Positioning of Efficient Virtualization

infrastructure optimization and business value

"*not all technologies are born equal or the devil is in the details…*"

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Agenda

- Some basic's…

IT Infrastructure Challenges

- Low utilization
- High number of servers/cpu's
- Rigid configurations – Silo's
- Fixed resources per server

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- Complexity of Application integration
- Lack of flexibility

2005-2006 Observations

Over 75% companies with 500+ employees deploy virtual servers

45% of new servers bought in 2007 will be virtualized. It was 8% in 2003

Source: IDC → http://w3.ibm.com/news/w3news/top_stories/2006/01/swg_cims_lab.html

Natural questions to ask…

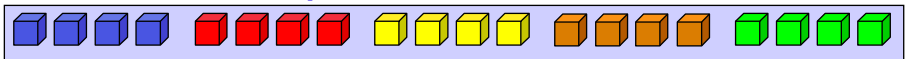
- How can we get more out of the systems & people we have ?
- How can we ensure that our systems perform as required so they don't cause problems or slow us down in our business development ?
- How to keep operational costs down to meet budget & ensure that costs to manage IT don't spiral out of control ?

Agenda

- **Some basic's…**
- **Virtualization and Efficient Virtualization**
- **Next generation virtualization and trends**

- **How can we get more out of the systems & people we have ?**
- **How can we ensure that our systems perform as required so they don't cause problems or slow us down in our business development ?**
- **How to keep operational costs down to meet budget & ensure that costs to manage IT don't spiral out of control ?**

Virtualization Concept



Virtual Resources
- Proxies for real resources: same interfaces/functions, different attributes.
- May be part of a physical resource or multiple physical resources
- We may also create virtual resources which are not present physically

Virtualization technology
- Creates virtual resources and "maps" them to real resources.
- Primarily accomplished with software and/or firmware.

Physical Resources
- Components with architected interfaces/functions.
- May be centralized or distributed. Usually physical.
- Examples: memory, disk drives, networks, servers.

- **Separates presentation of resources to users from actual resources**
- **Aggregates pools of resources for allocation to users as virtual resources**

Virtualization & ITSM

from a business point of view
today's technology and the vision

Efficient Virtualization is the process of
- presenting computing resources in ways that users and applications can easily get value out of them.

- presenting them in a way, which is independent of implementation, physical packaging or geographic location.

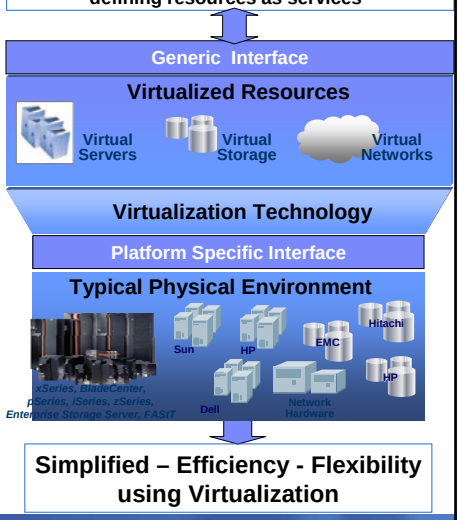
Virtualization provides in other words a logical rather than physical view of data, computing power, storage capacity, and other resources.

Jonathan Eunice, Illuminata Inc.

ITSM – IT Service Management

Common Processes / Workflows to simplify & optimize management of a Heterogeneous Infrastructure

the next level of virtualization defining resources as services



Simplified – Efficiency - Flexibility using Virtualization

Virtualization - *some technologies*

Virtualization sounds complex, but it is really a simple idea.

Sharing

Create multiple images of a resource within a physical resource
Servers - Memory - IO devices

Emulation

Create functions and facilities which appear to be real although they do not exist within the physical resource
In-Memory Virtual Networks and devices

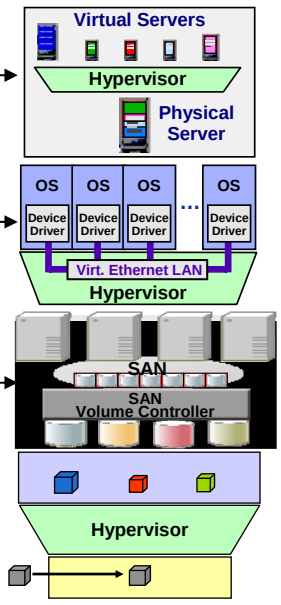
Aggregation - pooling

Pool multiple separate "distributed" resources so they appear as a single resources from the user point of view
Scalability Clusters - GRID - SAN Volume Controller

Insulation - an important requirement and ability

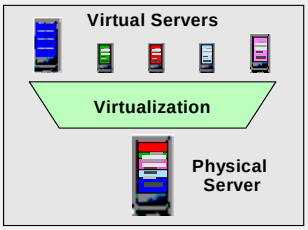
Ability to add, replace and change HW components dynamically
Capacity Upgrade on Demand, Spare Processors, Storage CU's

Not all capabilities are available with all Virtualization technologies



Efficient Server Virtualization - Business Value

Roles:
- Consolidations
- Dynamic provisioning/hosting
- Workload management
- Workload isolation
- Software release migration
- Mixed production and test
- Mixed OS types/releases
- Reconfigurable clusters
- Low-cost backup servers



Benefits:
- Higher resource utilization
- Greater usage flexibility
- Improved workload QoS
- Higher availability / security
- Lower cost of availability
- Lower management costs
- Improved interoperability
- Legacy compatibility
- Investment protection

In the final analysis, the virtualization benefits take three forms:

- **Reduced HW and SW costs**
  - Higher physical resource utilization
  - Less capacity needed for same or better QoS
- **Reduced management costs**
  - Fewer physical servers to manage
  - Many common management tasks become easier
- **Improved flexibility and responsiveness**
  - Virtual resources can be adjusted dynamically to meet new or changing needs and to optimize service level achievement
  - Virtualization is a key enabler of on demand operating environments

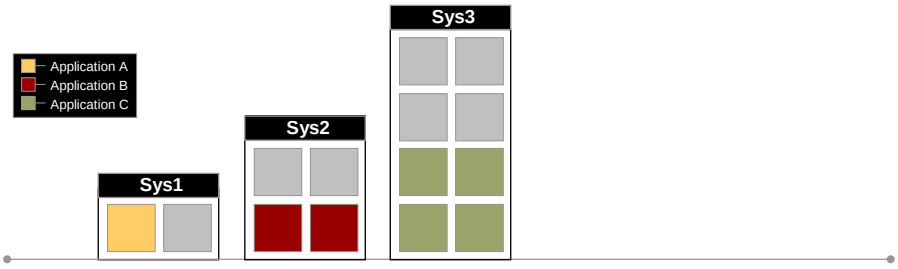
Many organizations today run a single application on a single server

Pain Point: enterprises are buying more processing power than needed and get…

…more to manage

…more costs - including environmental cost

…more complexity



Typical Physical Partitioning…*a solution attempt !!*

as provided by traditional UNIX and Intel vendors like SUN and HP

This this does mainly only addresses floor space…

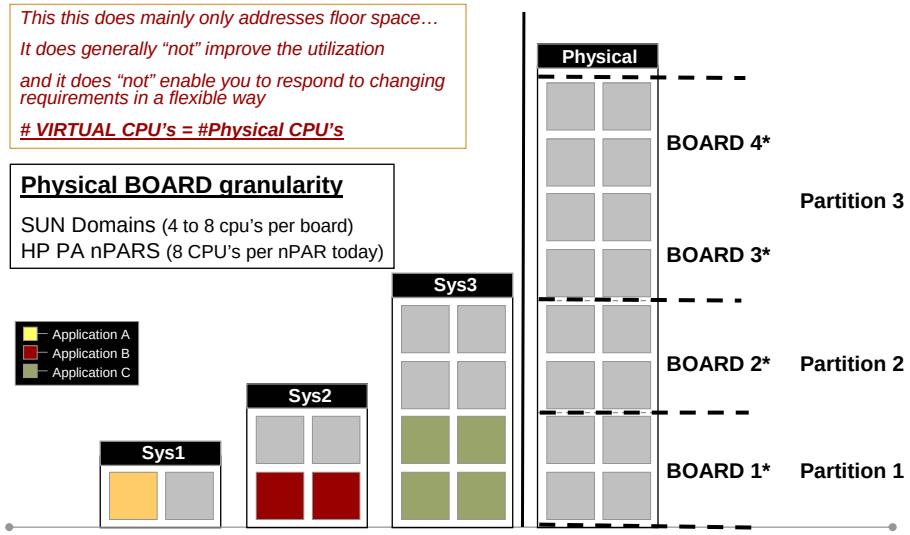
It does generally "not" improve the utilization

and it does "not" enable you to respond to changing requirements in a flexible way

 # VIRTUAL CPU's = #Physical CPU's

Physical BOARD granularity

SUN Domains (4 to 8 cpu's per board)
HP PA nPARS (8 CPU's per nPAR today)



Logical partitioning & Dynamic Logical partitioning

with some improved granularity and flexibility - a best practice example

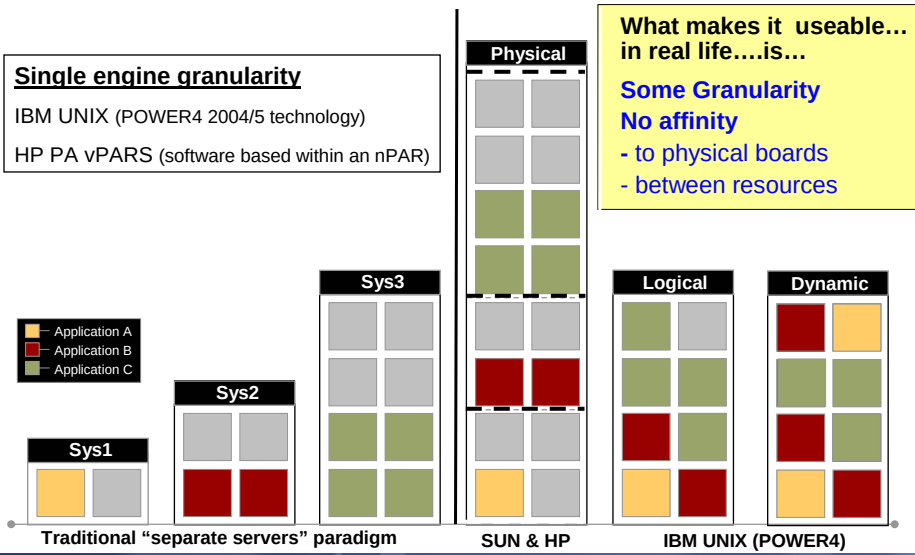
Single engine granularity

IBM UNIX (POWER4 2004/5 technology)

HP PA vPARS (software based within an nPAR)

What makes it useable… in real life….is…

Some Granularity
No affinity
- to physical boards
- between resources



Sub-engine virtualization – Shared Resource Spaces

best practices

Subengine granularity

IBM UNIX
VMware
Xen
HP IVM, but…
SUN LDOM's, but…
IBM System z (% level - HW implementation)

Notice they are not all equal by respect to efficiency, etc..

What makes it useable… in real life….is…

Granularity
No affinity
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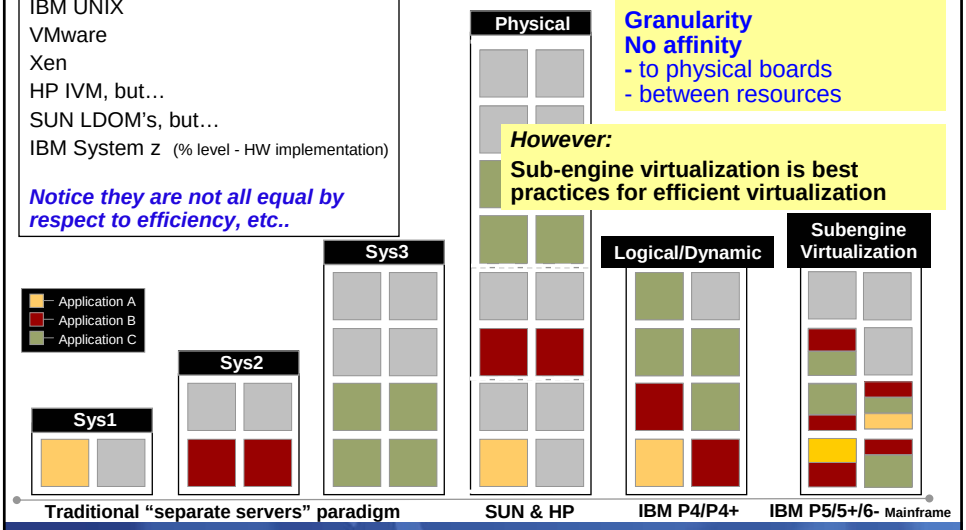
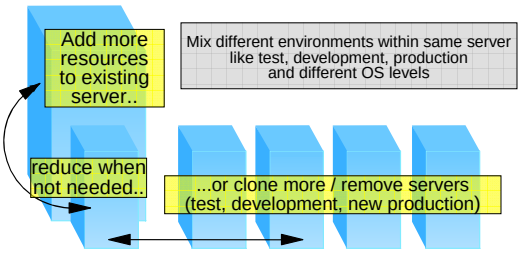
However:
Sub-engine virtualization is best practices for efficient virtualization



Value of *Efficient* Virtualization - Resource Sharing

Flexibility to adjust to different technical needs and different business needs



Translates into differences in ability to work in "real life" and ultimately into Business Flexibility Cost reduction – Cost avoidance

VALUE - Links Infrastructure to Business Goals

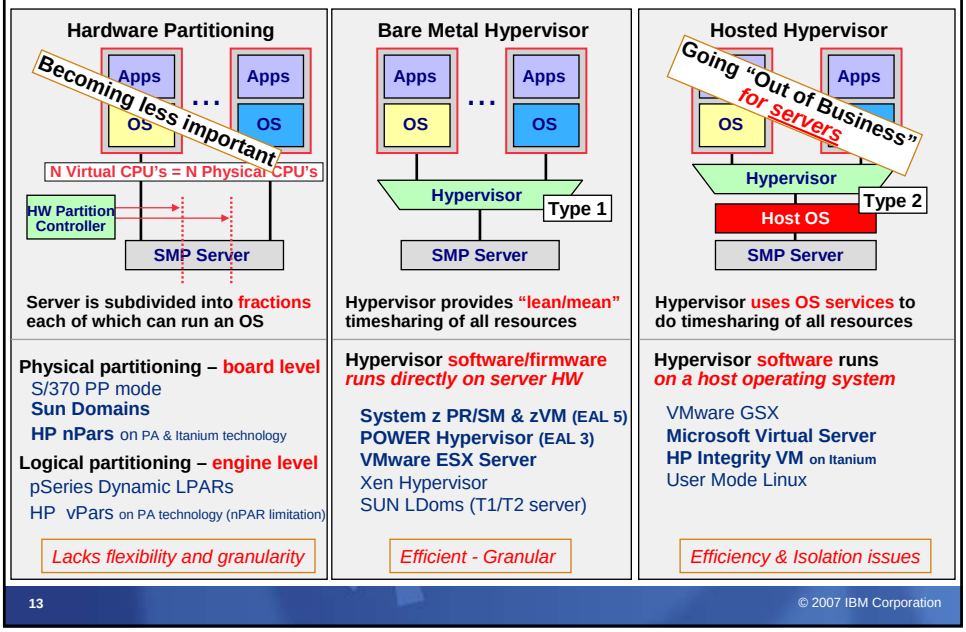
Efficient Virtualization

Hypervisor technology plays a large role
Scalability - Virtual & Physical
Resource Granularity
Dynamic Resource Allocation & Re-Allocation
NO affinity to Physical Configuration
Isolation & Hardware synergy
Policy based management of Resources

Virtualization benefits

- **Improve implementation speed of new solutions**
- Allows more simple provisioning & mgnt
- Allows constant and dynamic (re-)adjustment of resources
- Allows reuse of resources for multiple tasks and projects
- Allow for "cost-effective" HA solutions including back-up servers & cluster capabilities
- Allows for concurrent HW changes/additions making them transparent to software/users
- Allows higher utilization/efficiency of HW, SW and people resources
- Improved environmental characteristics
- **REDUCED cost**

Server Virtualization Approaches



Hypervisor Implementation Methods – affect resource usage

Trap and Emulate *("very early" technology)*

Scalability limitations:

VMware supports only up to **4 Virtual CPU's /Virtual Server**.
May run on physical servers with up to 16 cores/CPU's. Best practices seems to be 4 and 8way

Microsoft supports **only 1way virtual servers**, - but "Viridian" with 4way support is emerging !!

HP Integrity VM supports **only up to 4 Virtual CPUs/Virtual sever**
But HP describes "1way" as best practices, - probably because of performance challenges

Examples	CP-67, VM/370, **HP Integrity VM**
Benefits	Runs unmodified OS
Issues	**Risk for substantial** (extreme !) **overhead**

Translate – Trap and Emulate

Examples	**VMware, Microsoft VS**
Benefits	Runs unmodified, *but* **TRANSLATED** OS
Issues	**OK** but ***may*** have substantial overhead with high I/O & Memory over-commitment

Hypervisor Calls ("Paravirtualization")

Scalability

System z has "kind of unlimited" scalability for mix of core applications and server farms

POWER (System p) supports 1 to 64way Virtual Servers. Runs on 1 to 64way Physical HW

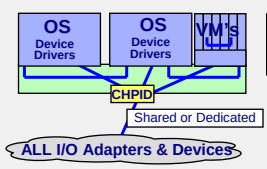
Xen has some limitations by respect to Virtual CPU's / virtual server and Physical HW, but may exceed 8 way servers in both areas

Examples	**POWER Hypervisor, Xen (today),**
Benefits	**High efficiency** *depending of Hypervisor code + eventual HW support*
Issues	**OS must be modified to issue Hcalls**

Direct Hardware Virtualization

Examples	**PR/SM and z/VM**
Benefits	Runs unmodified OS **Opportunity** for Highest efficiency
Intel/AMD	*Like the System z HW SIE-level in 1980* ***Only CPU no I/O HW support*****.....**

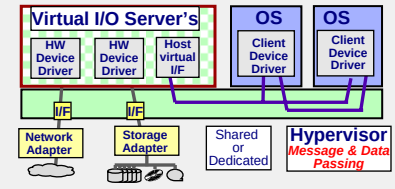
I/O Virtualization – *the platforms are not all equal…*



HARDWARE Virtualization

System z ....Intel & AMD is aiming at this, but it's far from being a reality

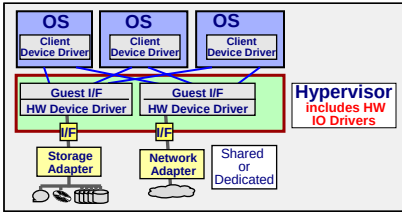
- IO and IO Interrupt Pass-Thru - transparent to users
- MIF and N-port Virtualization
- 4 LCSS, PAV's, Multiple Subchannel Sets
- PCI Hydra Cards
- Some IO assists for zVM / zLinux guests under zVM
- **Clearly the most complete and efficient implementation**



VIRTUAL IO Server *(to deal with non-virtualized PCI cards)*

System p, XEN, KVM, Microsoft (future)

- Firmware extension to Hypervisor; transparent to users
- Provides Virtual I/O Adapters and devices *(SCSI, GbEtn)*
- Introduces path-length and latency challenges
- **System p advantage** DMA Isolation HW *implements DIRECT data transfer to/from storage devices*



HYPERVISOR layer includes HW IO Drivers

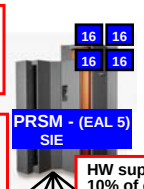
VMware *…..(and all type 2 hypervisor solutions)*

- Hypervisor includes DRIVER code (potential an unreliable area)
- Provides Virtual I/O Adapters and Devices *(SCSI, GbEtn)*
- Allows for PCI card sharing
- Transparent to users
- **Introduces potential AVAILABILITY challenge**

System z virtualization - multiple dimensions - *not an "add-on", but a "built-in"*

SIE
- **Establish Architecture for guest**
- *** Maintain status**
- *** Invoke SIE assists**

LPAR Zoning
Each LPAR has a 0-origin
This allows I/O to access LPAR memory without hypervisor intervention



HW support: 10% of circuits used for virtualization

Up to 60 Logical Partitions (LPARs)

zVM (EAL 3+)
SIE
10 – 100 – 1000 VM's
LINUX
SHARED memory

Shared Resource Space per footprint

up to 54 (64) CPU's		Shared %
512	GB	MB
1024	I/O	Shared

up to 32 z/OS images *in a CLUSTER* for SCALABILITY and Continuous Availability

"Most sophisticated & complete Hypervisors
z/OS, z/VM, Linux support
SHARED ALL Architecture
zVM may emulate multiple device not physically present
Application Integration via HIPERSOCKETs and VLANs
Intelligent & Autonomic WLM based on policies

The potential performance influence of the Linux Server Farm is isolated from the OTHER LPAR's

Virtualization is transparent for OS/Application execution
HW Enforced Isolation
40 years of maturity…

IBM Breakthrough Virtualization within UNIX/Intel

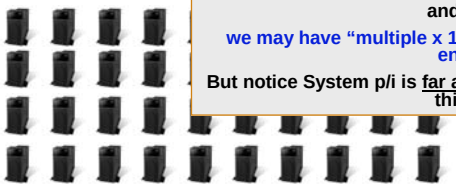
Micro-partitioning POWER5 system

Micro-partitioning™

Virtual server granularity - dov
Dynamic adjustable according

Example…

4-way POWER5



We need in practice at least a 32 way system to run 254 virtual servers (they will all be 1way only….)

System p/i Micro-Partitioning.
has NOT at this point implemented
a zVM like-facility

where the CPU impact from
a Linux server farm with multiple 100 of VM's
and multiple 100 of virtual CPU's
can be "isolated" from the other LPAR's

and where

we may have "multiple x 100 VM's" on relatively few IFL engines

But notice System p/i is far ahead of Sun, HP and VMware in this area

What's the value…

- run test, development and production together in same
- new upstart services can be initiated easy without significant investments
- supports an on demand pricing model for resources

Lower TCO – Improve System Utilization
Flexibility – Resource allocation according to business need

Intel/AMD - Virtualization

Blade and Brick type of systems

Physical partitioning at the Blade or Physical board level

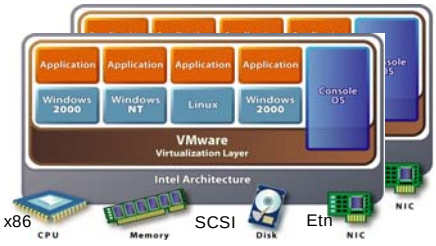
Hypervisor based virtualization

MULTIPLE Technologies

VMware
Xen
KVM (Kernel Virtual Machine)
Windows – Virtual Server 2005
HP IVM
others….incl. Sun

Intel/AMD - Virtualization HW

VMware ESX Technology



General ROT: 10- 20 Virtual Machines per 4WAY and more on an 8way

RESOURCE CONTROL & SHARE

- Virtualization maps VM's directly to x86 HW
- *32bit support - but 64bit just introduced*
- ***1 to 4way Virtual Machines only***
- Up to 128 VM's per VMware image (Max 16WAY)
- Memory expanded from 3.6GB to 16GB per VM
- CPU - shared capped/uncapped & dedicated
- No wasted resources ***but "cpu cost" may exceed 20%++, especially with high I/O rates***
- Memory Dedicate or Share
- Shared I/O & Network Interfaces
- ***I/O drivers located WITHIN the Hypervisor***
- Direct I/O Pass-through
- DASD emulated as SCSI
- Network Bandwidth - may be priority controlled
- ***SW managed security isolation (by VMware)***

- *Sustained AVERAGE load on physical server may exceed 50-60% - from below 5-10%*
- *May provide significant cost savings & flexibility*
- *Encapsulation of VM's - enables move of the VM*
- *Dynamic move via VMotion -*
- *Provide for Cost efficient Clustering -*
- *Provide Resource Pooling of Physical Servers*
- *Provide provisioning and re-allocation of VM's across physical servers via a Global scheduler*
- *Experiences show it is Highly Reliable*
- *Virtual Center 2, Dashboard, and P2V tool for migration*

VMware ESX Technology

RESOURCE CONTROL & SHARE

- Virtualization maps VM's directly to x86 HW
- *32bit support - but 64bit just introduced*
- ***1 to 4way Virtual Machines only***

Challenges

Scalability of VMware – Currently Max 16way HW
Scalability of VM's - CPU (4way) & Memory

Relatively high CPU cost
especially for I/O intensive and Memory intensive work

Lack of 64 bit support maturity, but experiences are coming…
I/O drivers runs within VMware

Some security concerns

Resources can not be added dynamically

Strength

Many advanced Resource Management and Availability functions

- *Provide provisioning and re-allocation of VM's across physical servers via a Global scheduler*
- *Experiences show it is Highly Reliable*
- *Virtual Center 2, Dashboard, and P2V tool for migration*

System p & System z

Positioning in respect to VMotion

Dynamic Move of Virtual Servers (Live Guest Migration)

will be made available for

1. System p LPAR's and WPAR's
2. Linux guest under zVM on System z

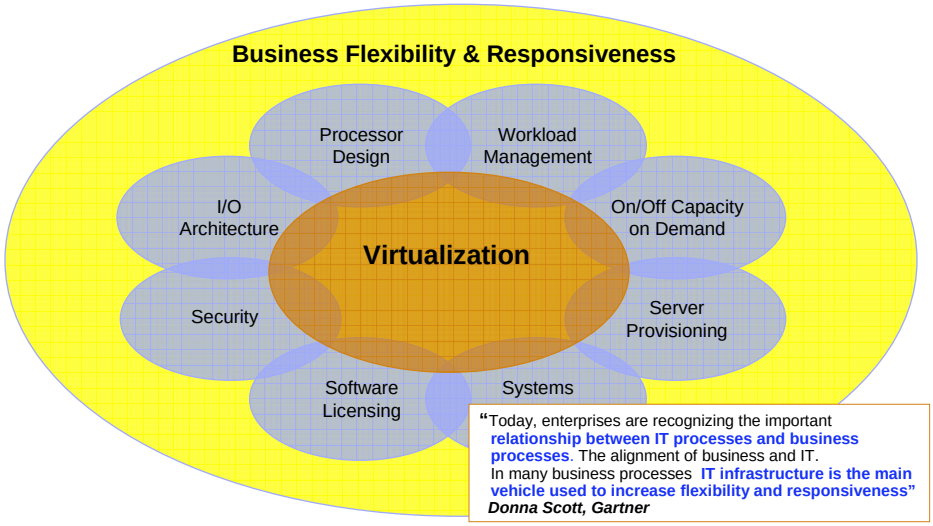
very efficient when combined with dynamic addition/removal of physical resources

Virtualize more - Manage Less

Future
IT Service Management

Server Partitioning and Virtualization

An Important Consideration for All Areas of Server Design and Deployment



"Today, enterprises are recognizing the important **relationship between IT processes and business processes**. The alignment of business and IT. In many business processes **IT infrastructure is the main vehicle used to increase flexibility and responsiveness"**
Donna Scott, Gartner