

Effectively running Linux on IBM System z in a virtualized environment and cloud



Enterprise2013

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Why Linux on and System z is a great Linux

- Linux is Linux - but inherits System z – characteristics like extreme virtualization
- System z the largest scalable server
- Reliability and availability of System z
- High Availability of System z and zEnterprise - out of the box
- System z servers can virtualize everything with up to 100% utilization rates

Linux on IBM System z

- About
- Software
- Solutions
- Support and services
- Resources
- Success stories
- Education
- News

Linux on System z - Why

It's efficient

An Ideal platform for optimized Workload deployment

Why Linux on System z

Advantages

Get started

Linux on System z: simple, efficient, secure.

Linux on System z servers can do more with less, providing IT organizations a robust and effective workload deployment platform for consolidation, to eliminate server sprawl and complexity, as well as re-deployment and new workload deployment. Linux on System z benefits from the open standards and the unmatched power of the IBM System z server and virtualization technologies.

Linux on System z can help on a smarter IT infrastructure that:

- Provides efficiency at scale
- Delivers industry-leading virtualization for effective deployment
- Enables flexible delivery of services through a private cloud
- Delivers real-time information and insight from data
- Provides unmatched security and reliability

The cost benefits

Linux on System z can help lower your IT costs by running up to thousands of virtual Linux servers concurrently with ensured isolation of each virtual server. Consolidation of distributed servers and new workload deployment onto a single IBM System z server provide cost reduction opportunities in:

- **Software licensing**
Linux on System z can fully leverage the IBM System z server and virtualization capabilities, for example, with a zEnterprise EC12 (zEC12) you can consolidate up to 48 virtualized x86 cores (Sandy Bridge) or more on a single IFL core or thousands in a single footprint¹. Software licensing costs can be reduced due to the fact that Linux software is usually priced on a per-core basis.
→ Shelter Mutual Insurance Company slashes costs and complexity
- **Administration and management**
Linux on System z allows running many virtual Linux servers onto a single physical server. A consolidation onto System z results in reduced numbers of servers and network components, and fewer components lead to a simpler and less complex IT infrastructure which requires less administration and maintenance efforts.
→ The City and County of Honolulu creates a customized cloud

We're here to help

Easy ways to get the answers you need.

➔ Request a quote

✉ E-mail IBM

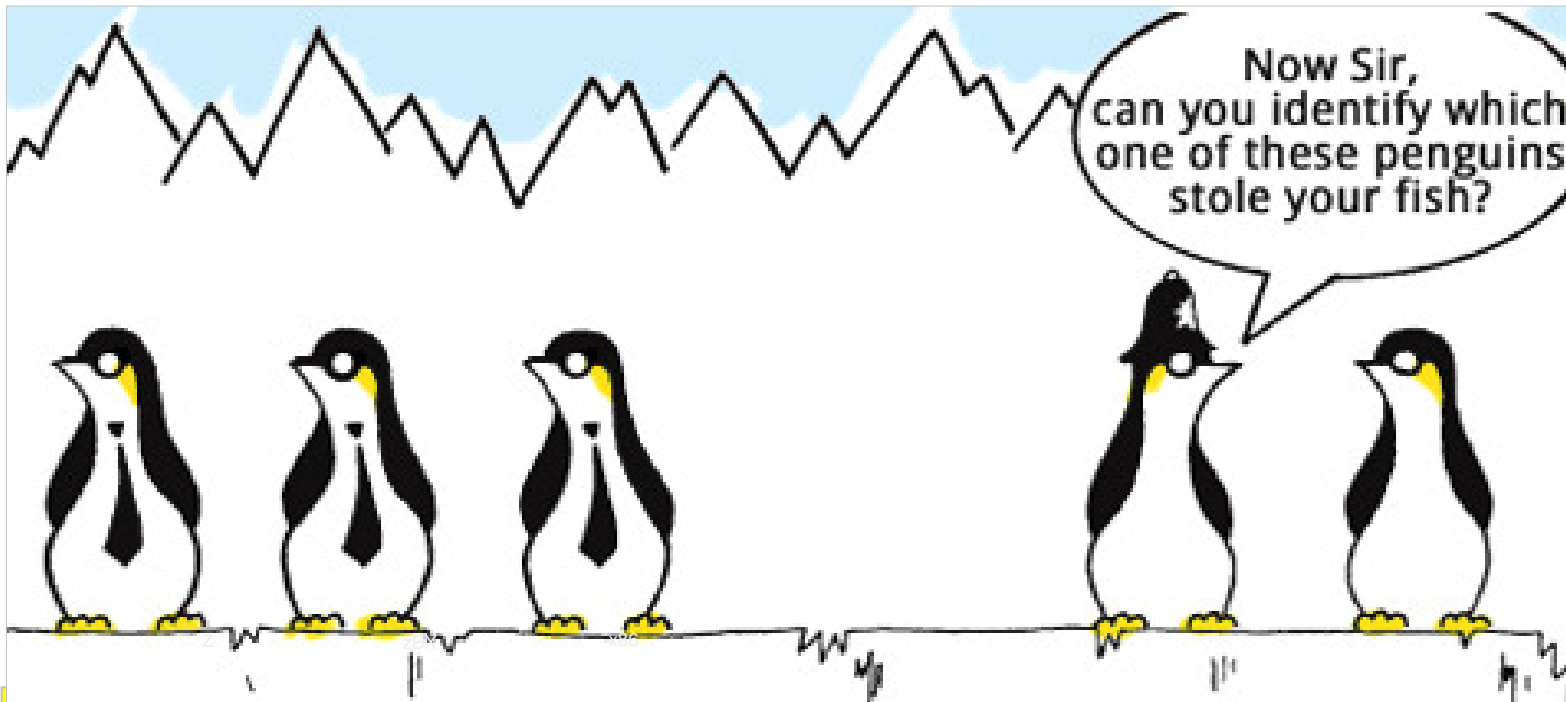
or call us at 866-883-8901
Priority code: 101AS13W

→ Learn from Linux on System z success stories

<http://www-03.ibm.com/systems/z/os/linux/about/index.html>



Virtualized environment on Linux - but what's best



The **Linux's all look the same** (on different architectures) and have the same Linux kernel source.

But they have **different personalities, qualities, features** and **options** derived from the architectures.



Linux on System z has a Continuous Focus on Characteristics the Workload Benefits from

Security Capabilities:

- Centralized Authentication,
- Cryptographic Acceleration,
- Regulatory requirements, Identity management, Common Criteria Certification, Image Isolation,
- Physically secure communications with HiperSockets™ and Guest LANs

Consolidation Capabilities:

- Server, Network, Storage, Applications, hosting of different workloads at the same time

Business Resiliency Capabilities:

- High Availability,
- Disaster Recovery, Serviceability, Reliability,
- Storage failover (HyperSwap™), Data replication (XRC, PPRC)

Operational Simplification Capabilities:

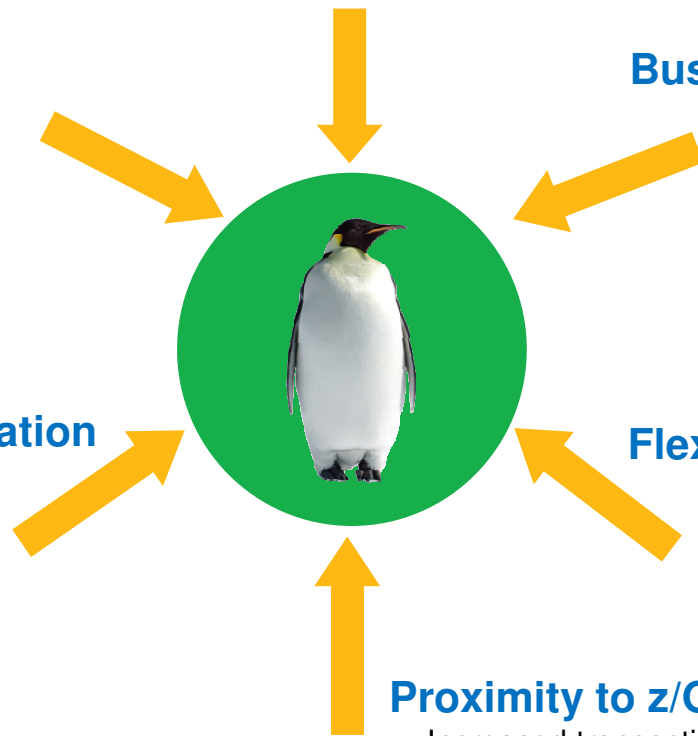
- Virtualization,
- Resource Sharing
- Single Point of Control,
- Single System Image,

Flexibility / On demand Capabilities:

- Mixed Workloads: Scale-up & scale-out,
- Rapid server (de)commissioning,
- Idle Servers don't consume resources

Proximity to z/OS managed Data:



- Increased transaction throughput, HiperSockets
- Shared data access
- Integrated storage management



What is Virtualization and why is it important ?

Virtualization is the logical representation of resources not constrained by physical limitations

- Enables user flexibility
- Centrally manage many resources as one
- Dynamically change and adjust across the infrastructure
- Create many virtual resources within single physical device
- Eliminates trapped capacities



IBM Virtualization

A comprehensive platform to help virtualize the IT infrastructure



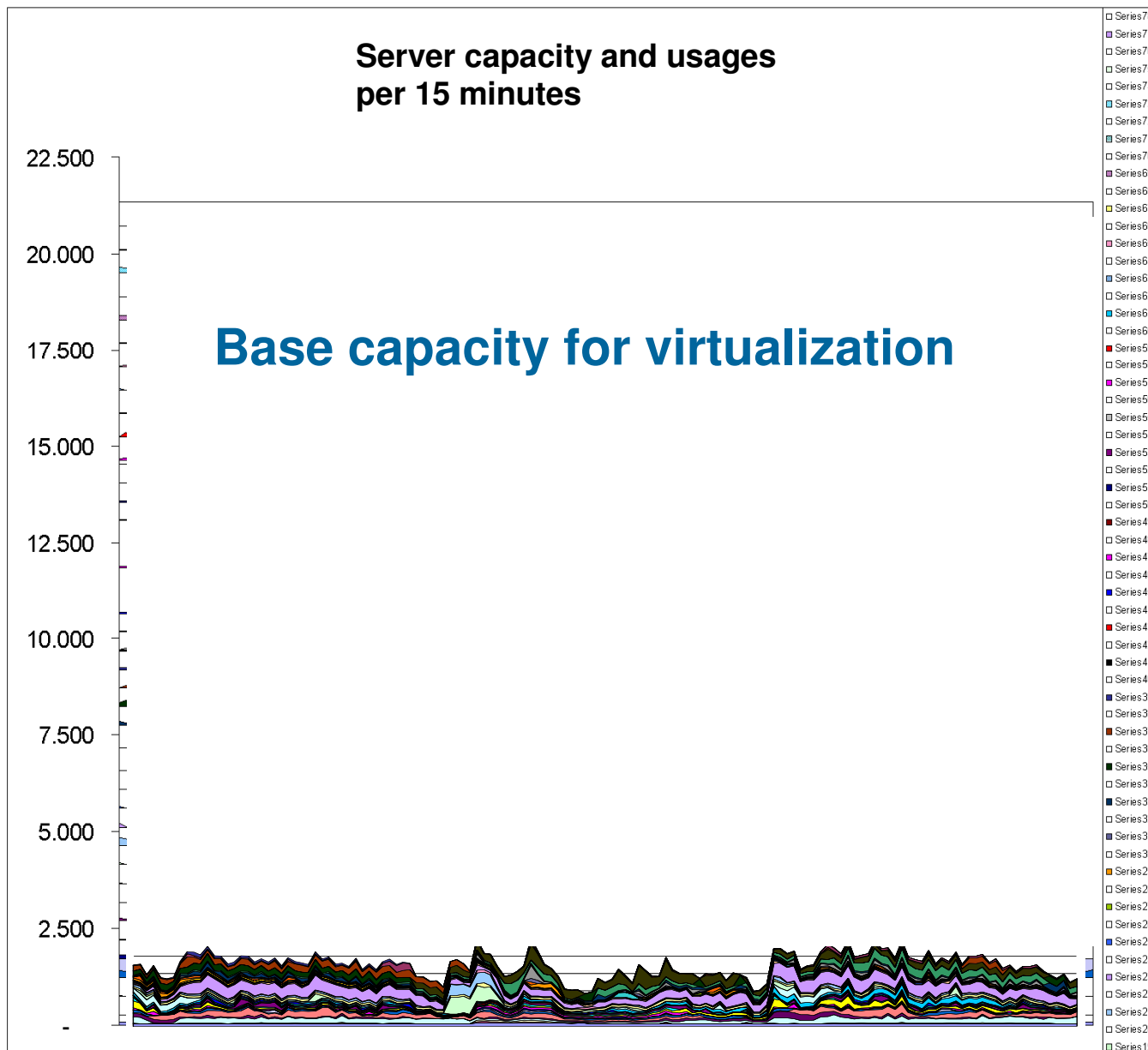
Terminology – ‘Virtualization’

- If it's there and you can see it - it's real.
- If it's there and you can't see it - it's transparent.
- If it's not there and you can see it - it's virtual.
- If it's not there and you can't see it - you erased it.



Accumulated USED Distributed Server capacity

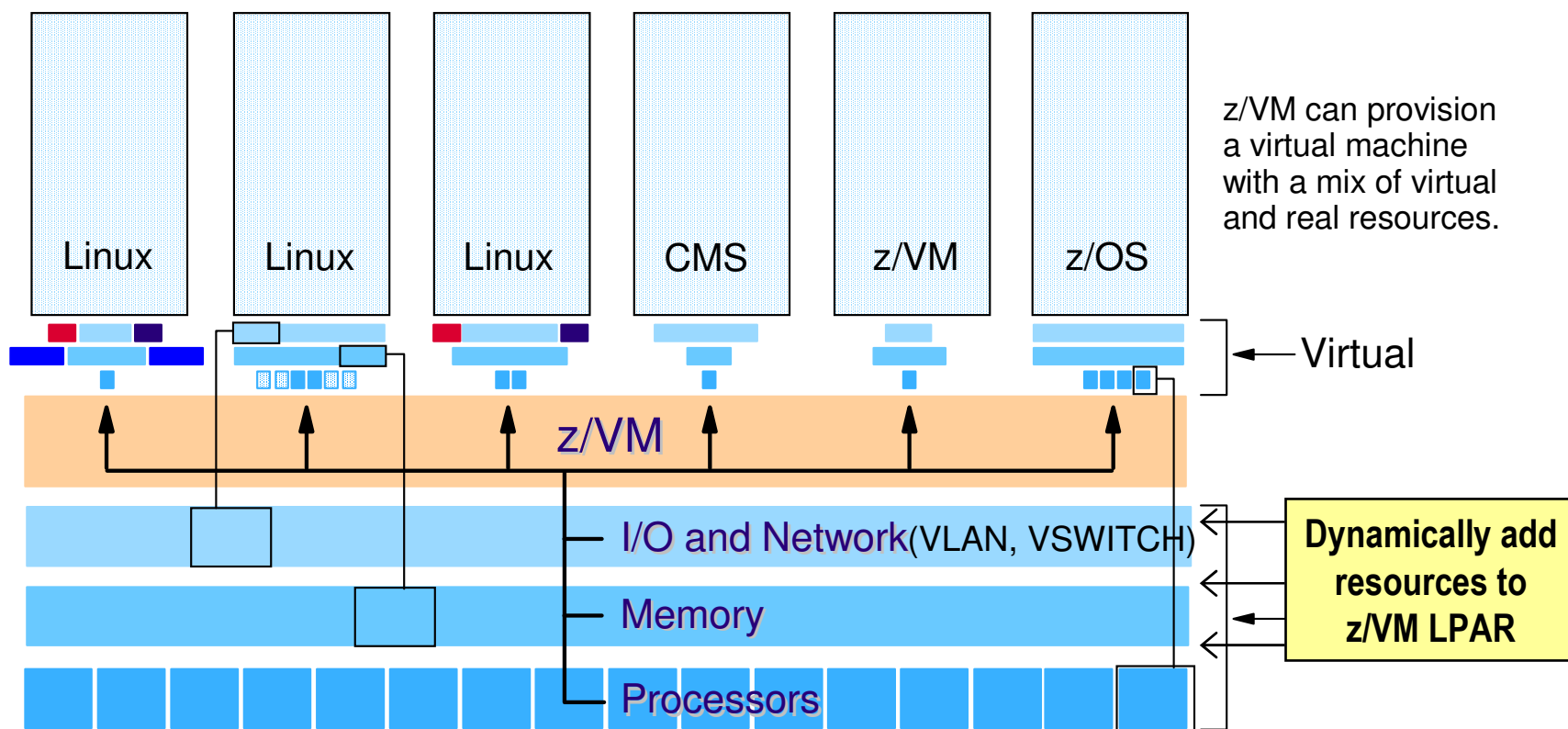
RPE2
 (Relative Performance Estimate
 from Ideas International™)



Global Virtualization in System z and zEnterprise

z/VM Technology: Share everything

- z/VM simulates the existence of a dedicated real machine, including processor functions, storage, and input/output resources.
- z/VM includes network Virtualization, high availability and integrated security between VMs
- It supports uniquely, **over commitment on all levels.**
- z/VM Virtualizes in a single virtualization Layer different workloads

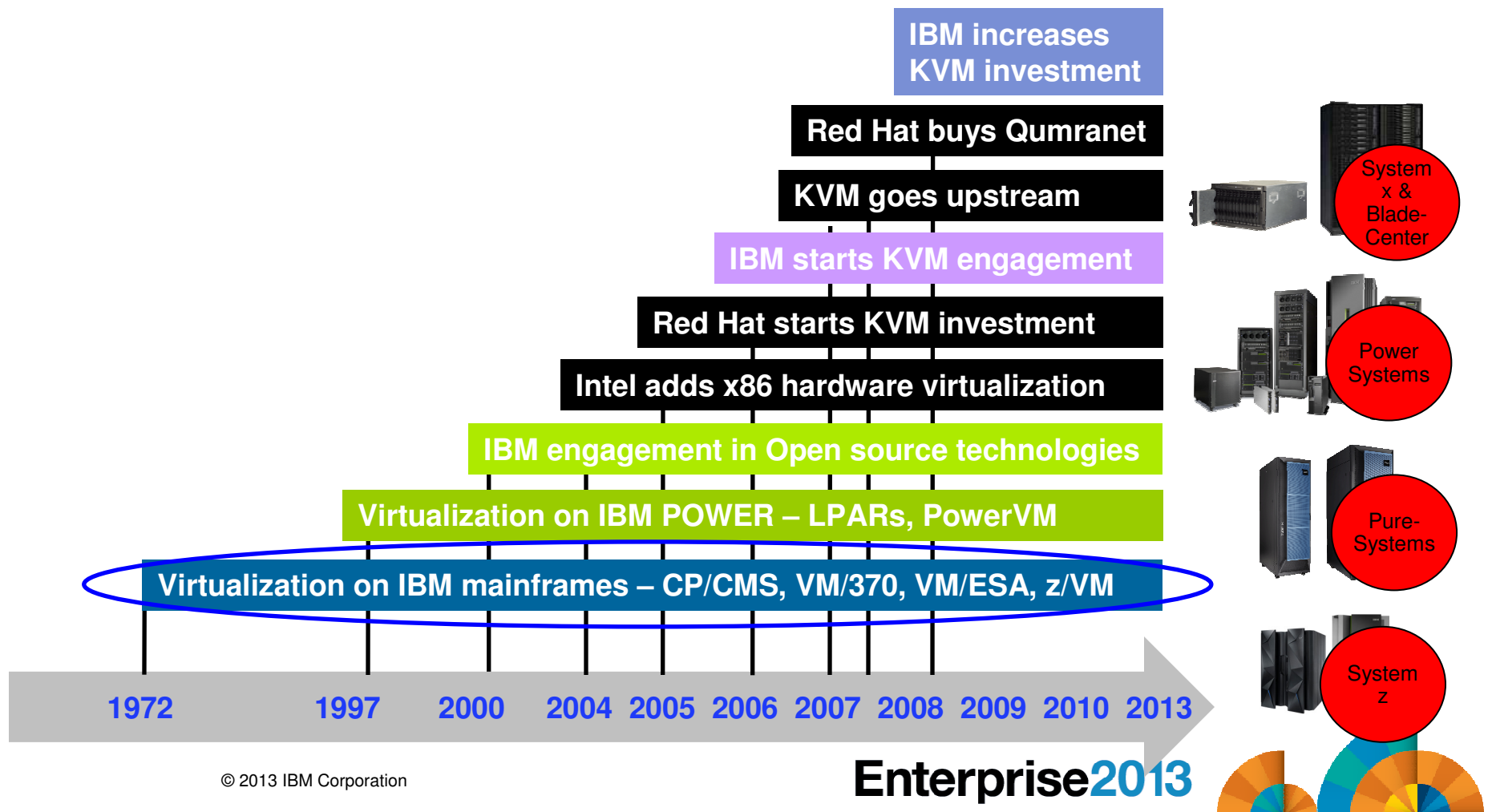


Linux on z/VM is the industry's most advanced virtual solution



A Brief History of IBM and Virtualization

IBM has 40 years of experience in virtualizing our servers. Virtualization was originally developed to make better use of critical hardware. Hardware support for virtualization has been critical to its adoption.



System z Multidimensional Virtualization Technology

Build-in and Shared Everything Architecture

Start Interpretive Execution (SIE)

Hardware assisted virtualization

Most sophisticated and functionally complete hypervisors

Able to **host** Linux, z/VM and z/VM-on-z/VM, z/OS, z/VSE, z/TPF
Highly **granular** resource sharing (less than 1% utilization)
Intelligent and **autonomic** workload management

Shared executables and filesystems

Less administration and reduced memory

Resources can be over-committed

CPU: up to 3:1 Memory 2 to 4:1

Internal high speed TCP/IP communication

Hipersocket, VLAN, Virtual Switches, Virtual Routers, Virtual Firewalls, CQ

HW (LPAR) and SW (z/VM) hypervisors

Linux virtual servers runs on bare metal but under control of hypervisor.

I/O is transparent to hypervisor

LPAR - PR/SM - SIE - EAL 5 Up to 60 Logical Partitions

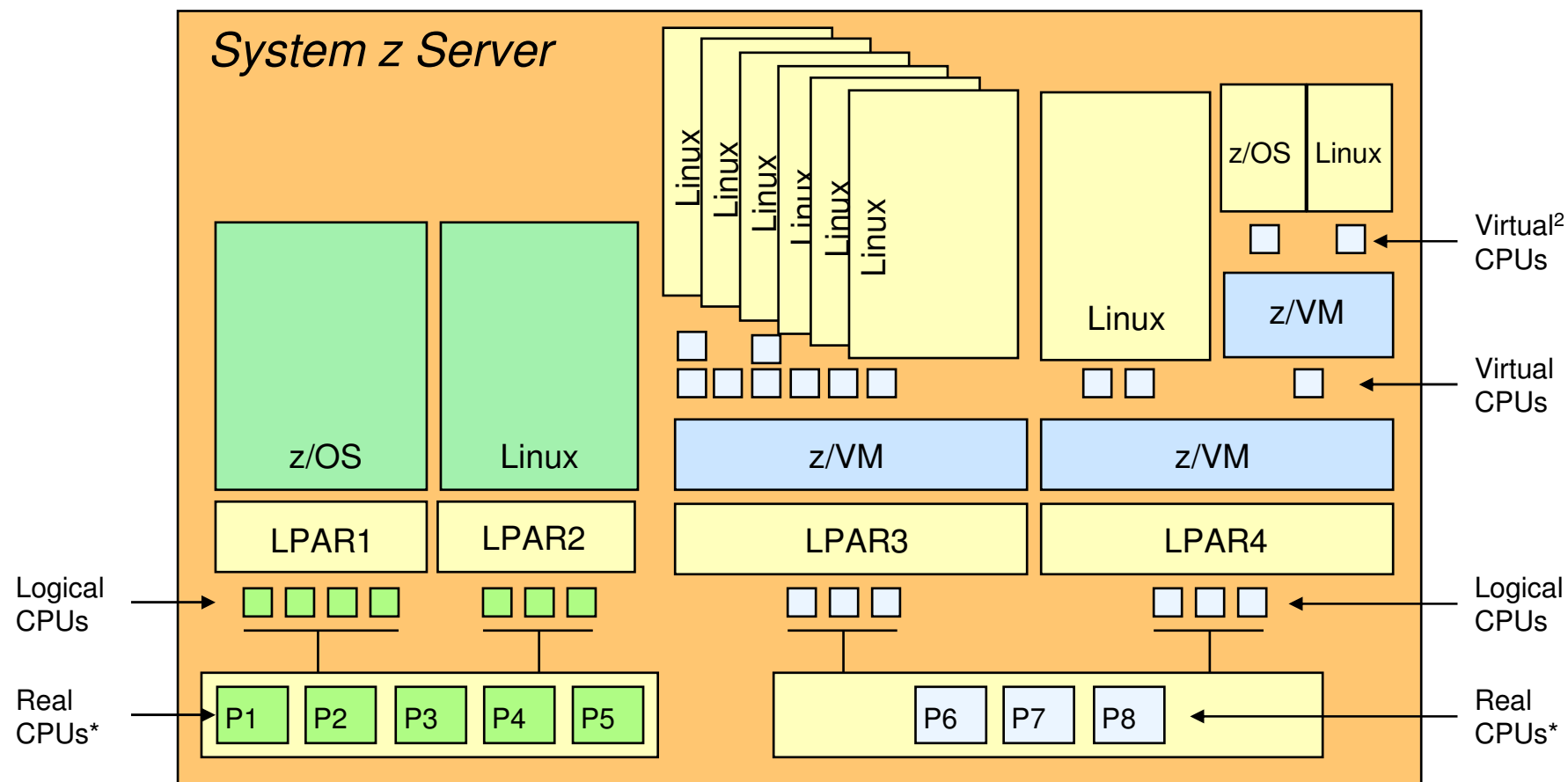
z/VM - SIE - EAL 4+ - 100s of Virtual Machines - Shared Memory

Maximum security and capacity isolation between virtual Linux servers



Effective via System z Virtualization

Note: There are typically dozens or hundreds of Linux servers in a z/VM LPAR.



P1 – P8 are Central Processors (CP) or Integrated Facility for Linux (IFL) Processors

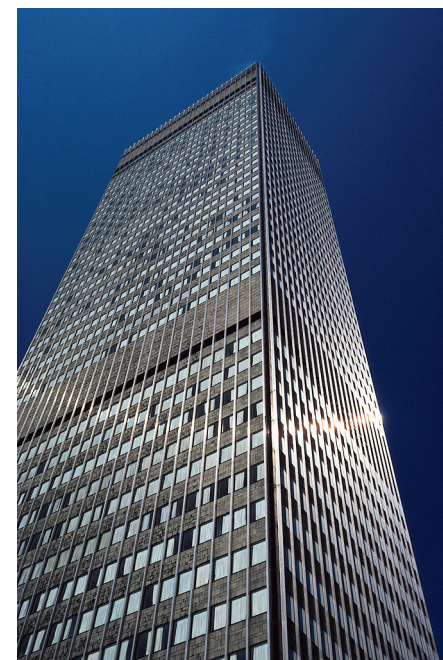
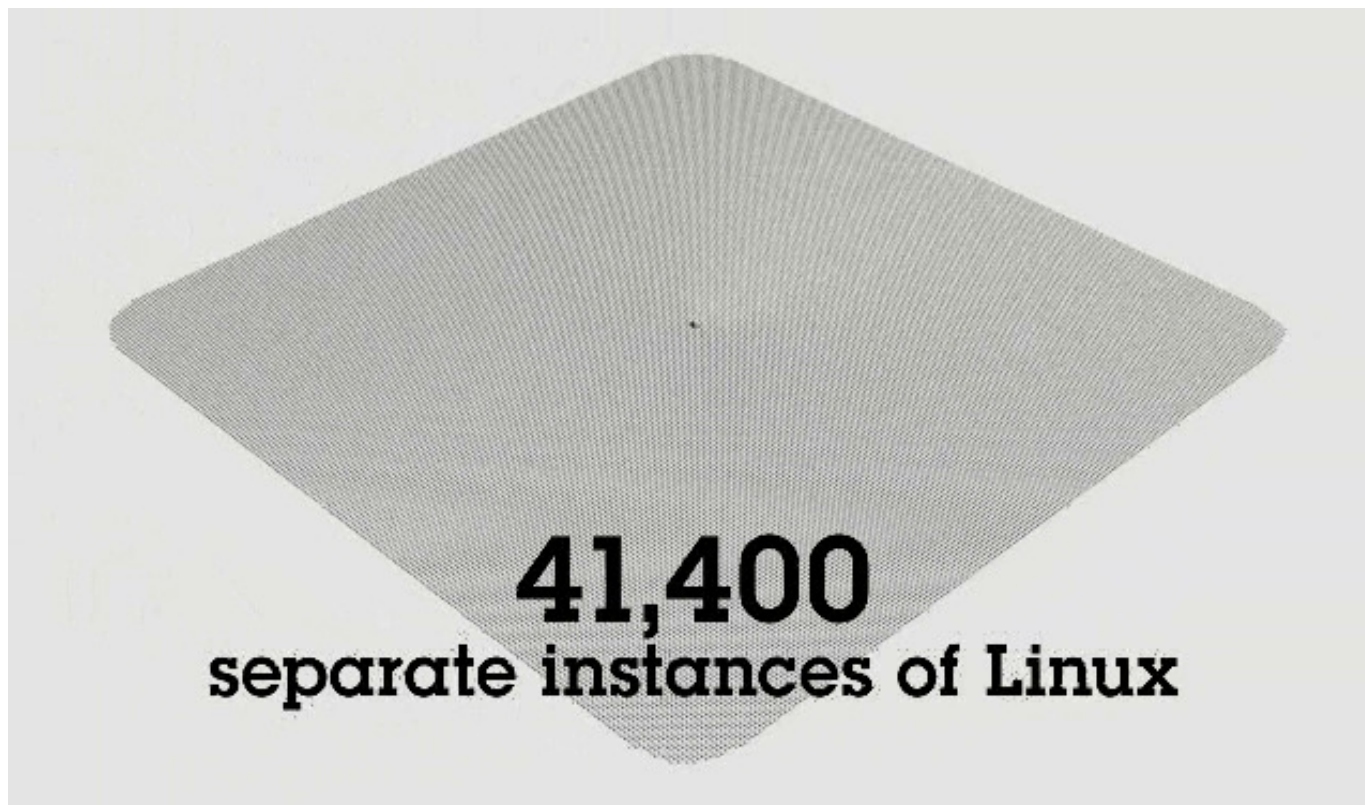
* - One shared Pool of CPUs per machine (CEC) only



Effectively running Linux on IBM System z in a virtualized environment and cloud

IBM Virtualization on System z, with Linux on System z

-Scalable to thousands of Linux guests

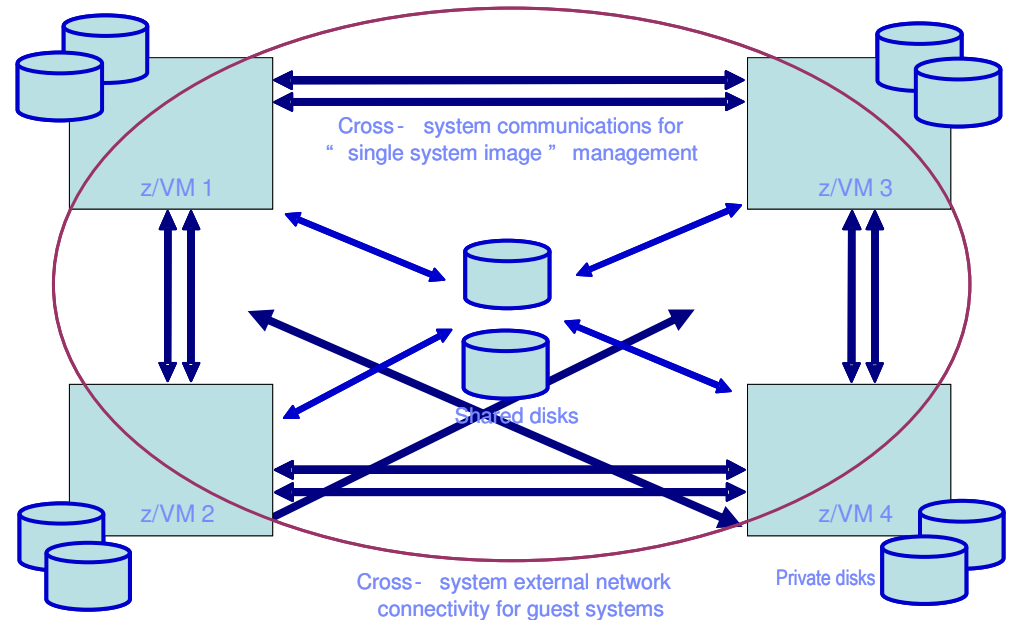


Increased flexibility in virtualization

Single System Image (SSI) Feature

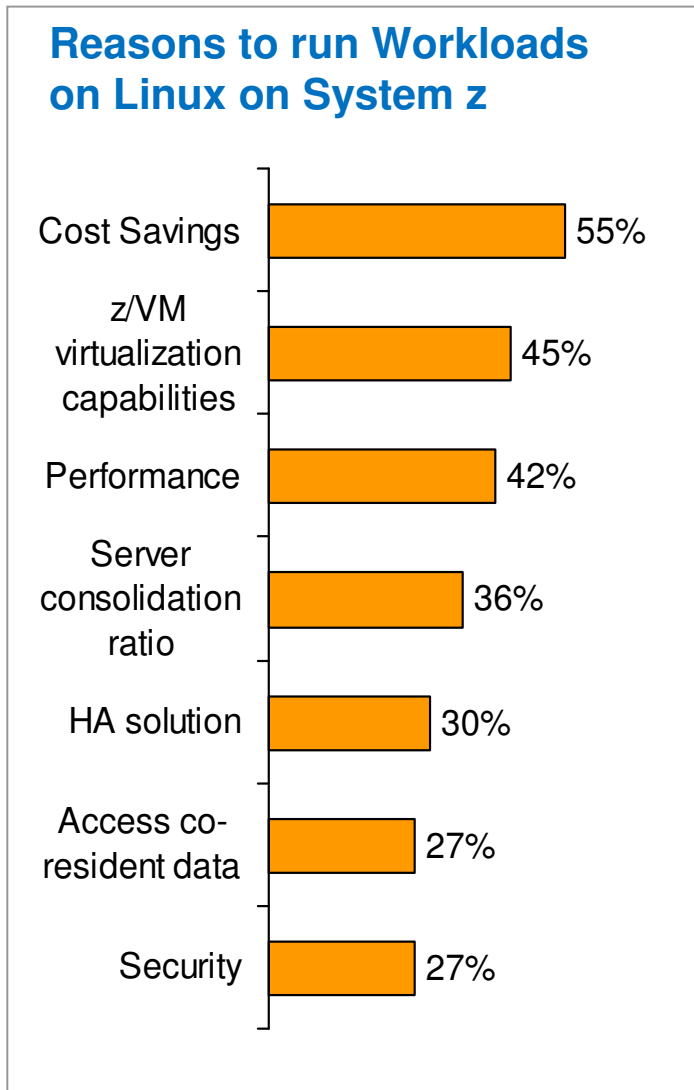
Clustered Hypervisor with Live Guest Relocation

- **Single System Image (SSI)**
 - Connect up to four z/VM systems as members of a Single System Image cluster
 - Cluster members can be run on the **same or different System z servers**
- Simplifies management of a multi-z/VM environment
 - Single user management
 - Cluster management from any member
 - Apply maintenance to all members in the cluster from one location
 - Issue commands from one member to operate on another
- **Live Guest Relocation (LGR)**
 - Non-disruptively move Linux guests from one z/VM member to another
 - Reduce planned outages
 - Enhance workload management

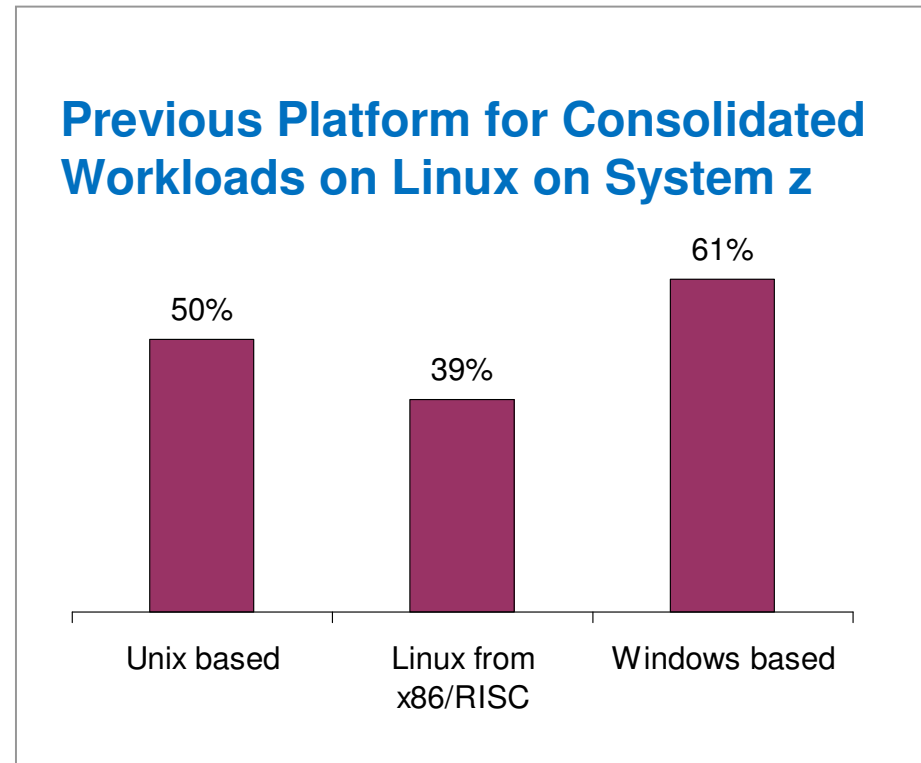


Client feedback from IBM Systems Directions Study

Consolidation and Virtualization together increase the effectiveness



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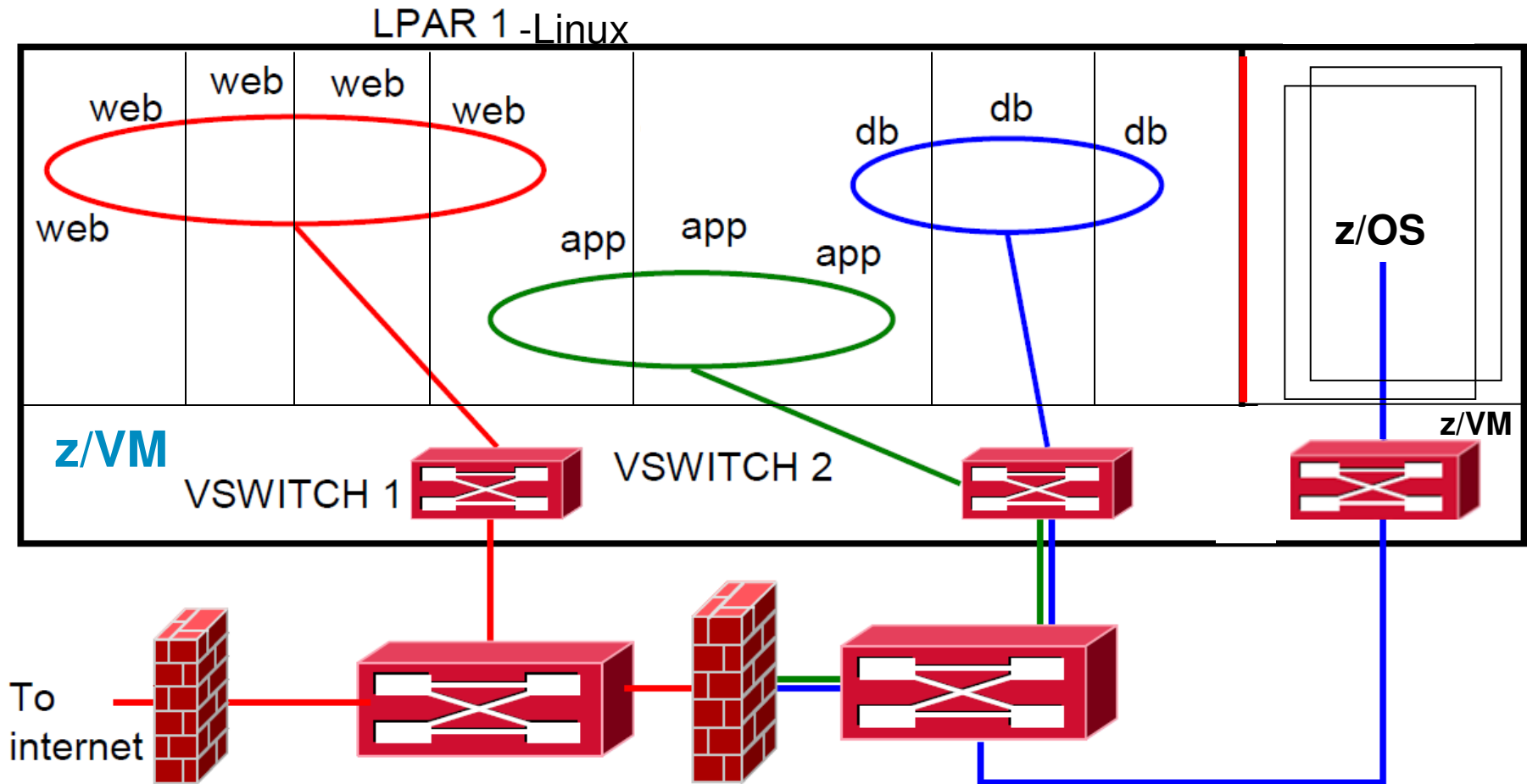
Source: March 2012 IBM Market Intelligence, Percentage of survey respondents



Effectively running Linux on z virtualized with z/VM



z/VM Multi-zone Network VSWITCH (red - physical isolation)



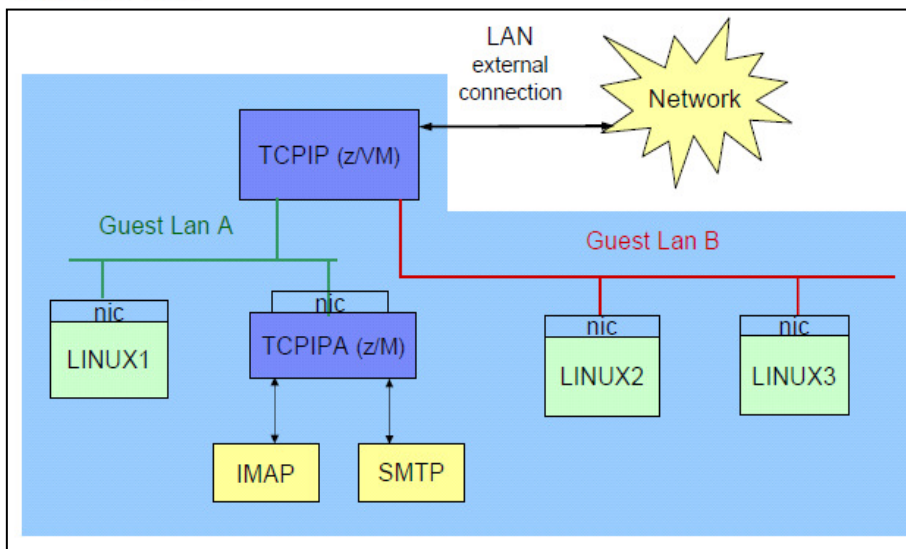
With 2 VSWITCHes, 3 VLANs, and a multi-domain firewall



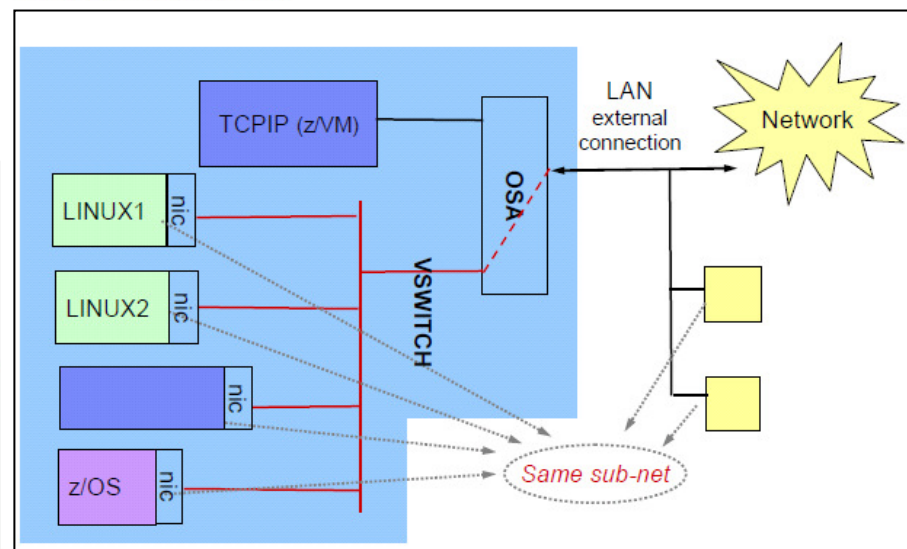
Network Virtualization - in z/VM

- z/VM virtualizes network connectivity
 - VLAN
 - VSWITCH
- Virtual connectivity uses memory to memory connections
 - Very high bandwidth
 - Low latency
 - Internal – no physical devices

Guest LAN

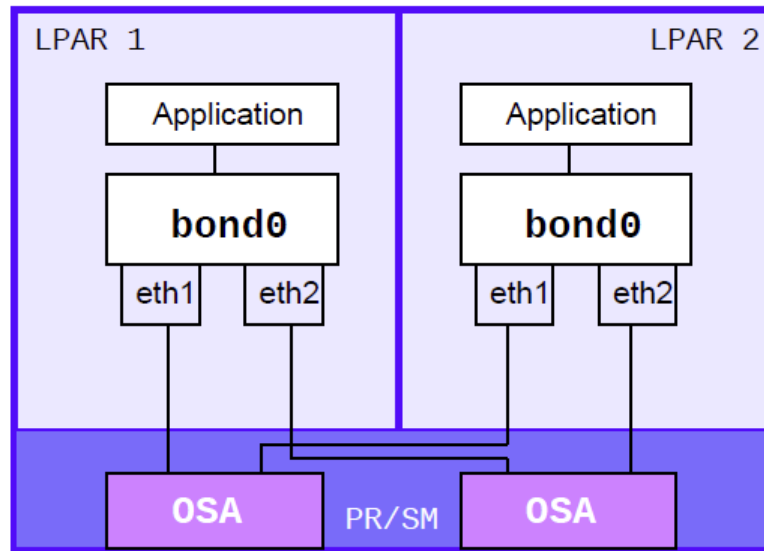


Virtual SWITCH



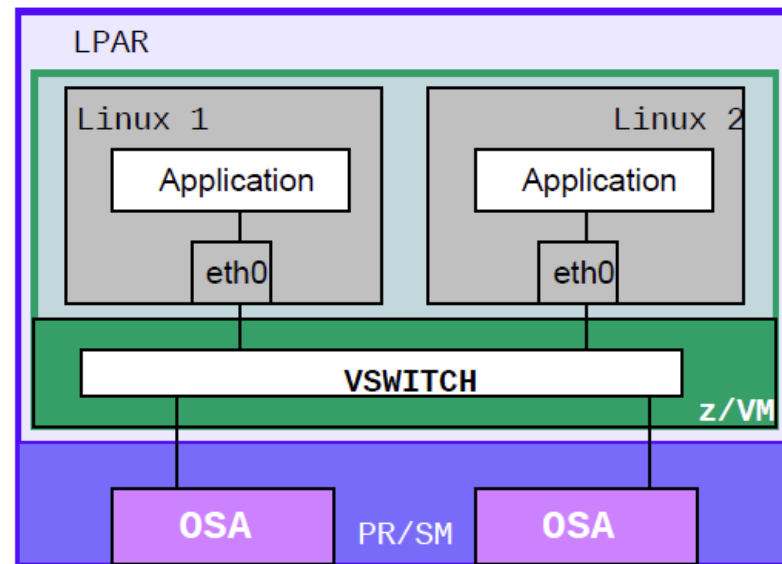
System z virtual network bandwidth enhancement and Automated Failover

Resource Virtualization: OSA Channel Bonding in Linux on z



- Linux *bonding* driver enslaves multiple OSA connections to create a single logical network interface card (NIC)
- Detects loss of NIC connectivity and automatically fails over to surviving NIC
- Active/backup & aggregation modes
- **Separately configured for each Linux**

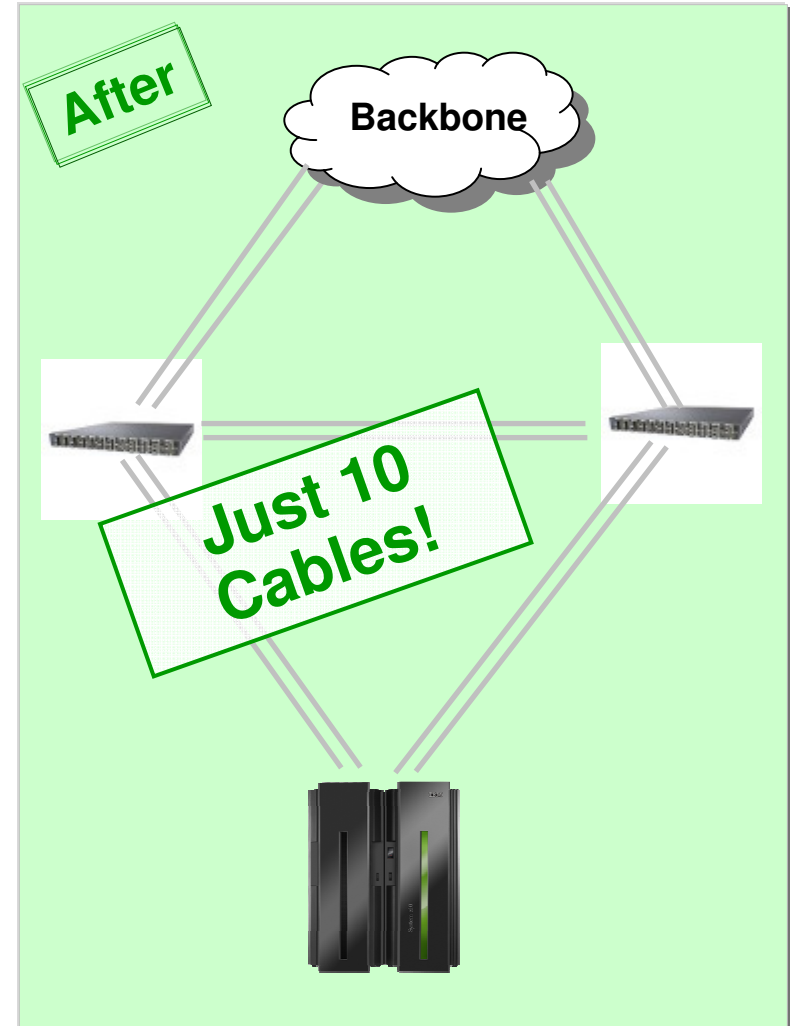
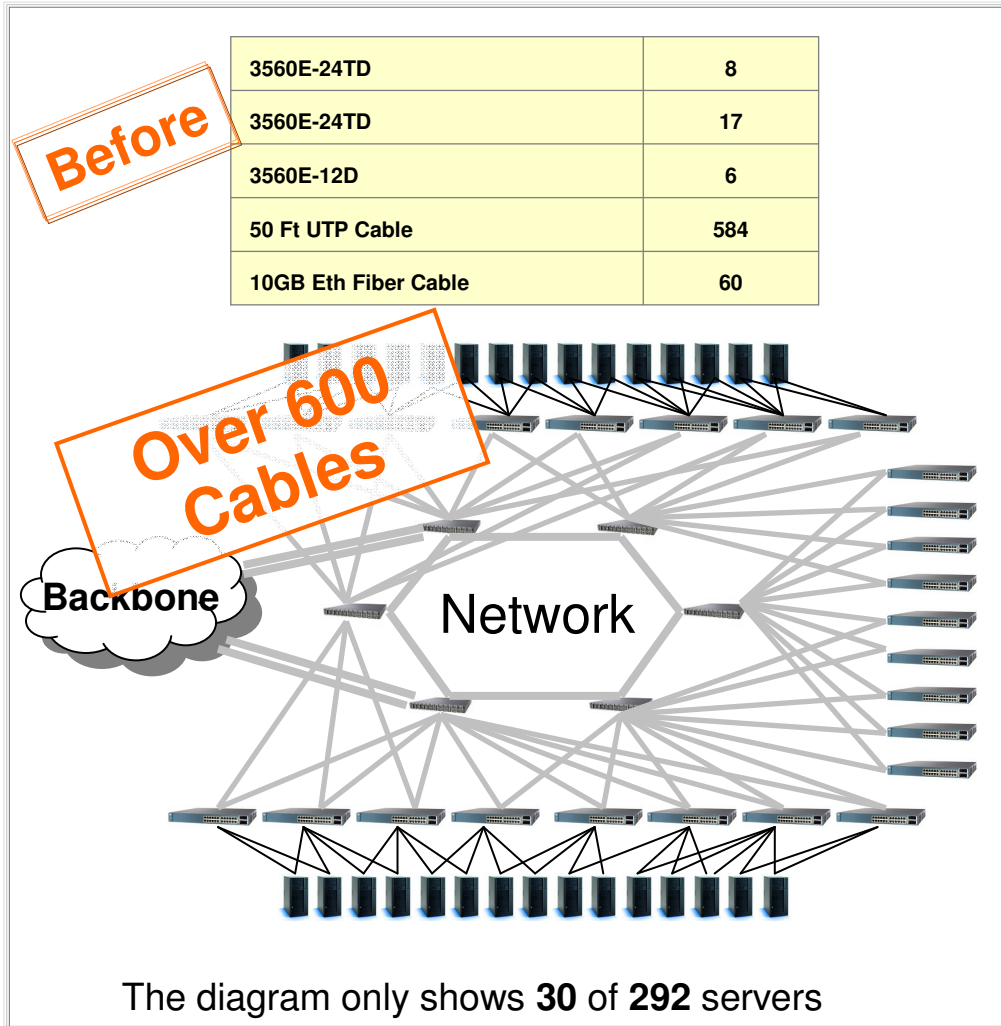
Network Virtualization: z/VM Port aggregation



- z/VM *VSWITCH* enslaves multiple OSA connections. Creates virtual NICs for each Linux guest
- Detects loss of physical NIC connectivity and automatically fails over to surviving NIC
- Active/backup & aggregation modes
- **Centralized configuration benefits all guests**



Insurance Company Consolidated 292 Servers to one System z

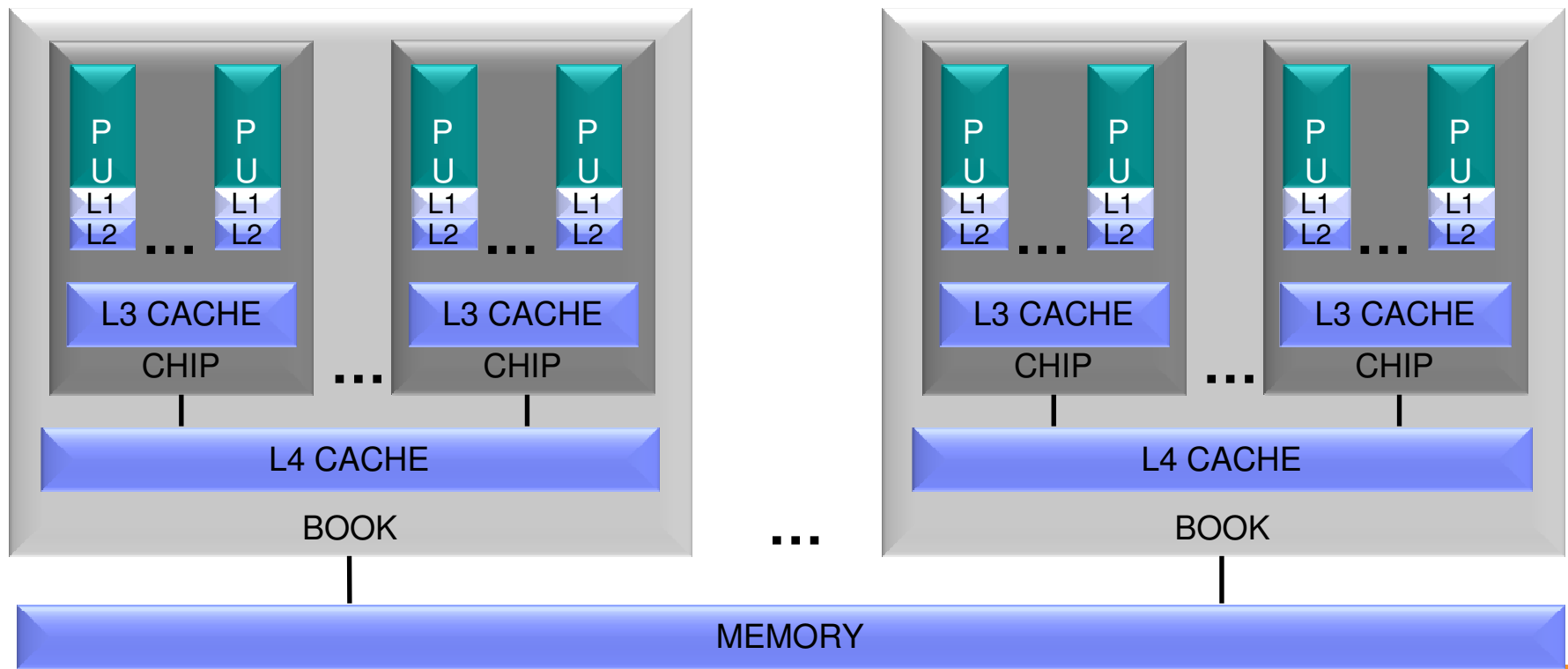


Data is based on real client opportunity and on internal standardized costing tools and methodologies. Client results will vary by types of workloads, technology level of consolidated servers, utilization factor, and other implementation requirements. Savings will vary by client.



z/VM Version 6 Release 3 HiperDispatch: Dispatching Affinity

- Processor cache structures become increasingly complex and critical to performance
- Re-dispatch virtual CPU near where its data may be in cache based on where the virtual CPU was last dispatched
- Keep virtual CPUs of the same virtual machine near one another

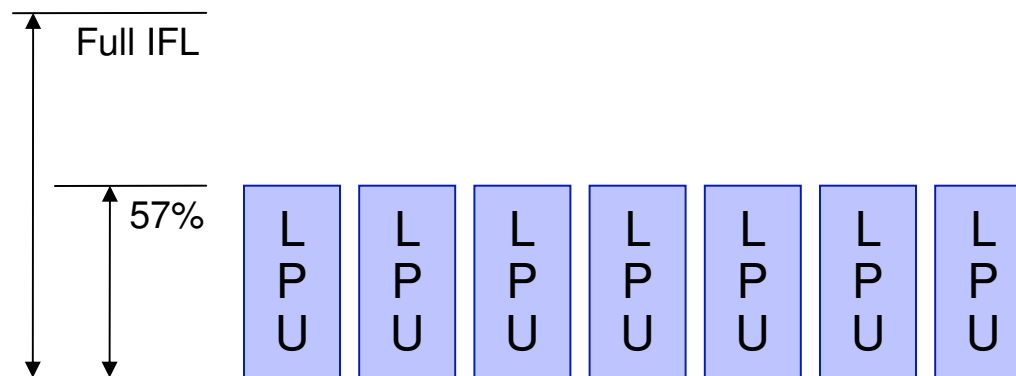


Horizontal vs. Vertical CPU Management

- Today's “horizontal” management distributes the LPAR weight evenly distributed across the logical processors of the z/VM LPAR

Horizontal:

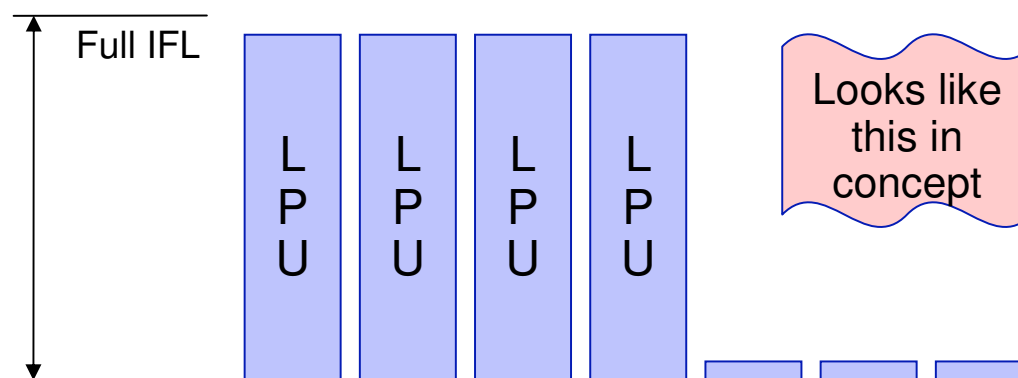
- The logical processors are all created/treated equally.
- z/VM dispatches work evenly across the 7 logical processors

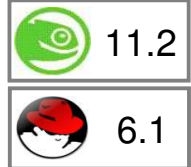


- “Vertical” management attempts to minimize the number of logical processors, allowing LPAR to similarly manage logical CPUs

Vertical:

- The logical processors are skewed to where some get greater share of the weight.
- z/VM dispatches work accordingly to the heavier weighted workload.





Linux interaction with the z/VM Hypervisor

CMSFS user space file system support

- Allows to mount a z/VM minidisk to a Linux mount point
- z/VM minidisk needs to be in the enhanced disk format (EDF)
- The cmsfs fuse file system transparently integrates the files on the minidisk into the Linux VFS, no special command required

```
# cmsfs-fuse /dev/dasde /mnt/cms  
# ls -la /mnt/fuse/PROFILE.EXEC  
-r--r----- 1 root root 3360 Jun 26 2009 /mnt/fuse/PROFILE.EXEC
```

- By default no conversion is performed
 - Mount with '-t' to get automatic EBCDIC to ASCII conversion

```
# cmsfs-fuse -t /dev/dasde /mnt/cms
```

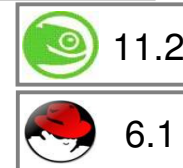
- Rread & Write support available
- use “vi” to edit PROFILE.EXEC anyone ?
- Use fusermount to unmount the file system again

```
# fusermount -u /mnt/cms
```

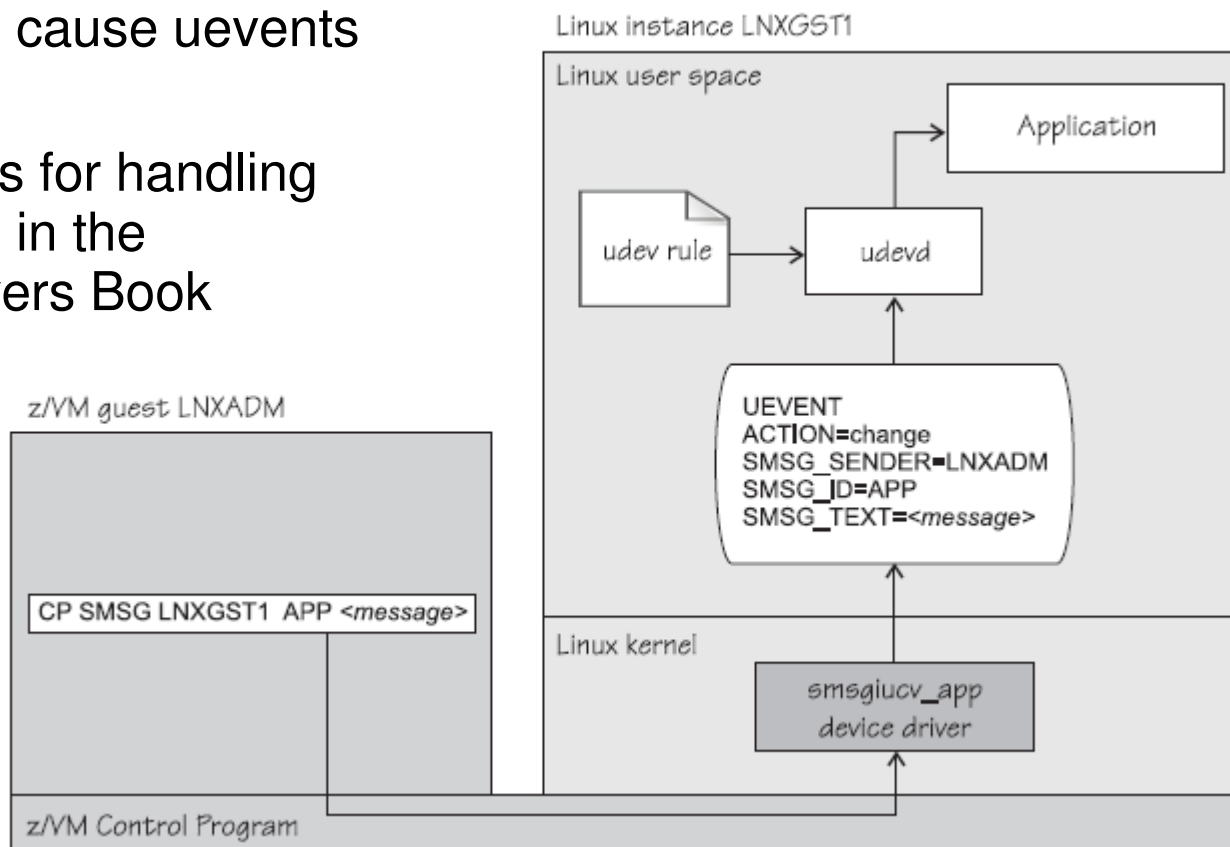


Automated z/VM actions via Linux

Deliver z/VM CP special messages as uevent



- Allows to forward SMSG messages to user space programs
 - Message needs to start with “APP”
- The special messages cause uevents to be generated
- See “Writing udev rules for handling CP special messages” in the Linux on z Device Drivers Book



Manage z/VM resources within the range of the guest definition

- Tool **cpuplugd**

- Sizing Linux z/VM guests made effective with **cpuplugd**
- Oversized guests often cause additional management effort by the Hypervisor and undersized guests often have performance-related issues with workload peaks
- A large amount of guests with large ratios of resource overcommitment (more virtual resources than are physically available) and changing workload characteristics over time makes a correct sizing even more challenging
- The cpuplugd daemon available with SUSE Linux Enterprise Server (SLES 11) SP2 or Red Hat Enterprise Linux (RHEL) 6.2, greatly enhances the capability:
 - to define rules
 - define the performance parameters for the rule set.
- This tool now enables the operating system of the guest to manage the resources within the range of the guest definition.
- The Linux cpuplugd daemon, can be used to automatically adjust CPU and memory resources of a Linux z/VM guest.
- The description ZSW03228-USEN-00 is available at the IBM Information Center
- http://publib.boulder.ibm.com/infocenter/lnxinfo/v3r0m0/index.jsp?topic=%2Fliaag%2FI0cpup00_2012.htm

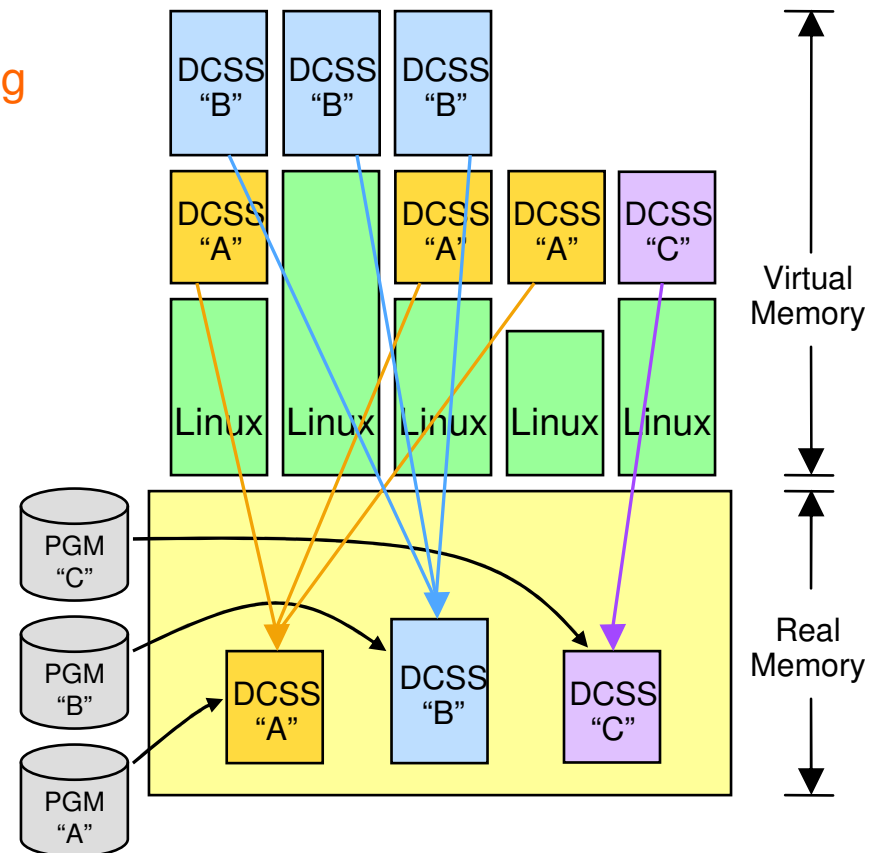


Effective Virtualization with Linux on z and z/VM shared memory

Linux Shared Memory Exploitation for many Virtual machines

z/VM Discontiguous Saved Segments (DCSS)

- **DCSS support is Data-in-Memory technology**
 - Share a single, real memory location among multiple virtual machines
 - Can reduce real memory utilization
- **Use Cases:**
 - As fast Swap device
 - For sharing read only data
 - For sharing code (e.g. program executables/libraries)
- **The large DCSS allows the installation of a full middleware stack in the DCSS (e.g. WebSphere, DB2, etc)**
- **The DCSS becomes a consistent unit of one software level**
- **NSS – Named Saved System – for a bootable Linux image**

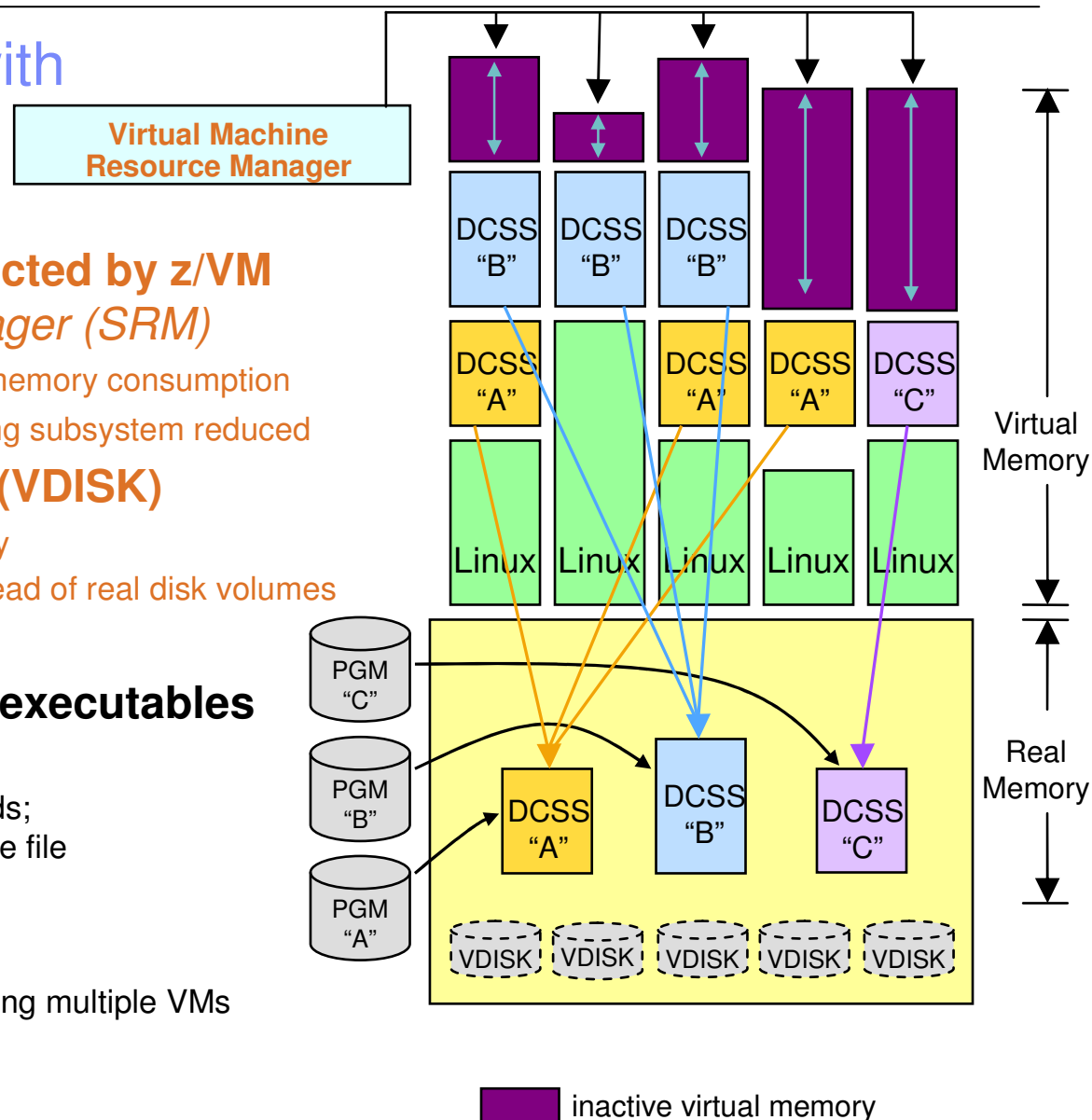


<http://public.dhe.ibm.com/software/dw/linux390/perf/ZSW03186USEN.PDF>



Effective Virtualization with Linux and z/VM SRM

- **Real memory constraint corrected by z/VM Virtual Machine Resource Manager (SRM)**
 - Linux images signaled to reduce virtual memory consumption
 - Demand on real memory and z/VM paging subsystem reduced
- **z/VM Virtual Disks in Storage (VDISK)**
 - Simulate a disk device using real memory
 - Use VDISKs for Linux swap devices instead of real disk volumes
 - Reduces demand on I/O subsystem
- **Linux guest: shared program executables**
 - Execute-in-place (xip2) file system
 - Access to file system is at memory speeds; executables are invoked directly out of the file system (no data movement required)
- **Data-in-Memory technology**
 - Share a single real memory location among multiple VMs
 - Reduce real memory utilization



<http://public.dhe.ibm.com/software/dw/linux390/perf/ZSW03186USEN.PDF>



Memory overcommitment

- **Memory overcommitment**, often mentioned as major **benefit of virtualized environments**
 - Memory overcommitment is the ability to use more virtual memory as physically available memory. It is based on the assumption that not all guests use their memory at the same time and/or some guests are over-sized in their memory setup.
- The most **common mistake made with Linux guests under z/VM is over-configuring Linux** memory:
 - In a virtualized environment under z/VM, oversized guests place unnecessary stress on the VM paging subsystem:
 - Real memory is a shared resource, caching pages in a Linux guest reduces memory available to other Linux guests.
 - Larger virtual memory requires more kernel memory for address space management.
- Very different definitions exist for the **level of memory overcommitment**
 - they are independent of the used middle ware
 - “Common” System z ratio is from 1.5 : 1 to 3: 1 virtual (guest memory) to physical memory
E.g. run guests defined with a total of 3GB on 1 GB real memory
 - Performance can be heavily degraded when memory overcommitment level is too high
- Identify “rules”
 - Determine the minimum amount of physical memory required to run with an acceptable performance
 - Identify a dependency on the used middle ware / applications



Test Scenario

■ Test environment

- Running a mix of server types as Linux guests on z/VM:
LPAR with 28GB central storage + 2 GB expanded storage

Guest workload

Guest Memory

WebSphere Application Server

13.5 GB (Java heaps 8GB)

Database DB2

12.0 GB (memory pools about 2 GB)

Tivoli Directory Server (ITDS)

1.5 GB

Idling guest

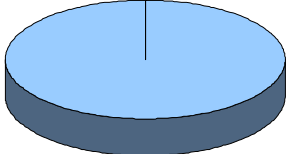
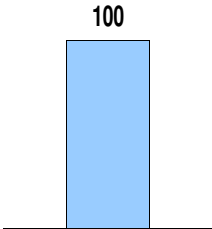

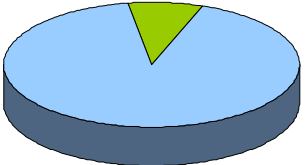
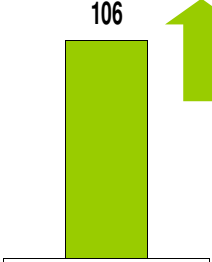


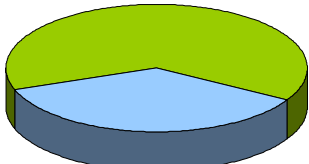
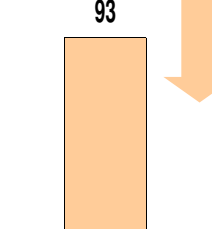

1.0 GB

■ Test scenarios

- Leave the guest size fix
- Decrease the LPAR size in predefined steps to scale the level on memory overcommitment
- Measure the execution time of a predefined workload (TPM)



Test Results

Memory – less is better		Performance – more is better
 <p>100%</p>	<p>BASE settings = 100%</p> <ul style="list-style-type: none"> • Sum of guest size definition • Base performance 	 <p>100</p>
 <p>8% saved</p> 	<p>OPTIMAL settings</p> <ul style="list-style-type: none"> + Reduce memory by 8% + Improved performance by 6% 	 <p>106  + 6%</p>
 <p>64% saved</p> 	<p>CHEAPEST settings</p> <ul style="list-style-type: none"> + Reduce memory by 64% - Decreased performance by 7% - effective for test & development env. 	 <p>93  - 7%</p>



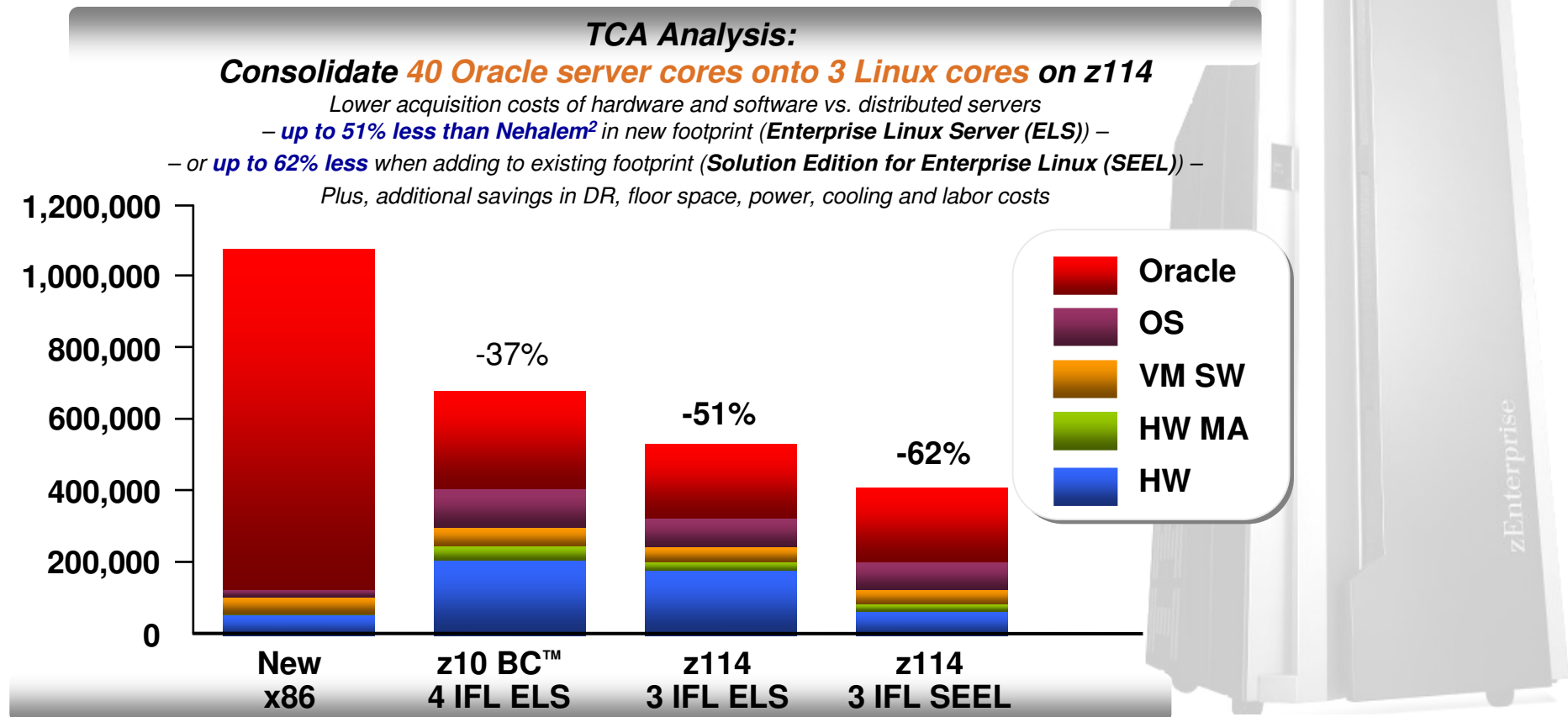
Virtualization Considerations for Linux guests

- Default SRM settings (q srm) - CMS guests are typically Q1 guests and Linux Q3 guests
 - **LDUBUF** : Q1=100% Q2=75% Q3=60%
 - **STORBUF**: Q1=125% Q2=105% Q3=95%
- LDUBUF – Defines amount of paging “capacity” to be used in scheduler algorithms
 - 60% for Q3 means:
 - All Q3 guests together can use maximum 60% of paging resources - if already used → eligible list
 - Recommendation:
 - SET SRM LDUBUF 100 100 100
 - to allow all Q3 guests to allocate the whole paging space
- STORBUF – to partition host storage (central storage)
 - 95% for Q3 means:
 - All Q3 guests together can use only 95% of the system storage
 - This prevents memory overcommitment when running Linux guests
 - Recommendation:
 - SET SRM storbuf 300 250 200
 - to allow all Q3 guests to allocate twice the amount of real storage
 - Depending on the level of overcommitment and amount of active/inactive guests, it might be necessary to go even higher, e.g. SET SRM storbuf 300 300 300
 - Ensure to have sufficient paging space!



The economics of virtualization and consolidation with Linux on z

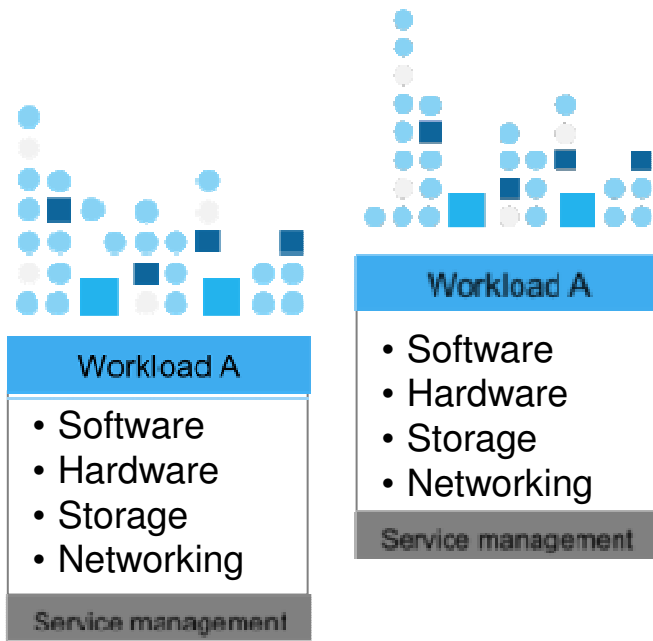
- Consolidate an average of **30 distributed servers** or more on a single core, or **hundreds** in a single footprint.
- Deliver a virtual Linux server for approximately **\$500 per year** or as little as a **\$1.45 per day per virtual server** (TCA)¹



49 ¹ Based on US Enterprise Linux Server pricing. Pricing may vary by country. Model configuration included 10 IFL cores running a mixed workload averaging 31 virtual machines per core with varying degrees of activity. Includes zEnterprise hardware and z/VM virtualization software. Does not include Linux OS or middleware software.
² Distributed server comparison is based on IBM cost modeling of Linux on zEnterprise vs. alternative distributed servers. Given there are multiple factors in this analysis such as utilization rates, application type, local pricing, etc., savings may vary by user.

What is Different About Cloud Computing?

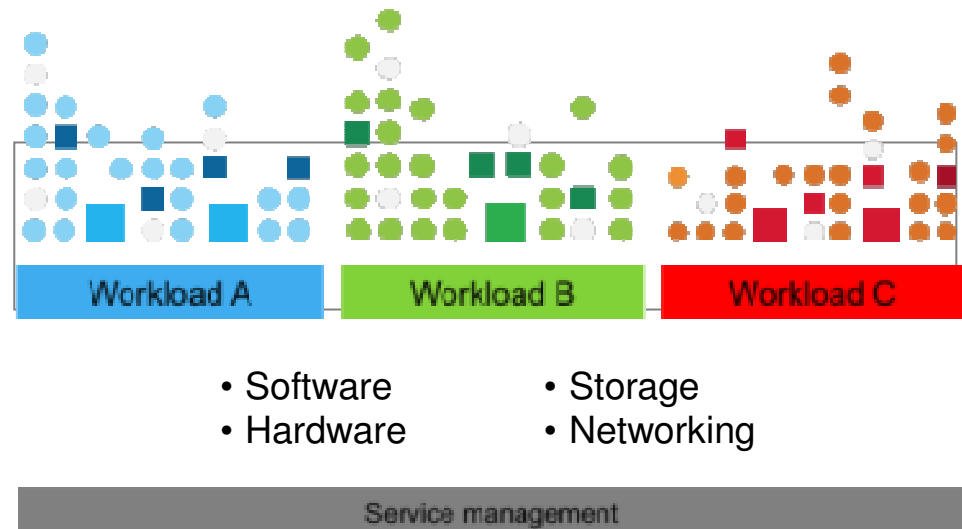
Without cloud computing



With cloud computing



- Virtualized resources
- Automated service management
- Standardized services
- Location independent
- Rapid scalability
- Self-service



Definition – National Institute of Standards and Technology



NIST National Institute of Standards and Technology
Information Technology Laboratory

SEARCH CSRC: GO

ABOUT MISSION CONTACT STAFF SITE MAP

Computer Security Division Computer Security Resource Center

CSRC HOME GROUPS PUBLICATIONS DRIVERS NEWS & EVENTS ARCHIVE

CSRC HOME > PUBLICATIONS > BY SPECIAL PUBLICATIONS

PUBLICATIONS

Special Publications (800 Series)

Special Publications in the 800 series present documents of general interest to the computer security community. The Special Publication 800 series was established in 1990 to provide a separate identity for information technology security publications. This Special Publication 800 series reports on ITL's research, guidelines, and outreach efforts in computer security, and its collaborative activities with industry, government, and academic organizations.

Special Publications

SP 800-146	May 2012	Cloud Computing Synopsis and Recommendations sp800-146.pdf
SP 800-145	Sept. 2011	The NIST Definition of Cloud Computing SP800-145.pdf

<http://csrc.nist.gov/publications/PubsSPs.html#800-145>

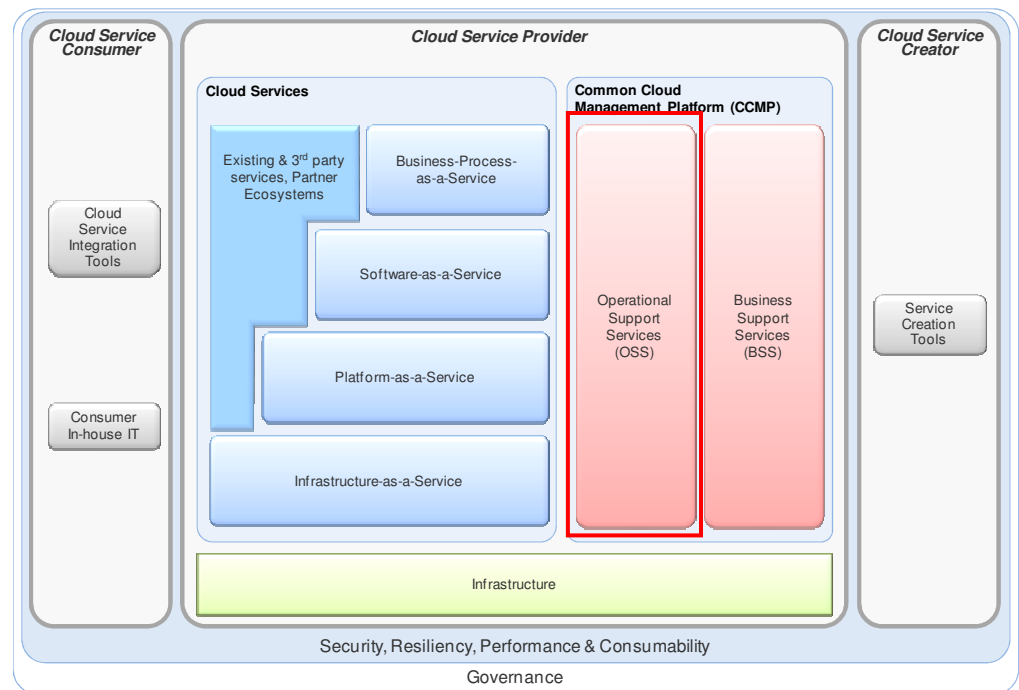


IBM Cloud Computing Reference Architecture (CC RA) – Cloud Lifecycle Management ‘Best Practices’

Publicly available RA whitepaper on ibm.com:

<http://public.dhe.ibm.com/common/ssi/ecm/en/ciw03078usen/CIW03078USEN.PDF>

- The IBM CC RA is based on Best Practices from:
 - IBM Cloud Projects with clients
 - IBM Public Cloud Offerings like Smart Cloud Enterprise
- The CC RA consists of 21 detailed Documents, with best-of-industry knowledge regarding Cloud Architecture, Design and Implementation



CCRA OpenGroup submission:

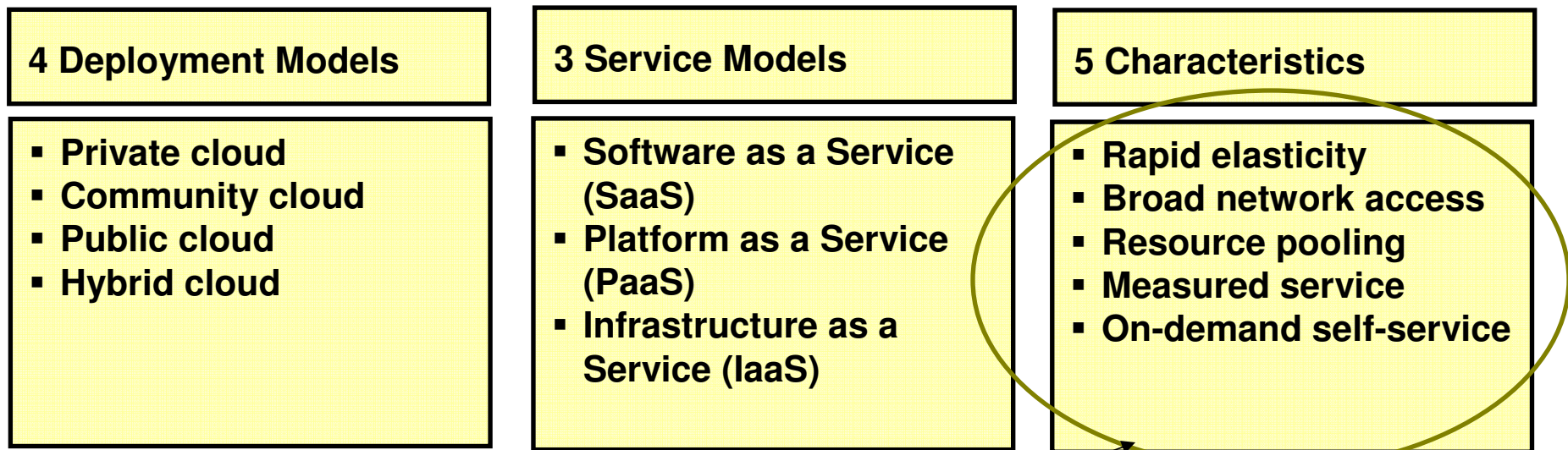
<http://www.opengroup.org/cloudcomputing/uploads/40/23840/CCRA.IBMSubmission.02282011.doc>

<http://www.opengroup.org/cloudcomputing/uploads/40/23840/CCRA.IBMSubmission.02282011.doc>





Cloud Computing – Deployment, Service, Characteristics



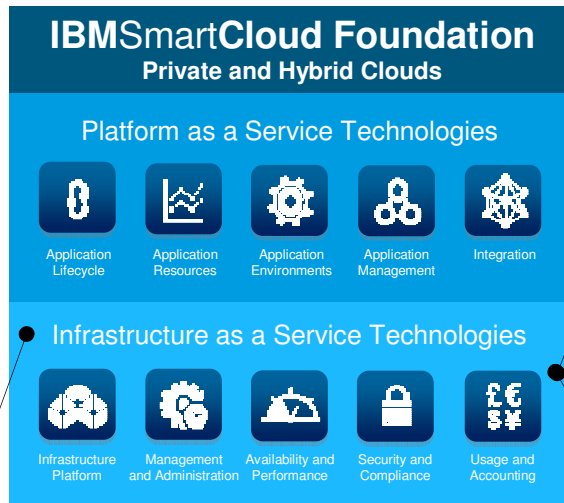
Decision criteria

<http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>



IBMSmartCloud Foundation


- System z Offerings




Integrated Systems

IBM PureFlex System


Private Cloud Management Solutions

- IBM SmartCloud Entry
- IBM SmartCloud Provisioning
- IBM Tivoli Service Automation Manager
- IBM Solution Edition for Cloud Computing (System z) 
- IBM Service Delivery Manager (ISDM)
- IBM SmartCloud Virtual Storage Center
- IBM Tivoli System Automation
- IBM SmartCloud Cost Management
- IBM Endpoint Manager Solutions
- IBM SmartCloud Patch Management
- IBM SmartCloud Monitoring
- IBM Service Management Extension for Hybrid Cloud
- IBM SmartCloud Application Performance Management

Infrastructure Systems and Storage

- IBM System x with ex5 technology
- IBM Power Systems with POWER7
- IBM System z with Unified Resource Manager
CSLWave. xCat 
- IBM Scale out NAS Storage Systems
- IBM BladeCenter Foundation for Cloud
- IBM Storwize V7000 Unified, IBM XIV Storage Systems Gen 3, IBM iDataplex

Infrastructure Management Solutions

- IBM Cloud Ready for Linux on System z
- IBM SmartCloud Control Desk 
- IBM Security Virtual Server Protection for VMware
- IBM Systems Director
- Tivoli Storage Manager for Virtual Environments



System z Cloud Roadmap

1 Integrate

2 Automate

3 Orchestrate

IBM Products & Offerings

- zEnterprise: zEC12, z196, zBC12, z114
- Linux on System z

▪ Tivoli Provisioning – Cloud Ready

▪ Tivoli Service Automation Manager



▪ z/VM 6.3 **New**

▪ SCE/SCP

▪ SCO
System z support currently in development

ISV Solutions

CSL Wave

- Provided by CSL International
- Hypervisor Manager

IBM recent acquisition

zPRO

- Provided by Velocity Software

MOAB

- Provides a policy based cloud management based on xCAT

Open Source Options

xCAT

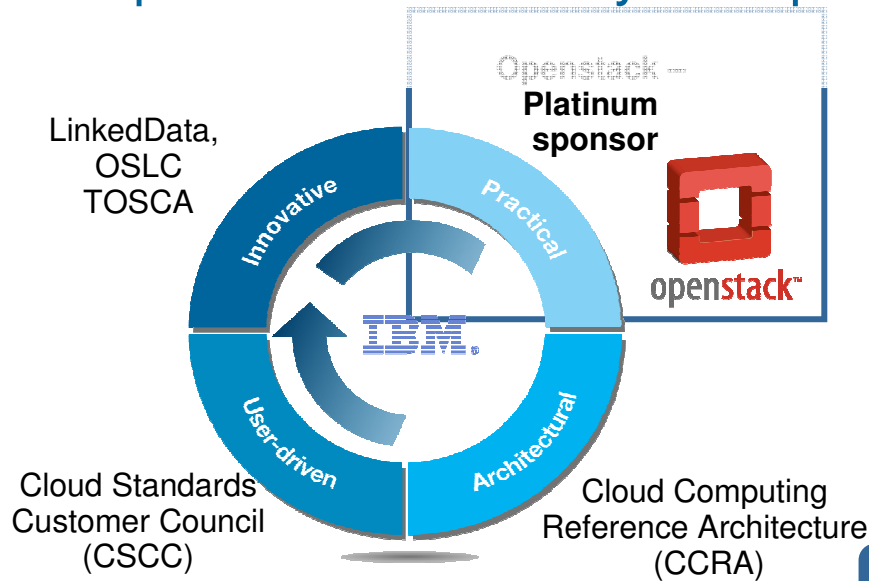
- Extreme Cloud Administration Tool

OpenStack

- Being enabled for z/VM first and eventually zManager
- Being used as a code base for SCE / SCP / SCO



Openstack – Industry Accepted IaaS Cloud Computing Model



IBM joins the new OpenStack Foundation as Platinum Sponsor

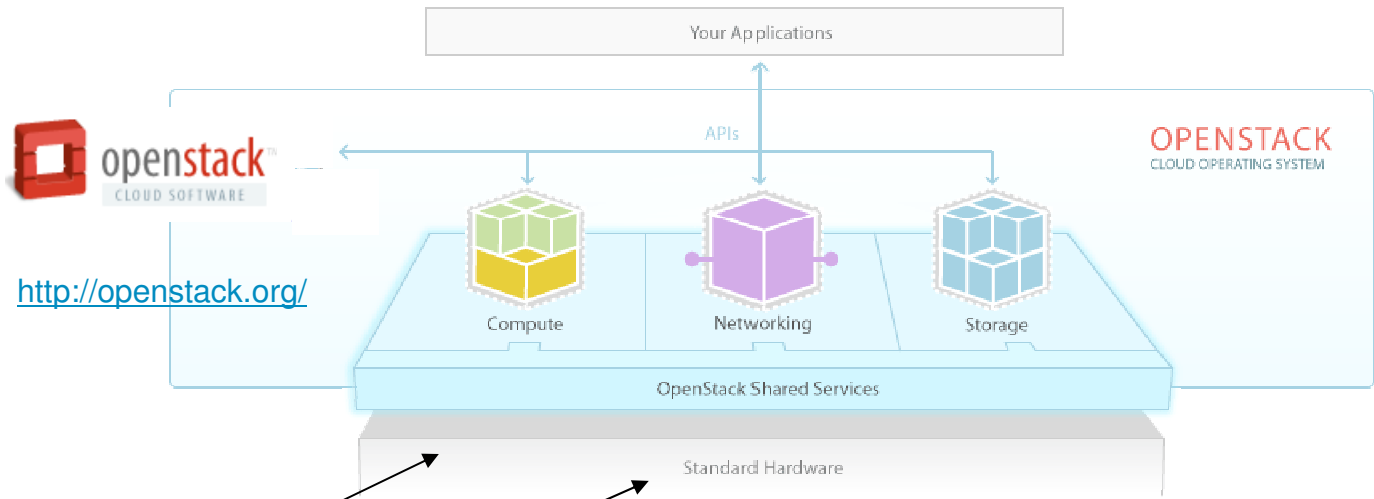
Objectives

- OpenStack is an Infrastructure as a Service (IaaS) cloud computing project that is free open source software released under the terms of the Apache License.
 - Managed by the OpenStack Foundation, a non-profit corporate entity established in September 2012
 - More than 150 companies have joined the project among which are AMD, Intel, Canonical, SUSE Linux, Red Hat, Cisco, Dell, HP, IBM, NEC, VMware and Yahoo
 - It is portable software, but is mostly developed and used on the Linux operating system.
- <http://en.wikipedia.org/wiki/OpenStack>



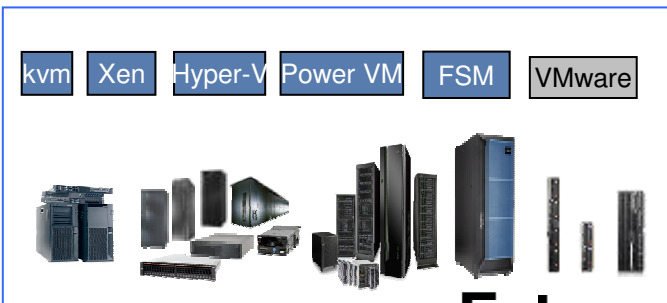
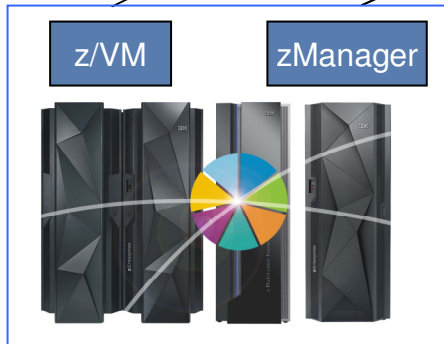
System z - Participation in OpenStack

Self-Service **Cloud Management Application** Multi-Tenant
 Services Catalog (including SmartCloud technologies) Billing and Charge-back



**Compute (Nova)
Storage (Cinder)
Network (Quantum)**
Provision and manage virtual resources such as servers, networking, and storage.

Direct Hypervisor Integration
System z support (z/VM followed by zManager) being added to OpenStack, in the same manner as other hypervisors



A z/VM Cloud Management with Open Source multi-platform tool xCAT

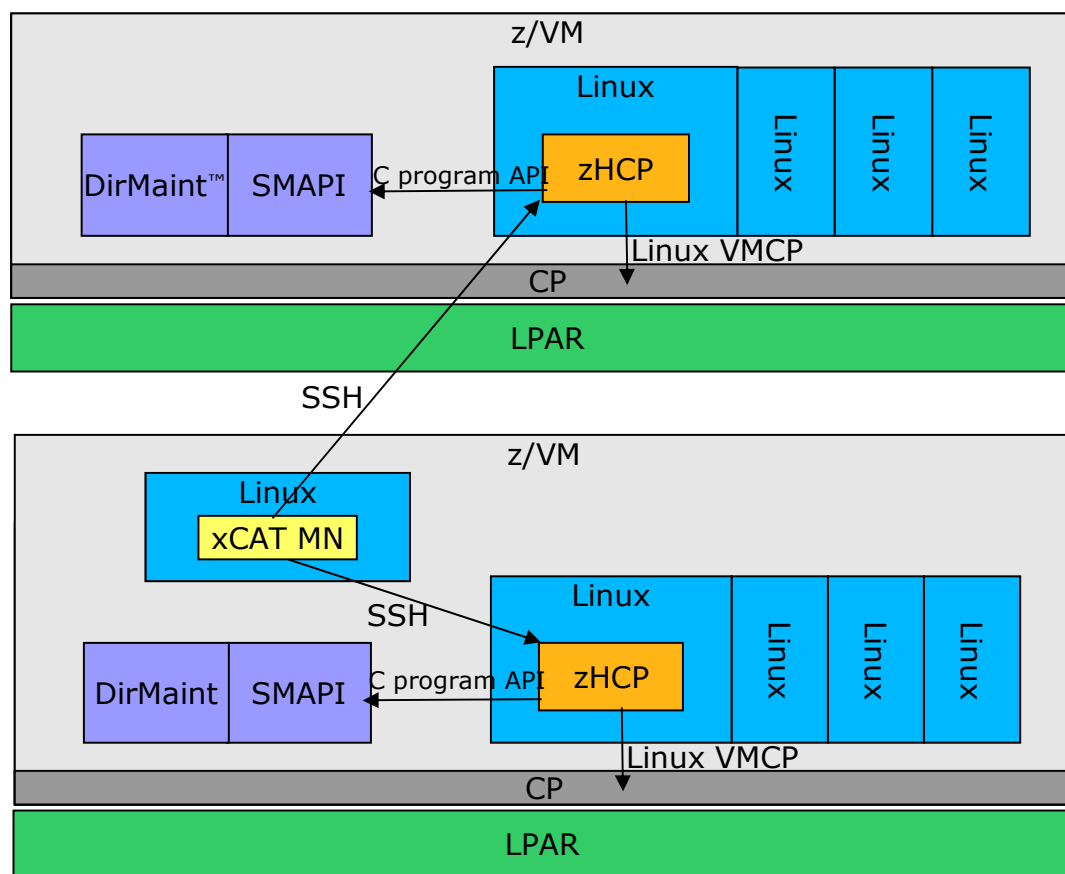
xCAT Architecture on System z

<http://www.vm.ibm.com/sysman/>

- Stands for Extreme Cloud Administration Toolkit - xCAT
- Tool to manage, provision, and monitor physical and virtual machines including IBM servers
- Open sourced in 2007 and licensed as EPL (Eclipse Public License)
- Used by NASA, University of Toronto, IBM, Adaptive Computing, Los Alamos Laboratory, and more!

xCAT MN: Central management server running on normal Linux

zHCP: Runs on privileged VM and manages other VMs via SMAPI and CP



xCAT GUI – Nodes, Actions, incl. Migrate



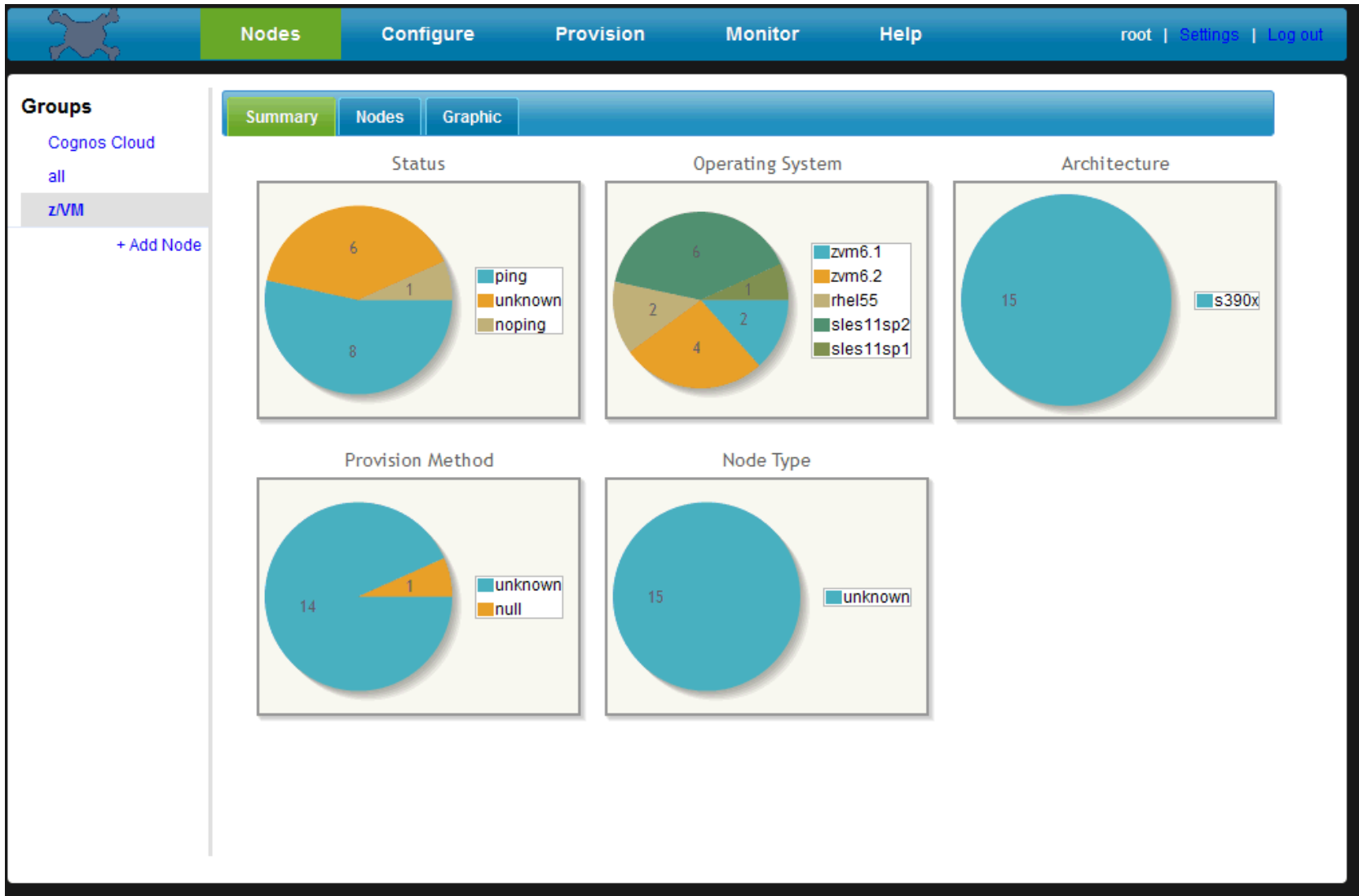
The screenshot shows the xCAT GUI interface. At the top, there is a navigation bar with tabs for Nodes, Configure, Provision, Monitor (selected), and Help. The user is logged in as 'demo01'. Below this, there is a sub-navigation bar with Monitor and Resources tabs. A yellow message box prompts the user to 'Select a platform to view its current resources.' Below this, a list of platforms is shown: ESX (selected), KVM, zVM, BladeCenter, iDataPlex, and System p. An 'Ok' button is present.

The main content area shows the 'Nodes' section. The navigation bar at the top of this section includes Nodes (selected), Configure, Provision, Monitor, and Help. The user is logged in as 'root'. Below this, there are tabs for Summary, Nodes (selected), and Graphic. A yellow message box provides instructions: 'Double-click on a cell to edit a node's properties. Click outside the table to save changes. Hit the Escape key to ignore changes.' Below this, there are dropdown menus for Actions, Configuration, and Provision, and a search box.

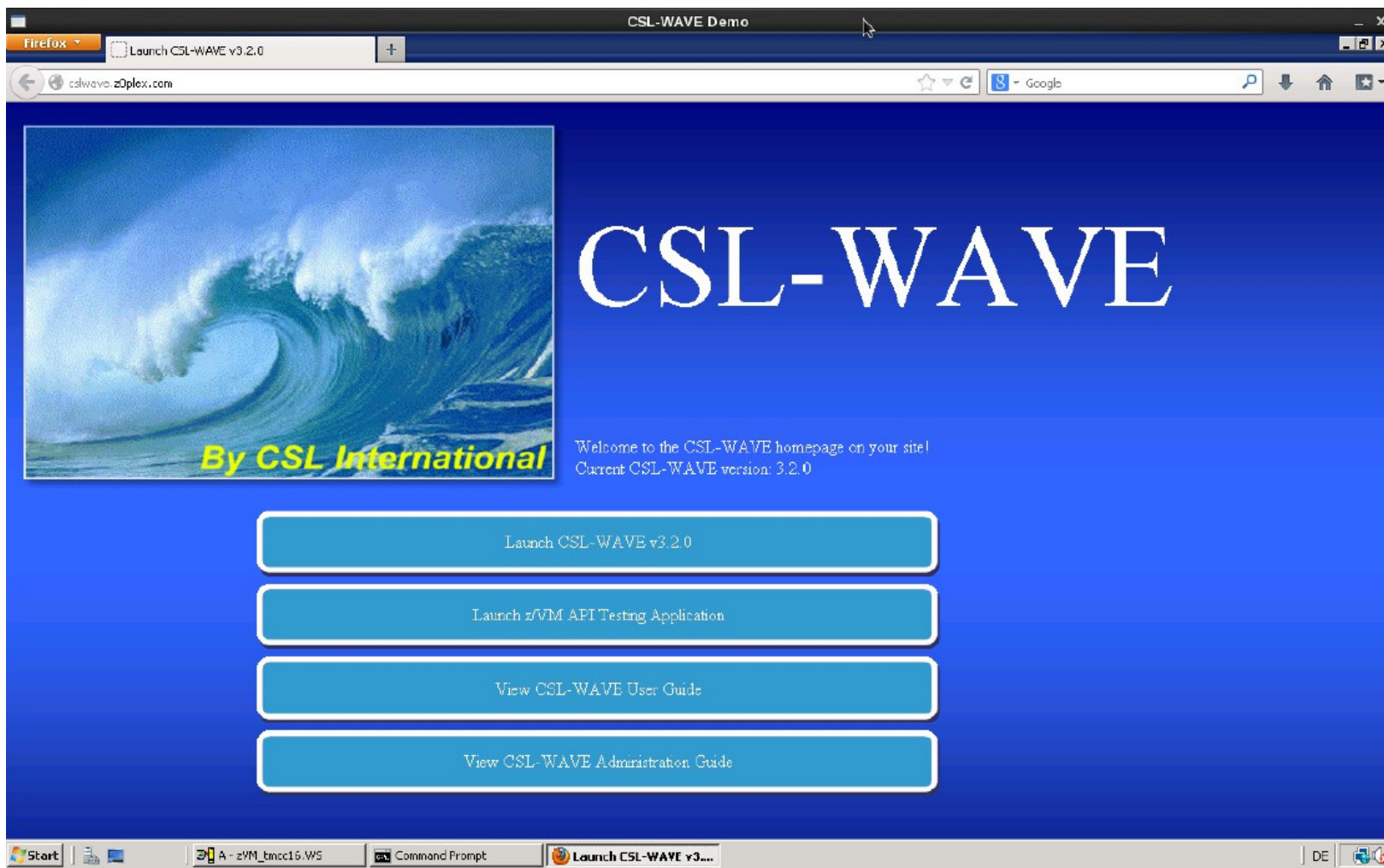
The 'Nodes' table is displayed with the following columns: status, power, monitor, comments, arch, groups, and hcp. The 'Actions' dropdown menu is open, showing options: Clone, Migrate, Delete, Monitor on, Monitor off, Power on, Power off, and Run script. The table contains five rows of node data:

status	power	monitor	comments	arch	groups	hcp
ping			🗨	s390x	Cognos Cloud,all	zhcp17.z0plex.com tmcc-1
ping			🗨	s390x	Cognos Cloud,all	zhcp17.z0plex.com zdisp
ping			🗨	s390x	Cognos Cloud,all	zhcp17.z0plex.com tmcc-1
ping			🗨	s390x	Cognos Cloud,all	zhcp17.z0plex.com zdisp
ping			🗨	s390x	Cognos Cloud,all	zhcp17.z0plex.com zdisp

xCAT GUI – Nodes, Summary



New IBM tool: CSL-WAVE – z/VM and cloud management



Effectively running Linux on IBM System z in a virtualized environment and cloud

Hardware Viewer – the z/VM Users group

The screenshot shows the CSL-WAVE 3.2.0 interface. The title bar reads "CSL-WAVE Demo" and the window title is "CSL-WAVE 3.2.0 (WAVESERV Hostname: cslwave.z0plex.com, IP Address: 192.168.9.70)". The menu bar includes File, Auto Detect, User-Group Management, Network Management, Prototype Management, Storage Management, Administrative, User Tasks, Reports, Window, and Help. The toolbar contains icons for Home, Refresh, Stop Updates, and other functions.

The main interface is divided into several sections:

- Hardware Viewer:** Shows a graphical representation of the hardware configuration.
- Property Viewer:** Displays details for the selected system (TMCC16).

Property	Value
Name	ZLIN79
Status	Active
Eligible	Yes
Group	USER-LOCAL
Type	CMS
CPUs	1
Memory Min ...	1024
Memory Max ...	1024
Modified By	WAVE Daemon Updater on 2013-08-20 ...
Create By	WAVE Daemon Updater on 2013-08-20 ...
- Current System View - "TMCC16":** Displays a grid of system icons. A yellow callout box states: "Depending on the assigned OS you will see different icons for the guests". The grid includes icons for IBM-COM, CF2, ZVMND, XYMON, IBM-OPER, BACKUPFM, ZLIN79 (*Unknown*), OPMGRS1, WAVEADM, CSLWAVE (*Unknown*), ZHCP16 (*Unknown*), XCAT90, WAVEINTERN, LINUX90, ELIZA, IBM-SMAP1, IBM-ENS, IBM-UTIL, and IBM-NA.
- Right Panel:** Contains a yellow callout box: "You can create your own 'managed' groups". Below it are options to Arrange Items, Add New Site Defined Group, Collapse All, and Expand All.

The bottom taskbar shows the Start button, several open applications (A - zvm_tmcc16.WS, Command Prompt, cslwave.z0plex.com - Pu..., Launch CSL-WAVE v3.2..., CSL-WAVE 3.2.0 (WAV...)), and system tray icons including BTS Online and waveadm.



Hardware Viewer – the Network

The screenshot displays the 'Current System View - "TMCC16"' window in the CSL-WAVE Demo application. The interface includes a menu bar (File, Auto Detect, User-Group Management, Network Management, Prototype Management, Storage Management, Administrative, User Tasks, Reports, Window, Help) and a toolbar with icons and a 'Stop Updates' button. The main area shows a network topology diagram with the following components:

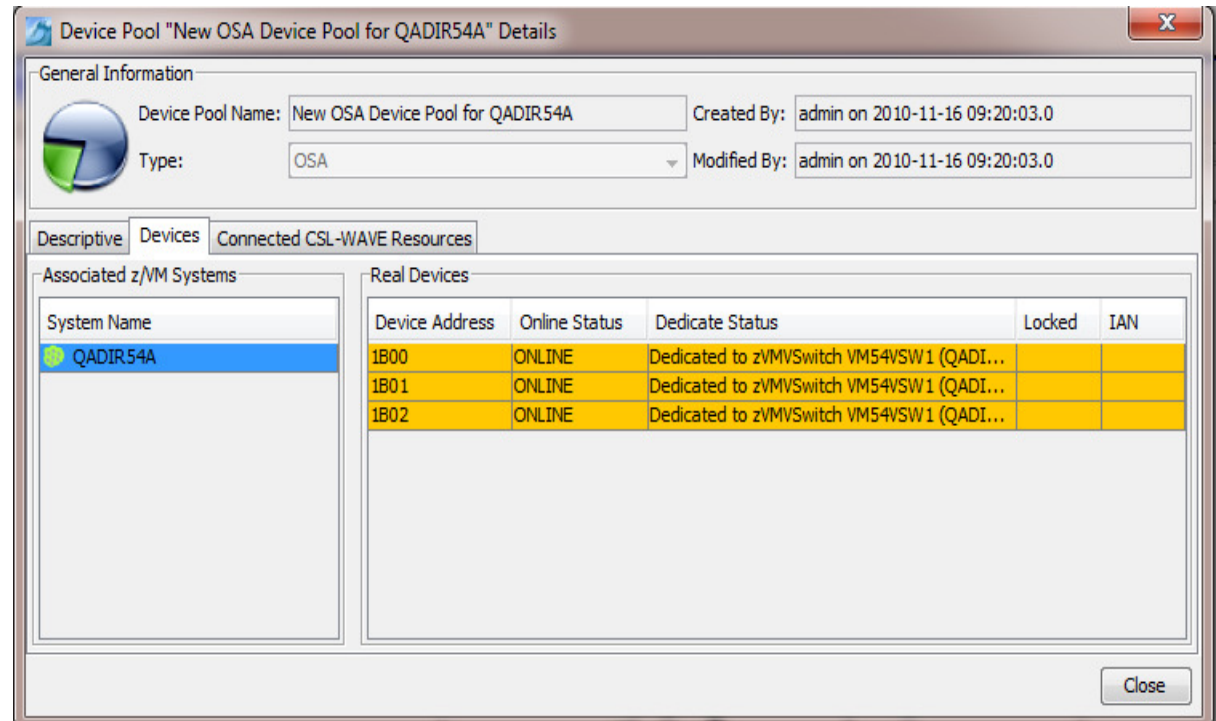
- Device Pools:**
 - New HIPER Device Pool for TMCC16 (0/0 devices available)
 - New OSA Device Pool for TMCC16 (5064 devices available)
- Switches:**
 - DEMOLAN
 - XCATVSW1
 - DTCSMAP1
- Network Segments:**
 - Unknown IP (DEMOLAN)
 - 192.168.9.0
 - Unknown IP (XCATVSW1)
 - Unknown IP (DTCSMAP1)
 - Auto-created Virtual Network Segment (10.70.100.0)
- Virtual Machines (VMs):**
 - XCAT80 (*Linkswt*)
 - CSLWAVE (*Linkswt*)
 - ZHCPI6 (shep16)
 - ZLIN79 (zlin79)

At the bottom of the diagram, it indicates: TMCC16, 14 Users, All Accessible. The Windows taskbar at the bottom shows the Start button, several open applications (A - zVM_tmcc16.WS, Command Prompt, cslwave.z0plex.com - Pu..., Launch CSL-WAVE v3.2..., CSL-WAVE 3.2.0 (WAY...)), and system tray icons including 'BTS Online' and 'waveadm'.



Dedicated Device Pools

- Drilling into the Device Pool Manager, we get to the actual Device Pools which list information about each device in the pool
- Information such as:
 - Device Address
 - ONLINE status
 - Usage
 - Owner
 - LOCK status
 - IAN (Intelligent Active Note) status



Effectively running Linux on IBM System z in a virtualized environment and cloud

System Viewer – the system activity

The screenshot displays the CSL-WAVE System Viewer interface for a system named 'TMCC16'. The interface includes a hardware viewer on the left, a central dashboard with five utilization gauges, and a table of objects requiring attention on the right. The gauges show the following values: Total Storage Utilization (pie chart), z/VM CPU Utilization (2.0%), Virtual to Real Ratio (204.0%), z/VM Page Space Utilization (1.0%), and z/VM Spool Space Utilization (1.0%). The table lists various objects with their names, attention required details, and user severity levels.

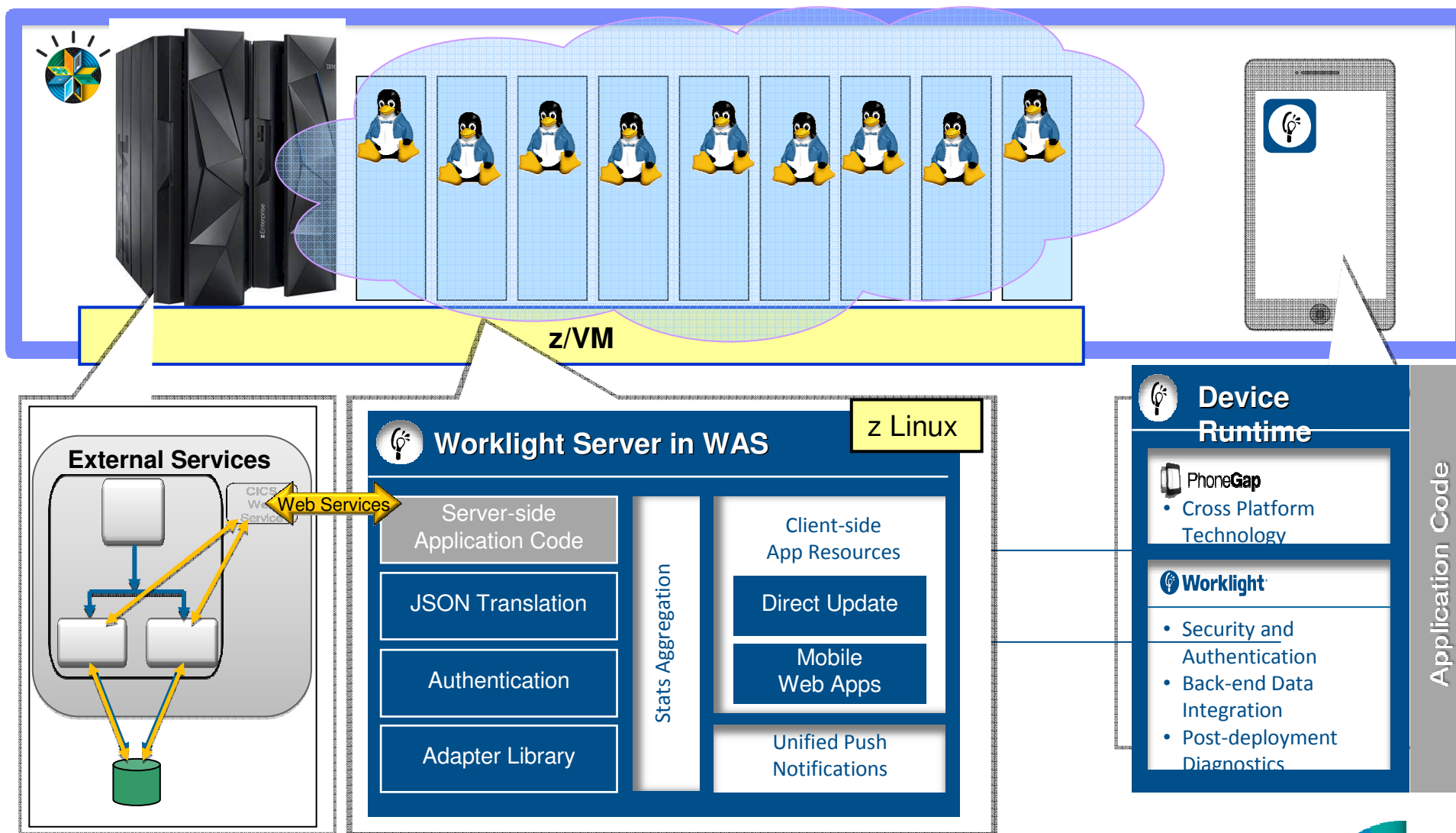
Object Type	Object Name	Attention Required Details	User Severity
zVM DASD Vol...	901D	Inconsistent, Offline	50
zVM DASD Vol...	902F	Inconsistent, Offline	50
zVM DASD Vol...	911D	Inconsistent, Offline	50
zVM DASD Vol...	911E	Inconsistent, Offline	50
zVM Prototype	CM5	No z/VM User associated, No DASD group Assigned	50
zVM Prototype	LINUX	No z/VM User associated, No DASD group Assigned	50
zVM User	XCAT80	zipl.conf has parameters lines without "root=" parameter, Not init'd for CSL-WAVE Use, CM5F5 package status for quest is unknown, VMCP no...	30
zVM User	ZPCP16	Not connectable	80
zVM Switch	DTCMAP1	Virtual Network is missing data	70
zVM Switch	XCAT/SWI	Virtual Network is missing data	70
zVM Switch	TESTLAN	Virtual Network is inconsistent	50



Effectively running Linux on IBM System z in a virtualized environment and cloud

MobileFirst: Linux on z and IBM Worklight Server

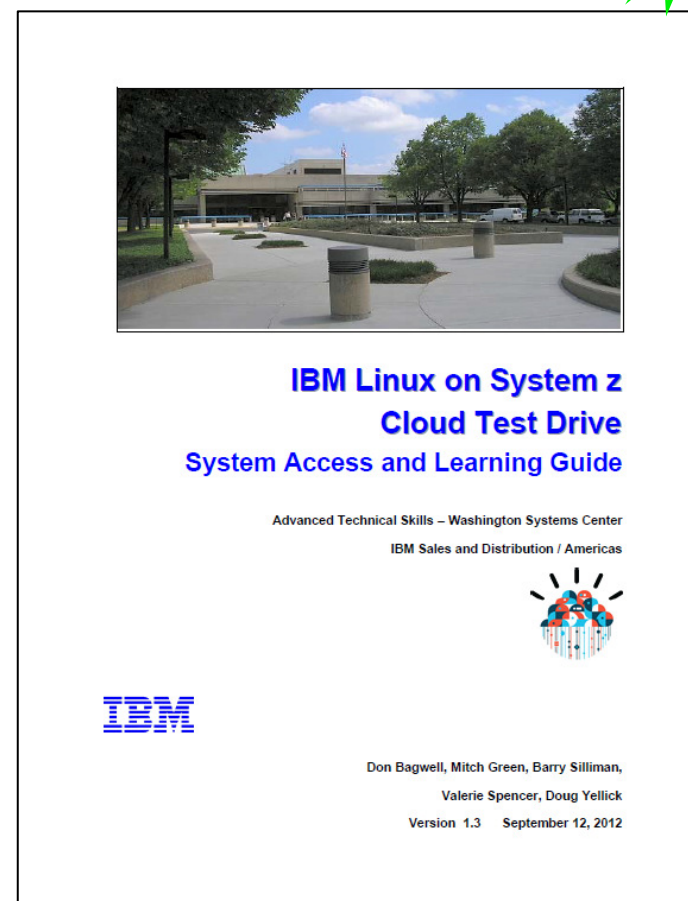
– A Cloud environment on System z for mobile Devices



Cloud Test Drive with Linux on System z - Effective Virtualized environment



- **Up to 90 days, free of charge, access to up to 3 Linux on z servers under z/VM**
- Hands-on experience with Cloud, Linux on z, z/VM, Tivoli Provisioning Manager (TPM), and a selection of 5 system images based on SUSE or Red Hat
 - SLES 11 SP1 Base
 - RHEL 5.8 Base
 - SLES 11 SP1, DB2 9.7 Fixpack 5, WAS 8.5, IBM HTTP Server 8.5
 - RHEL 5.8, DB2 9.7 Fixpack 5, WAS 8.5, IBM HTTP Server 8.5
 - SLES 11 SP1, Oracle 11gR3, WAS 8.5, IBM HTTP Server 8.5
- Simple remote access over the internet to zEnterprise in the IBM Washington System Center in Gaithersburg, Maryland
- Customize your own Linux cloud with your own secure data
- Guided exercises for training



<http://techsales5.austin.ibm.com/tsna/techxpress.nsf/request.html>



IBM System z customers with effective virtualization and cloud solutions

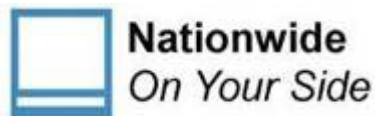
<http://www-03.ibm.com/systems/z/os/linux/solutions/>

TRANSZAP

Moved to System z from Intel to deliver the availability and security their clients demand of their e-Procure-to-Pay SAAS, while supporting the strong growth the company is experiencing



Casas Bahia centralized operations on System z to support rapid growth and reduce IT costs



Consolidated Windows-based systems to Linux on z to achieve substantial cost efficiencies and introduce cloud solutions



Satyam has positioned the mainframe as a platform to reach the SMB audience in growth markets with hosted web business services



Entering provider space for cloud services for universities, schools systems and other public entities



Their massive-multi-player game and virtual world application middleware runs on System z. (www.taikodom.com)

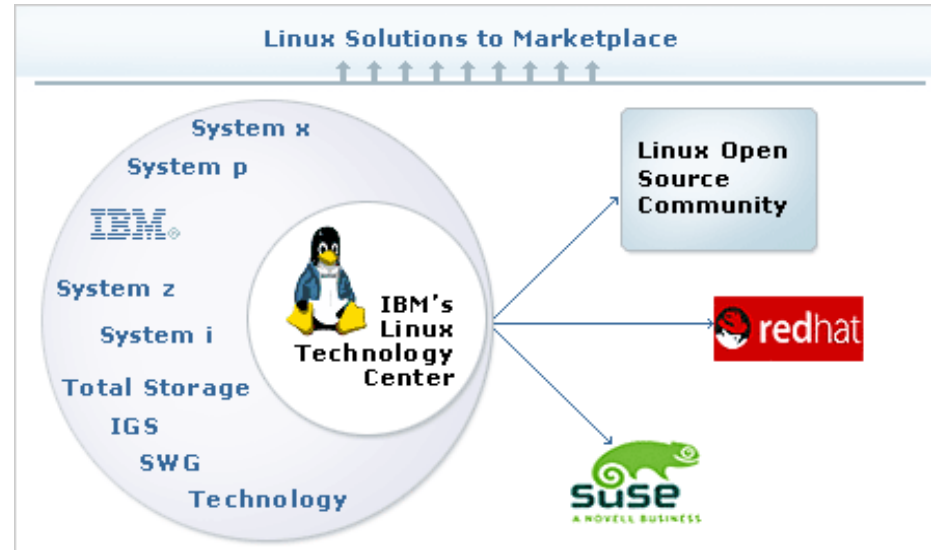


IBM Linux Technology Center, LTC

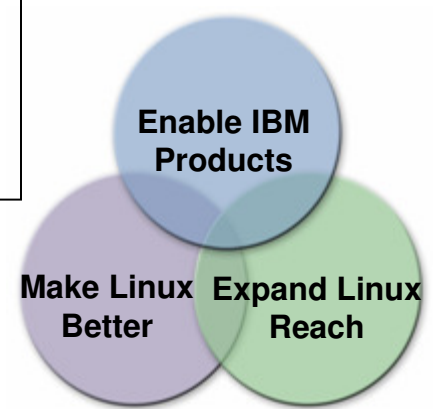
IBM Linux Technology Center (LTC)
Development team for all server and software platforms and other key initiatives, such as:

- Linux on POWER, Linux on Cell, Linux on System z and z/VM
- Security: EAL certifications, Trusted Computing, SELinux, sHype
- Virtualization: z/VM, Xen/KVM, APV support
- Systems Management: kdump, SystemTap, xCAT

Technical liaison to IBM's customers and Linux Distribution Partners



LTC:
 Over 600 developers
 40+ locations
 100+ projects





Effectively

Linux on IBM System z



Increased economics for optimized workload deployment
Linux on IBM zEnterprise EC12 is designed for cost savings, operational simplicity and reliability



Consolidating Linux workloads
Transform your IT economics



Optimized systems with Linux
How Linux reduces your costs



z/VM 6.2 - Accelerates Smarter Computing
Announcing Multi-system Virtualization and Virtual Server Mobility



Lower your monthly costs by up to 50%
The Enterprise Linux Server can allow you to grow while also saving money



Solution Edition for Enterprise Linux
Using new attractive pricing to consolidate and deploy new Linux workloads.



Software for Linux on System z
Application development, business intelligence, virtualization, collaboration, and more.



Red Hat offering (link resides outside of ibm.com)



SUSE offering (link resides outside of ibm.com)

Why Linux on IBM System z

Smarter Computing is IBM's approach to IT innovation, helping to transform to an ideal IT infrastructure that is cloud ready, data ready and security ready. Linux on System z offers a uniquely powerful solution for that approach, with great efficiency for optimized workload deployment: simple, efficient, secure.

- [Read about the benefits of Linux on System z](#)
- [Learn from the success stories](#)

What we offer

- Application development
- Cloud Computing
- Business Intelligence
- Email & Collaboration
- Oracle consolidation
- Systems Management
- IBM Software
- Vendor Software
- Solutions overview

Special offers

- A quantitative analysis of the business differentiators among x86, Unix, and System z virtualization technologies provided by Solitaire Interglobal Ltd (2.06MB)
- In this commissioned study, Forrester Consulting examines the total economic impact and potential ROI organizations may realize by deploying IBM System z

Get more from Linux on System z

Tools, support and services Development system

We're here to help

Easy ways to get the answers you need.

- Chat now
- Request a quote
- E-mail IBM

or call us at 866-883-8901
Priority code: 101AS13W

Build your IBM System z skills

- Test drive an IBM Systems z training course today—on us!

Now Available

- Using z/VM v 6.2 Single System Image (SSI) and Live Guest Relocation (LGR)
- Installation Experiences with Oracle Database 11gR2 Real Application Clusters on Linux on System z

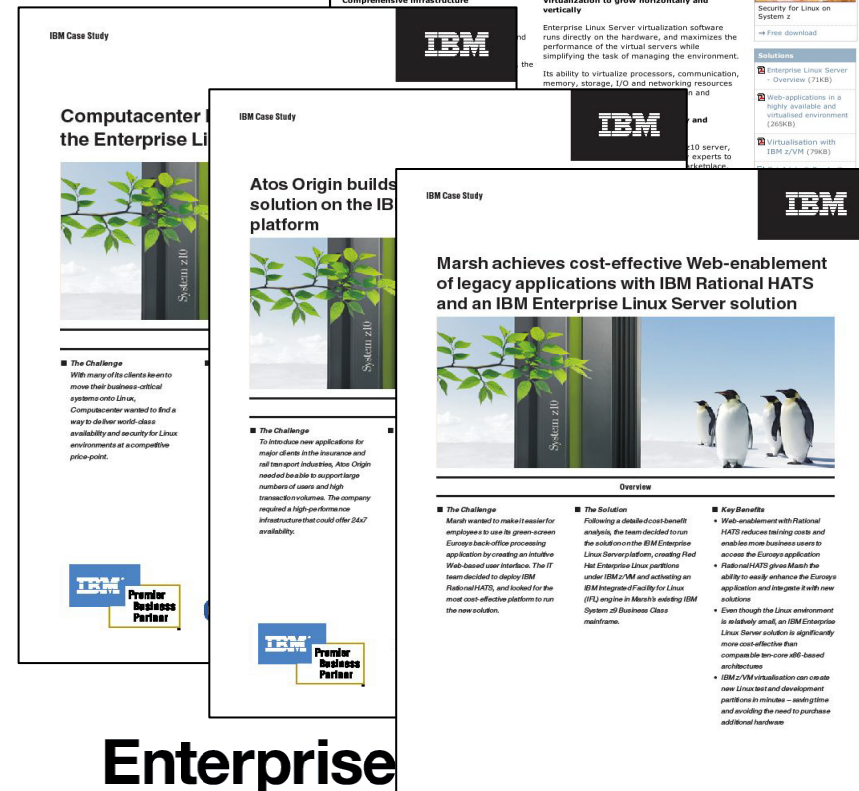
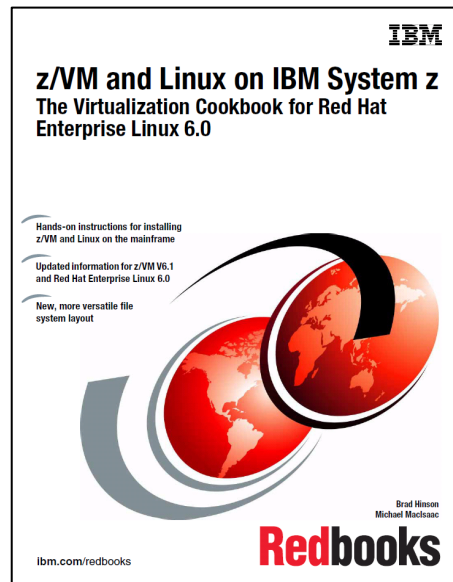
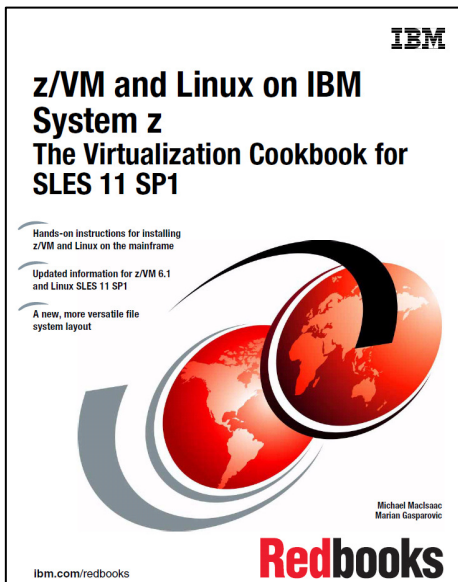
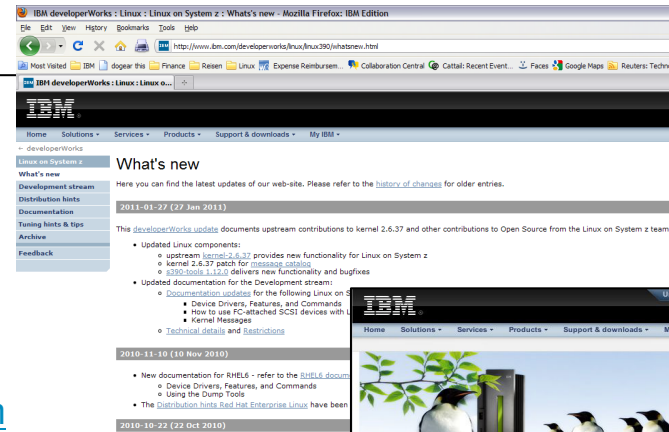


Effectively running Linux on IBM System z in a virtualized environment and cloud



Additional Information

- Enterprise Linux Server information:
<http://www-05.ibm.com/de/promotions/els/>
- IBM Information Center - Linux on System z
http://publib.boulder.ibm.com/infocenter/lnxinfo/v3r0m0/index.jsp?topic=%2Fliag%2Fli0lgr00_2012.htm
- Linux on z Hints and Tips
<http://www.ibm.com/developerworks/linux/linux390/perf/index.html>
- RedBooks
<http://www.redbooks.ibm.com/portals/linux>



Enterprise

Questions?



Wilhelm Mild
IBM IT Architect



IBM Deutschland Research
& Development GmbH
Schönaicher Strasse 220
71032 Böblingen, Germany

Office: +49 (0)7031-16-3796
mildw@de.ibm.com



Additional Information

- **IBM Systems - System z - z/VM, Home**
<http://www.vm.ibm.com/> | <http://www.ibm.com/vm/>
- **Linux on System z Information Center**
http://publib.boulder.ibm.com/infocenter/lnxinfo/v3r0m0/index.jsp?topic=%2Fliaag%2F10lgr00_2012.htm
- **IBM developerWorks - Technical topics - Tuning hints & tips - Linux under z/VM**
http://www.ibm.com/developerworks/linux/linux390/perf/tuning_vm.html
- **z/VM System Management**
<http://www.vm.ibm.com/sysman/>
- **Extreme Cloud Administration Toolkit (xCAT) - Overview (IBM)**
<http://www-03.ibm.com/systems/software/xcat/index.html>
- **Cloud Computing with xCAT on z/VM (by Thang Pham)**
<http://www.vm.ibm.com/sysman/xcatinfo.pdf>

