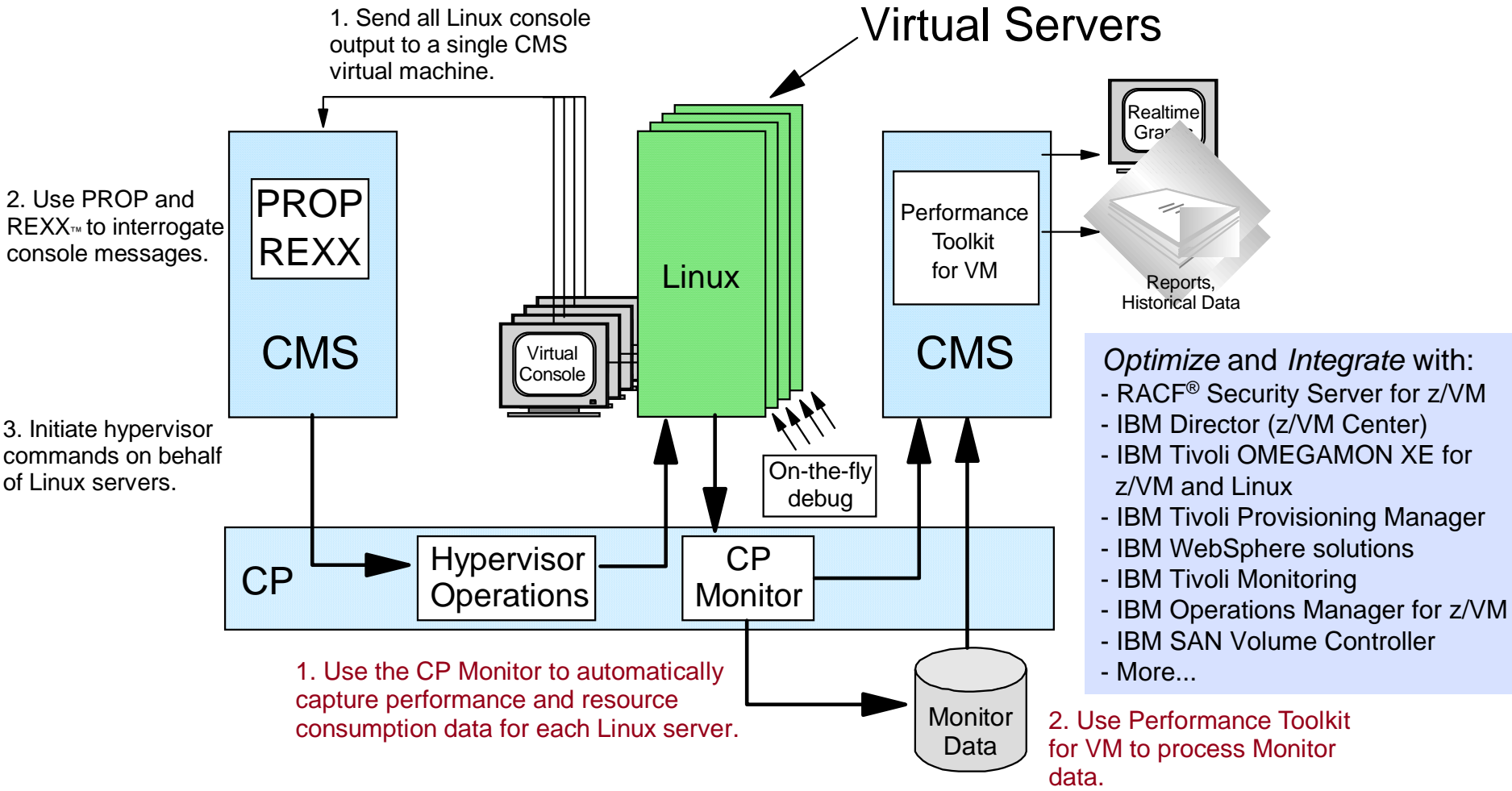
Optimize and *Integrate* with:
- RACF® Security Server for z/VM
- IBM Director (z/VM Center)
- IBM Tivoli OMEGAMON XE for z/VM and Linux
- IBM Tivoli Provisioning Manager
- IBM WebSphere solutions
- IBM Tivoli Monitoring
- IBM Operations Manager for z/VM
- IBM SAN Volume Controller
- More...

1. Use the CP Monitor to automatically capture performance and resource consumption data for each Linux server.

Monitor Data

2. Use Performance Toolkit for VM to process Monitor data.

GDPS/PPRC Multiplatform Resiliency for System z
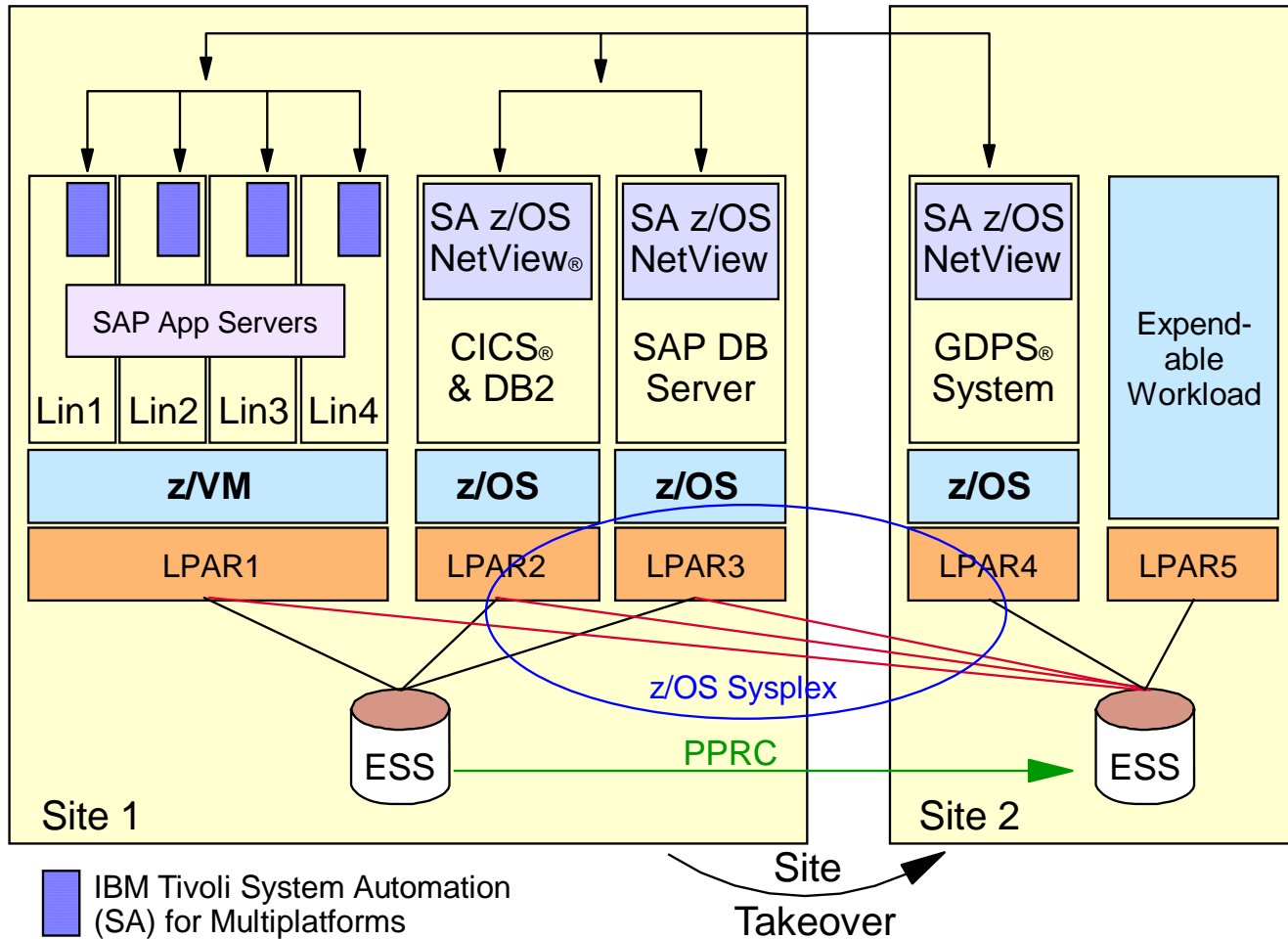
- **Designed for customers with distributed applications**

- **SAP application server running on Linux for System z**

- **SAP DB server running on z/OS**

- **Coordinated near-continuous availability and DR solution for z/OS, Linux guests, and z/VM**

- **Uses z/VM HyperSwap function to switch to secondary disks**

- **Sysplex support allows for site recovery**

Key Virtualization Product Releases
Since Last Year's zSummit

- **z/VM V5.3**

- **IBM Director V5.20 (with z/VM Center)**

- **IBM Tivoli OMEGAMON XE for z/VM and Linux V4.1**

- **IBM Tivoli Provisioning Manager V5.1**

- **IBM Backup and Restore Manager for z/VM V1.2**

- **IBM SAN Volume Controller V4.1**

z/VM Version 5 Release 3

Refer to IBM Software Announcements 207-019 (February 6, 2007) and 207-135 (June 12, 2007)

Provisioning Virtual Linux Servers on System z
Using IBM Director for Linux on System z V5.2 with z/VM Center

IBM Director Base Functions

- Discovery
- Group Management
- Inventory
- Basic Resource Monitor
- Event Action Plan (EAP)
- Process Management
- Remote Session
- File Transfer
- Network Configuration
- Software Distribution
- SNMP Browser

z/VM Center

- Utility Service Configuration Manager **New**
- z/VM Virtual Server Deployment
- z/VM Server Complexes

Software Distribution Premium Edition **New**

- Software package distribution