IBM Systems and Technology Group University 2005

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IBM Virtualization Engine vs. the competition

Course #: CB16

1/10/2005

What Does This Presentation Cover?

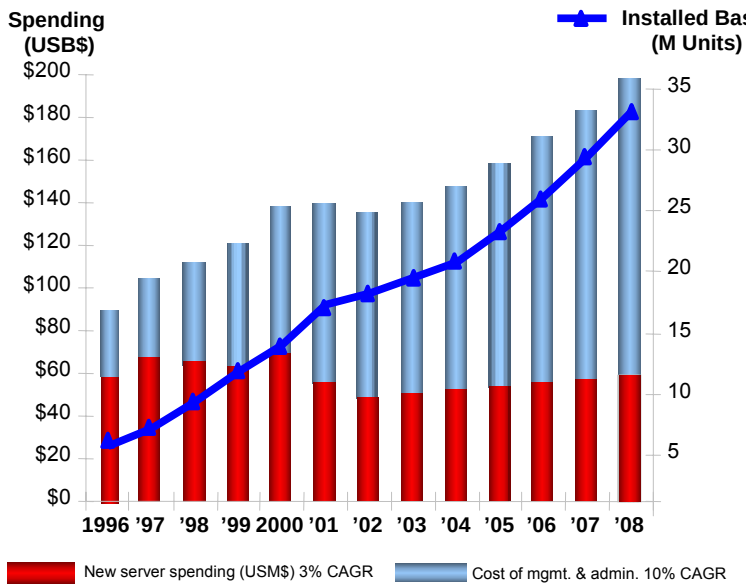
After attending this session, you will know what HP and Sun are talking to your customers about in the area of Virtualization! This session will discuss HP's and Sun's overall strategy, technology, products and solutions supporting their version of Virtualization.

- Be familiar with the messages and claims from HP and Sun in order to talk and respond to your customers.
- Learn how to directly compare IBM's Virtualization strategy and product offerings to HP's and Sun's.
- Learn how the broad Virtualization portfolio of IBM can be used to beat the competition.

Why IT optimization and Virtualization?

1. **Complexity and administrative cost are growing faster than hardware cost.**
2. **Growing revenue while containing cost remains #1 concern of management.**
3. **Businesses cannot address the need for integration of people, etc without first addressing the underlying infrastructure.**

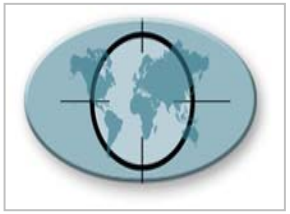
Cost of People vs. Spending on new systems



- ✓ **Lower the cost of their existing infrastructure**
- ✓ **Reduce the complexity of adding to that infrastructure**
- ✓ **Build heterogeneous infrastructure across multiple Data Centers that are more responsive to their business needs**

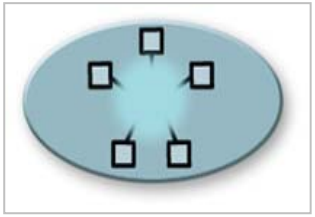
Virtualization Solutions: Stages of Deployment

Orchestrate Infrastructure: Sense and respond to changes based on business policies



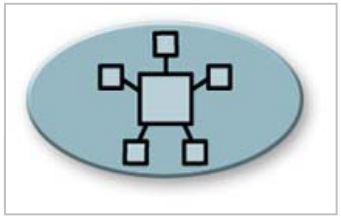
Virtualize Outside The Enterprise: Suppliers, partners, customers and external resources

Secure Cross Enterprises: Enable internal and external integration and resources.

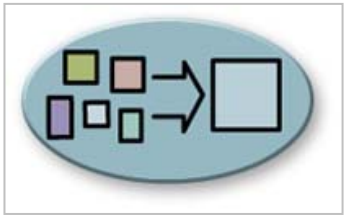


Virtualize The Enterprise: Enterprise wide Grids and Global Fabrics

Automate Workflows: Tasks like change/ configuration, ITIL processes



Virtualize Unlike Resources: Heterogeneous systems, application based Grids and networks



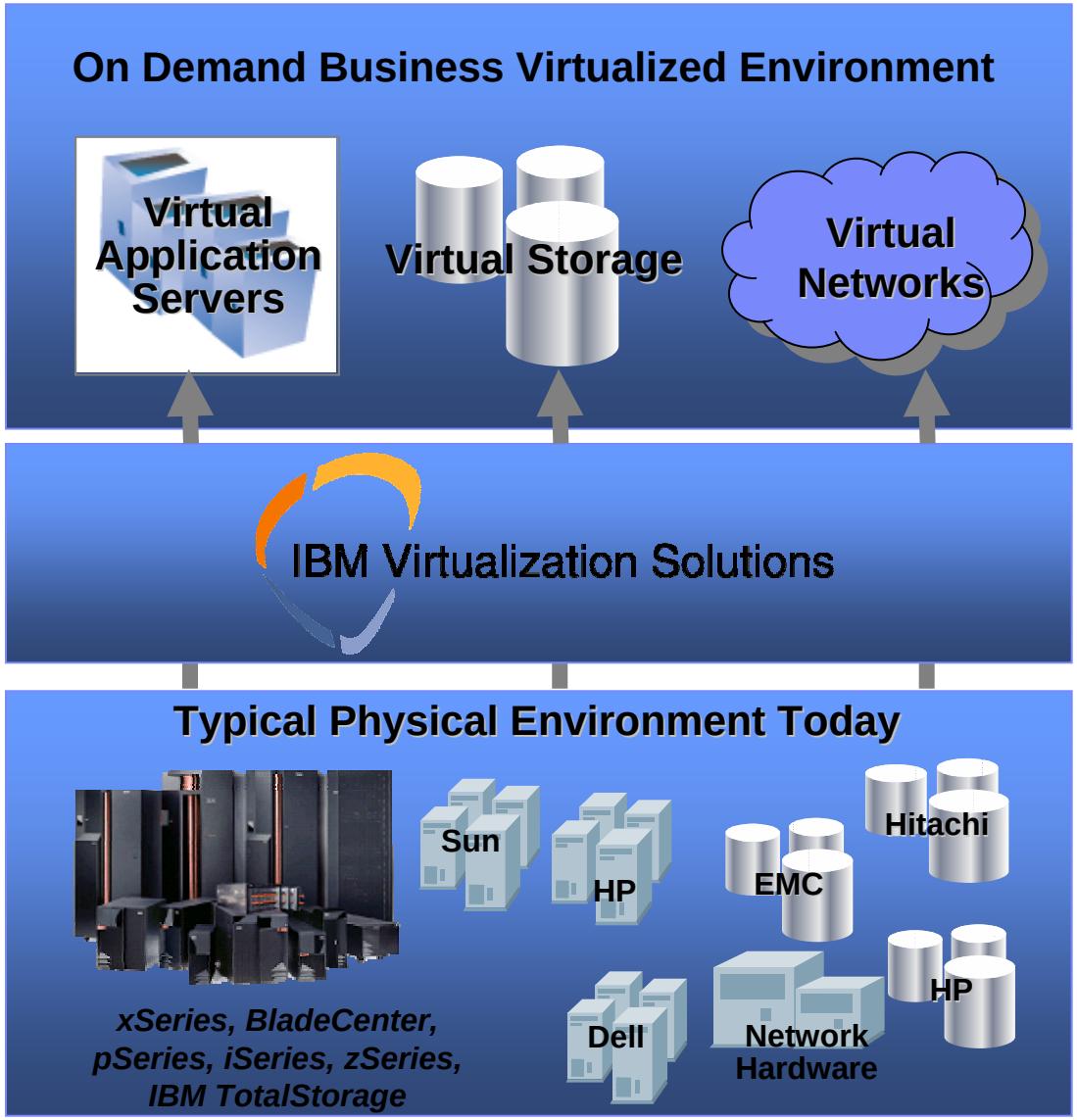
Virtualize Like Resources: Homogenous systems, storage and networks

Updated IT Governance and Management Processes

Value of Virtualization

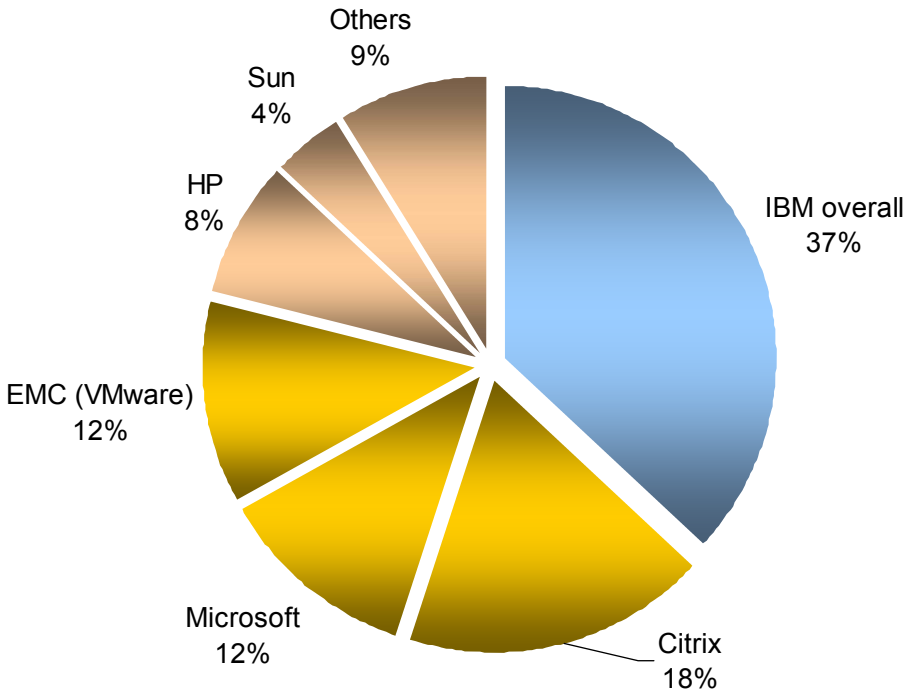
IBM Virtualization Benefits

- ☑ *Can help improve cost and speed*
- ☑ *Allows easier provisioning, management and deployment*
- ☑ *Changes are transparent to users which improves efficiency*



Customers Consider IBM a Leader in Virtualization

"What vendor would you consider to be a leader in Virtualization offerings?"



	Overall	1000+	100-1000	<100	US	EMEA	AP
2Q04	37%	38%	41%	30%	33%	41%	46%

IBM is in a dominant position as Virtualization brand leader with particular strength in AP and medium sized companies

Source: IT Trends 1H04

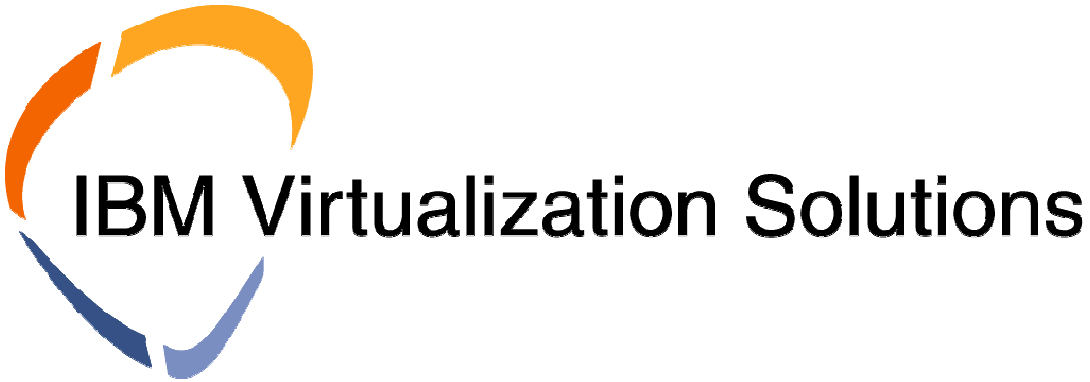
Before We Begin let's Review IBM Virtualization Engine

What is the elevator speech?	Infrastructure Simplification helps to reduce complexity and costs, improve resource utilization, and helps simplify the management of the Infrastructure resources --all of which enable on demand business breakthroughs. There are three different entry points to Infrastructure Simplification breakthroughs --Virtualization, IT optimization, and Systems management. IBM eServer, IBM TotalStorage and IBM Software platforms provide unique value for Infrastructure Simplification capabilities which are IBM-differentiators. These differentiating capabilities are delivered via the ***IBM Virtualization Engine***.
Who needs?	▪ Clients who need to aggregate pools of resources into consolidated, logical views. ▪ Clients who want to Increase the value of Infrastructure investments by leveraging current systems. ▪ Client who need to reduce complexity and increase utilization.
How is it delivered?	The ***IBM Virtualization Engine (VE)*** portfolio is designed to help manage applications and resources both within a single system as well as across multiple diverse platforms. ***VE Systems Technologies*** are functions built into each IBM eServer and TotalStorage platform that provide unique value for optimizing resources within a single system. ***VE Systems Services*** are the "fabric" that bind the various platform technologies together so they can operate cohesively as a single entity.
Why is it different?	▪ Can manage non-IBM server and storage infrastructure ▪ Does not require "rip and replace" hardware and software upgrades ▪ Builds on existing client infrastructure to help manage ***heterogeneous*** environments
Who cares?	▪CIOs ▪CTOs ▪IT Directors ▪IT Managers ▪Enterprise Architects ▪IT Strategy Executives

IBM Virtualization Solutions

IBM Virtualization Engine Suite for Servers
- Enterprise Workload Manager (EWLM)
- Director Multiplatform
- Tivoli Provisioning Manager
- Grid Toolbox
- VE Console

IBM Virtualization Engine Suite for storage
- TotalStorage SAN Volume Controller
- TotalStorage SAN File System
- TotalStorage Productivity Center



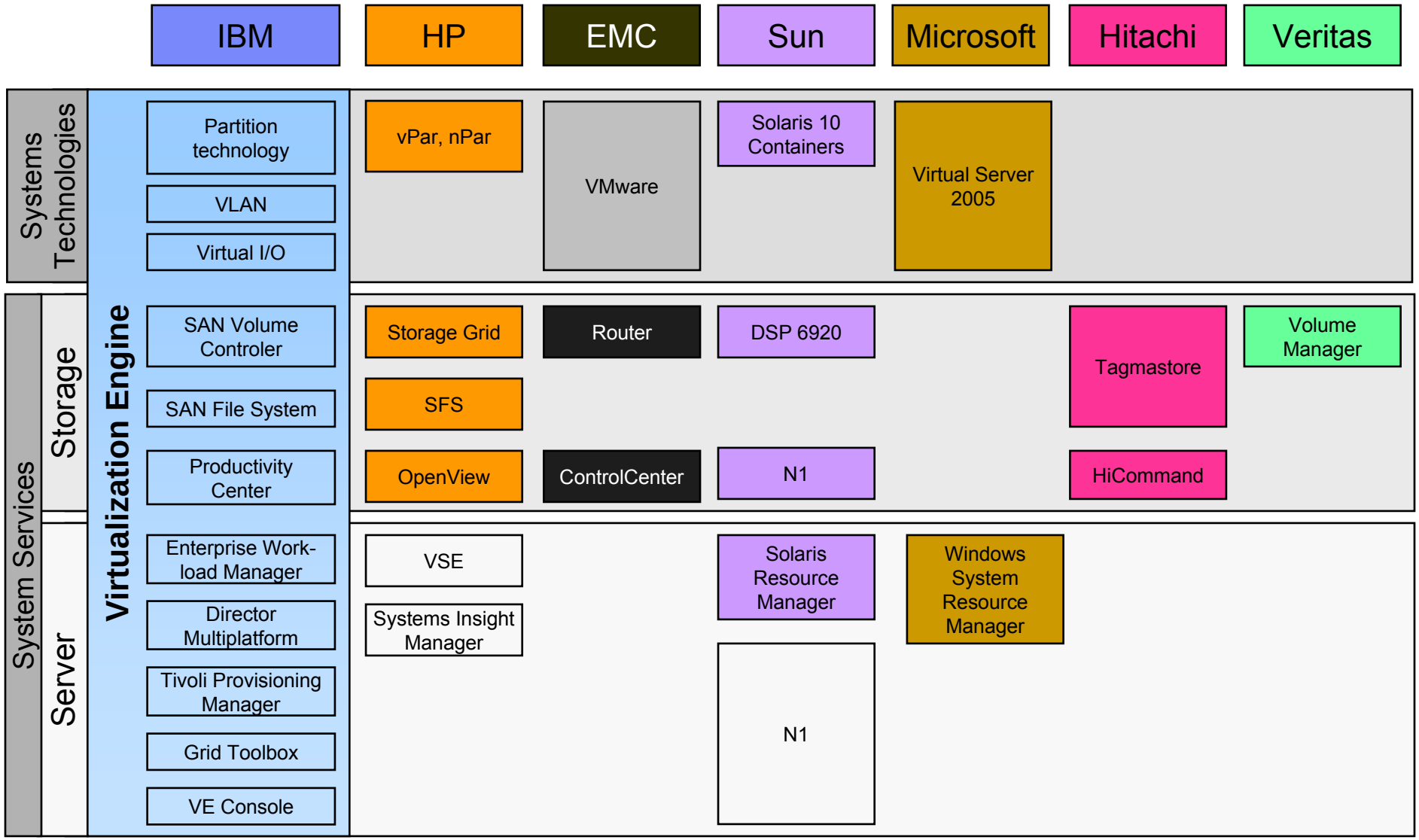
IBM Virtualization EngineSystemTechnologies
- Hypervisor, DLPAR (included in base POWER4/POWER5)
- Advanced POWER Virtualization (optionally priced feature)
  - Micro-partitioning
  - Shared processor pooling
  - VLAN
  - Virtual I/O (vSCSI, Shared Ethernet)
  - Partition Load Manager (PLM)

Virtualization gives you a **logical rather than physical view** of data, computing power, storage capacity, and other resources

IBM Virtualization Engine, leveraging 30 years of **mainframe virtualization heritage**, can help simplify the IT Infrastructure:

- Lower the cost of existing infrastructure
- Reduce the complexity of adding to that infrastructure
- Reduce the complexity of managing the infrastructure
- Build new infrastructures that are more responsive to business needs
- Improving reliability and prioritizing IT and business decisions so they all support the business better

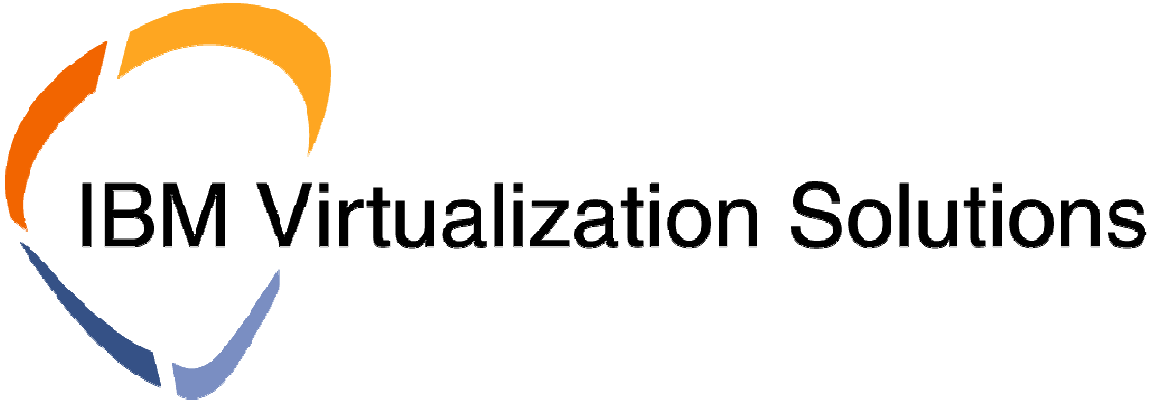
Virtualization Engine and the Competition



Sources: Vendors web-pages:

All commentary on this page is based upon IBM's view.

Virtualization Engine
Systems Technologies



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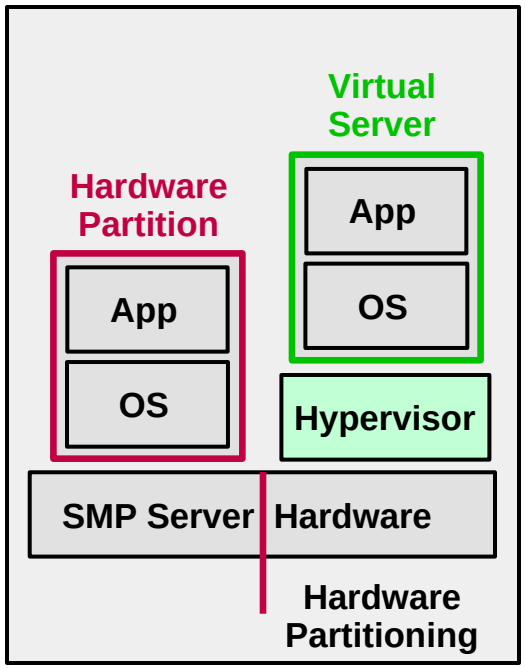
Server Virtualization Hierarchy



Virtual Servers (Most Fine-Grained Adjustability)

Hypervisor software or firmware creates virtual SMP servers whose physical resource use dynamically adjustable with fine granularity.

Examples: Virtual SMP servers created by, z/VM, PHYP, VMware, Microsoft VS

Hardware Partitions (Highest Isolation)

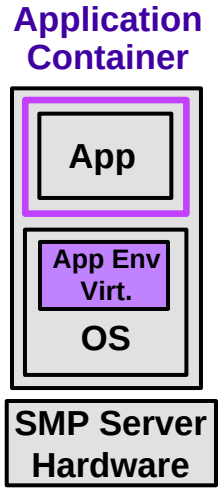
SMP server hardware is subdivided into fractions each of which is a complete SMP server and able to run an OS

Examples: zSeries PR/SM, Sun Domains, HP nPars, Fujitsu PPAR, xSeries PPAR

Application Containers

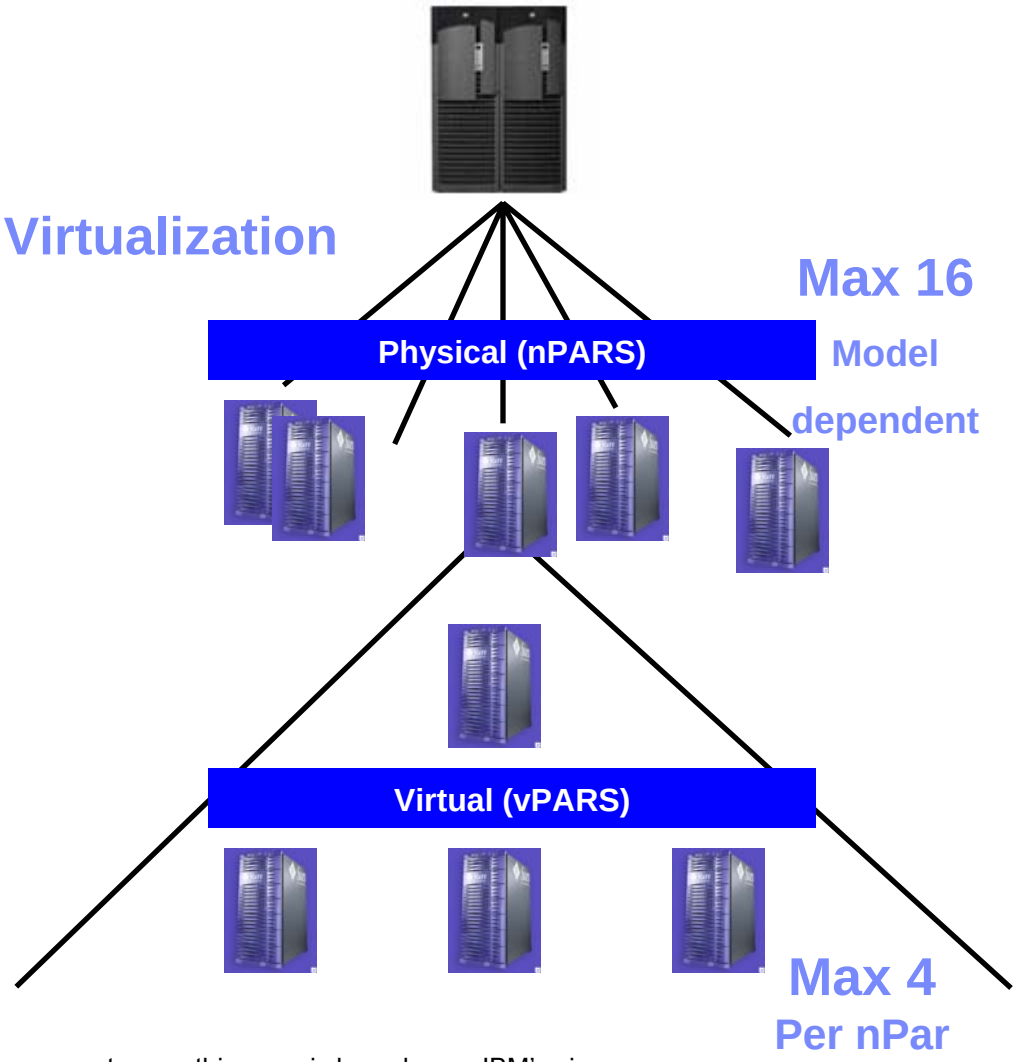
Primarily focussed on workload management Software in OS, or running on OS, creates virtual application environments which are isolated from each other and whose resources are dynamically adjustable with very fine granularity.

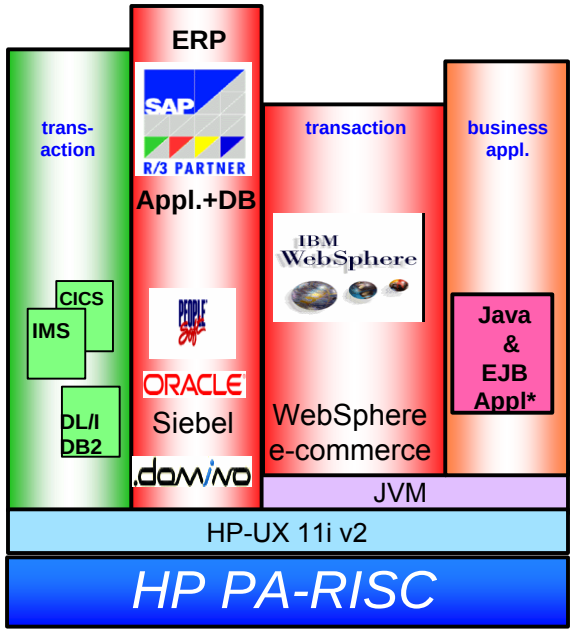
Examples: Solaris N1 Grid Containers, z/OS Address Spaces, OS/400 Subsystems, AIX WLM Classes, WebSphere AS



All commentary on this page is based upon IBM's view.

HP Virtualization / Partitioning Capabilities





- **nPars:** PA-RISC servers with HP-UX, IPF servers with HP-UX, Linux, Windows and in the future OpenVMS
- **vPars:** PA-RISC only, not supported on IPF
- Resource partitions: HP-UX only, predecessor to HP "containers"
- Partition management software:
  - Parmgr: basic nPars management for PA-RISC and IPF servers
  - vParmgr: basic vPars management within nPars for PA-RISC servers

All commentary on this page is based upon IBM's view.

HP Virtualization Plans for Tomorrow

2005 - 2006

- **vPars for IPF servers (without sub-processor partitioning) – 1Q05**
- **Increase nPars granularity to 8 processors**
  - Tied to Montecito (dual core Itanium2) and PA-8900 release
- **Integrity Virtual Machine (VM) for Integrity servers (based on Intel "Silvervale" technology)**
  - Max 20 VM's per CPU; max 256 VM's per physical machine; max 2 CPU's per VM
  - Dynamic CPU share allocation and adjustment including Virtual memory and I/O
  - HP-UX 11i v3, Linux "soon after" HP-UX in 2006; OpenVMS support (probably in 2006)
- **GWLM 2.0 with cross-server / cross-nPars virtual machine management capability**

Beyond 2006

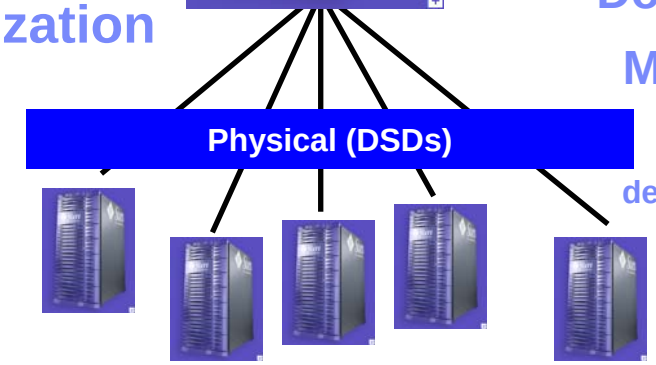
- **Enhancements to Integrity VM**
  - Add support for Windows and up to 4 CPU per VM
- **Lots of unknowns**
  - Live VM migration?
  - Add application level workload management ?
  - Transition from IPF to EM64T server architecture?

All commentary on this page is based upon IBM's view.

source: HP World 2004 sessions – August 2004

Sun Virtualization / Partitioning Capabilities

Virtualization



Dynamic System Domains

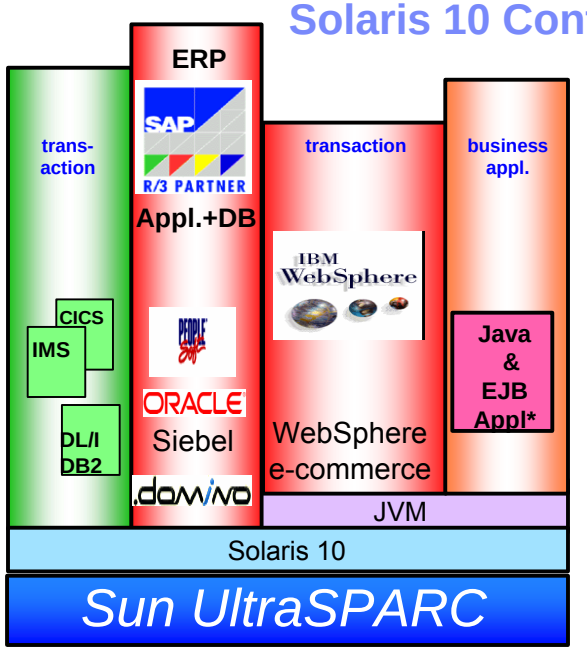
Max 18

Model dependent

- Allows blended technology (mixed CPUs) and electrical isolation between system boards
- Partitioning granularity at the board level
  - CPUs and Memory move together
  - I/O moved in four slot increments
  - Sub processor allocation not possible
  - Partitioning is not available on V480, V490, V880, V890 or V1280

All commentary on this page is based upon IBM's view.

Solaris 10 Containers



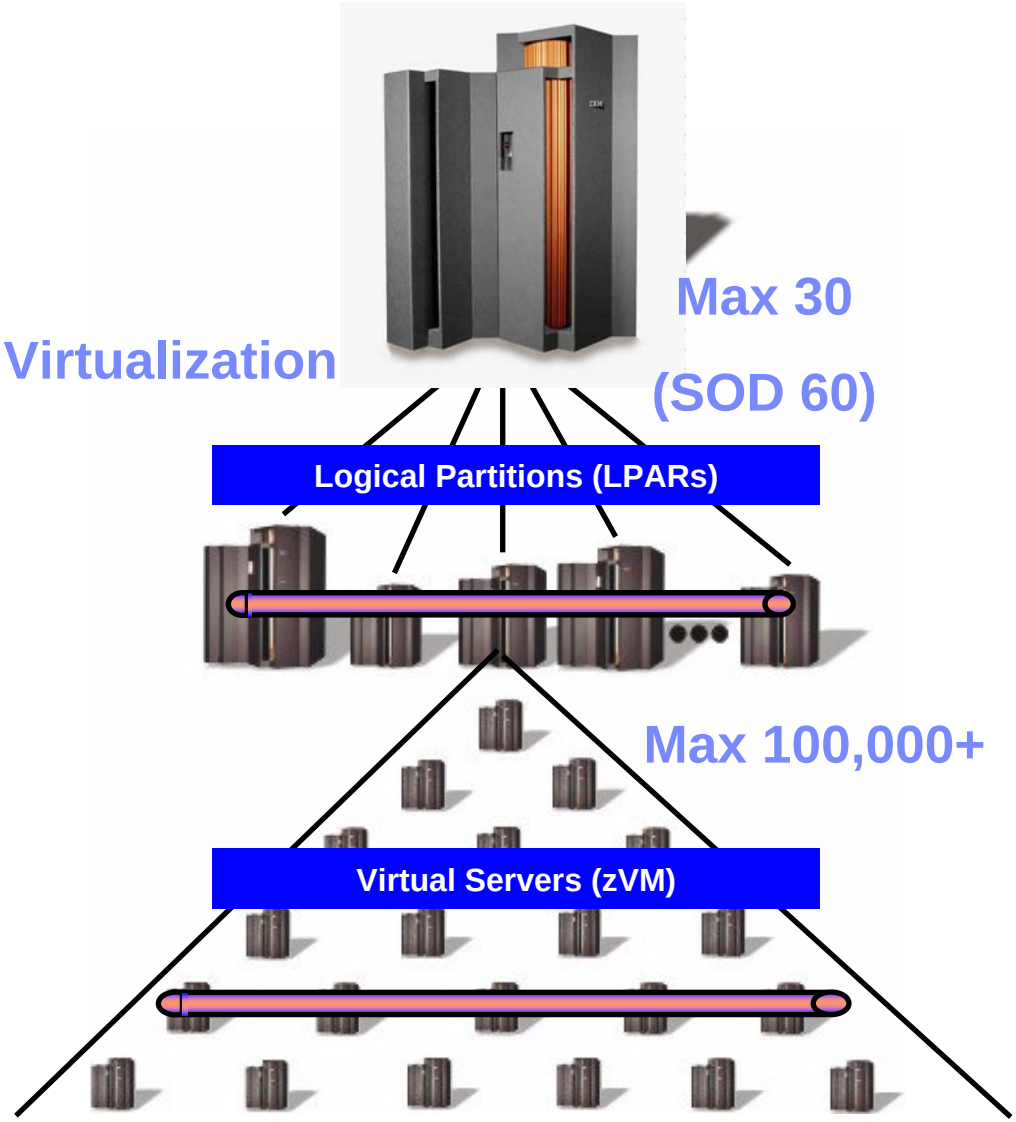
Solaris Containers (formerly known as N1 Grid Containers) is NOT a virtualization capability.

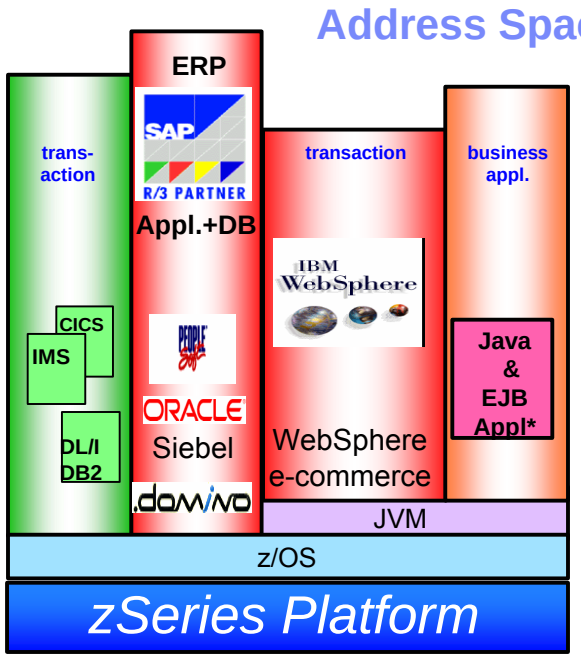
Enables multiple applications to run on a single OS instance, claiming:

- Application independence & isolation
- Managed Resources via Solaris Resource Mgr
- High Server Utilization

Partial implementation of a 30-year-old IBM technology

zSeries Virtualization / Partitioning Capabilities





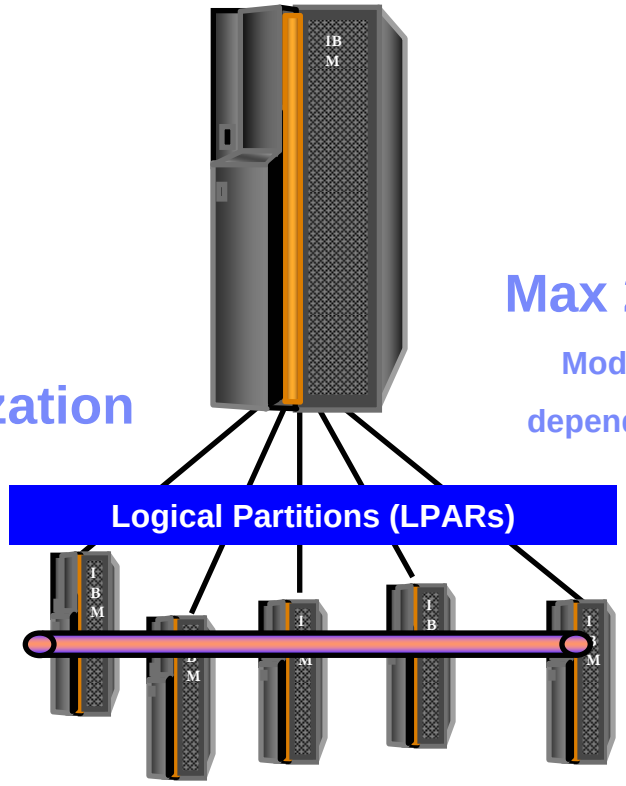
- Enables multiple applications to run on a single OS instance …
  - Independently
  - Securely
  - With Managed Resources (WLM)

… to maximize utilization.

First introduced in the 1970's.

POWER5 Virtualization / Partitioning Capabilities:
iSeries and pSeries Servers

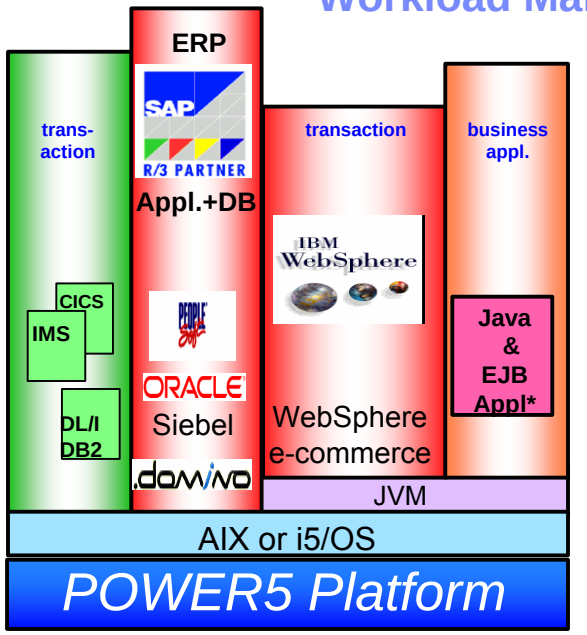
Virtualization



Max 254

Model dependent

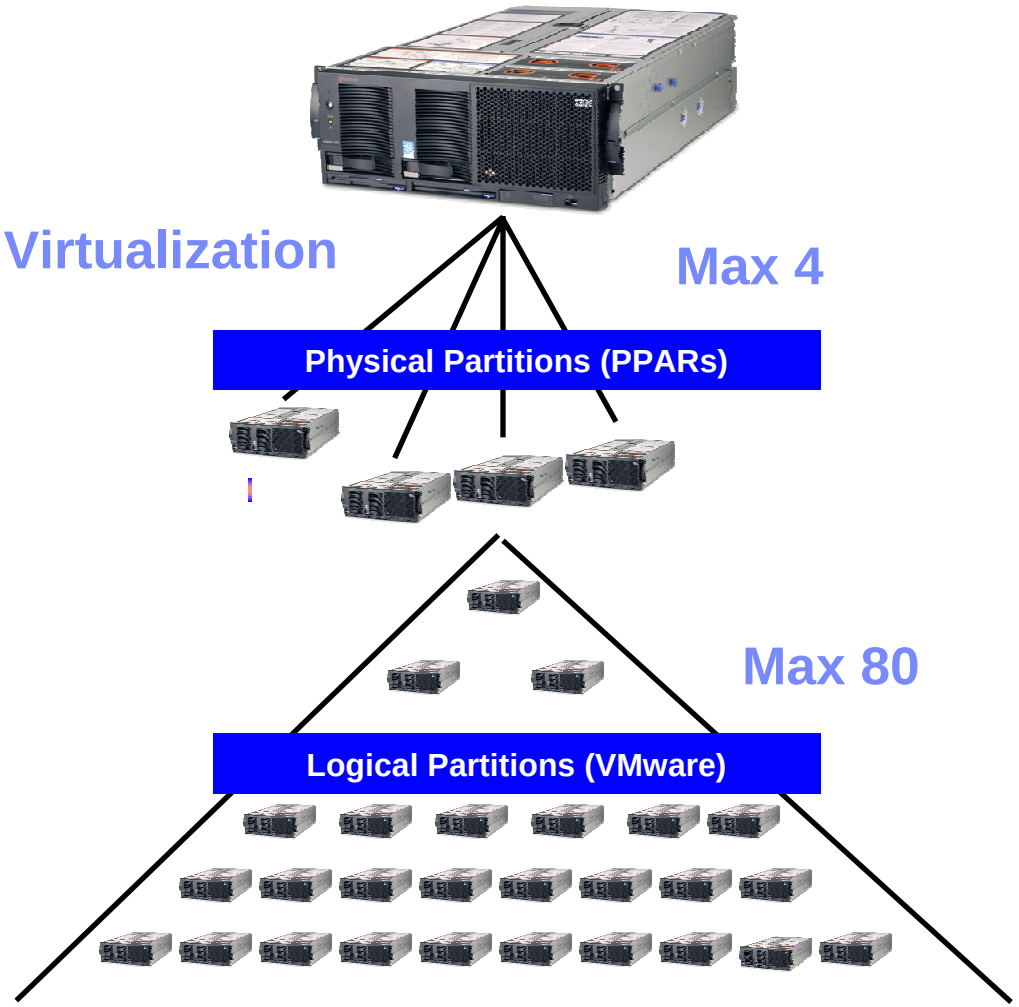
Workload Manager

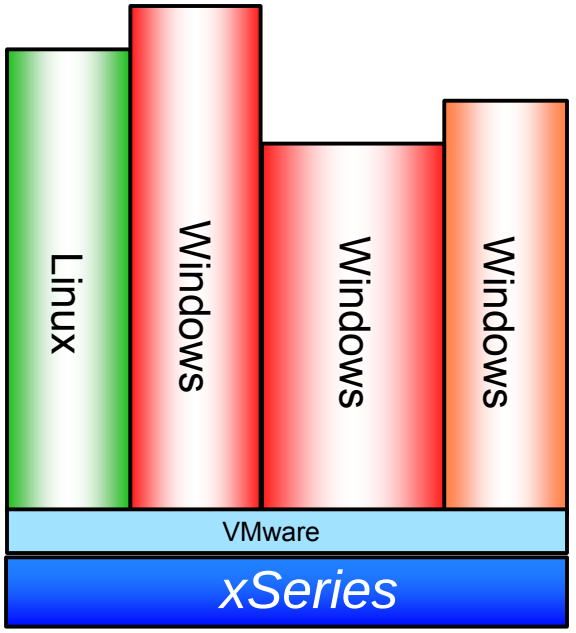


Enables automatic resource allocation across multiple tasks to maximize utilization

- Micro-partitioning
- Virtual LAN, Virtual disk
- Shared processor pooling

xSeries Virtualization / Partitioning Capabilities

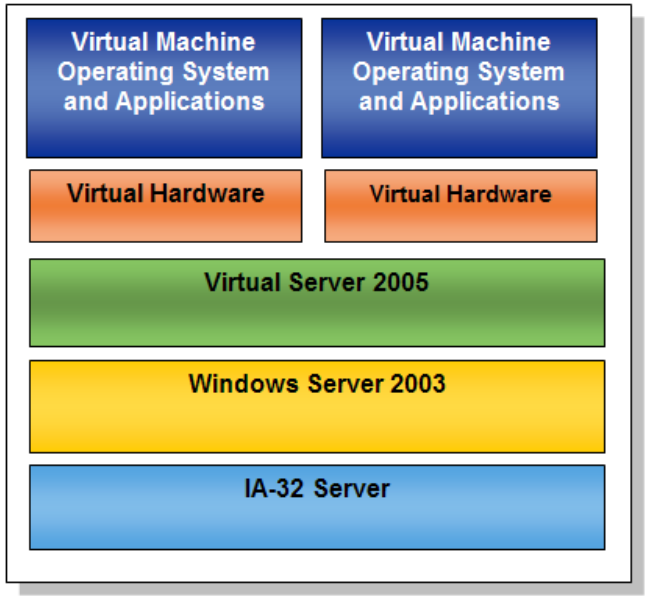




Allows physical isolation of OS images and applications

So what is Microsoft Virtual Server?

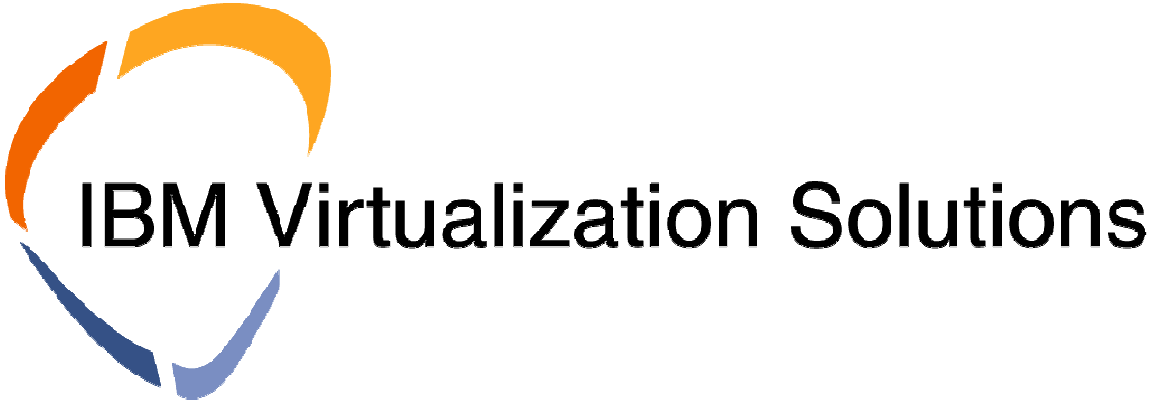
- Windows only – runs on Windows 2003 server (32-bit only)
- For consolidation of legacy Windows servers
- Also runs Novell NetWare and Linux – but no support from Microsoft
- Virtual I/O and LAN
- Enterprise Edition – 32 CPUs ($1000*)
- Standard Edition – 4 CPUs ($500*)
- Competes with VMware



* Price per server

source: Microsoft web page http://www.microsoft.com/windowsserversystem/virtualserver/default.mspx

Virtualization Engine
Systems Services - Server



IBM Virtualization Engine Suite for Servers

- Enterprise Workload Manager (EWLM)
- Director Multiplatform
- Tivoli Provisioning Manager
- Grid Toolbox
- VE Console

Virtual Server Environment Components

HP Virtual Server Environment (VSE)

Control

- Systems Insight Manager
- Workload Manager WLM for HP-UX
- 3) Global Workload Manager
- 2) GlancePlus Pack

Availability

- 2) MC/Serviceguard
- 2) MC/Serviceguard Manager

Partitioning

- nPars
- pSets
- 1)HP Integrity Virtual Machines with sub-CPU and shared I/O
- 1)Secure resource partitions

Utility Pricing

- Instant Capacity on demand - iCOD
- Temporary Instant Capacity on demand - TiCOD
- Pay Per Use - PPU

1) Available 2H05
2) VSE Enterpise only
3) Available 1H05

source: IBM recreated based on HP World 2004 sessions – August 2004

IBM Virtualization Engine versus HP VSE

IBM VE strengths versus HP VSE

- Breadth of platforms supported
  - first pass of VSE will primarily be HP-UX centric, some Linux
  - heterogeneous to HP is Unix, Windows, Linux and OpenVMS
- Integration
  - HP VSE is piece part components
  - expect overall configuration and setup to be complex
- Robust provisioning included
  - not sure where HP is going with UDC components
- Virtualization fabric
  - 12 – 24 months ahead

IBM VE weaknesses versus HP VSE

- Director MP, VE Console
  - late to market
  - many management packs and updates in process
  - HP strategy put all management function under SIM
- EWLM function
  - EWLM heterogeneous, but less function (on paper)
  - expect GWLM to be strong solution as it is the fabric for VSE

All commentary on this page is based upon IBM's view.

What is HP's System Insight Manager (SIM)?

HP's perspective

"HP SIM combines the best of Insight Manager, Toptools, and Servicecontrol Manager to deliver hardware fault, asset, and configuration management for all of your HP Systems."

"HP SIM can be easily extended to deliver rapid deployment and performance management for ProLiant Servers, or workload and partition management for Integrity and HP 9000 systems. It can be extended with management for HP clients, storage, printers and power products, and can manage non- HP platforms through industry standard management protocols."

source: www.hp.com

IBM's perspective

HP's next generation, heterogeneous systems management product and console that is a direct competitor to IBM's Director Multiplatform and integrated console

All commentary on this page is based upon IBM's view.

IBM Director Advantages over HP SIM

- Management of non-IBM servers
- Robust monitoring and alerting
- Multiple actions in response to single alert
- Granular, security-rich management of groups of systems
- Real time diagnostics
- RAID management
- FRU numbers in alerts & inventory
- Support for Predictive Failure Analysis (PFA)
- Calendar based task/event scheduler
- Software Inventory
- Software Remote Control

All commentary on this page is based upon IBM's view.

HP-UX 11i VSE MC Versus AIX VE

Goal-based Workload management	YES	YES EWLM	1
Multi OS management with provisioning	YES	YES TPM w/ DIR MP	
Integrated Management console for visualization	YES	YES VE Console	
Integrated mission-critical Visualization	YES	NO	2
Hard partitions	YES	not strategic to IBM	3
Soft partitions	YES	YES	
Sub CPU partitioning	Planned	YES	
Secure resource partitions	Planned	NO need to analyze	4
Ressource partitioning (PRM, pSets)	YES	YES	
Integrated Utility pricing with Virtualization	YES	YES Reserve CuOD	5

1. This comparison is HP-UX 11i VSE MC versus AiX, it is not heterogeneous or cross-platform.
2. True, no VE integrated clustering. HP only has for HP-UX, possibly Linux. How integrated is it?
3. Hardware partitioning has limited value.
4. Secure resource partitions are containers, hybrid partitioning. IBM needs to analyze.
5. Reserve CuOD is integrated with Advanced Power Virtualization (APV).

All commentary on this page is based upon IBM's view.

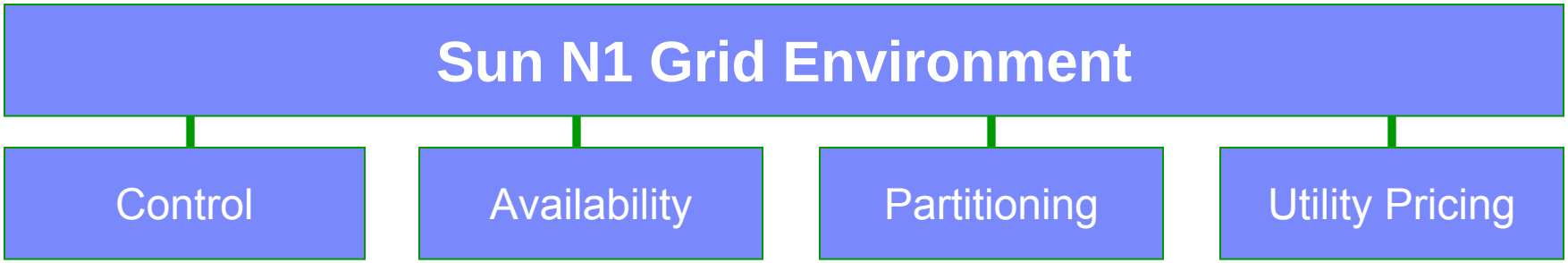
source: HP @ HP World 2004 – August 2004, with IBM STG MI generated updates

HP VSE Competitive Assessment Summary

- Comparing Apples to Apples
  - HP is focused only on the UNIX and Intel space
  - HP's definition of heterogeneous support only includes HP/UX, Linux and Windows
  - HP's claim of heterogeneous support will not be fully realized until late next year.
- HP's recent announcement threatens our perceived leadership in that specific market
- With delivery, IBM can be positioned as an overall leader in 2005 and beyond..
- Modification to existing plan is needed to further improve competitive perception. Recommendations include:
  - EWLM needs to provide some level of AIX local management to compete with HP WLM / GWLM. The combination of LPAR management, provisioning integration, and process entitlement are needed to catch up and pass HP's VSE capability
  - Invade their turf – consider adding HP monitoring to Director MP and EWLM on both HP Intel and HP/UX
  - AIX needs to understand the value / cost of containers and build a plan to either implement / counter-attack HP
- HP includes an HA solution in VSE.
  - Leverage current platform specific HA solutions? (eg. HAGEO, Linux CSM)
  - Add HA solution to VE Suite? Is RMS alone enough?

All commentary on this page is based upon IBM's view.

N1 Grid Environment Components



- Solaris Resource Manager
- N1 Grid Provisioning Mgr

- Sun Clusters

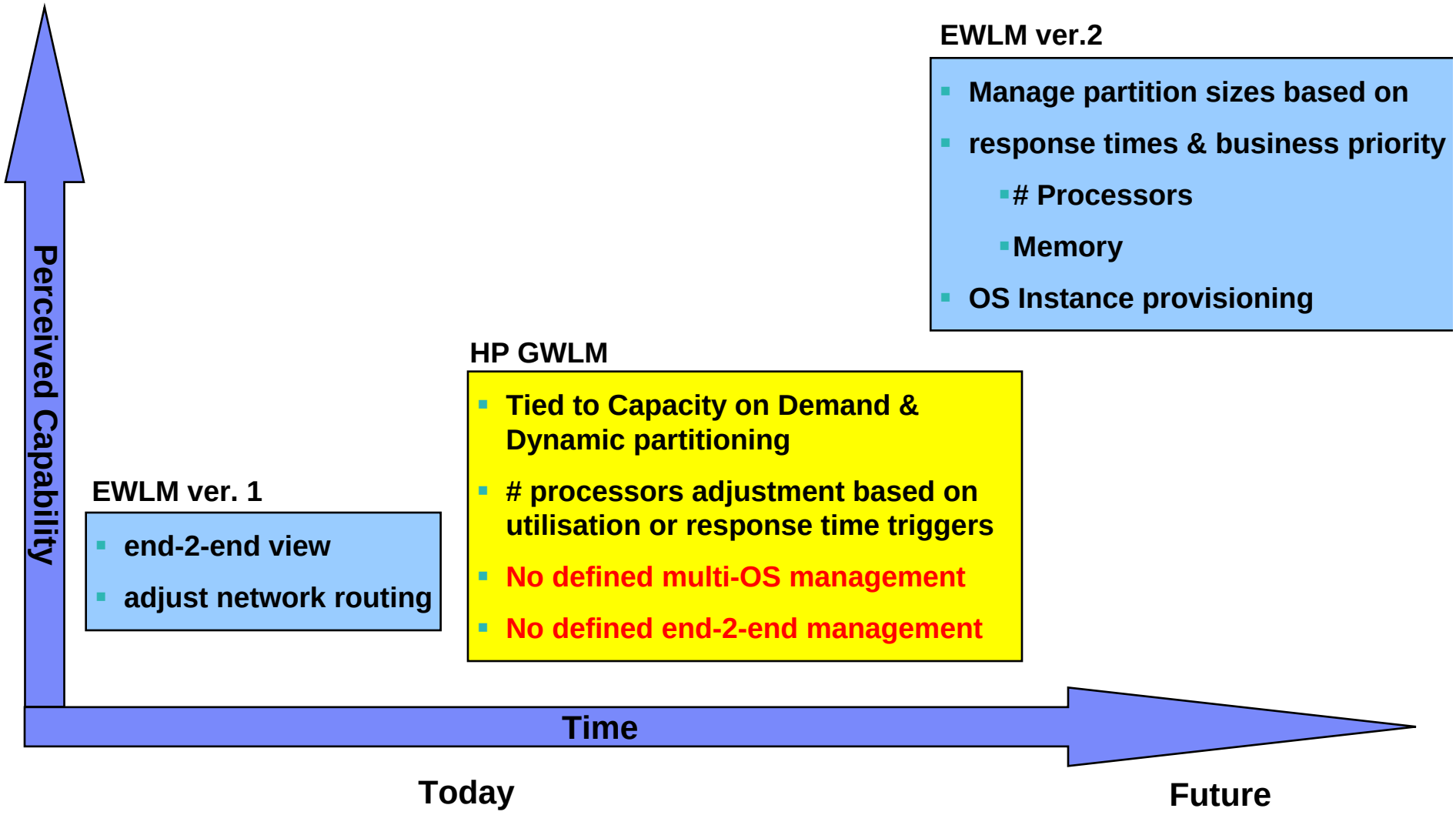
- Dynamic System Domains (DSDs)
- Solaris 10 Containers*

- Pay-per-cycle computing ($1 per CPU per hour)
- Capacity on Demand (COD)
- Temporary Capacity on Demand (T-COD)

source: http://wwws.sun.com/software/n1gridsystem/ - December 2004

*primarily a workload management technique, not partitioning / virtualization

EWLM vs. HP GWLM



All commentary on this page is based upon IBM's view.

Competitive Analysis – Enterprise Workload Manager

- **IBM Advantages:**
  - Multi-system, heterogeneous application monitoring available now
    - Windows, AIX, i5/OS, Solaris
  - Multi-system, heterogeneous management via network load balancing available now
  - Ride zWLM capability “coat-tails”
- **HP Advantages:**
  - Integration with nPAR and CUOD capability on HP/UX now with the promise of multi-OS support later
  - Integration with Insight Manager and MC/ServiceGuard
  - Threshold based management, but not as robust as the goal-based algorithms used by EWLM
- **HP’s position when GWLM is delivered:**
  - Management is still done at a single system level
  - Multi-system management console – with the ability to define common policies and single point of contact for performance monitoring / report

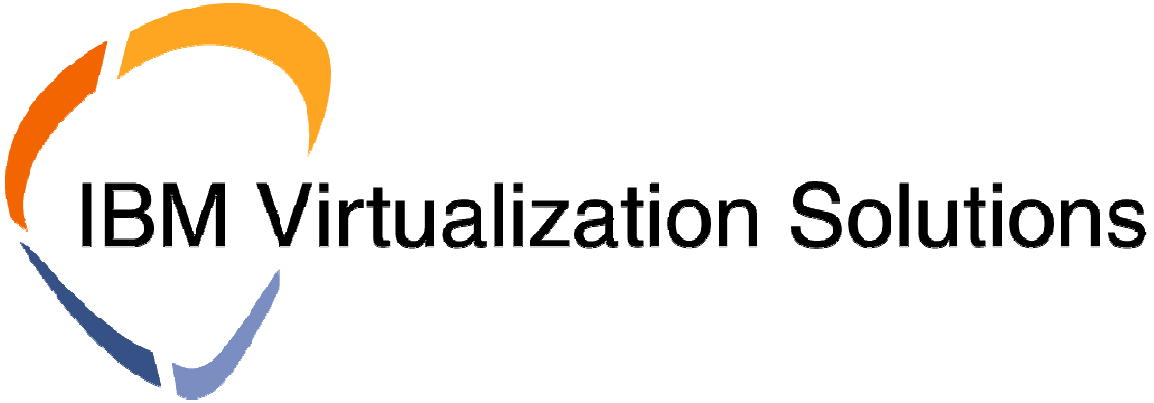
All commentary on this page is based upon IBM’s view.

EWLM vs. Solaris Containers

- **Solaris Containers**
  - Being distanced from Sun's N1 Grid strategy
  - Scope is a single Solaris instance
  - Attempts to overcome domain constraint of system board granularity
  - Isolates workloads so that they can not accidentally overwrite each other
  - Will get same amount of marketing hype as Domains on E10K
  - Efficiency totally dependent upon Solaris Resource Manager
- **EWLM**
  - Integral component of IBM's VE and ON Demand strategy
  - Supports heterogeneous server environments
  - An end-to-end throughput optimization and drill-down reporting capability operating under a service class policy
  - Influences network routing decisions

All commentary on this page is based upon IBM's view.

Virtualization Engine
Systems Services - Storage



IBM Virtualization Engine Suite for storage

- TotalStorage SAN Volume Controller
- TotalStorage SAN File System
- TotalStorage Productivity Center

Storage Management Components

Function	IBM	HP	EMC	SUN	HDS	Veritas
Device Management	✓	✓	✓	✓	✓	
Performance Mgmt.	✓	✓	✓		✓	
Replication Mgmt.	✓	✓	✓	✓	✓	✓
Storage Resource Mgmt.	✓	✓	✓	✓	✓	✓
SAN Mgmt.	✓	✓	Limited	✓	✓	✓
Automated Provisioning	✓	✓	✓	✓	Limited	✓
Workflow Automation	✓					✓
Multi-Pathing	✓	✓	✓	✓		✓
SMI-S Enablement	✓	✓	✓	✓	✓	✓

✓ Heterogenous support ✓ Vendor's devices

Sources: Vendors web-pages:

All commentary on this page is based upon IBM's view.

Management Suites side-by-side

	IBM	HP	EMC	HDS
	Productivity Center	OpenView Storage Area Manager Suite	ControlCenter Open Edition	HiCommand Storage Services Manager
Device Management	PDC for Disk	HP OpenView Storage Operations Manager	Symmetrix Manager	HiCommand Device Manager
Performance Management	PDC for Disk	OpenView Storage Optimizer	Performance Manager	HiCommand Tuning Manager
Replication Management	Productivity Center for Replication	HP OpenView Storage Mirroring	SRDF/Timefinder Manager	HiCommand Device Manager
Storage Resource Mgmt.	Productivity Center for Data	OpenView Storage Area Manager	SRDF/Timefinder Manager	Resource Manager
SAN Management	Productivity Center for Fabric	OpenView Storage Node Manager	SAN Manager	
Automated Provisioning	Tivoli Provisioning Manager	OpenView Storage Provisioner Storage Allocater	Automated Resource Manager	HiCommand Path Provisioning
Workflow Automation	Tivoli Intelligent Orchestrator			
Multi-Pathing	Subsystem Device Driver (SDD)	StorageWorks Secure Path	PowerPath	Hitachi Dynamic Link Manager
SMI-S Enablement	native CIM agents use SMI-S	native CIM agents use SMI-S	Solutions Enabler Kit	native CIM agents use SMI-S

Sources: Vendors web-pages:

All commentary on this page is based upon IBM's view.

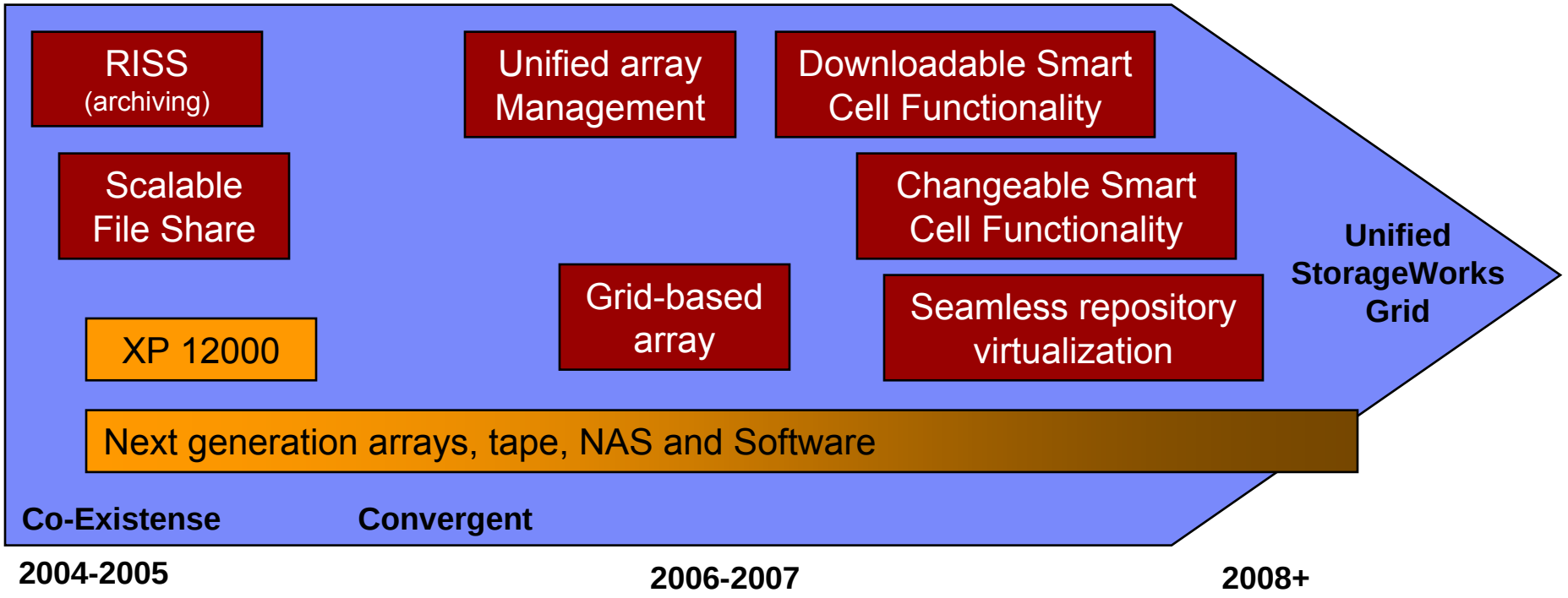
HP *Invents* Virtualization … Again and Again!

- **Year End 2003 –** Drops development of VersaStor
  - *Reasons: Cost, Complexity, Not meeting customer needs*
- **MAY 2004 –** Loses court case with EMC over CASA patent infringements
  - *EMC says it might push to bar sales of CASA*
- **SEP 7, 2004 –** OEMs HDS TagmaStore as StorageWorks XP12000
  - *Array-based in-band heterogeneous virtualization*
- **SEP 21, 2004 –** Confirms CASA is no longer a marketing focus **(effectively withdrawn)**
  - *Promises to "talk about our virtualization plans" in 4Q04*
  - *ComputerWire: "The company looks likely to resurrect the VersStor virtualization technology"*
- **DEC 2004** – Says that the company's only storage virtualization plans now are related to the storage grid technology **it hopes to ship in around three years' time.**
  - *Says that suggestions it made in September that led to a ComputerWire report that it would be announcing fresh virtualization developments were misinterpreted.*

See speaker notes for sources

All commentary on this page is based upon IBM's view.

HP Storage Grid

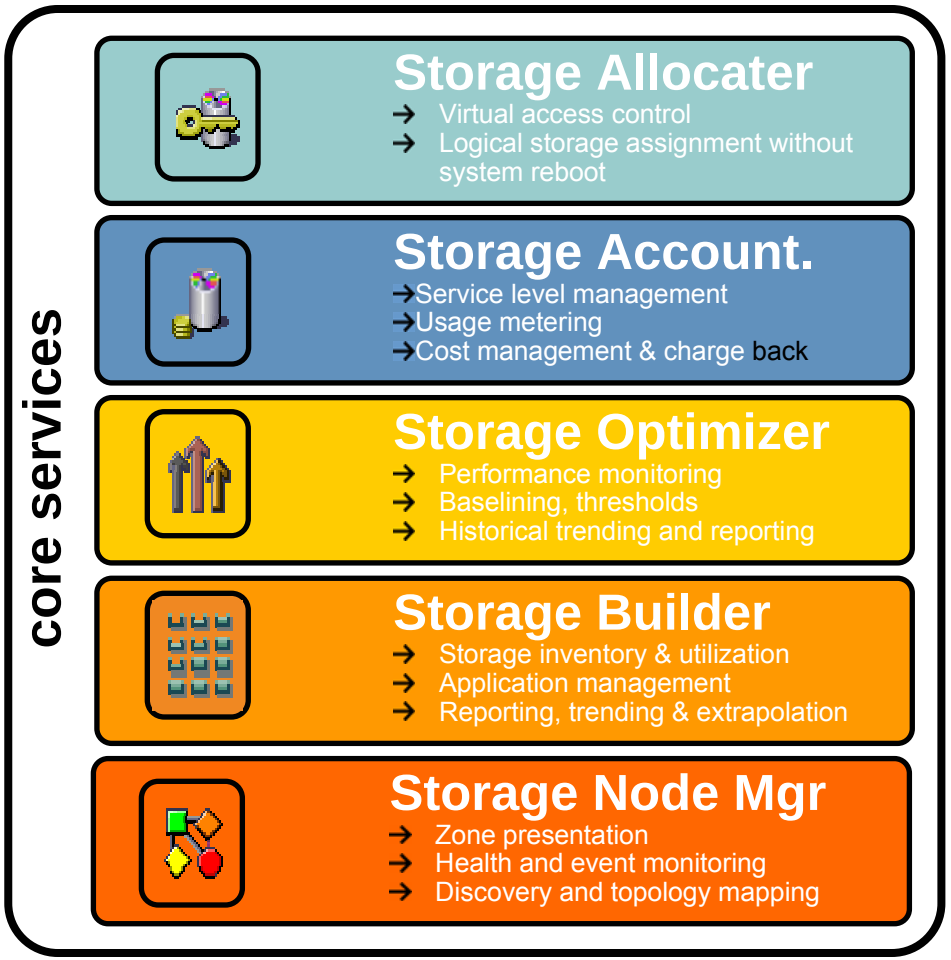


- Still only an announcement
- Investment protection?
- Does HP have the resources to deliver this technology?

All commentary on this page is based upon IBM's view.
source: IBM recreated based on HP StorageWorks Web-cast - http://h18006.www1.hp.com/storage/highlights/swconf2004.html - December 2004

HP OpenView Storage Area Manager

- OpenView consists of a set of components that are used for management of different areas – some well integrated and some not integrated at all
  - HP has at least three different consoles in the OpenView product portfolio
- HP is investing in management software and will position themselves as the vendor that… *"makes it all work together with a fast return on investment"*
  - What about "Unified array Management"?
  - What about integration of existing products that customers have already invested in?



All commentary on this page is based upon IBM's view.

Source: http://h18006.www1.hp.com/products/storage/software/sam/index.html - December 2004

EMC Virtualization – Hype vs. Reality

Storage Router positioning

EMC claims:

- Migrate/move/manage/adjust data in a non-disruptive way
- allow customers to keep their current array-based replication products
- handle block virtualization using both Fiber Channel and **iSCSI**

Concerns:

- Maintaining a consistent product across 3 switch brands
- Special host software would likely be required for host / storage provisioning
  - **(PowerPath is the seed for this)**
- Not good for snapshots
- Might have difficulty with auto-invoking Symmetrix management after migrating data from CLARiiON
- Premium cost for the intelligent switches
- Unproven hardware & software (at least in the near term)
- Disruption required to an existing SAN fabric to add this function

ControlCenter

"ControlCenter is having a single console providing a single interface for storage management"

- ControlCenter is a set of framework components and a set optional components with its own functions and interface characteristics
- EMC itself does not use ControlCenter as a single interface. Only some EMC management products are supported by ControlCenter
- PATROL Storage Manager acquired from BMC and the storage products EMC acquired in its acquisition of Legato is not integrated into ControlCenter.

"A benefit of ControlCenter is its ability to manage a heterogeneous storage environment."

- CLARiiON is managed by Navisphere and Access Logix while Symmetrix is managed by the Symmetrix Manager and EMC SAN Manager.
- Most management of non-EMC disk systems is limited to reporting/monitoring only. It is not possible to modify logical configuration attributes (e.g., creating volumes).

All commentary on this page is based upon IBM's view.

HDS TagmaStore Universal Storage Platform

- **Universal Volume Manager** – 32PB Ext. storage attach with single management
  - NO 3rd party external storage in initial release – only Lightning & Thunder
  - 1st Heterogeneous in 2005: Only 14PB, LUN passthrough (no capacity allocation)
  - Full virtualization support not expected until 2H05 (Evaluator Group)
  - No ability to scale the single TagmaStore (no clustering)
  - Supports ~200x the pool size of Lightning with only ~4-5x the performance
  - "Single-pane-of-glass management with HiCommand software"
- **Private Virtual Storage Machines** – up to 32 partitions of Capacity/Cache/Ports
  - Not due until second release – basically resource partitioning
  - No way to allocate workloads to controller processor / OS partitions (resources only)
- **Universal Replicator** – Cacheless Async. Replication – "Pulled" from target
  - Not due until 2Q05
  - Appears to be only TagmaStore-to-TagmaStore Replication - pass-through to Target
- **Pricing** - Starts at $700K
  - Ties you to high-end array just to get started with virtualization
  - If customer decides to change virtualization method later > Rip, Replace, Migrate data

All commentary on this page is based upon IBM's view.

Sun virtualization – StorEdge 6920

- **Data Services Platform (StorEdge 6920).**
  - Integrated virtualization switch from the Pirus acquisition
- **OEM of the Hitachi USP (StorEdge 9900)** creates potential product conflicts with Data Services Platform
  - 6920 is not the same scalability, performance or throughput as USP
- **Is conceptually similar to USP, but late to market.**
- Comes with 14 preset **Storage Profiles** for creating pools (such as for an Oracle OLTP application). The user can also create customized profiles**.**
- **Requirements**
  - Solaris host
  - Veritas for dynamic multi-pathing
  - Veritas for volume replication

All commentary on this page is based upon IBM's view.

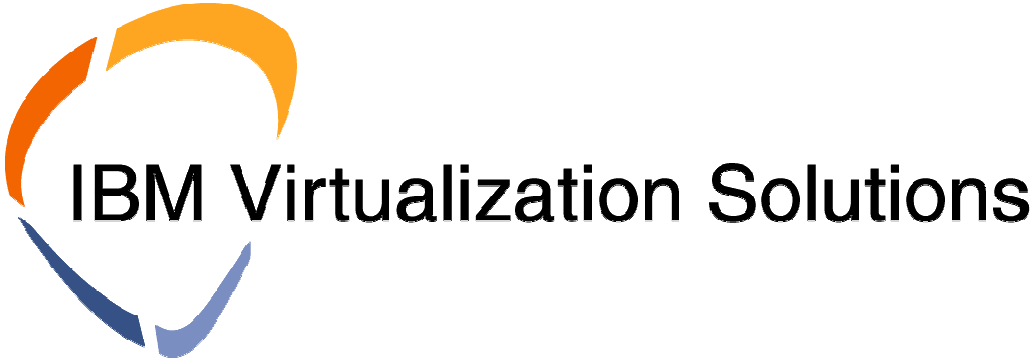
Current Competitive Landscape – Storage Virtualization

- IBM is the only traditional storage player offering a cache-based virtualization architecture.
- IBM is alone in offering a scalable appliance solution which virtualizes a large single pool of storage.
- IBM is the only traditional storage player with a SAN based virtualization solution available TODAY.

All commentary on this page is based upon IBM's view.

IBM Against the Competition - Virtualization

- Customers have plans for virtualization
- Most competitors are heading where IBM are now
- IBM has a broad offering of Virtualization
- We are in a very good position right now
- You should go out and exploit these opportunities



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The Virtualization Engine Resource Kit is the one-stop shopping location for all relevant information on Virtualization Solutions. Either use the link above or go to Systems Sales Home Page (w3.ibm.com/systems/sales) search on the keyword VESK to find the resource kit. Includes: Brochures, Events, FAQs, Analyst Reports, Press Release and copies of this; and other presentations.

Note to Business Partners, http://www.ibm.com/partnerworld/sales/systems/ Due to Security features on www.ibm.Partnerworld we cannot provide direct hyperlinks . To access Virtualization Resource Kit, log into IBM System Sales home page. After you log in, then enter "VESK" in the search box on System Sales home page. Virtualization engine resource kit (VESK)

IBM Virtualization Engine vs. the competition - This presentation

w3-1.ibm.com/sales/systems/portal/_s.155/254?navID=f340s300&prodID=IBM eServer And TotalStorage Products&docID=vecomp

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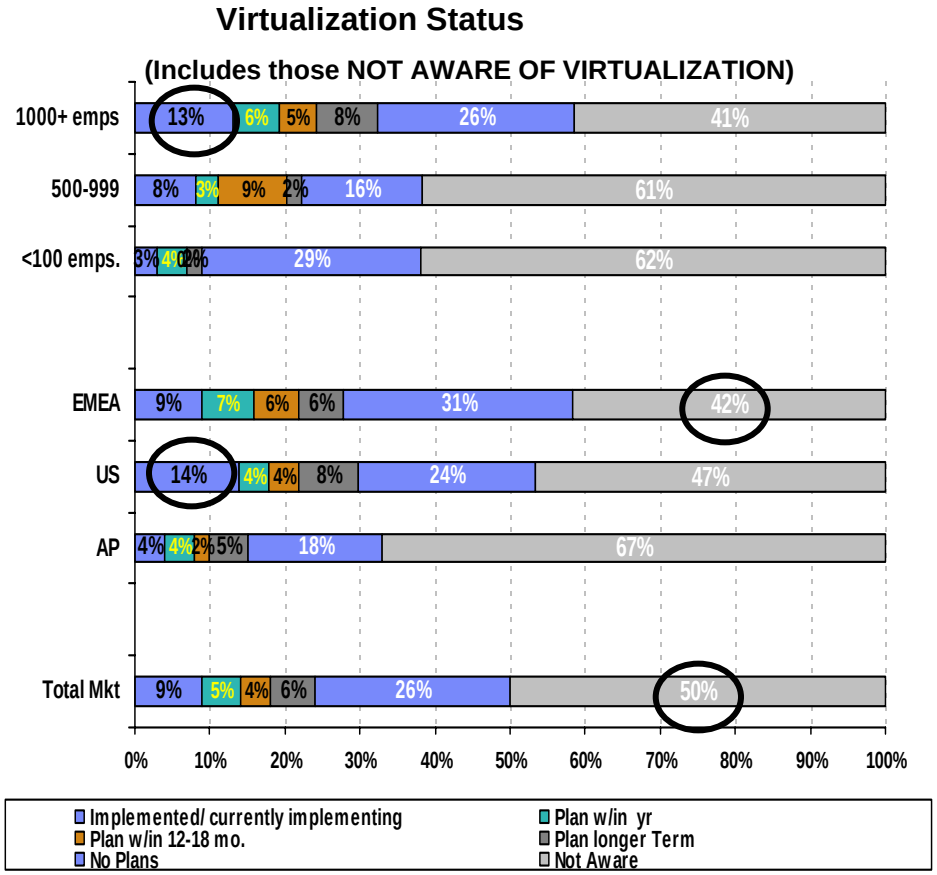
Further virtualization

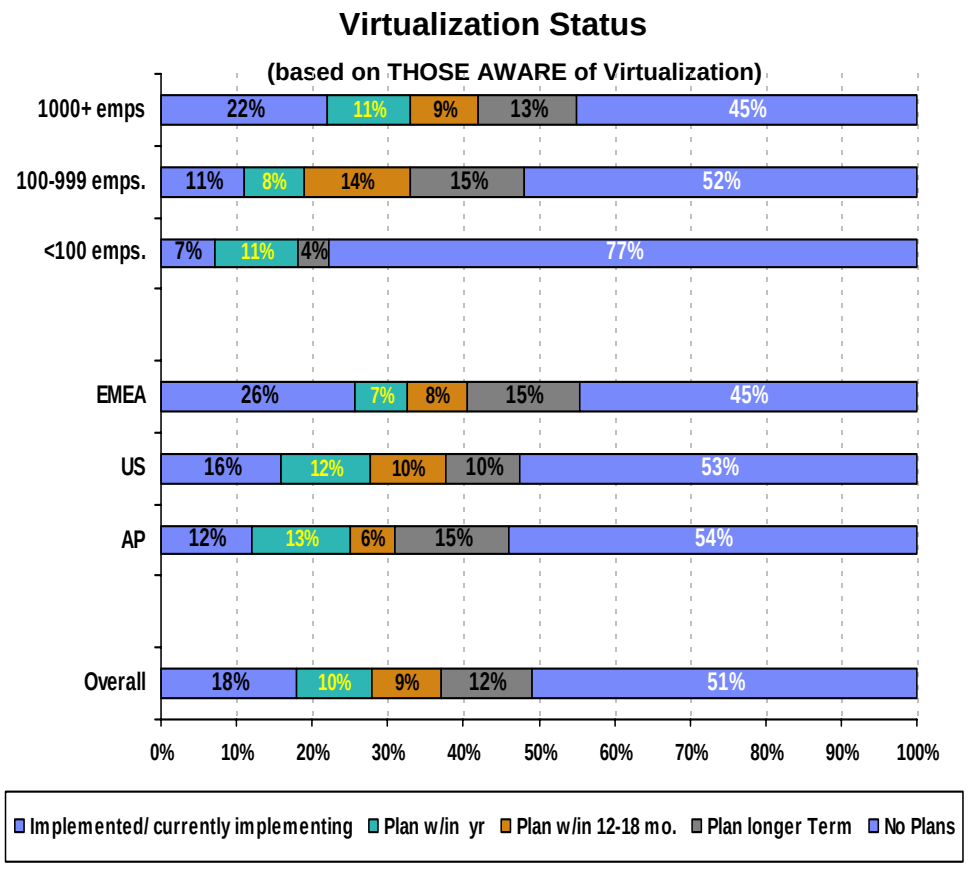
- **z/OS plans to extend its role in cross-system optimization with capabilities in support of the IBM Virtualization Engine. IBM plans to deliver:**
  - Enterprise Workload Manager support for z/OS in 2005.
  - Common Information Model (CIM) support on z/OS in 2005. This set of open interfaces can enable cross-platform systems management solutions
- **In the future, Linux guests running on z/VM may benefit from IBM Virtualization Engine support for Linux on zSeries, which is intended to include Enterprise Workload Manager support for zSeries, Linux for zSeries participation in IBM Director Multiplatform, and the IBM Dynamic Infrastructure for mySAP Business Suite, a solution using Virtualization Engine systems provisioning.**

- **All statements regarding IBM plans, directions, and intent are subject to change or withdrawal without notice.**

Virtualization Status: Half Are Not Aware of Term in 2Q04

Overall, 50% are not aware of the virtualization definition in 2Q04. Large enterprises and the US lead in percent implementing. EMEA has the lowest percent "not aware". However when those who are not aware of virtualization technologies are taken out of the base, EMEA led in implementation of virtualization. Further analysis revealed Citrix was a large reason for this higher adoption in EMEA.



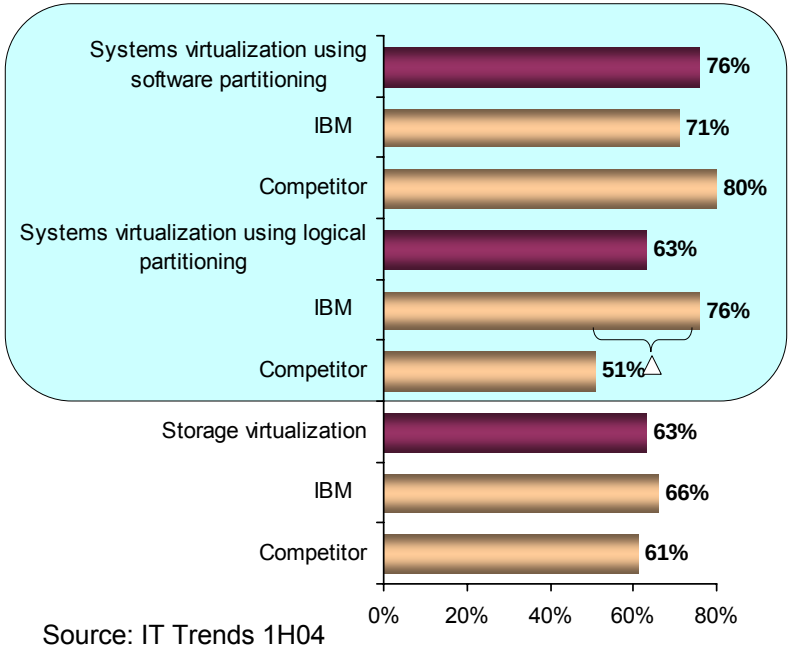


Source: IT Trends 1H04

Virtualization technologies: IBM sites display significantly different behaviour to competitor sites

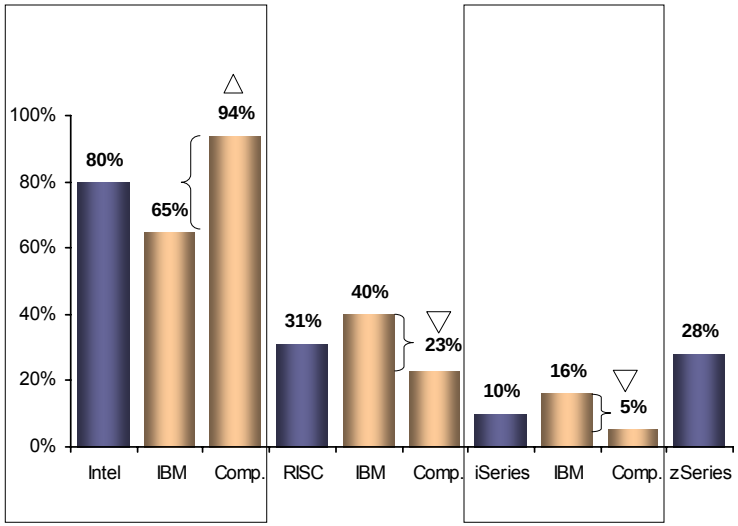
Although software partitioning is the leading Virtualisation technology overall, logical partitioning is also very popular at IBM sites. Competitor sites however, prefer SW partitioning. Both types of partitioning are most commonly implemented on Intel platforms but is significantly more likely at competitor sites vs. IBM sites. Although not as widely used as Intel in general, partitioning on RISC/iSeries at IBM sites is popular. Partitioning on zSeries is high at 28%.

2Q04: Use/planned use of different Virtualization technologies (Base: Implemented/currently implementing Virtualisation)



2Q04: Server platforms for use/planned use of logical or software partitioning

(Base: Using/planning to use logical/software partitioning)



Source: IT Trends 1H04

IBM confidential

	VE Offering Matrix	p	i	z	x	TS	Blades
VE Systems Technologies	Hypervisor	V	V	V	A	FF	A
	VLAN	V	V	V	n/a	n/a	n/a
	Virtual I/O	V	V	V	A	n/a	A
VE Systems Services	IBM Grid Toolbox	V	V	V	V	FC	V
	IBM TPM for eServer servers	V	V	V	V	FF	V
	IBM Enterprise Workload Manager	V	V	FF	V	FC	V
	IBM Director Multiplatform	FF	V	A	V	P	V
	VE Console	V	V	A	V	P	V
	Disk Virtualization	V	A	A	V	V	V
	File Virtualization	V	A	A	V	V	V
	Storage infrastructure management	V	V	A	V	V	V
Assessments	IT Optimization Solutions Services	V	V	FC	FC	FC	FC
	Scorpion Study	V	V	V	V	V	V
	Virtualization engine planning assistant	V	FC	FC	FC	FC	FC
	IT Rationalization Study	V	V	FC	FC	FC	FC

V = included in VE A = alternate means available outside of VE FF = Future Feature n/a = not applicable or not needed FC= Future consideration P= Participant

IBM and the Competition - Hypervisor, Partitioning

Area	Capabilities and Attributes	IIBM zSeries VM	IBM zSeries PR/SM	IBM POWER Hypervisor	HP vPARs	VMware ESX Server	Microsoft Virtual Server
Function	Processor architecture support	z/Arch	z/Arch	Power	PA-RISC	x86 32, x86 64	x86 32
	Guest operating system support	z/OS, VM, VSE, TPF, Linux	z/OS, VM, VSE, TPF, Lin	AIX, Linux, OS/400	HP-UX	Win, Lin NetW, Solaris	Win, Lin
	Processor resource capping	Yes	Yes	Yes	Yes	Yes	Yes
	Shared memory regions	Yes	No	No	No	Yes	No
	I/O adapter sharing	Yes	Yes	Yes	No	Yes	No
	Server-local virtual disks	Yes	Yes	Yes	No	Yes	No
	Virtual networks	Yes	Yes	Yes	Yes	Yes	Yes
Scalability	Max. # VMs	1000's	30	254	64 / 128 (1)	200	256
	Max. physical server size	48	48	64	64 / 128 (1)	16	32
	Max. processors per VM	64	32	64	64 / 128 (1)	2-4	1
	Hypervisor efficiency						
	Pageable VMs	Yes	No	No	No	Yes	Yes
Granularity	Min. processors per VM	<<1	<<1	<<1	1	<<1	<<1
	Min. memory	<1MB	64 MB	128 MB	2 GB	512 MB	256 MB
	Memory granularity	<1MB	64-256 MB	16 MB	64 MB	4KB	1 MB
On-Demand Support	Floating virtual processors	Yes	Yes	Yes	Yes	Yes	Yes
	Vary # of processors	Yes	Yes	Yes	Yes	Yes	No
	Vary virtual processor weights	Yes	Yes	Yes	Yes	Yes	Yes
	Vary memory	Yes	Yes	Yes	Yes	Yes	No
	Vary I/O	Yes	Yes	Yes	Yes	Yes	Yes
	Move running VM	No	No	No	No	Yes	No
	Wkld ,mgmt automation enable	Yes	Yes	Yes	Yes	Yes	Yes
	Aut. reserve capacity exploit	Yes	Yes	Yes	Yes	No	No
RAS	Max. # physical partitions	1	1	1	16 nPARs	1	1

Leadership	Advantaged	Competitive	Marginal	Non-Competitive

source: IBM Systems Virtualization Leadership Team, Competitive Sub teams

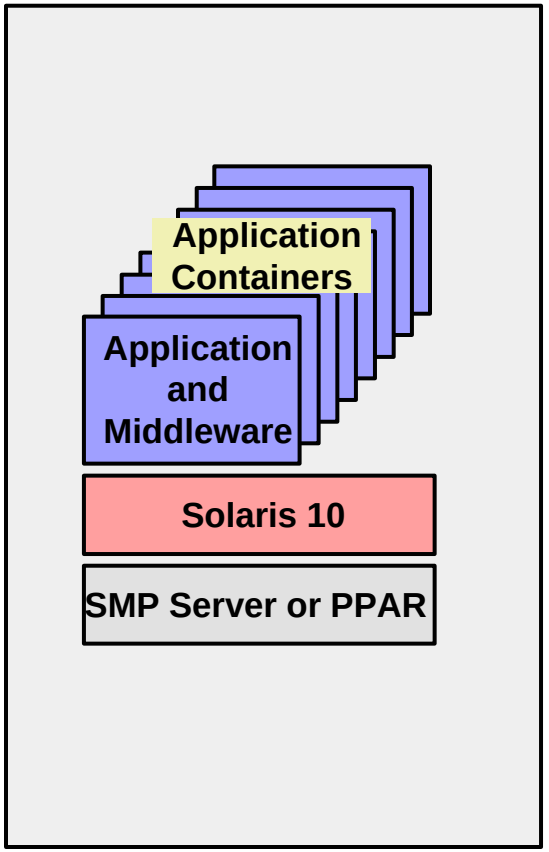
Solaris Containers (Solaris 10)

Each application has its own isolated Solaris environment.

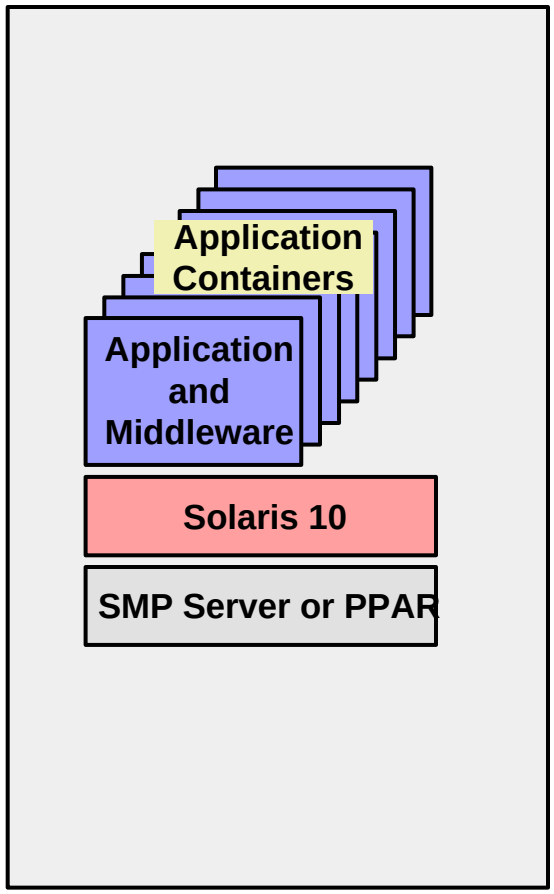
- File namespace, user namespaces, and services
- IP addresses and hostnames
- Security profiles and root password

Claimed capabilities:

- Fine-grained resource sharing (up to 8192 containers per OS instance
- Resource reassignment (manual or automated based on policy)
- Full resource containment and control for predictable service levels
- Strong fault isolation and security isolation
- Container-level administrative functions and resource accounting
- Container clustering for scale out and high availability (failover)
- Read-only shared file system for shared data
- Container reboot without impacting others
- High efficiency (less than 1% overhead)
- Predictive self-healing functions in Solaris
- Simplified management: One OS to install, operate, maintain
- Moveable from OS to OS transparently for load balancing & availability
- Available everywhere Solaris 10 runs: SPARC, IA-32, x86-64



Solaris Containers - Assessment



Strengths:

- Fine-grained resource sharing (Sub-CPU)
- High-end SMP scalability
- Good application isolation
- High efficiency

Weaknesses / Issues:

- Solaris-only solution: no Linux or Windows capability (but enhanced Linux compatibility is claimed)
- OS-based solution has worse availability than a purpose-built hypervisor (planned and unplanned outages)
- Enables use of fewer OS kernel instances, but any OS fault or service patch affects all containers
- OS version must be the same for all containers (cannot be used for OS-level testing or release migration)
- Container management required