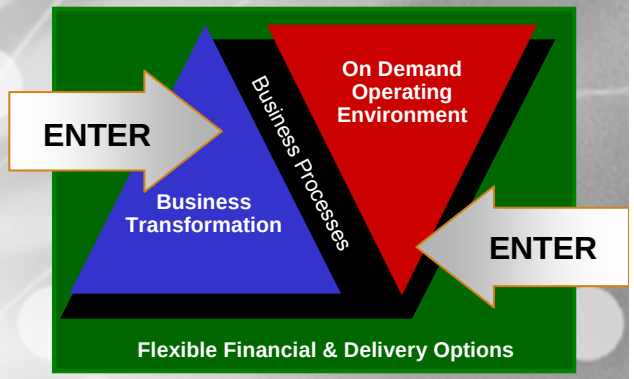
IBM Systems and Technology Group University 2005

IBM Virtualization Solutions -
from a technical point of view !!!

Session: CB35



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ON DEMAND BUSINESS™

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Abstract:

Virtualization is a set of technologies clients can use to simplify their IT infrastructure and making it more responsive to business requirements.
The session gives an overview over some of the technologies, discusses client value, position them in respect to ODOE & VE and in respect to competition.

Objectives:

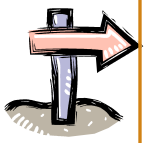
1)Learn about some of the HW/SW Virtualization technologies across IBM's platforms.
2) Understand how to position their value within and alongside of VE.
3) How do these golden nuggets stack up against our competition ?

at the conclusion of this material, you should be able to:

- **Describe how the various HW virtualization technologies form the foundation for the Virtualization Engine offerings**
- **Articulate the value of Virtualization today and in respect to becoming "on demand"**
- **Position IBM's core Virtualization capabilities against competitors' offerings**
- **Identify current and future opportunities for Virtualization**

This presentation has primarily been built for the education of professionals from the Systems Group like SA's, FTSS's, ATS's. Techline professionals as well as for a related technical audience like IGS professionals, CITA's and business partners working with System Group related products and solutions.

It is further put together in a way, so it may have value for more sales oriented people like eSMs, eTMs, brands and sector sales, - assuming these people want to develop a more detailed understanding of how virtualization technologies provide business value, which can be used effectively to support their sales activities.



The specific purpose of this presentation is to provide the audience sufficient understanding and insight about how IBM has implemented virtualization to day across the server and storage space from a technology point of view, - how is differ from competition,- and how IBM is planning to take the virtualization concept to a higher level as "an enabler" of the on demand operating environment.

The overall general purpose is to make it possible for the audience to realize, that they can translate this technical understanding into business value, - and that they can use it to support the sales process, whatever we are talking about general solutions within the on demand space, specific technology related server and storage solutions for simplifying and increasing the effeciency of the IT infrastructure, or we are talking partnership related solutions based on a combination of management products and services with the purpose of optimizing the IT environment of the enterprises.

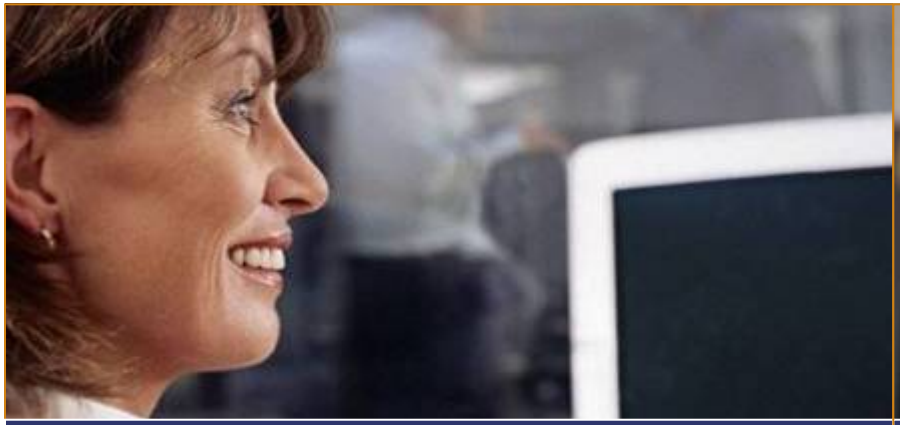
This presentation is intended for the education of IBM and Business Partner sales personnel. It should not be distributed to customers.

Agenda…

0	Preface
1	Setting the scene - technical and business needs of enterprises
2	Virtualization today and tomorrow – the reality and the vision
3	Virtualization - used at different steps to become on demand
4	Virtualization - what is needed to provide value
5	Virtualization - server and storage implementation
6	Value Summary and Conclusion - and additional material

This presentation will discuss the Virtualization from a technical point of view !
in the context of customer needs and customer values with an on demand perspective

What's on the minds of 450 of the world's leading CEOs



CEO needs

- **Revenue growth** with cost containment
- Key competency **responsiveness**
- Critical success factor: enable effectiveness of **people**

Source: CEO Study of 456 WW CEOs IBM Corporation - Feb 2004

CIO challenges

- Aligning IT and business goals to **grow revenue** and contain costs
- Building **responsiveness and agility** into the organization through IT
- How can IT help **enable people** and teams to be more effective

Source: Operating Environment Market Drivers Study, IBM Corp. 2004

The IBM Global CEO Survey 2003 yielded 3 key themes in the views and priorities of CEOs across industries and geographies, including telecom

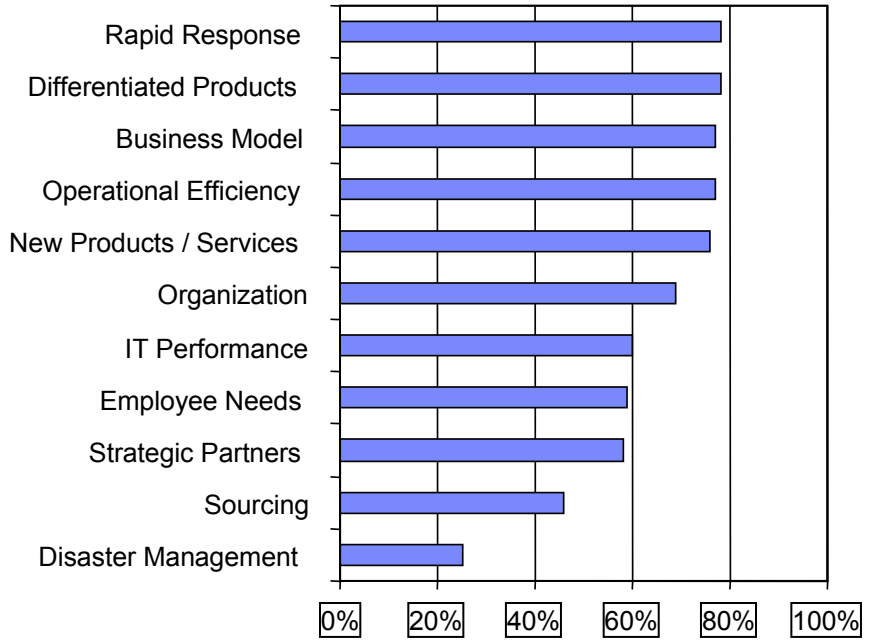
1. Revenue Growth is a Renewed Priority

"Welcome back to the top line"

- Four out of five CEOs across the world believe that revenue growth is their number one priority – and the means to achieve their financial performance objectives
- At the same time, CEOs believe they must maintain their ongoing emphasis on cost containment
- Most CEOs believe that differentiated products and services will be a key driver of growth in a hypercompetitive market – and product/service innovation will only be achieved through new capabilities

2. Responsiveness is the New Key Competence

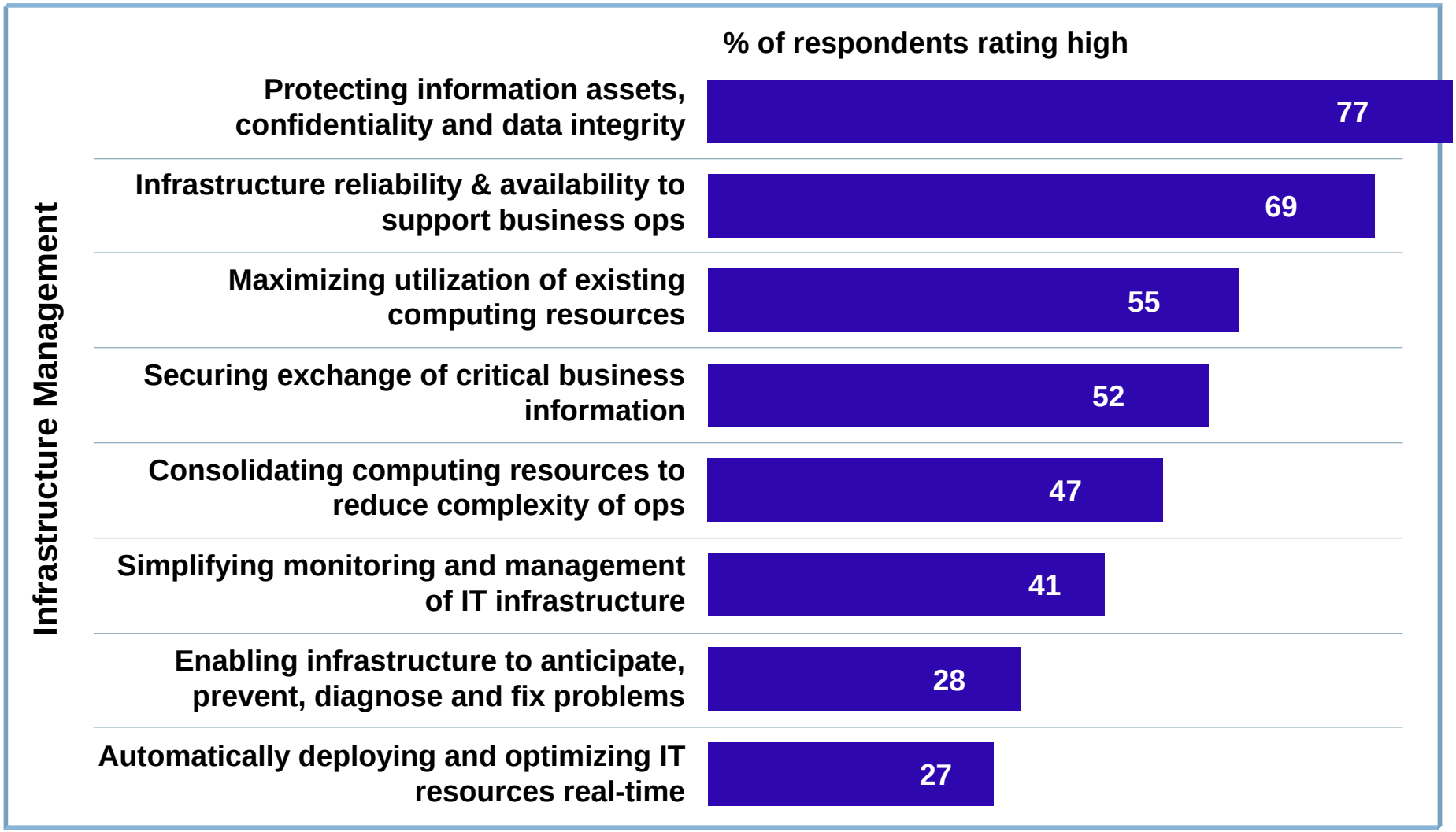
CEO's rating their priorities for the next 3 Years



3. The Challenge Lies Within: Limited internal capabilities and leadership resources to manage change are a major constraint

Customer survey – required IT capabilities to support business

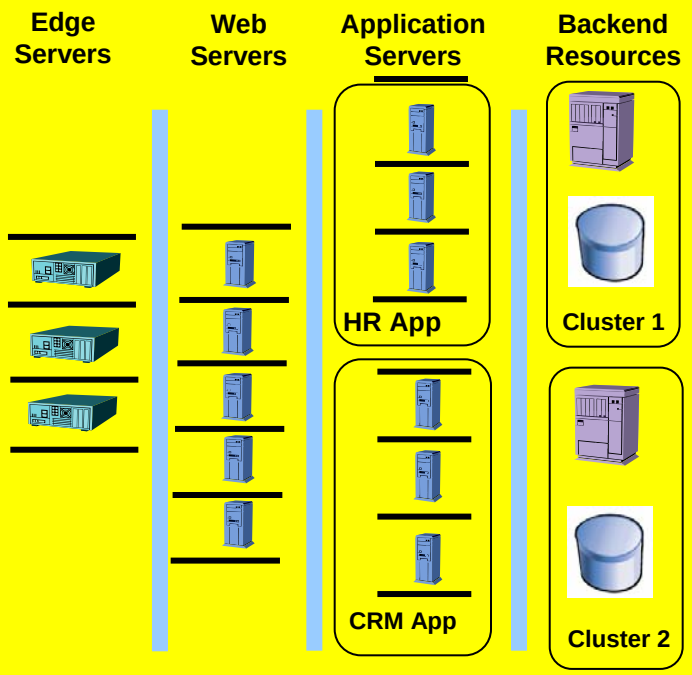
Virtualization … a key ingredient for making it happen



Source: IBM Corporate Market Intelligence

Typical IT infrastructure reality today - *Silo's, Vertical fragments…*

Static NON-SHARED Vertical SILO's



Underutilized Resources
Quality of Service issues
Complex System Management
Long time to deploy new services

the "siloed" organisation is an inhibitor for (Horizontal) Integration
need for a culture change

Business Challenges

Revenue Growth
Time to Customer/Market
Responsivenes/Flexibility

Cost Reduction
Quality of Service

Technical challenges - addressing business needs

Horizontal Integration
Improved Resource Utilization
Resource Sharing - Service Policies
Automation
E2E Convergence of System Management

need for

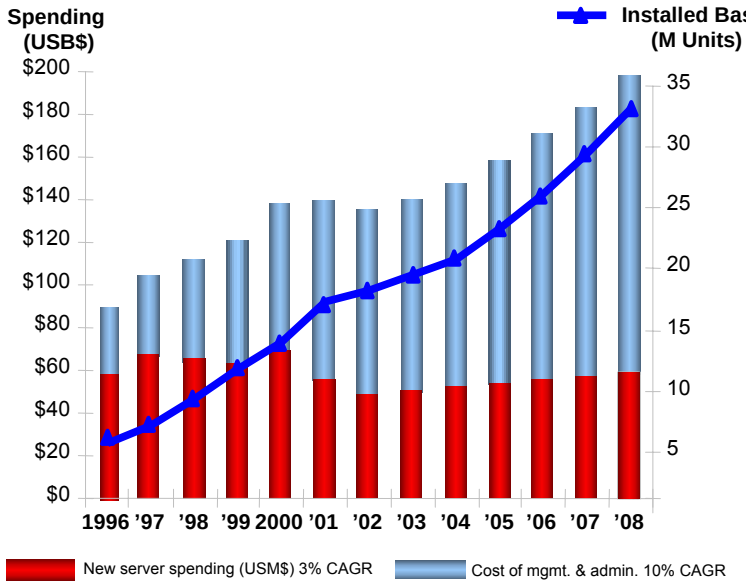
Infrastructure Simplification & IT Optimization

Virtualization and Open Standards are key technology enablers

Why Infrastructure Simplification, 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**

Why Virtualization?

IBM Advanced e-business Council

Customer Requirements

Share departmental workloads across a single processor footprint.

View all data resources as a single entity.

Reduce operation and systems management cost while maintaining needed capacity.

Utilize information and resources across organization efficiently.

Respond quickly to application needs of customers.

Gather information across the enterprise quickly.

Deliver SLA response times during spikes in production and test scenarios.

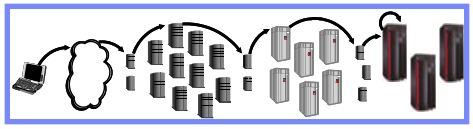
Solution Needs to:

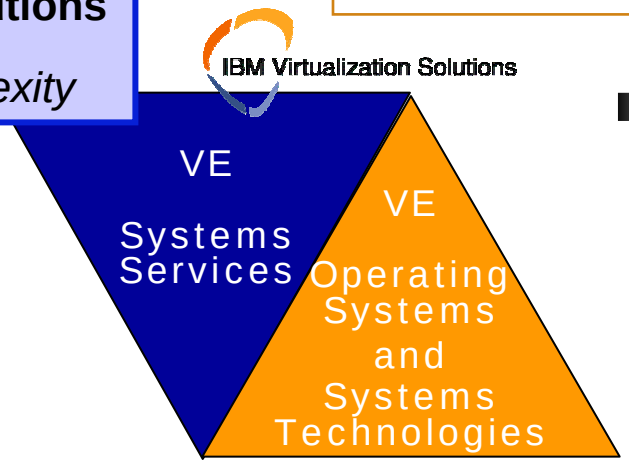
- **Break the boundary of Physical Resources**
- **Change the scope from Local to Distributed**
- **Be Managed through Open interfaces**
- **Federate and Integrate Access**

The IBM Virtualization Engine™

a "set of tools and technologies"
to assist in the construction of
on demand operating environments
to support clients
to become on demand enterprises

VE Suite for Servers
Cross System Virtualization and Management Products and Solutions
to increase integration
and reduce management complexity





OPEN STANDARDS

System and Cross System Virtualization Technologies
Server, Storage & Network Virtualization

Integration of a set of tested systems technologies & management services

Reduce Cost
Improve Efficiency
Leverage Current Investments
Cross Platforms & Cross Vendors

Enable Horizontal Integration
Components Based & Modular
Built for change
Infrastructure design matches Business design

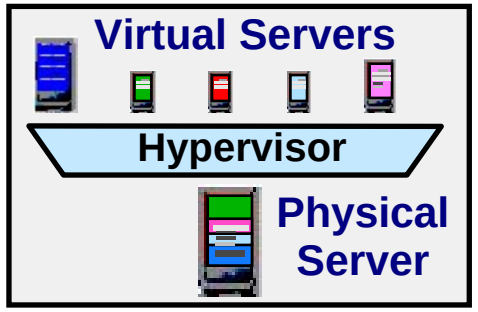
What is Virtualization

why is it important
for
Infrastructure Simplification
and
the on demand operating environment

Virtualization - *levels of technologies*

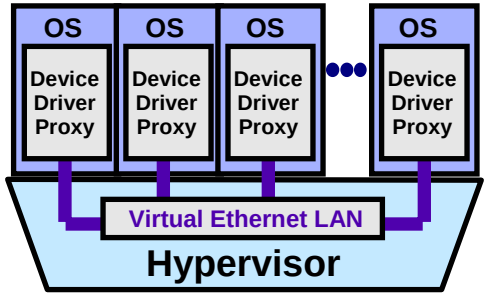
Create multiple images of a resource within a physical resource

Virtual Memory - LPAR's – Virtual Machines – Logical Channels



Create functions and facilities which appear to be real although they do not exist within the physical resource

Virtual Networks, Hipersockets, Virtual Disk and Caches



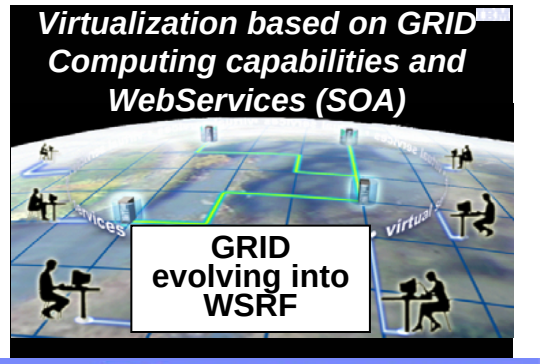
Pool multiple separate "distributed" resources so they appear as a single resources from the user point of view

Clusters - Grid - SAN Volume Manager - SAN File Sharing

Create services using open interfaces and standards, where the services are "unaware of" and "have no dependency" on the underlying "distributed", "heterogeneous" and "shared" physical infrastructure

Automation – Convergence of Systems Management

WebServices Resource Framework (WSRF)



Virtualization

from a business point of view

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

Rather than presenting them in a way dictated by their implementation, physical packaging or geographic location.

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

Jonathan Eunice, Illuminata

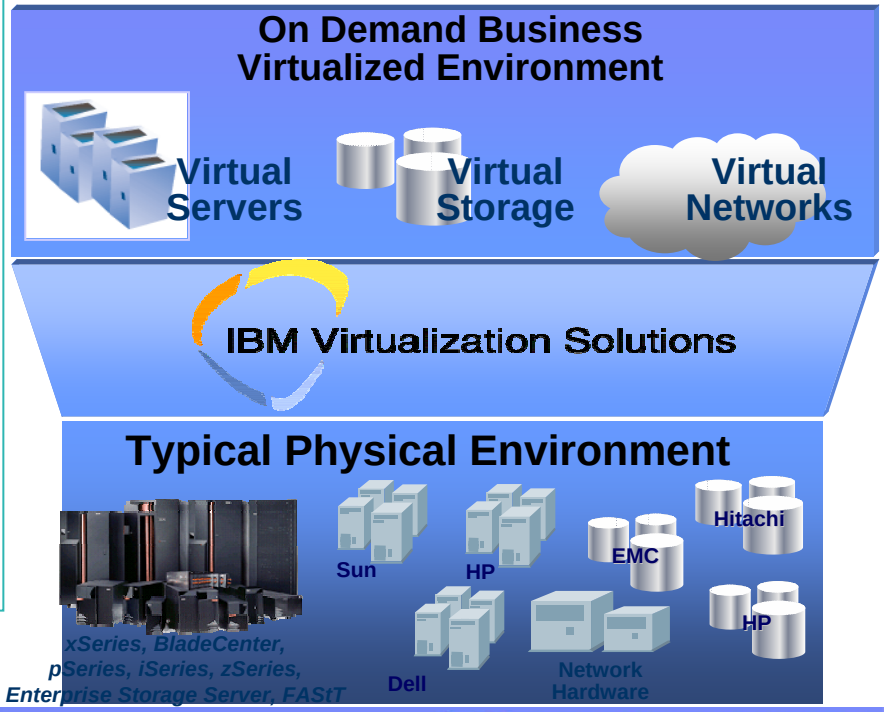
Efficient Virtualization

..simplifies the IT Infrastructure..

..separates applications from technology complexity..

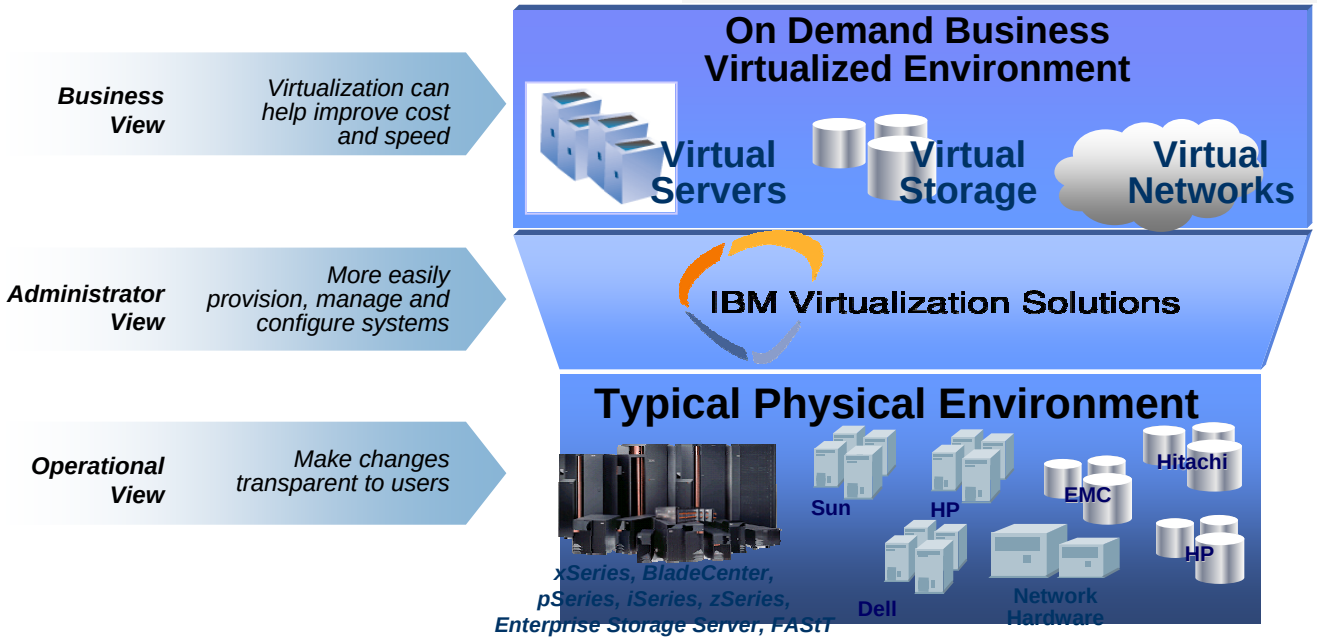
..makes it possible to view the IT resources as an "on demand" utility..

..which can adapt dynamically to changing demands..



Virtualization value
when efficient…!!!

Virtual servers can be created rapidly.	*Fast application deployment*
Resources can be increased as growth demands.	*Non-disruptive business growth*
Resources can be increased or decreased dynamically.	*Cost-effective approach to workload peaks*
Resource utilization can be increased greatly, allocating resources to when and where needed.	*Improved efficiency and reduced IT costs*



Efficient Virtualization
provides
Resource Sharing
WITH

Increased Flexibility
(TTM/TTC)

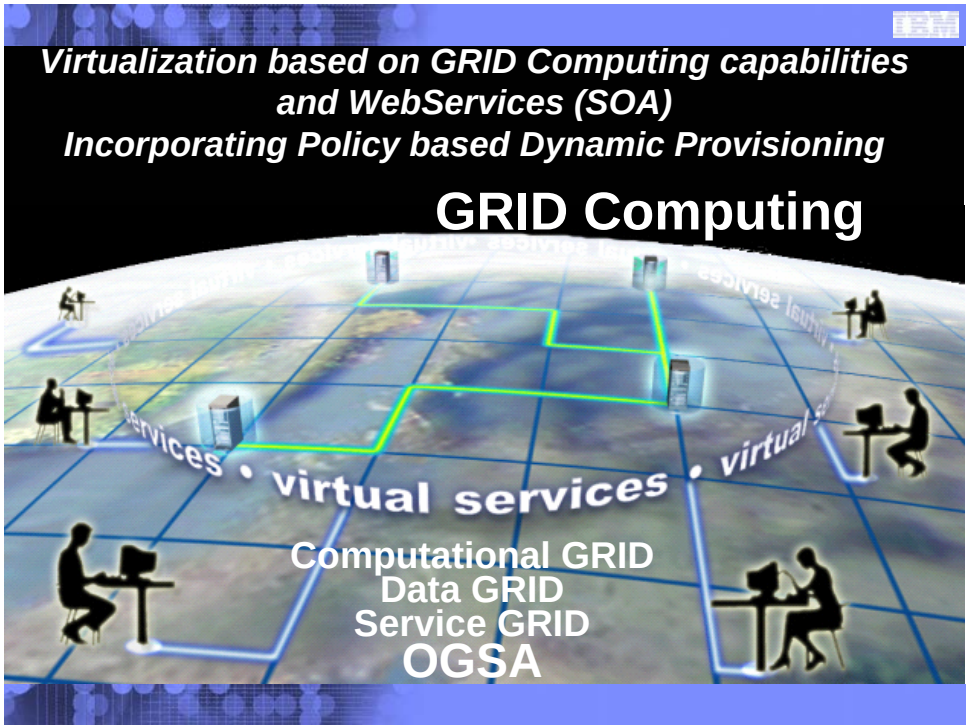
Improved Service Levels
(QoS)

Reduced Cost
(TCA and TCO)

The Vision

creating
the on demand operating environment
using
an expanded set
of
Virtualization Technologies

The Next Level of Virtualization – the Vision



Access and Manage Distributed I/T Resources

(Applications & I/T infrastructure)

as

Web Services

available via the Service Bus

(WS-RF – Web Services Reference Framework)

(OGSA – Open Grid Service Architecture)

Resource = Service

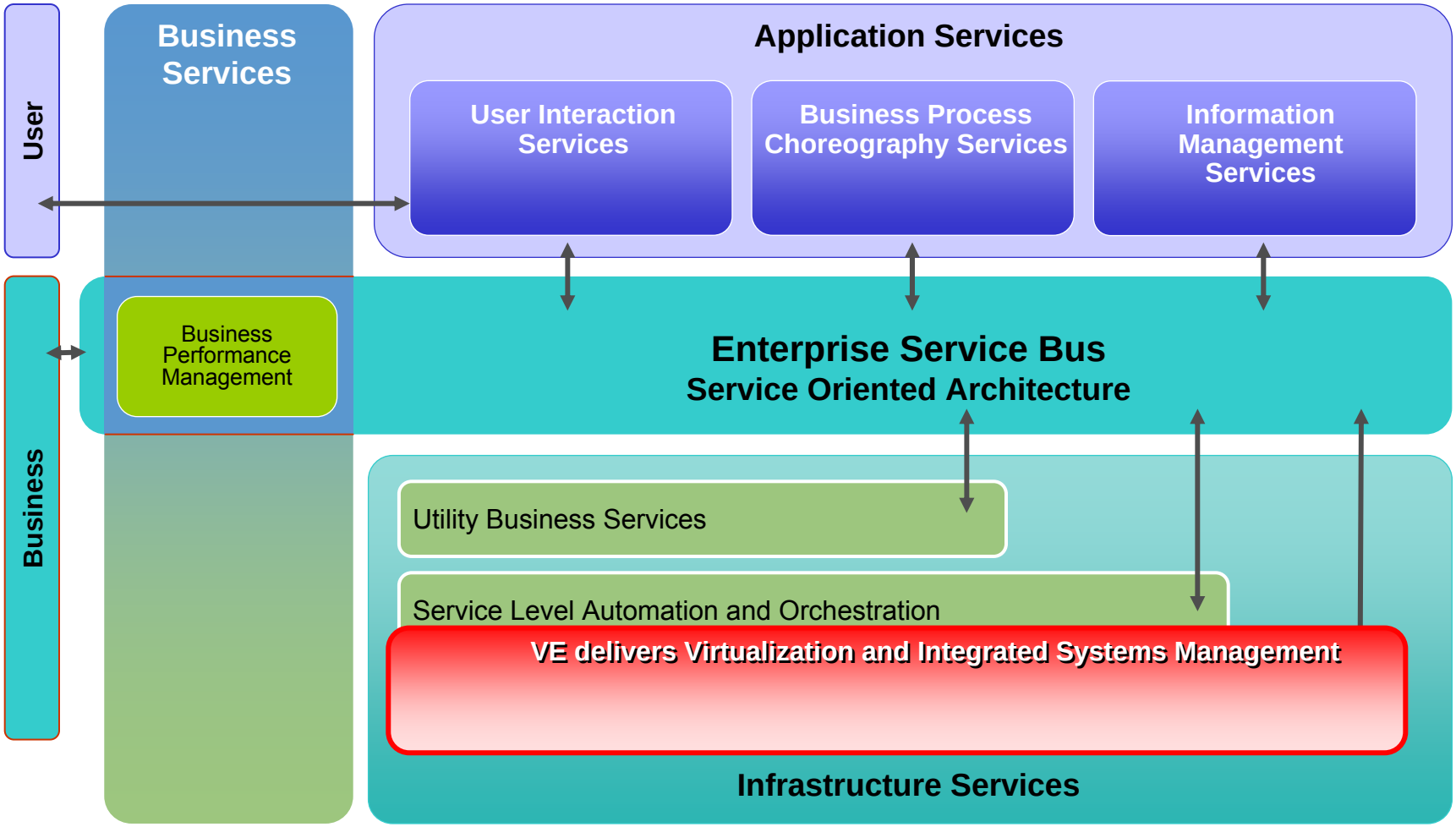
Expands the virtualization concept to handle

De-centralized, Distributed, Heterogeneous Resources over a network Enabled by Open Standards

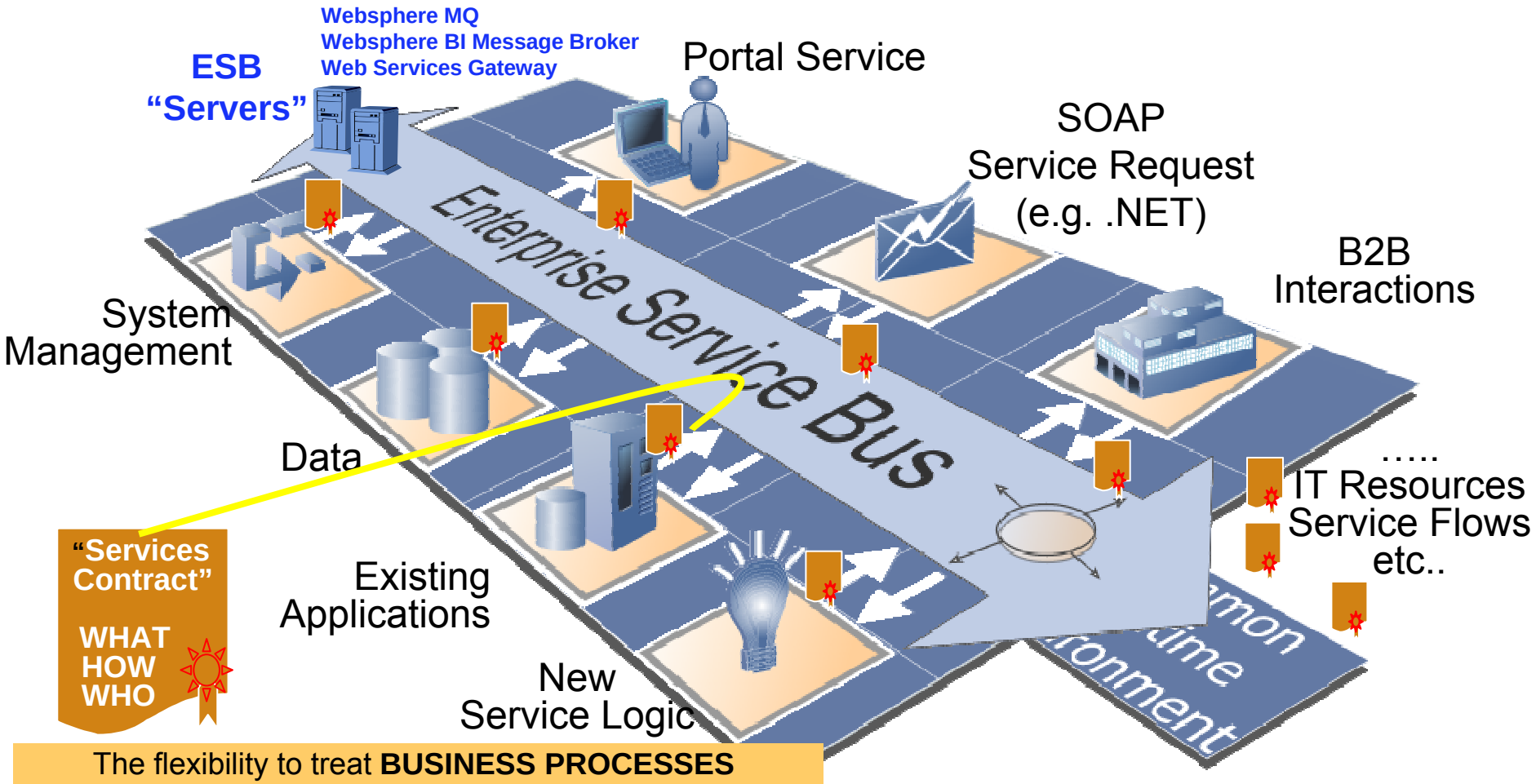
dynamic provisioning – on demand – system management

VE and the On Demand Operating Environment Architecture (ODOE)

ODOE is based upon the concepts of a Service Oriented Architecture.
Each element is a service that together implement the ODOE capabilities



Service Oriented Architecture - Enterprise Service Bus (ESB)



The flexibility to treat **BUSINESS PROCESSES** and the underlying **IT Infrastructure RESOURCES** as ***DEFINED COMPONENTS*** that can be "***MIXED & MATCHED" at will Accessed Anytime from Anywhere***

Not a theoretical abstract concept, but a practical reality being implemented...

The next level of virtualization – the vision

OGSA Common Resource Model Architecture

Abstract representation of logical IT resource (node, process, disk, file system, IP address, XML database, Security service, Commerce Server) described as a web services interface (WSDL)

Common operations to configure and monitor resource details.

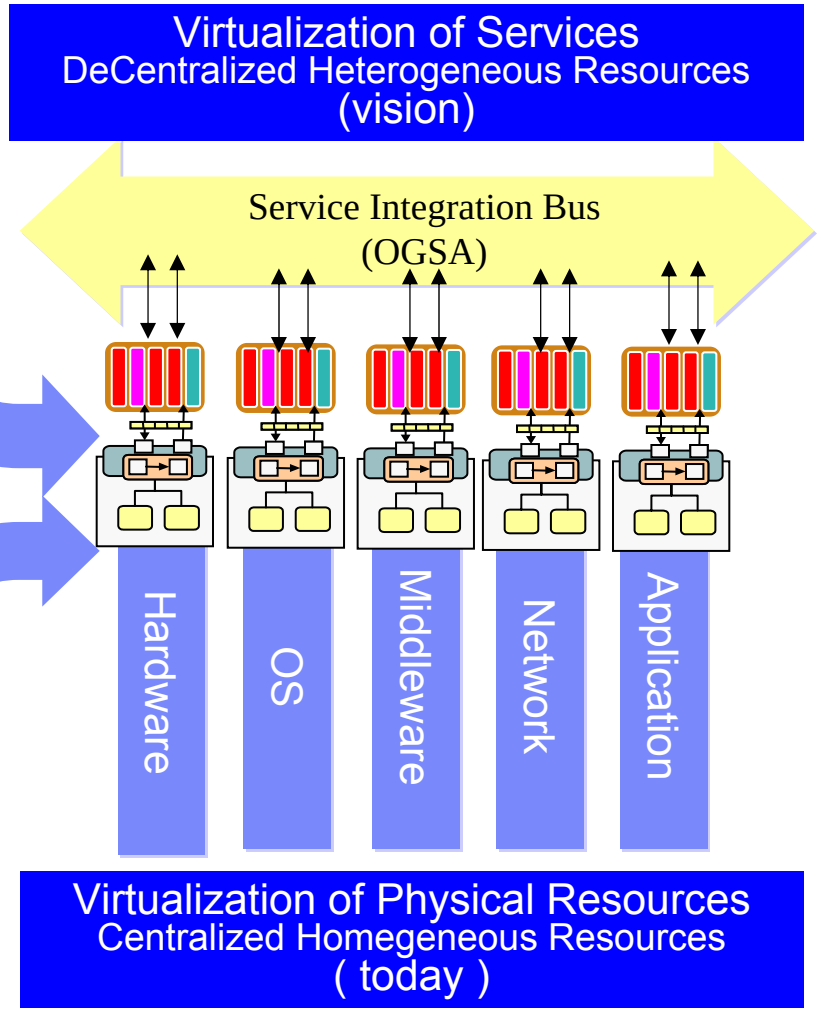
Provide common behavior for lifecycle, discovery, and events.

Adapter/Connector can push down onto multiple underlying resource instrumentations such as CIM or SNMP or RMC

Resources are expressed as Services

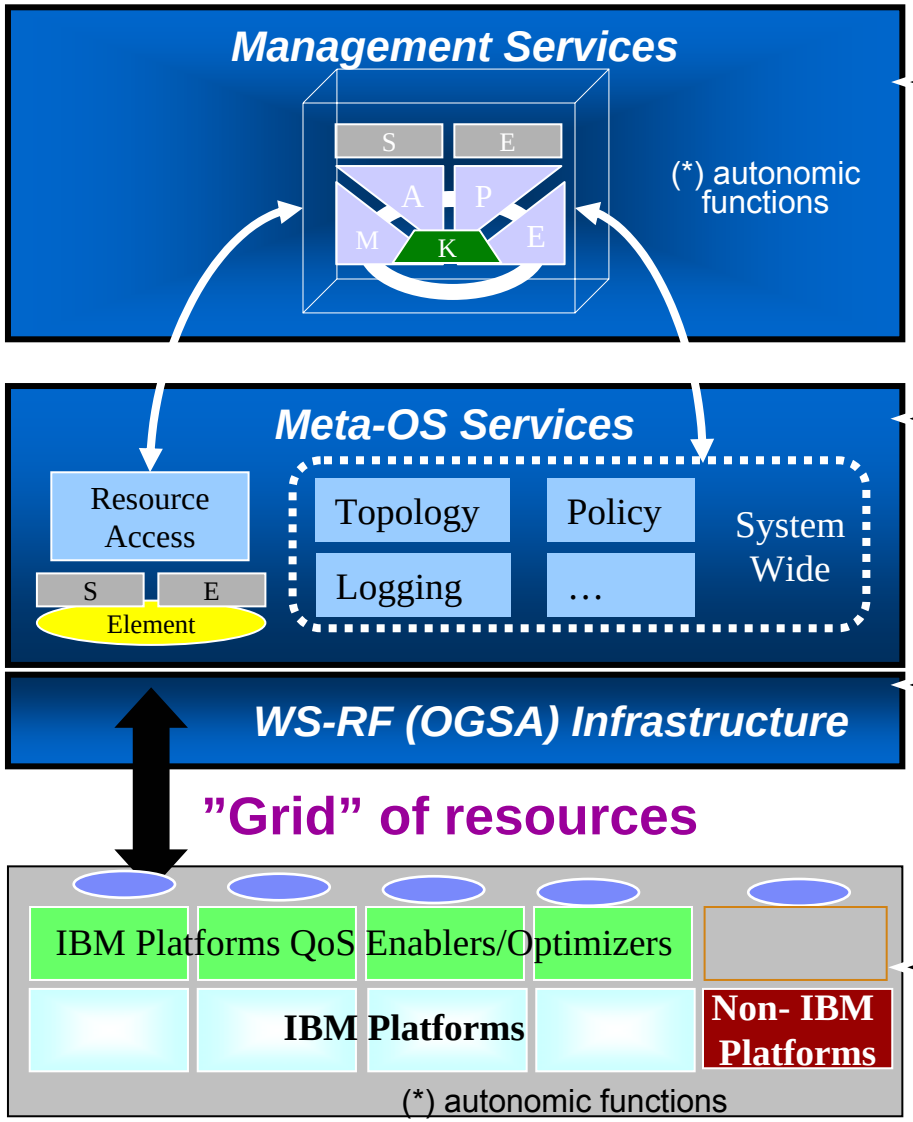
The role of current virtualization technologies are unchanged

Service interaction with underlying resources can be local or remote



On Demand System Environment – the vision

VE and Virtualization is "one of the tools" to establish this "vision"



Autonomic Management Tools

- Access to resources
- Access to system-wide information
- Direct the global mgnt actions

Distributed Resource Services

- System Environment SERVICES
- Enable system-wide resource mgnt

Open Service Architecture (BUS)

- Established via GRID extended Web Services
- Supports distributed heterogeneous topologies
- Dynamic Binding

Today's siloed infrastructure

- Local platforms perform detailed mgnt actions
- Silo'ed Homogeneous environments

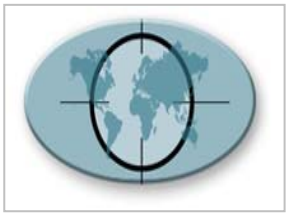
The steps to build

an on demand infrastructure

Virtualization is a key technology

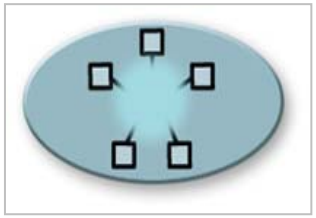
Virtualization solutions: Stages Of Deployment

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



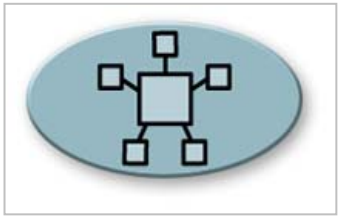
Virtualize Outside The Enterprise: Suppliers, partners, customers and external resources

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

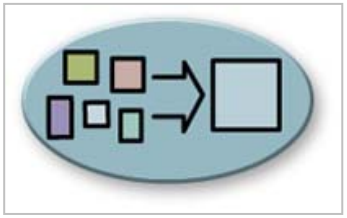


Virtualize The Enterprise:
Enterprise wide Grids and Global Fabrics

Automate Workflows:
Tasks like change/configuration provisioning, workload mgnt, availability mgmt, (ITIL processes)….



Virtualize Unlike Resources:
Heterogeneous environments - servers, SAN/storage, application based Grids and networks



Virtualize Like Resources:
Homogenous environments - servers, SAN/storage and networks

Infrastructure Simplification and IT optimization
Updated IT Governance and Management Processes

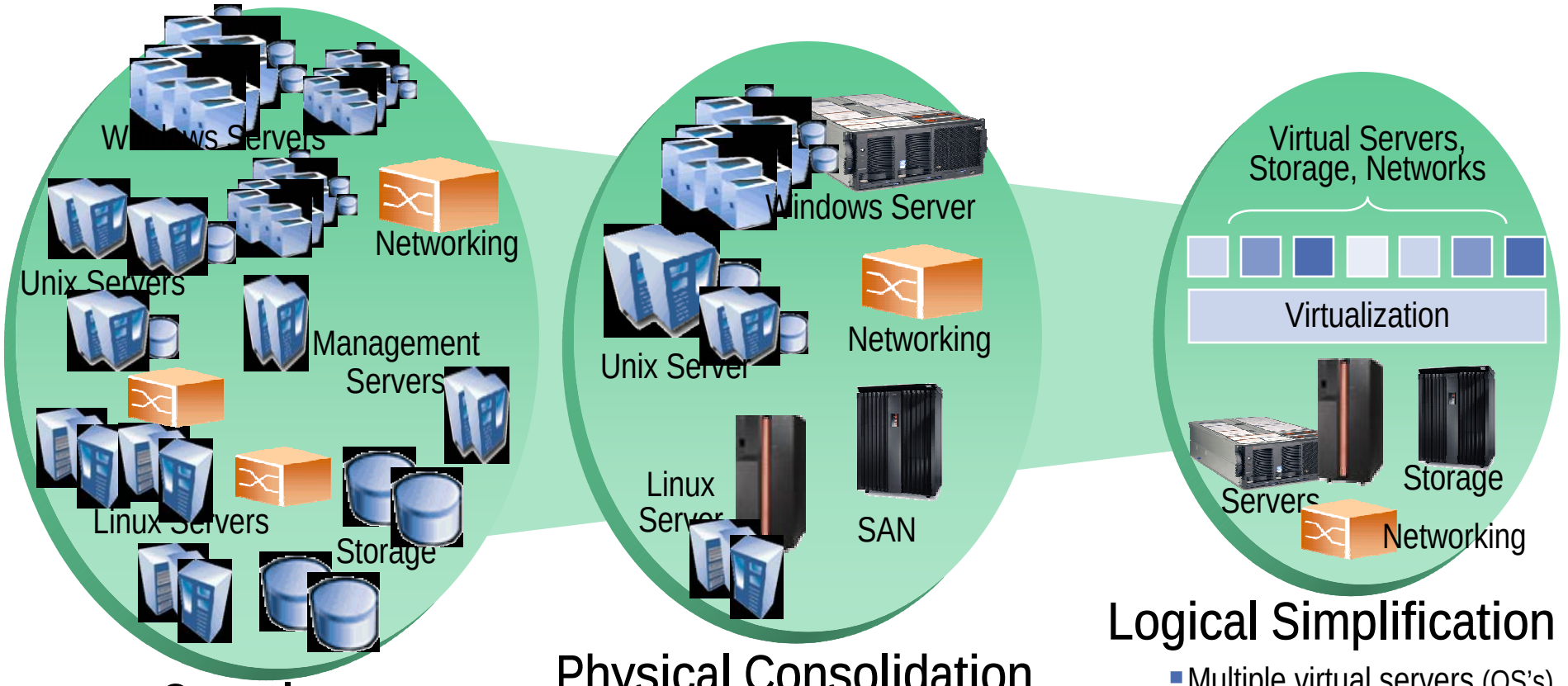
The steps to build an on demand infrastructure

the 1st step

Infrastructure Simplification

Infrastructure Simplification…*requires breakthrough technologies*

Efficient Virtualization provides the best ROI and minimize the RISK



Complex

- 1 workload per server
- Manual provisioning
- No sharing
- Vertical silo'es
- Disparate mgmt tools
- Multiple sites

Physical Consolidation

- Fewer sites
- Use of larger servers / SAN's
- Mostly environmental savings
- Disparate management tools
- Labor intense provisioning
- Workload mgnt and isolation issues

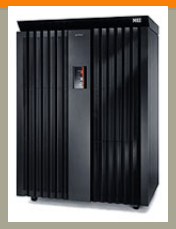
Logical Simplification

- Multiple virtual servers (OS's) per physical server
- Significant savings – fewer servers, higher utilization
- Rapid provisioning
- Automatic workload mgmt
- Preserve logical server to application relations

VE Foundation - Virtualization Capabilities Today

Servers

- **Partitioning**
  - Virtual machines
  - Blades
- **Clustering**
  - Parallel Sysplex
  - HACMP
  - Linux clusters
- **Workload Mgnt.**
  - Policy based
  - Heterogeneous

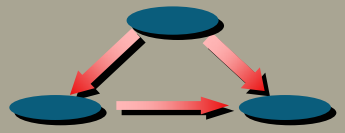


Storage

- **SAN Volumes**
  - Storage Pools
  - Centralized mgnt
- **TotalStorage Virtualization**
  - SAN Block Virtualization
  - SAN File Aggregation
  - IBM & non-IBM
- **Storage Server Virtualization**
  - POWER5-partitioning
- **Total Storage Management**
  - Manage storage according to policy

Distributed Systems

- **GRID**
  - Globus Toolkit
  - IBM OGSA Toolbox
- **Server Allocation for Web Application Servers**
  - Computation heavy, parallel applications
  - Manage multiple applications across multiple server clusters
- **ISV Grid middleware**
  - Provide services such as data services, scheduling, etc



Network

- **VLANs**
  - Isolate/prioritize traffic on shared network, 802.1
- **Hipersockets/ Virtual Ethernet**
  - Optimized inter-partition communications, virtual network
- **Differentiated Services**
  - Prioritize network traffic
  - Network QOS, IP TOS
- **Vendor Alliances**

IBM Virtualization Engine™ -

*Systems Technologies - foundation for **Infrastructure Simplification***

Key Technologies are Integrated in the Systems Hardware and/or OS

… Foundation for Simplifying the Infrastructure…

provides the base for cost savings

reduced migration risk - allows to maintain logical application/server structure

may provide improved quality of service

Business Value of Virtualization - *via consolidation*

Sharing of Resources
Consolidation & Integration of Server, Storage, Workloads
Multiple Different Platforms on same Server
Investment Protection & Legacy Compatibility

Reduced Cost – TCA and TCO
Enables High/Improved Resource Utilization

Rapid Provisioning & Deployment
Improved Quality of Service according to Business Objectives
Flexibility via Dynamic SHARING of Resources

More efficient Manageability with Lower Cost
standardization - cloning - simplification

Higher Availability
More complete setup of Test & Development systems

The ENABLER of
Infrastructure Simplification
and a more efficient and flexible resource usage

The steps to build an on demand infrastructure

the 2nd step

IT Optimization

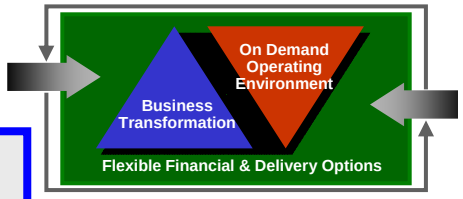
via

Convergence of System Management

across platforms

elevates virtualization to the next level

The IBM Virtualization Engine™



Cross System Virtualization and Management products and solutions

VE Suite for Servers

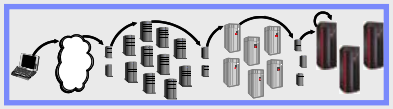
Enterprise Workload Manager

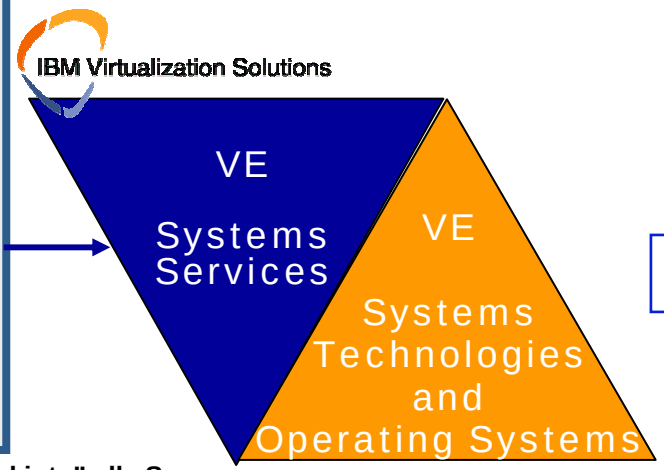
IBM Director for Multiplatform(*)

VE Console

Systems Provisioning

IBM Grid Toolbox





OPEN STANDARDS

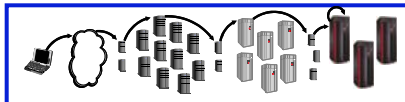
(*) Notice: IBM Multiplatform Director is being "integrated into" all eServers

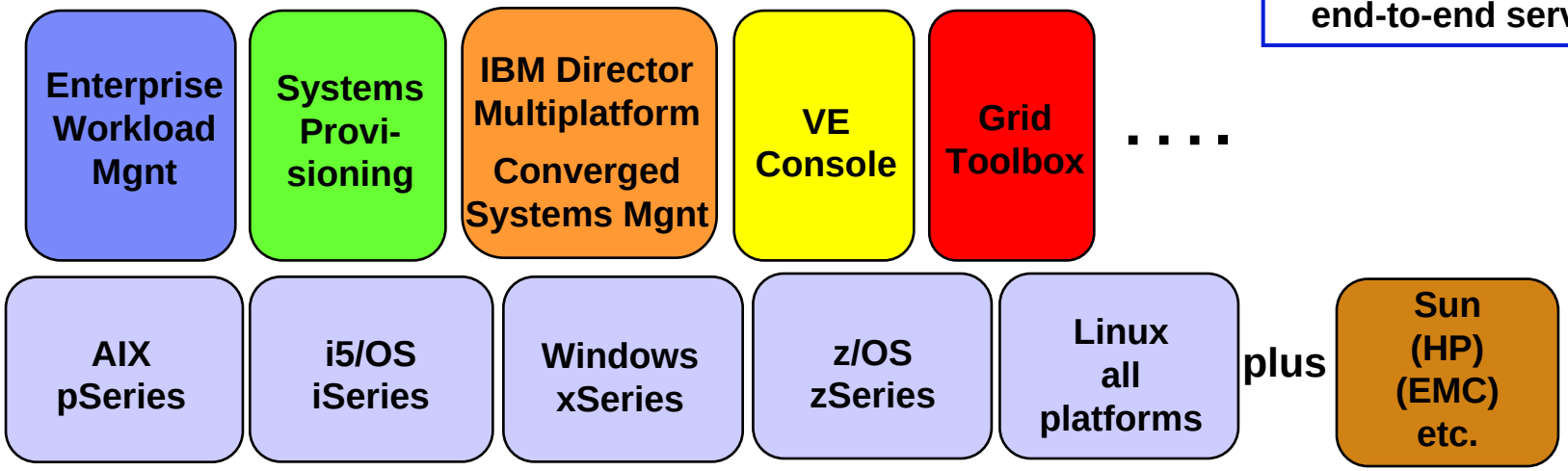
System and Cross System Virtualization Technologies
Server, Storage & Network Virtualization

Integration of a set of tested virtualization and management products & solutions to…

Optimize the usage of the IT Infrastructure
Increase Resource Utilization
Reduce Management Complexity via a unified interface
Provide Flexibility and Allocate Resources according to Bbusiness needs
Deepening the Integration of IT with Business …
Support multi-vendor & multi-platform infrastructures

Virtualization Engine Services – *what is it ?*





Enterprise Workload Mgnt
Policy based workload management End-to-End

Systems Provisioning - Tivoli Systems Provisioning Manager
Dynamic provisioning of IT resources, operating systems and applications

IBM Director Multiplatform
Converged System Management across multiple platforms

VE Console
Converged Portal based console for all platforms

GRID Toolbox
A complete Globus toolkit for development and deployment of GRID applications

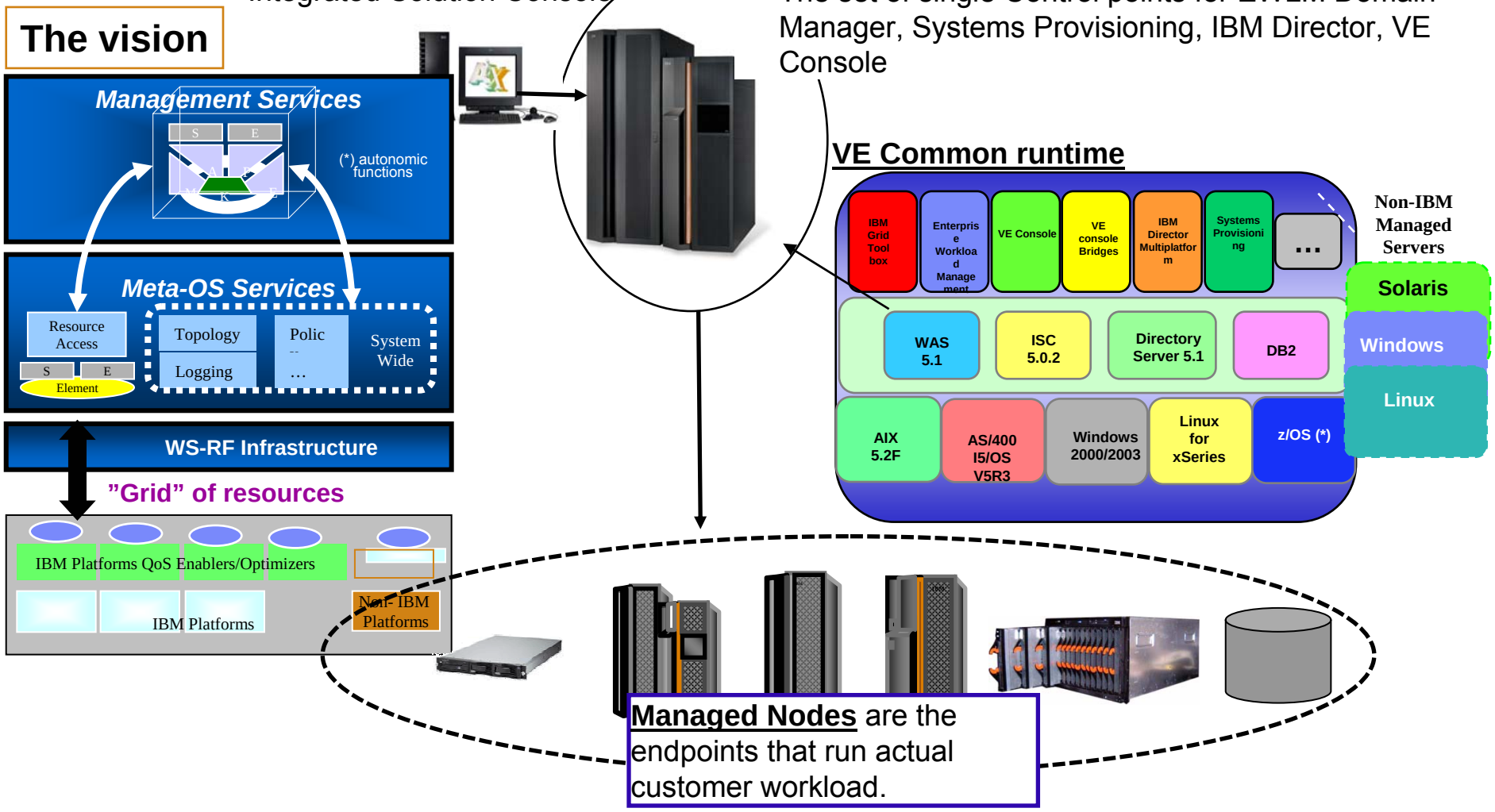
Virtualization Engine Services - *implementation of the vision today*

Operations Management UI

Integrated Solution Console

Management Servers & Managed Thru Servers

The set of single Control points for EWLM Domain Manager, Systems Provisioning, IBM Director, VE Console

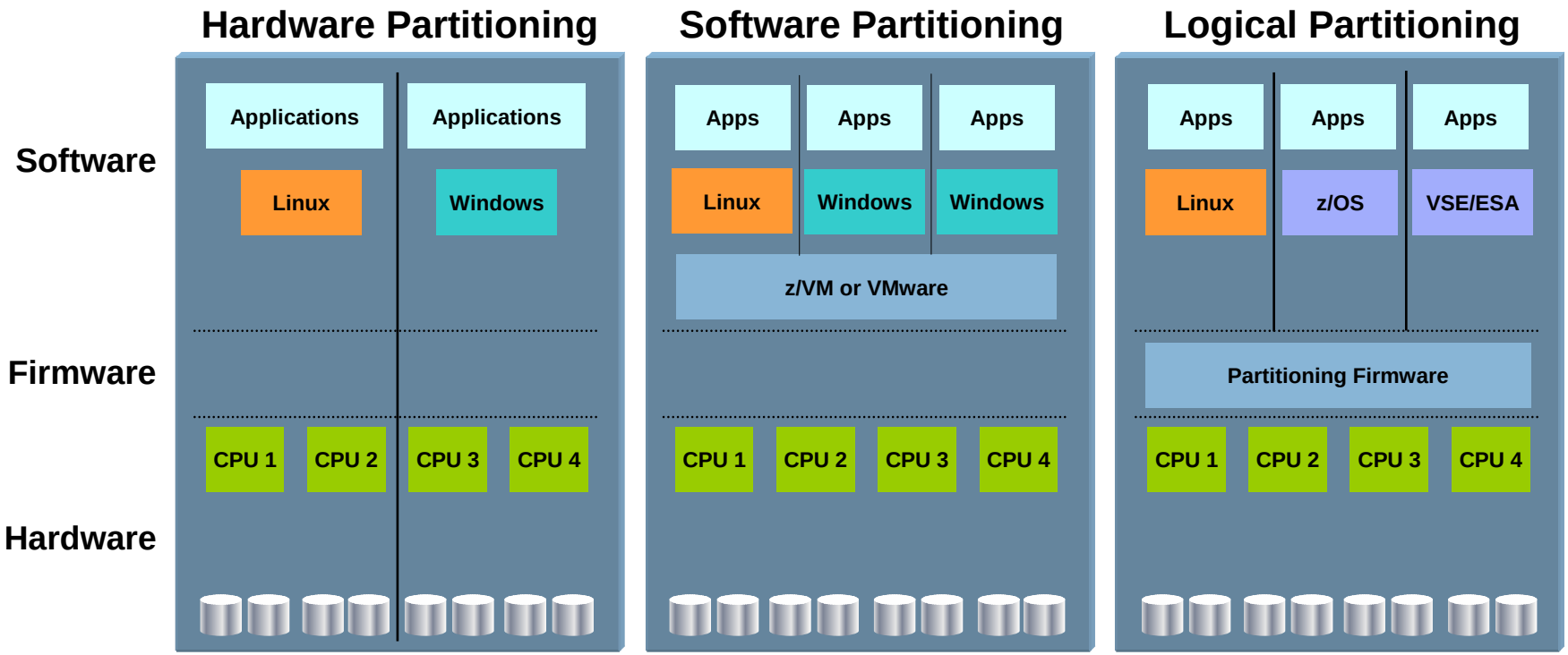


Managed Nodes are the endpoints that run actual customer workload.

Server Virtualization

what is required to provide value

Understanding Virtual Server Partitioning



- BladeCenter
- xSeries

- z/VM on zSeries
- VMware on xSeries & BladeCenter

- LPAR on zSeries with Intelligent Resource Director
- LPAR on iSeries & pSeries

DataCenter Virtualization

What is the average system utilization of a UNIX server?

- **10-15%**

What is the average utilization of a Mainframe?

- **85%**

What is the average utilization of a Windows Server?

- **5-10%**

Why the huge gap? (multiple choice)

a. COBOL coders are brilliant. Java and C++ coders are dumb
b. Unix system admins are morons compared to Mainframe Admins
c. Efficient Virtualization optimizes the assignment of physical resources to meet IT and business priorities
d. All the above

Source: IBM Server Group, "Scorpion – Simplifying the Corporate IT Infrastructure"

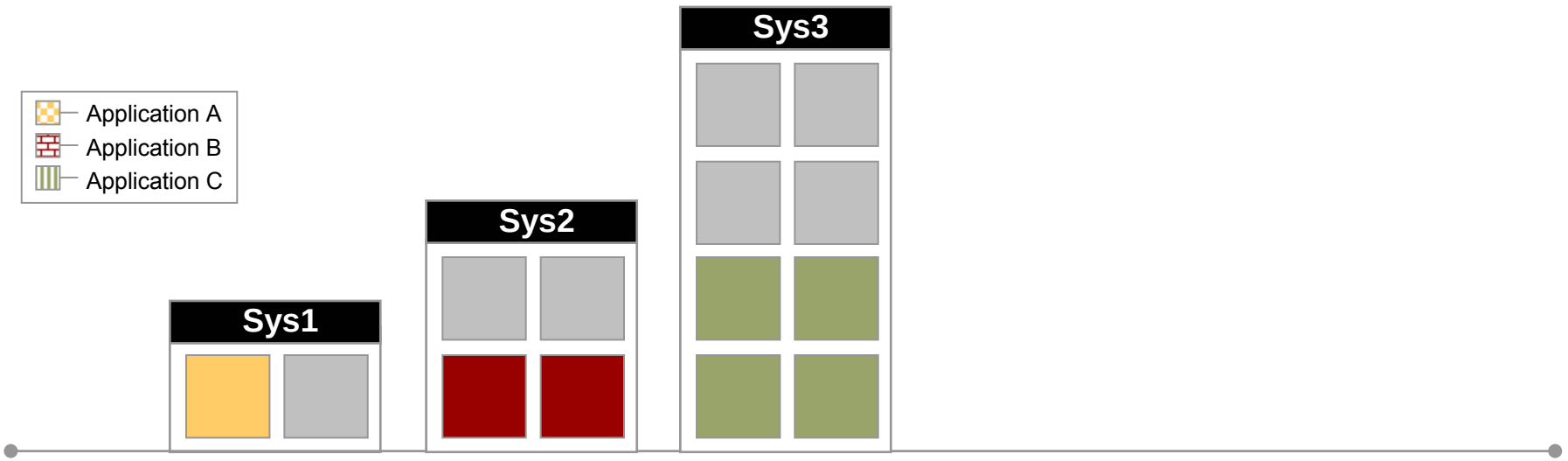
Many organizations today run a single application on a single server

Pain Point: enterprises are buying more processing power than needed and getting ..

more to manage

more costs

more complexity



Typical Physical Partitioning…*a solution attempt !!*

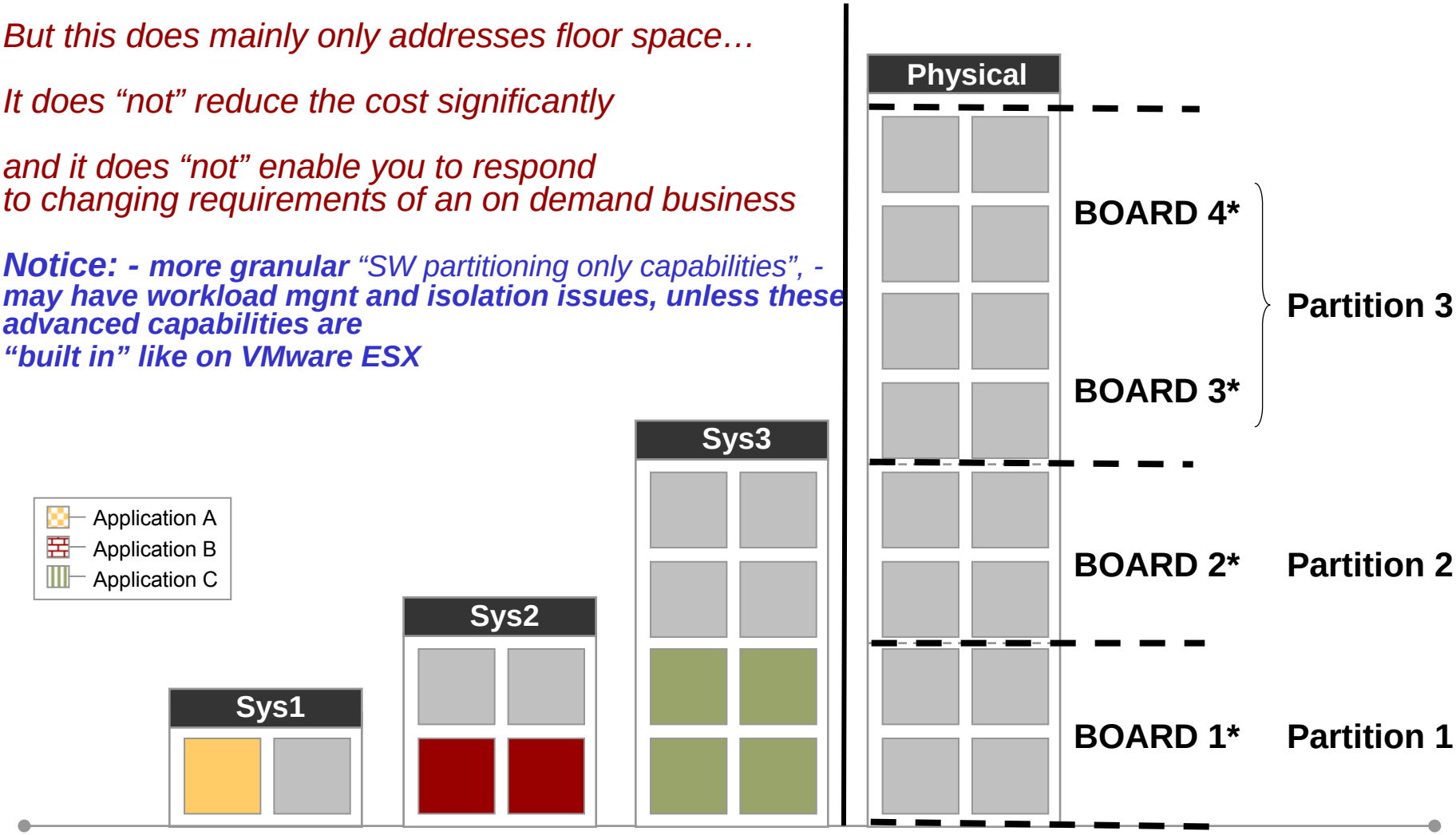
as provided by traditional UNIX and Intel vendors like SUN and HP

But this does mainly only addresses floor space…

It does "not" reduce the cost significantly

and it does "not" enable you to respond to changing requirements of an on demand business

Notice: - more granular** "SW partitioning only capabilities", - **may have workload mgnt and isolation issues, unless these advanced capabilities are "built in" like on VMware ESX



**Boards may contain CPU's, I/O and Memory*

Efficient Virtualization - *IBM compared to Competition*

elements needed to provide value

Translates into differences in

ability to work in "real life"
and ultimately into

Cost reduction
Business Flexibility

Elements to be evaluated

Resource Granularity

Dynamic Resource Allocation & Re-Allocation

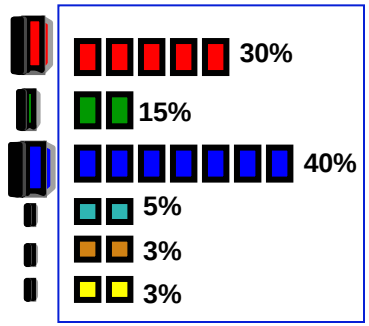
Resource Independence and Affinity

Partition affinity to Physical Configuartion

Isolation & Hardware synergy

Policy based management of Resources

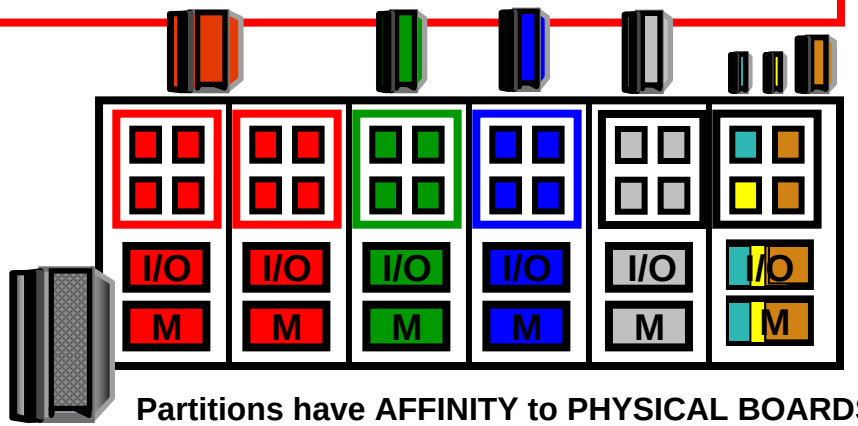
IBM Virtual Servers & Logical Partitions



Guaranteed Capacity
I/O & Memory Resources
may be re-allocated
dynamically / automated

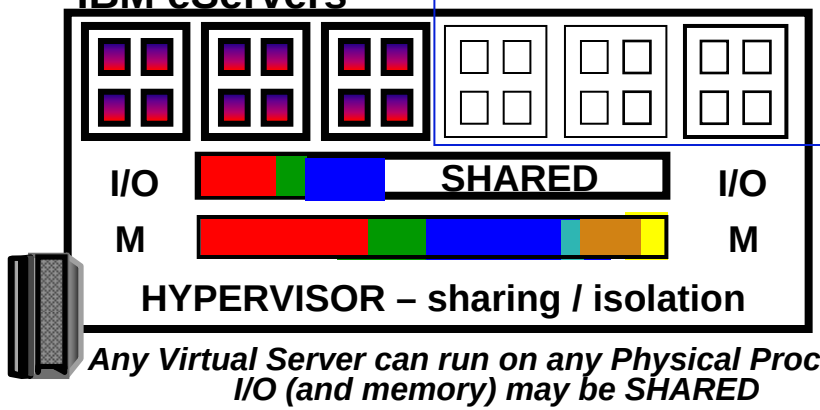
SAVED Capacity
could be be used for
Cost savings ?
Disaster Backup ? CUoD ?

Traditional Intel and UNIX server



Partitions have AFFINITY to PHYSICAL BOARDS

IBM eServers



Any Virtual Server can run on any Physical Processor
I/O (and memory) may be SHARED

Typical Competitive implementations

physical partitioning with strong board affinity - some limited SW based partitioning

HP

nPARS = Physical Partitioning (PA/Itanium) = Board affinity
vPARS (PA only) - Software based partitioning WITHIN a nPAR - Full engine granularity

provides a limited ability for moving resources dynamically among partitions
because of board affinity – and a rather ”poor” cpu granularity

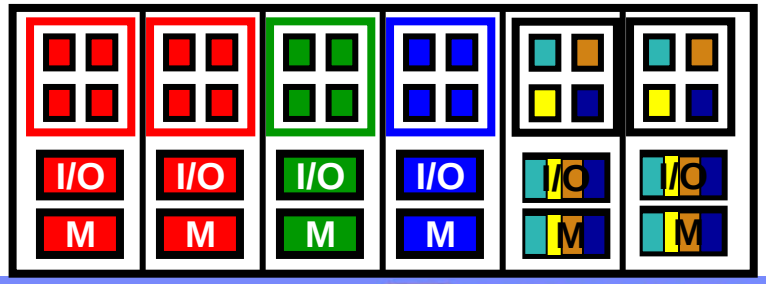
SUN

Domains = Physical Partitioning = Board affinity
N1 Grid Containers (Solaris 10) – runs multiple WITHIN a Domain

”Containers” is NOT server virtualization, but appear more like workload consolidation
have some similarities to ”z/OS address spaces”, BUT with some Solaris OS included limitation in OS functions compared to standard Solaris systems

Dynamic Reconfiguration Support
but limited ability to move resources in production environemnts ,
´because of the board affinity, IT resource affinity and poor granularity

Partitioning of
Traditional Intel and UNIX servers on the market



Characteristics of an efficient virtualization technology

important requirements to provide business value

Fine Resource Granularity

”No Direct Affinity” between ”Virtual servers and the Physical Configuration”

Dynamic Resource Allocation & Re-Allocation in production setup’s

Resource Independence between CPUs, IO and Memory

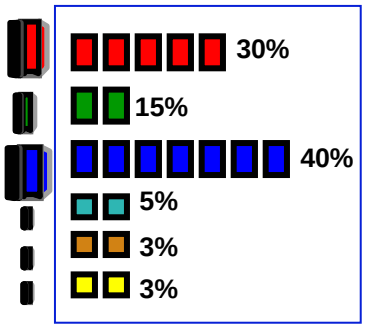
HW Architecture support for Virtualization for ”performance” and ”isolation”

Policy based workload management of resources

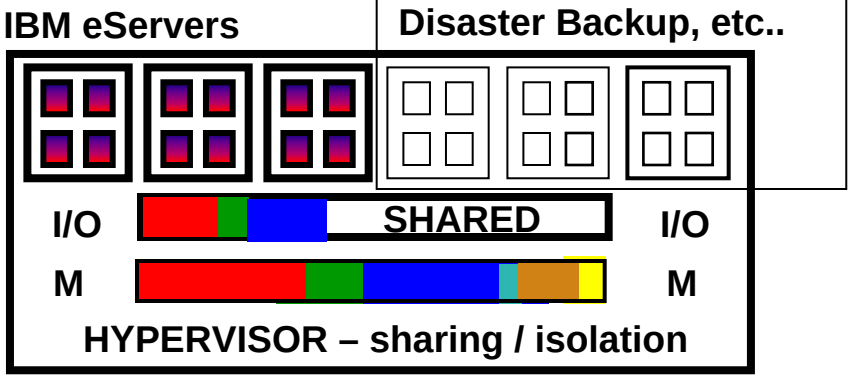
***IBM eServers implement* the above characteristics creating a base for an efficient on demand infrastructure solution**

Less capacity need to be installed compared to traditional UNIX and Intel systems

can be used for CUoD Disaster Backup, etc..



ANY Logical Processor or Virtual Server can run on ANY physical processor. I/O (and memory) can be shared CPU resources can be ”moved” by REDEFING the GUARANTEED capacity CPU, I/O and Memory can be moved dynamically withoutany affinity

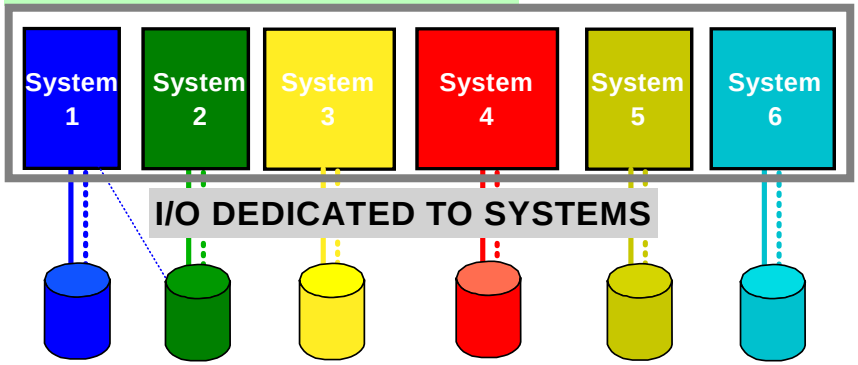


Value of resource sharing – IBM compared to competition

less capacity neeeded – higher quality of service possible

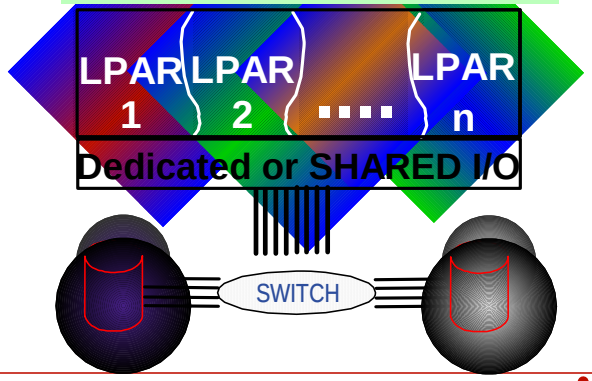
Physical Partitions = SEPARATE systems

UNIX / NT - SHARED NOTHING
"SINGLE" WORKLOADS

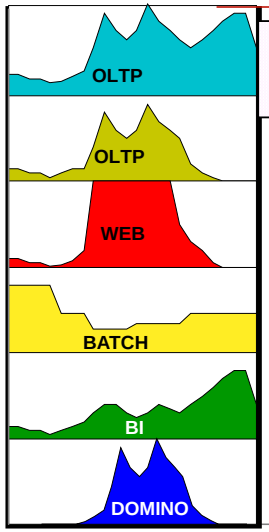


Logical Partitions

SHARED RESOURCES
(multiple workloads)



CAPACITY



"NO" difference between Physical Partitions and Separate Systems

- ✓ Strong AFFINITY between the Physical Partions and the Physical Configuration of the Server
- ✓ No Sharing
- ✓ Less Useable Capacity
- ✓ Typical LOW Utilization

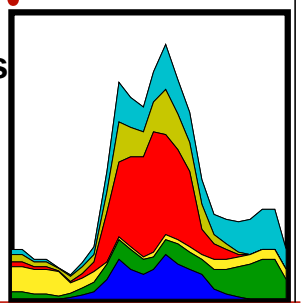
typical UNIX / Wintel

- ✓ NO affinity between the Logical Partitions and the physical resources
- ✓ Engines SHARED across LPAR's
- ✓ HIGH EFFECTIVE Capacity
- ✓ Utilization up to 60-100%

IBM eSERVERs

Less Capacity

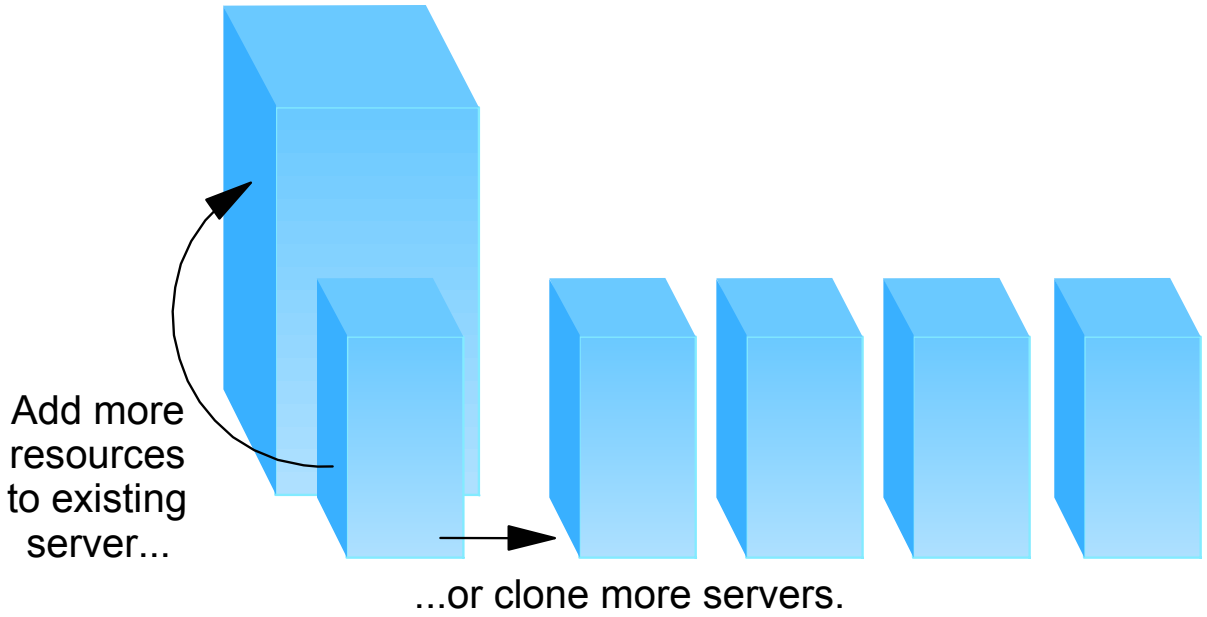
Higher Quality of Service



CAP

Value of Resource Sharing

Flexibility to adjust to different technical needs and different business needs



- Granular efficient virtualization based on SHARING allow an installation to grow horizontally and vertically on the same server, **dynamically**

- It is possible to “provision” a virtual machine for peak utilization and allocate its resources to other servers during off-peak hours, **automatically**

Virtualization Capabilities – A Quick Comparison

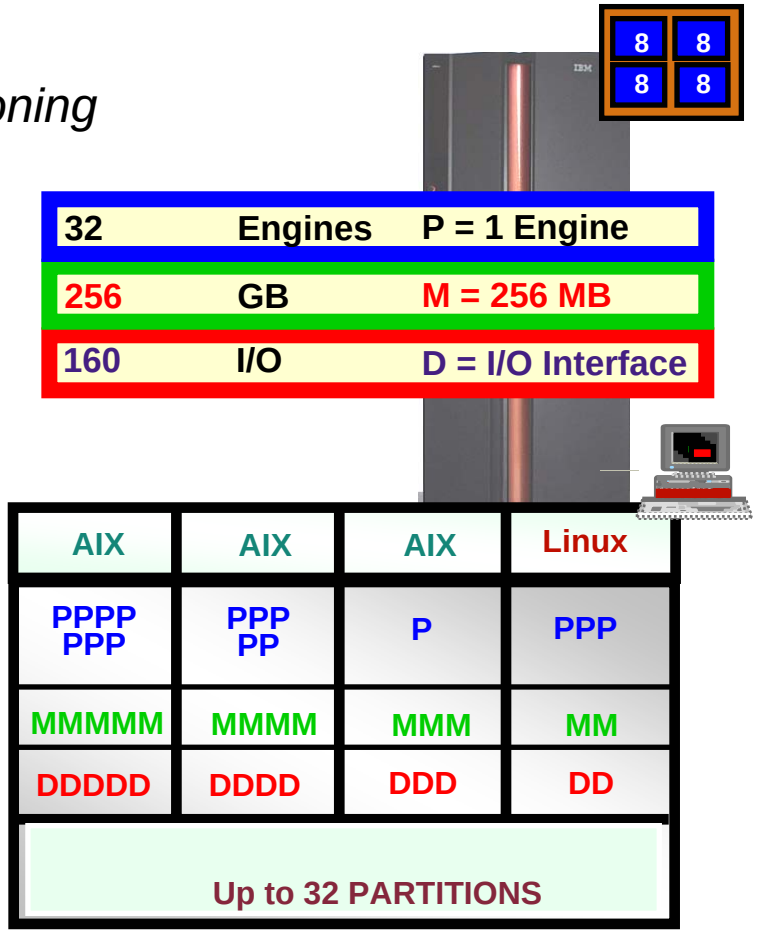
IBM zSeries	*The gold standard. Software Hypervisor (VM) virtualization since 1967. Logical partitioning based on microcode/hardware Hypervisor (PR/SM) since 1987. SW Hypervisor with hardware integration since 1987. Dynamic partitioning, Virtual I/O and Networking, Swtiches and Routers, - Sub-processor partitioning at the % capacity level..*
IBM p & i Series	*POWER5 Micropartitioning: Built by "the same developer base" as the zSeries and moving rapidly toward the similar capabilities. Firmware based approach is simple, truly logical and works for Linux, i5/OS, OS/400, and AIX.* *POWER4 LPAR partititioning: Provides a very efficient partitioning capability with no direct mapping between LPAR's and the physical configuration, single engine granularity, ability to mover resources dynamically, and no affinity between engines, I/O and memory.* *Unique implementation within the UNIX and Intel space.*
HP	*Complex combination of physical partitioning (npars) and software partitioning (vpars). vpars provides single engine granularity, but are contained witin npars with no specific HW support fo isoltion between vpars.* *Limited flexibility/reliability: npars are directly mapped onto the physical cell board structure. npars are not dynamic reconfigurable (require reboot). All vpars contained within an npar fail, if the npar fails. you must move entire cell boards at one time, only cpus within an npar can be moved between vpars, not I/O or memory. There are no sharing of board resources between npars, etc.*
SUN	*Physical partitioning into domains with direct mapping onto the physical board configuration. Limited ability to move resources dynamically in practice, because there are some affinity between processors, memory and or I/O interfaces. Claim to have LPAR software partitioning via "containers" in Solaris 9 and zones in Solaris 10. Zones implements an infrastructure, which in reality are very close to what we normally understand with multiple workloads running under one operating system, - but without any hardware supported isolation.*

Server Virtualization

pSeries

IBM pSeries - where were we ?

POWER 4 & AIX 5.2 provided industry leading partitioning capabilities within the UNIX and Intel space



Dynamic Logical Partitions (DLPAR)

- ***Granular, multiple OS images per system:*** **Single CPU, 256 MB Memory, I/O Adapter level granularity**
- ***Dynamic Reconfiguration (DR):*** **Processor, memory and adapter DR w/o reboot**
- ***DR Middleware/App support:*** **APIs and Scripting event notification - incorporated by leading ISVs: like Oracle, DB2, etc.**
- ***Fault and security isolation:*** **enforced by Hardware & Firmware**

No other Unix vendor is matching this combined level of granularity and dynamic capabilities

Existing and New Workloads

Dynamic creating of new patitions
Dynamic move of Capacity to Workload (variable & responsive)

Allow IT people to be spend more time enabling new work (focused)

IBM partitioning innovations - *designed for granularity and flexibility*

In 2001: **Logical Partitioning**

- ✓ enabled consolidation of multiple workloads
- ✓ maintaining the logical infrastructure between applications and servers
- ✓ reducing migration time and risk

In 2002: **Dynamic Logical Partitioning**

- ✓ enabled dynamic reassignment of capacity to workloads

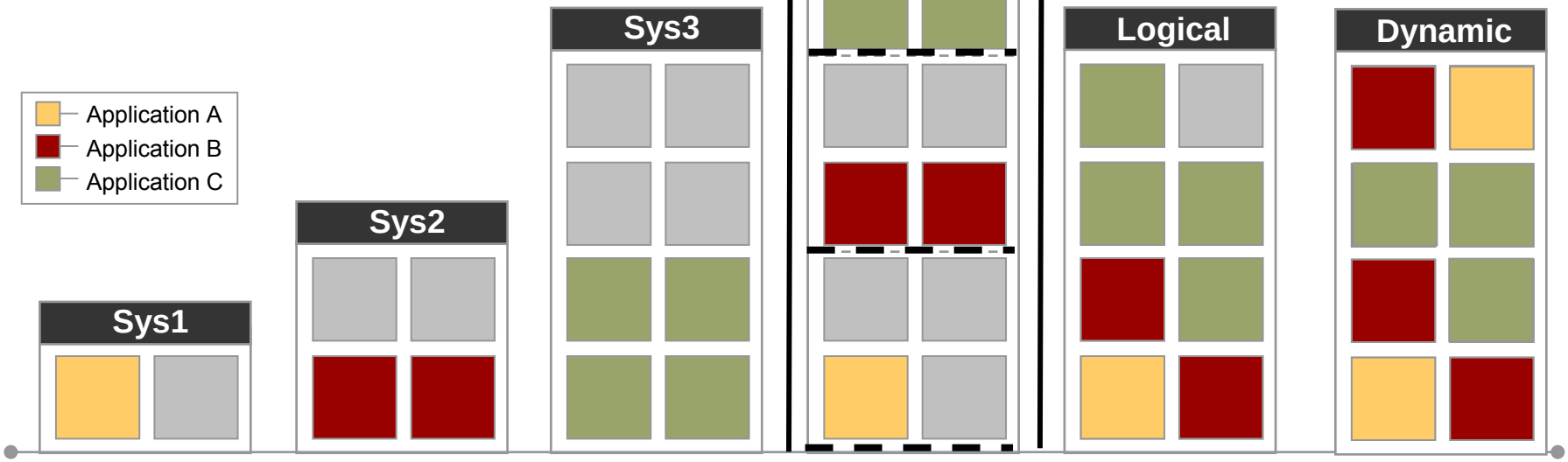
What makes it useable… in real life….is…

Granularity

No affinity

- to physical boards
- between resources

UNIQUE implementation within the UNIX and Windows space



IBM UNIX partitioning innovations - *takes it to the next level*

***In 2001:* Logical Partitioning**
- ✓ enabled consolidation of multiple workloads
- ✓ maintaining the logical infrastructure between applications and servers
- ✓ reducing migration time and risk

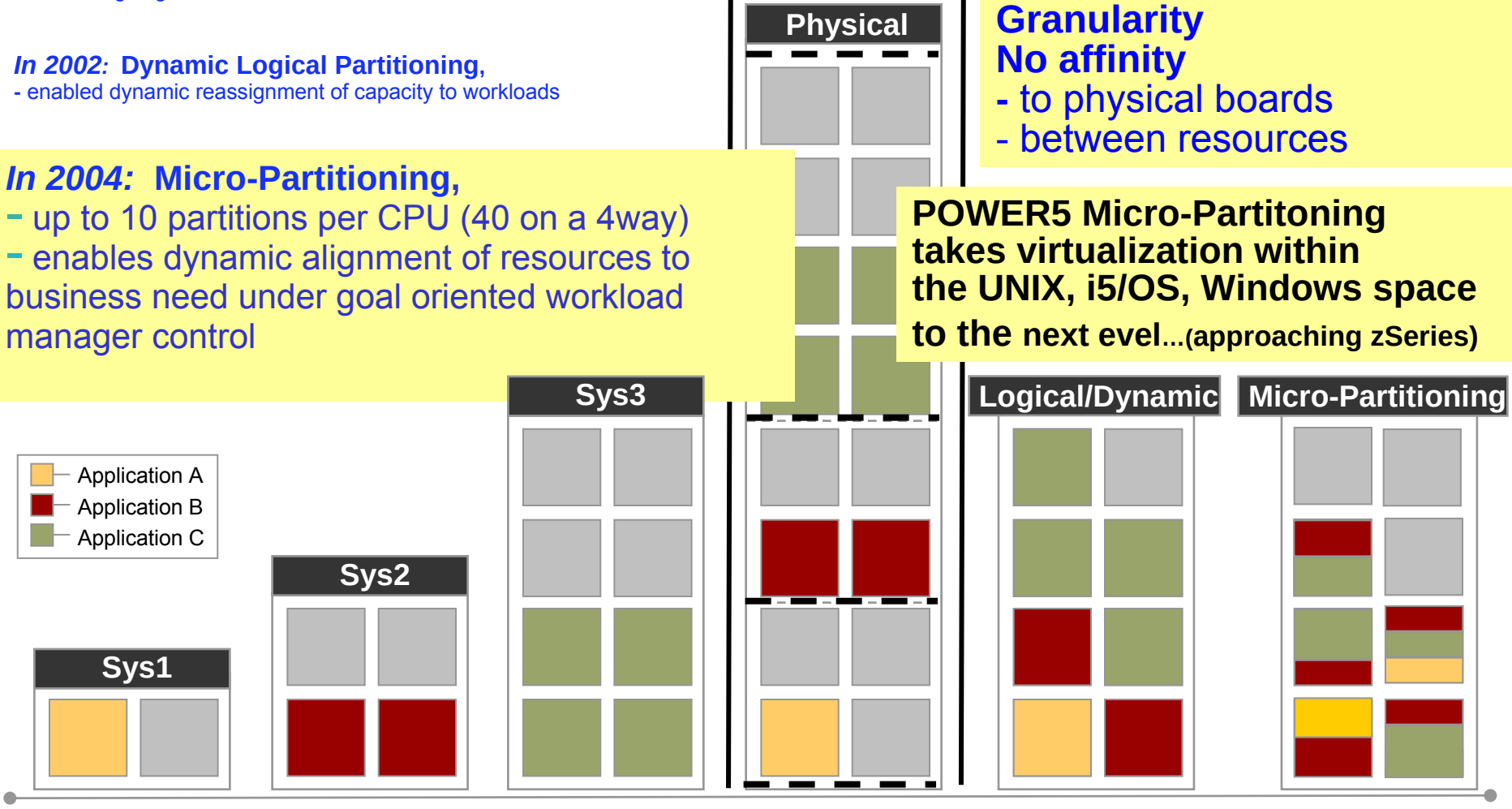
***In 2002:* Dynamic Logical Partitioning,**
- enabled dynamic reassignment of capacity to workloads

***In 2004:* Micro-Partitioning,**
- up to 10 partitions per CPU (40 on a 4way)
- enables dynamic alignment of resources to business need under goal oriented workload manager control

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

Granularity
No affinity
- to physical boards
- between resources

POWER5 Micro-Partitoning takes virtualization within the UNIX, i5/OS, Windows space to the next evel…(approaching zSeries)

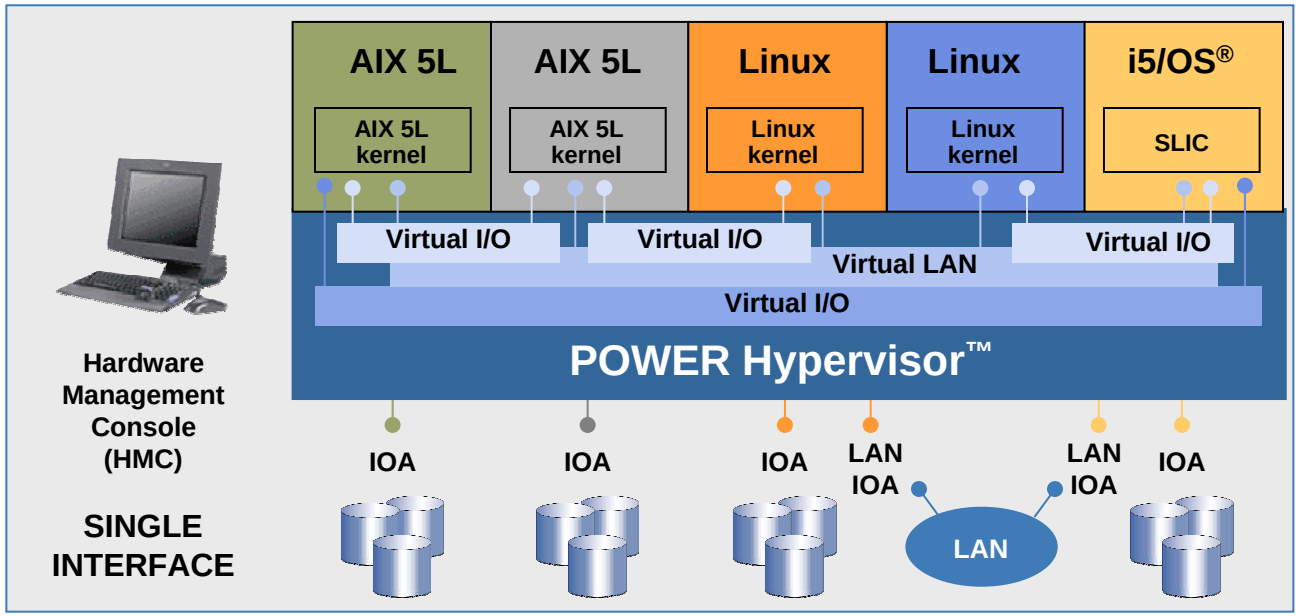


pSeries virtualization with POWER5 - micropartitioning

Resources on demand

- Micro partitioning
- Shared Processor Pool – high utilization
- Virtual I/O – shared I/O (disk)
- Virtual LAN – memory bandwidth

- All POWER5 systems – up to 64 processors
- Simplification through virtualization
- X-partition resource mgnt & provisioning
- Mainframe like function
- Capacity Upgrade on Demand



Micro-partitioning

Processors may be DEDICATED or SHARED

up to 10 partitions/processors with max 254 partitions

Time-sliced, Capped and Uncapped

Guaranteed Capacity per LPAR

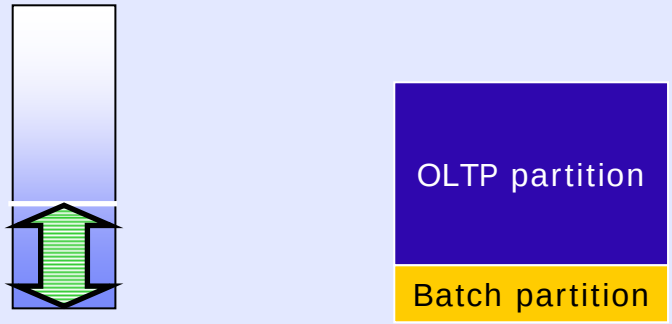
Resources may be reassigned or moved dynamically

Capacity Upgrade on Demand Permanent, On/Off, etc..

MicroPartitions - on POWER5 Systems

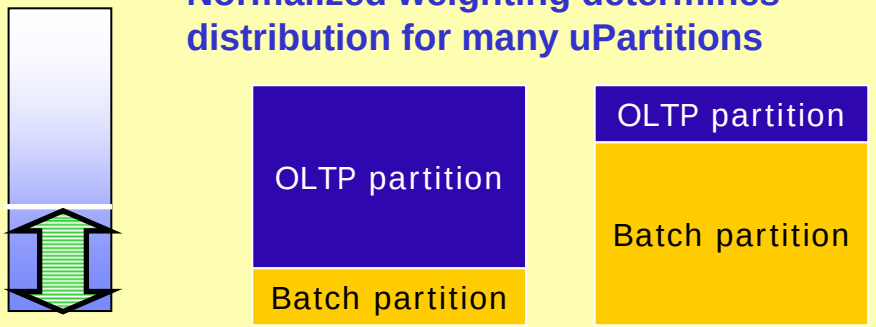
Capped Processor Sharing

- uPartition has "entitled capacity"
- Example: 1.5 x CPUs capacity
- uPartition may "utilize" CPU cycles up to that capacity
  - Actual utilization depends on the partition's workload
  - uPartition is always guaranteed full entitled capacity
  - uPartition never uses more than its entitled capacity
  - Unless the entitled capacity is changed



Uncapped Processor Sharing

- uPartition guaranteed capacity
- uPartition able to use more
  - If it has more workload than entitled capacity
  - If spare capacity in other partitions
  - If some capacity is not assigned
- All uncapped partitions share this "unused" capacity
  - Cycles dispatched on need, and user-defined weighting factors
  - Normalized weighting determines distribution for many uPartitions



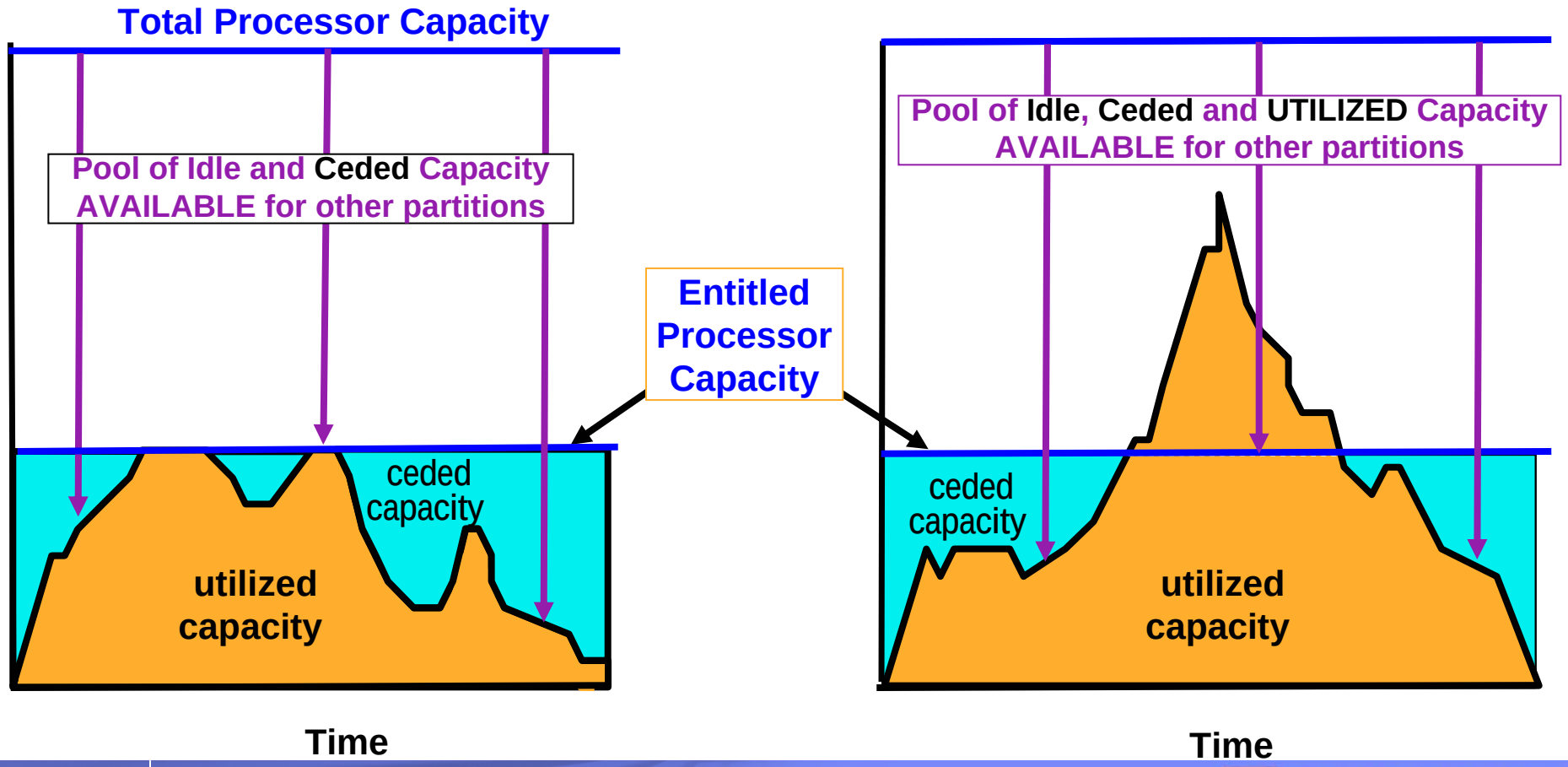
MicroPartitions - Processor Capacity Utilization

Capped Shared Processor LPAR

- Unused capacity is returned (ceded) to Hypervisor
- Images don't exceed capped capacity

Uncapped Shared Processor LPAR

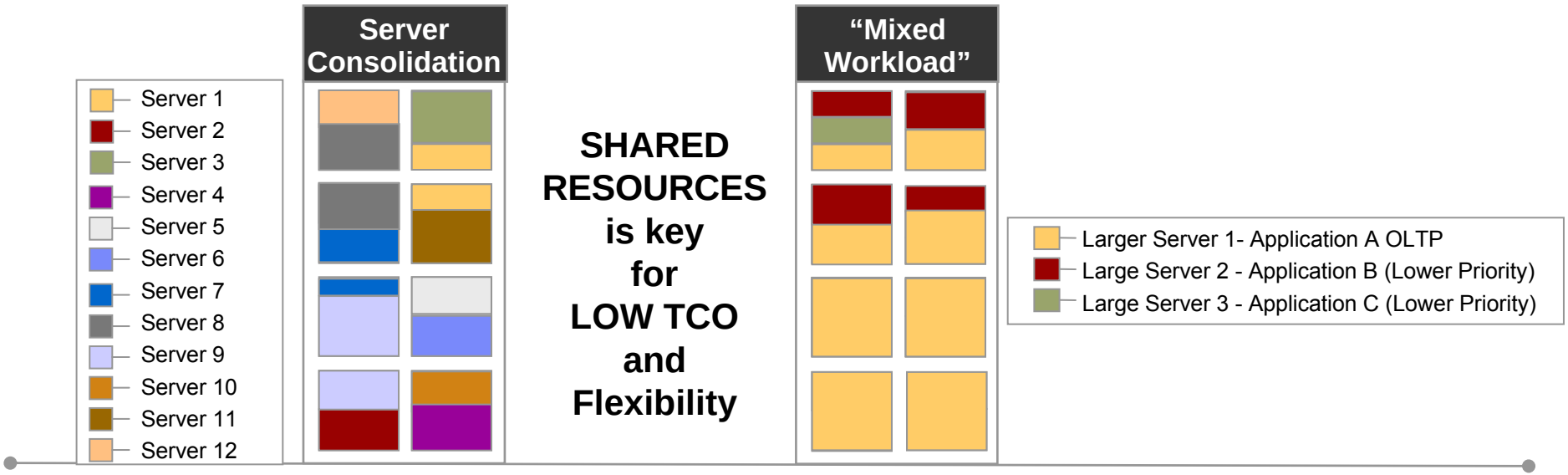
- Unused capacity is returned (ceded) to Hypervisor
- Images are allocated all available cycles
  - Based on variable capacity weights



Micro-Partitioning enables very high flexibility

value goes beyond server consolidation….

MANY small servers *(server farm)* **+** **a FEW large servers** *(“variable workloads”)*

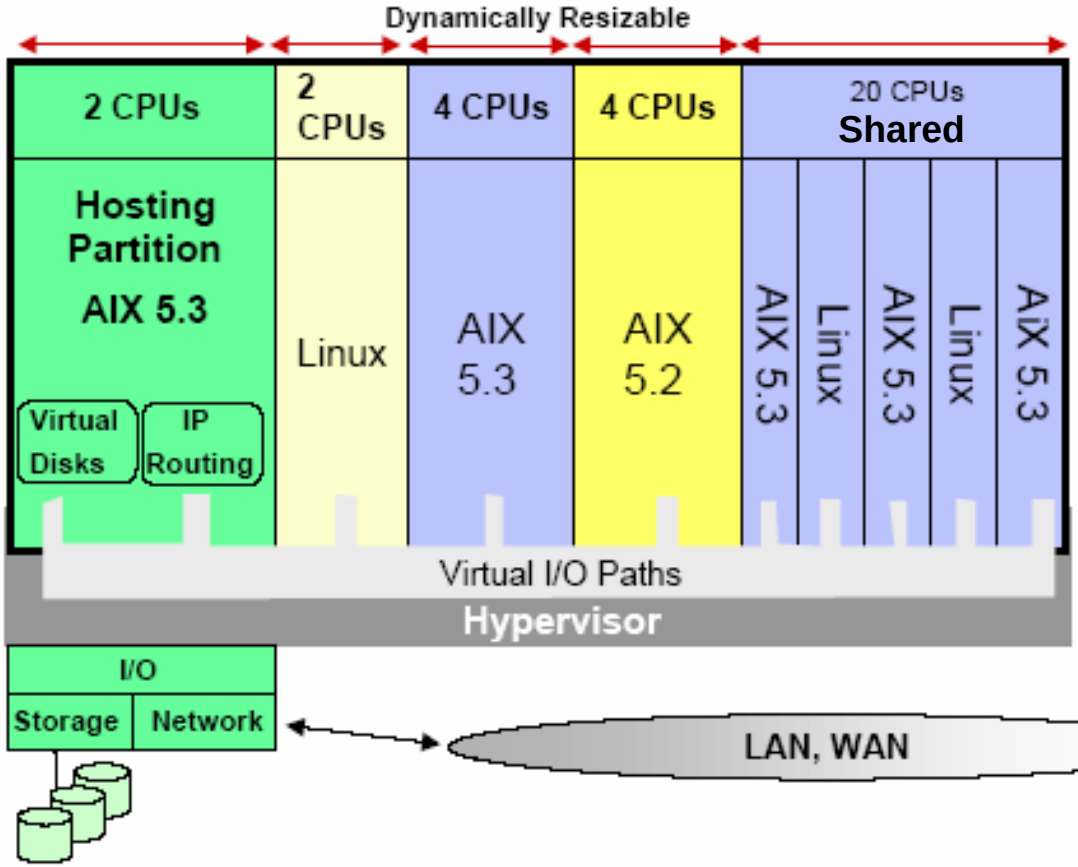


- *simplify your environment*
- *rapidly respond to changing needs*
- *drive higher system utilization – reduce cost*

POWER5 Micropartitioning

AIX 5L 5.3 Logical Partition Support (LPAR)

Greatly improved physical resource utilization though virtualization of processors, memory, and I/O resources



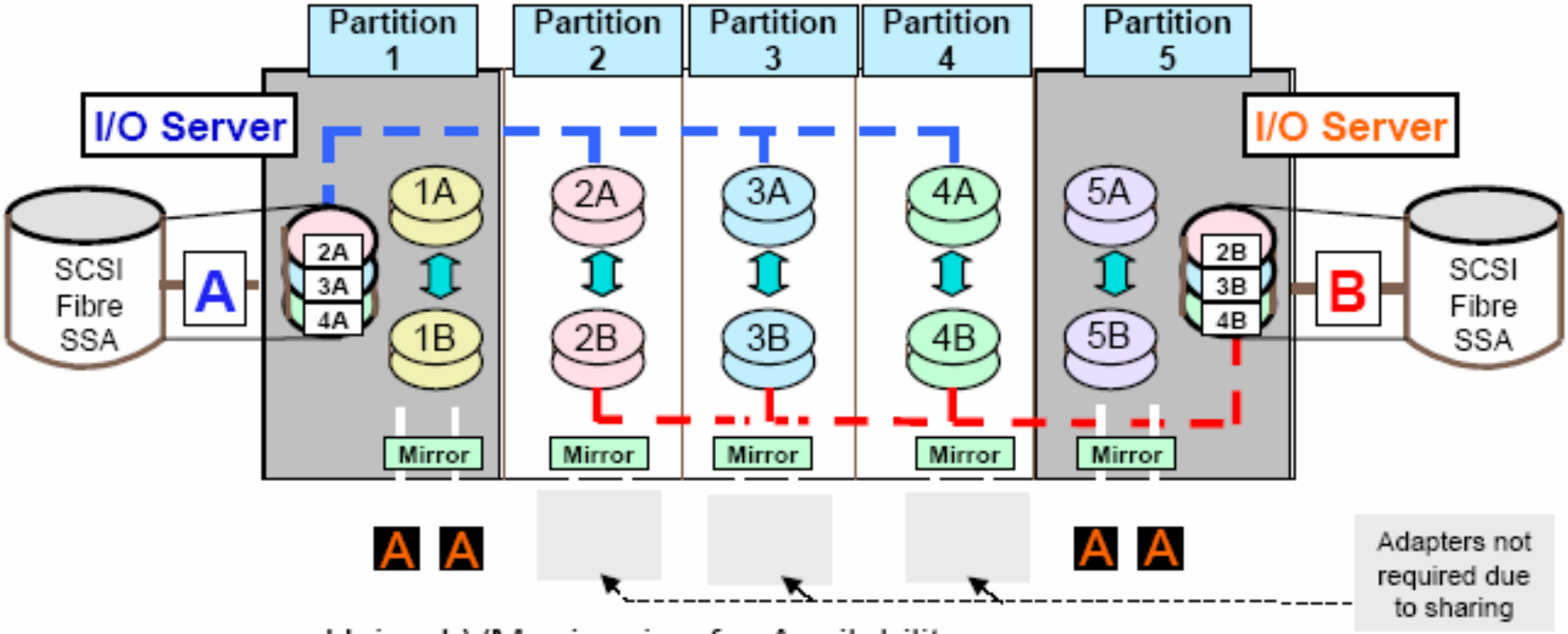
Increased number of LPARs
AIX support for 254 partitions

Shared processor LPARs
A single processor might be shared by up to 10 partitions

Virtual inter-partition Ethernet
LPARs can communicate without having to use physical I/O adapters

Virtual I/O Disks
Client partitions can use virtual disks hosted by another partition

POWER5 / AIX 5.3 LPAR DISK Sharing



Using LVM mirroring for Availability

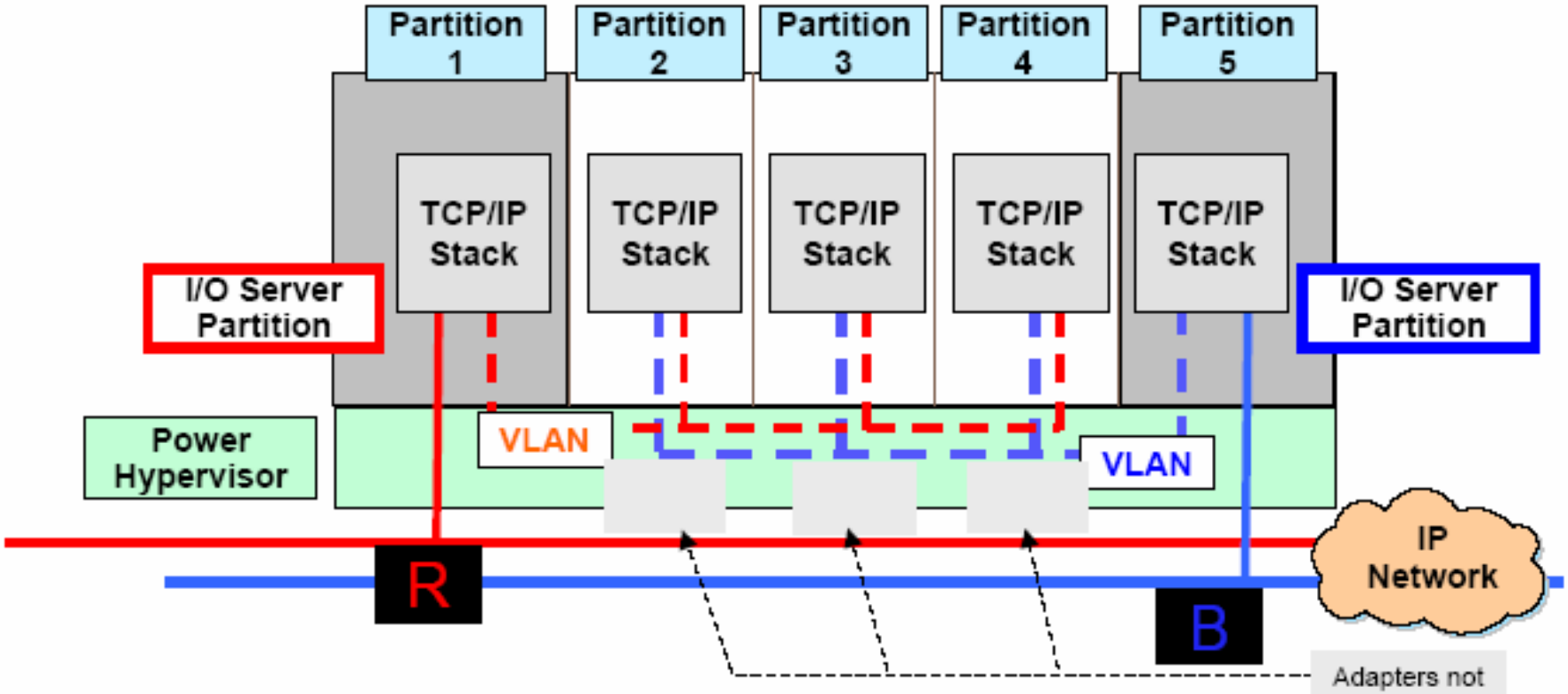
One physical drives appears to be multiple logical drives

- LUNs appears as individuals logical drives

Minimizes the numbers adapters

SCSI, SSA, and Fibre supported

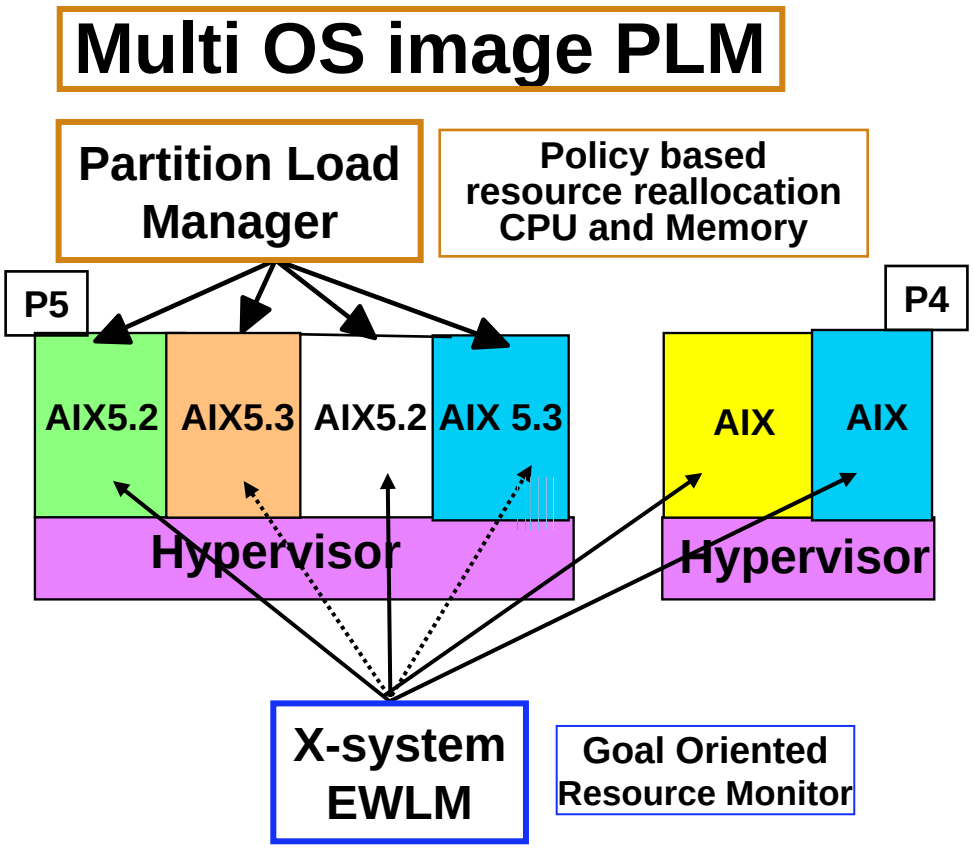
POWER5 / AIX 5.3 LPAR Virtual Ethernet



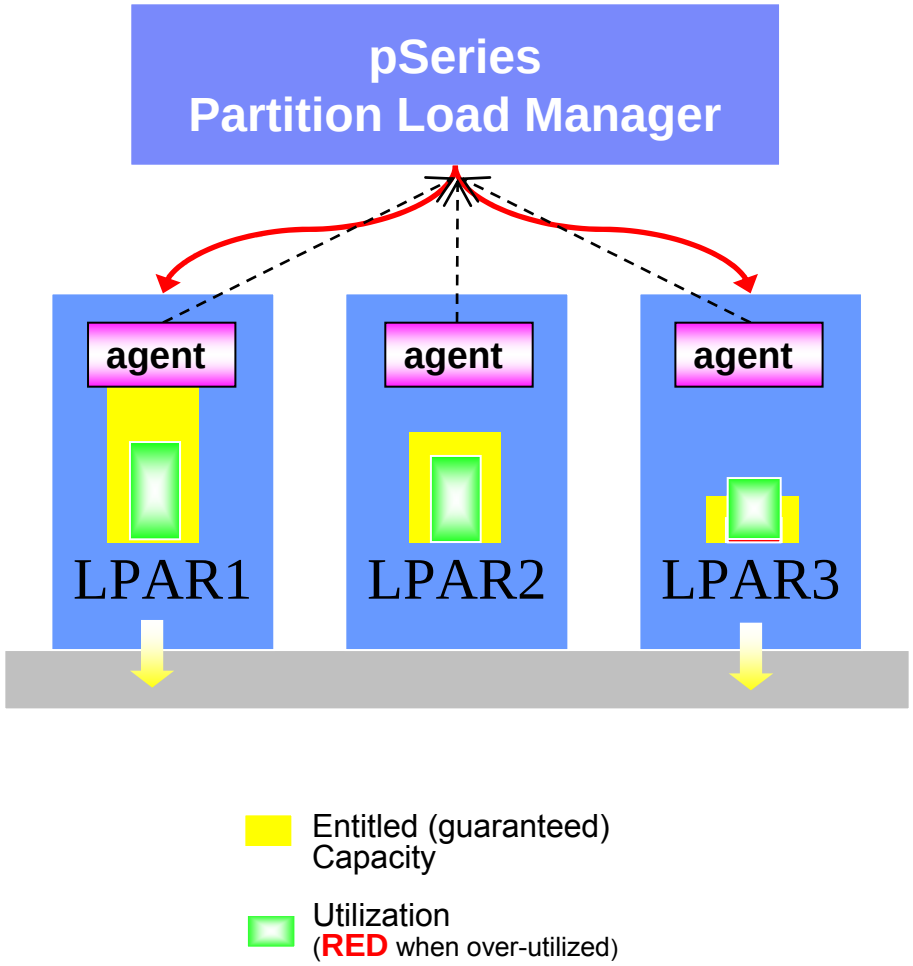
- Inter-partition communication support
- IP forwarding provided by I/O Server partition
- Can have multiple connections per partition

pSeries - Partition Load Manager (PLM)

Multi OS image PLM



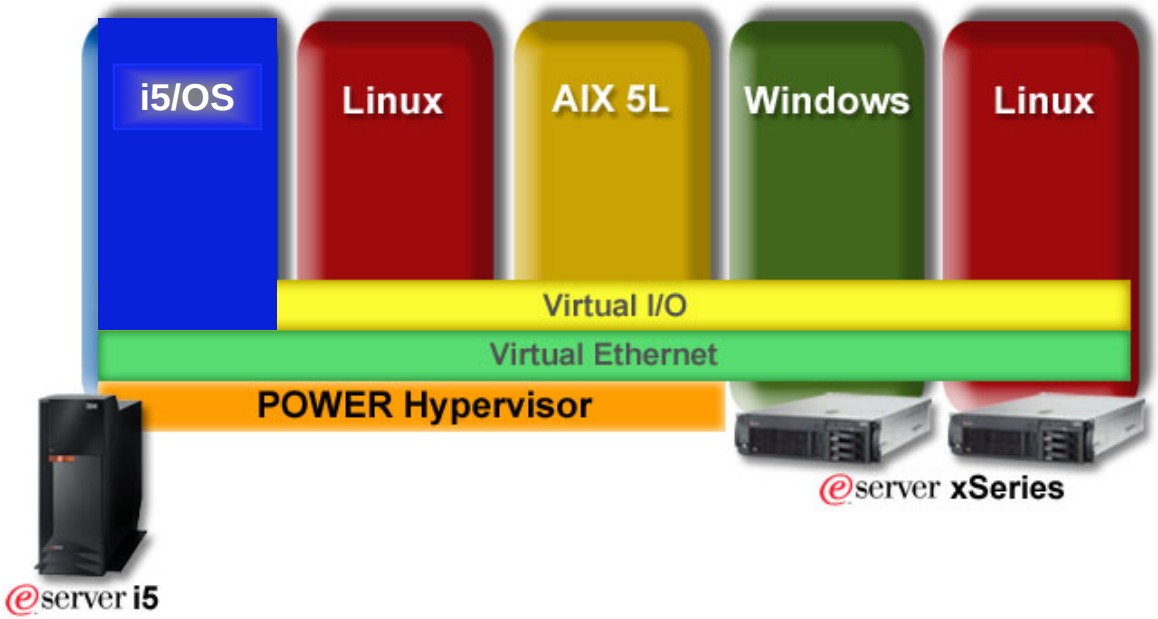
Multi OS image/Server eWLM



Server Virtualization

iSeries

IBM eServer i5 On Demand Operating Environment



- POWER Hypervisor™ supports i5/OS, AIX 5L, Linux
- Improve server utilization rates across multiple workloads with automatic processor balancing with uncapped partitions

"As well as consolidating physical servers, the iSeries provides an easy way to integrate multiple environments. iSeries is the ultimate server for integration, and it has delivered immediate and significant advantages."

*Statement of Direction: IBM plans to support AIX in a logical partition in the future.

This presentation contains information about IBM's plans and directions. Such plans are subject to change without notice.

OS Support for POWER5 Virtualization

Function/OS	AIX 5.2F	AIX 5.3	Linux SLES9	Linux RHEL 3 U3	I5/OS	OS/400
DLPAR						
Processor	Y	Y	Y	N	Y	Y
Memory	Y	Y	N	N	Y	Y
I/O	Y	Y	Y	N	Y	Y
Micro-partitions	N	Y	Y	Y	Y	
Virtual I/O Hosting Partition	N	Y	N	N	Y	Y
Virtual I/O (storage)	N	Y	Y	Y		
Virtual Ethernet	N	Y	Y	Y	Y	Y
Partition Load Manager	Y	Y	N	N		

Server Virtualization

zSeries

zSeries – unlimited scalability and flexibility

most flexible and most cost effective solution for server consolidation, integration and on demand

Scalable

Virtualized

Flexible

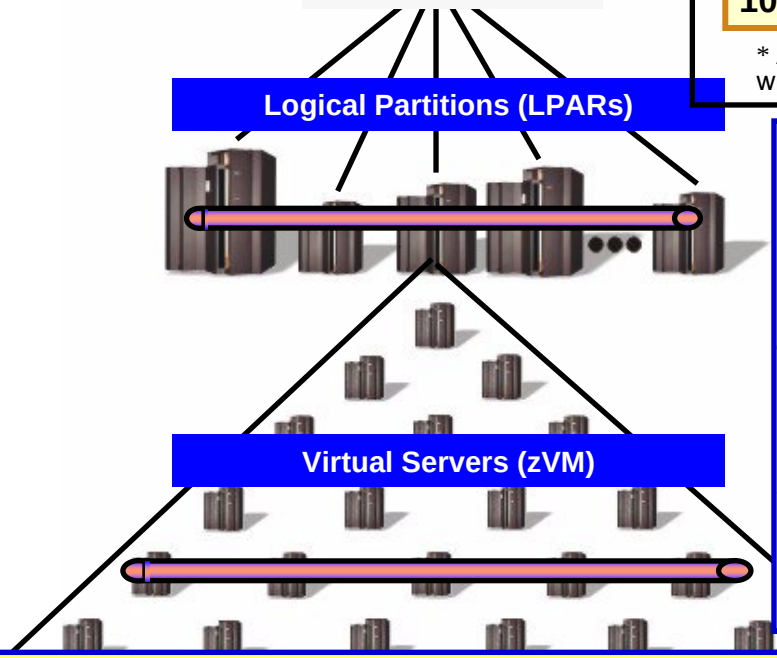
Continuous Available

zSeries Resource Space

32(48)	CPU's	Shared %
256	GB	MB
1024	I/O	Shared)
30 LPARs (Virtual servers) – SOD for 60*		
100-1000 Virtual Machines		

up to 32 systems
> 1500 CPU's
in a CLUSTER
for
SCALABILITY
and
Continuous Availability

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



"Unlimited" Virtualization = "Unlimited" Flexibility

Multiple applications (100's) per logical partition – based on the most advanced and mature workload management on the server market – enables integration and QoS

Self-Managed Workload Mgnt (IRD) across LPAR's for Quality-of-Service according to a goal-Business Policy

Virtual I/O and Shared I/O for cost reduction

Enabling of application Integration using **HIPERSOCKETs** (Virtual GbEtn) connections between LPAR's / virtual servers

Hardware Support for LPAR and z/VM
SIE Instruction - Micocode assist features
HW Isolation

First partitioning implementation in the 1967 time frame
Logical Partitions delivered in 1987
Virtual Servers first implemented in 1967

zSeries Clustering – Pools of Resources

unlimited scalability - continuous availability – on demand

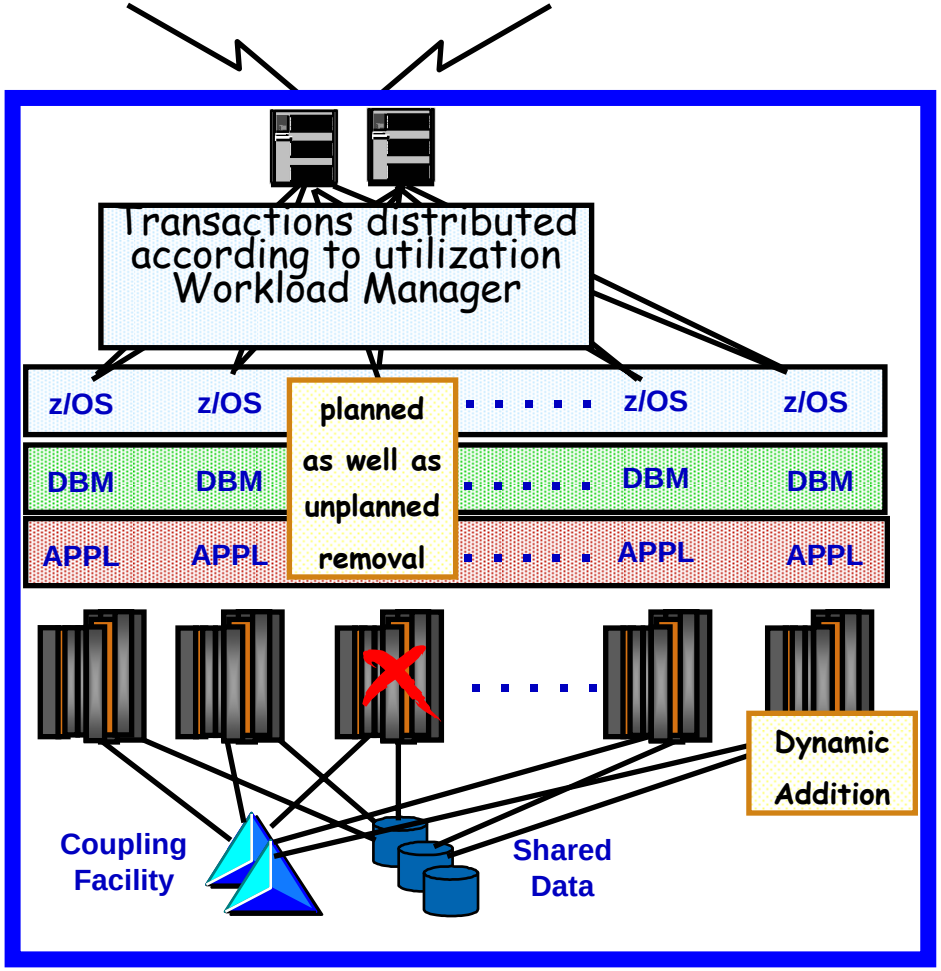
24 x 7 x ....

WORKLOAD
Dynamic
Self-Managing
Policy-Driven

PHYSICAL

Multiple HW & SW elements of each type

HW Systems & SW components may be added, removed modified DYNAMICALLY



Up to 32 CECS, each of which may be 20-way processors. How about that for scalability!

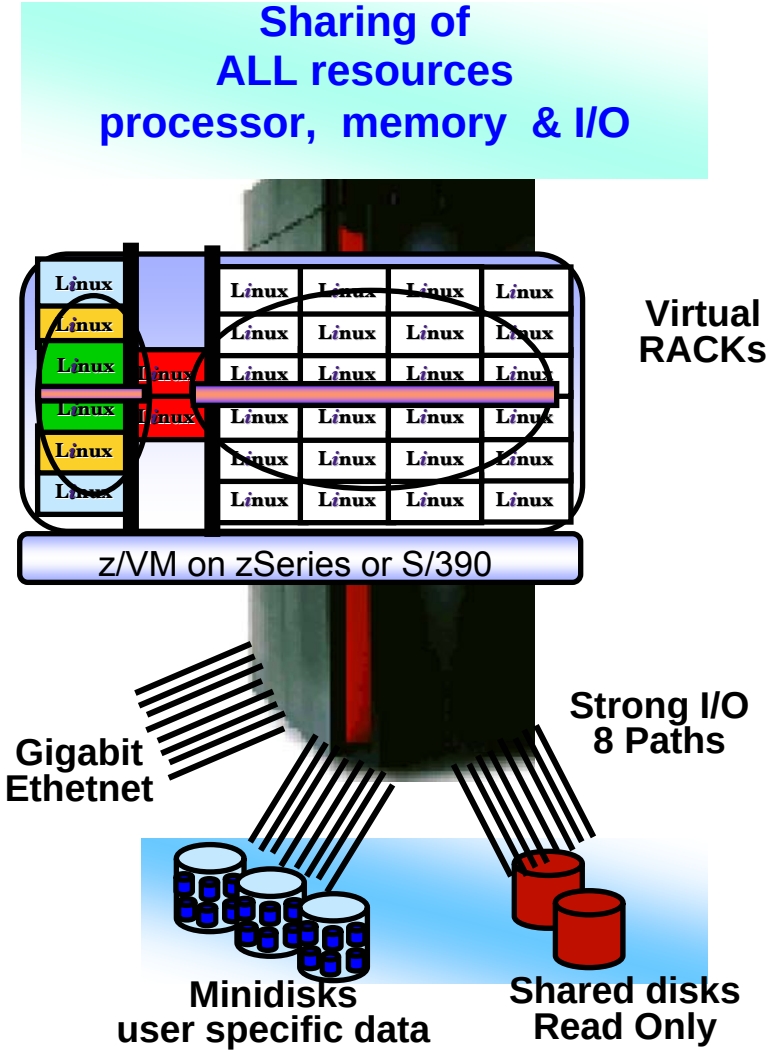
LOGICAL

ONE SINGLE SHARED Resource Space

Any system may be dynamically added or removed (planned and unplanned) End-user service continues uninterrupted

zSeries - utilizing the virtual capabilities of zVM

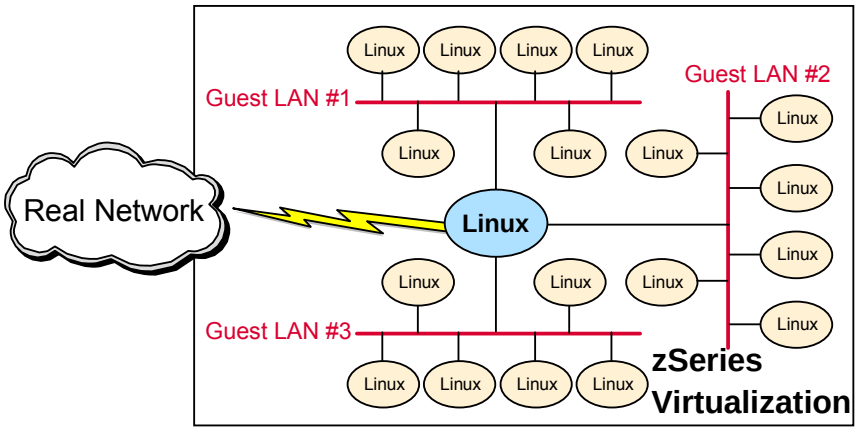
flexible and cost effective - for consolidation, integration and on demand



- Virtual Machine - Software Hypervisor "integrated" with the HW Architecture
- 10's, 100's, up to 1000's of "virtual servers"
- New Servers installed in "minutes" - CLONING
- Sharing of CPU,Memory & I/O resources
- Virtual Network – Virtual Switches/Routers
- Virtual I/O (mini-disks, temporary disks...)
- Virtual Appliances (SNA/NCP etc..)
- 64bit support - REAL & VIRTUAL
- Self-Optimizing Workload Mgnt - PRIORITIES, capping, monitoring, reporting, charge back...
- Excellent Automation & System Mgnt facilities
- Low "cpu-cost" via HW & ucode support
- Very FLEXIBLE "NO COST" solution for Test, Development & Proof-of-Concept
- Mature technology – VM first time introduced in 1967

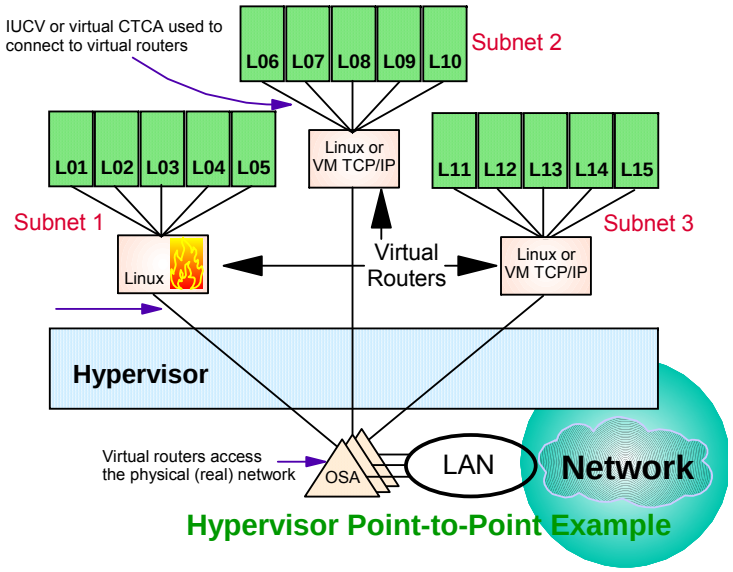
Virtual Networking with z/VM

Granular, simple, secure, and cost effective communication

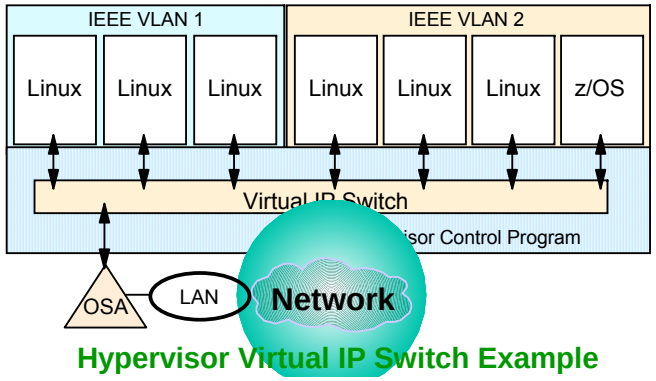


Hypervisor Virtual LAN Topology Example

- **Simple and cost effective**
  - **Eliminate complex, costly external network connections**
  - **Virtualize switches and routers**
- **Flexible**
  - **Point-to-point connections**
    - **Virtual Channel to Channel**
    - **Inter-User Communication Vehicle (IUCV)**
  - **Virtual Lan Topology**
    - **HiperSockets**
    - **Ethernet**
  - **Virtual IP Switch**
    - **Eliminate Router(s)**
    - **Exploit IEEE VLAN topology**



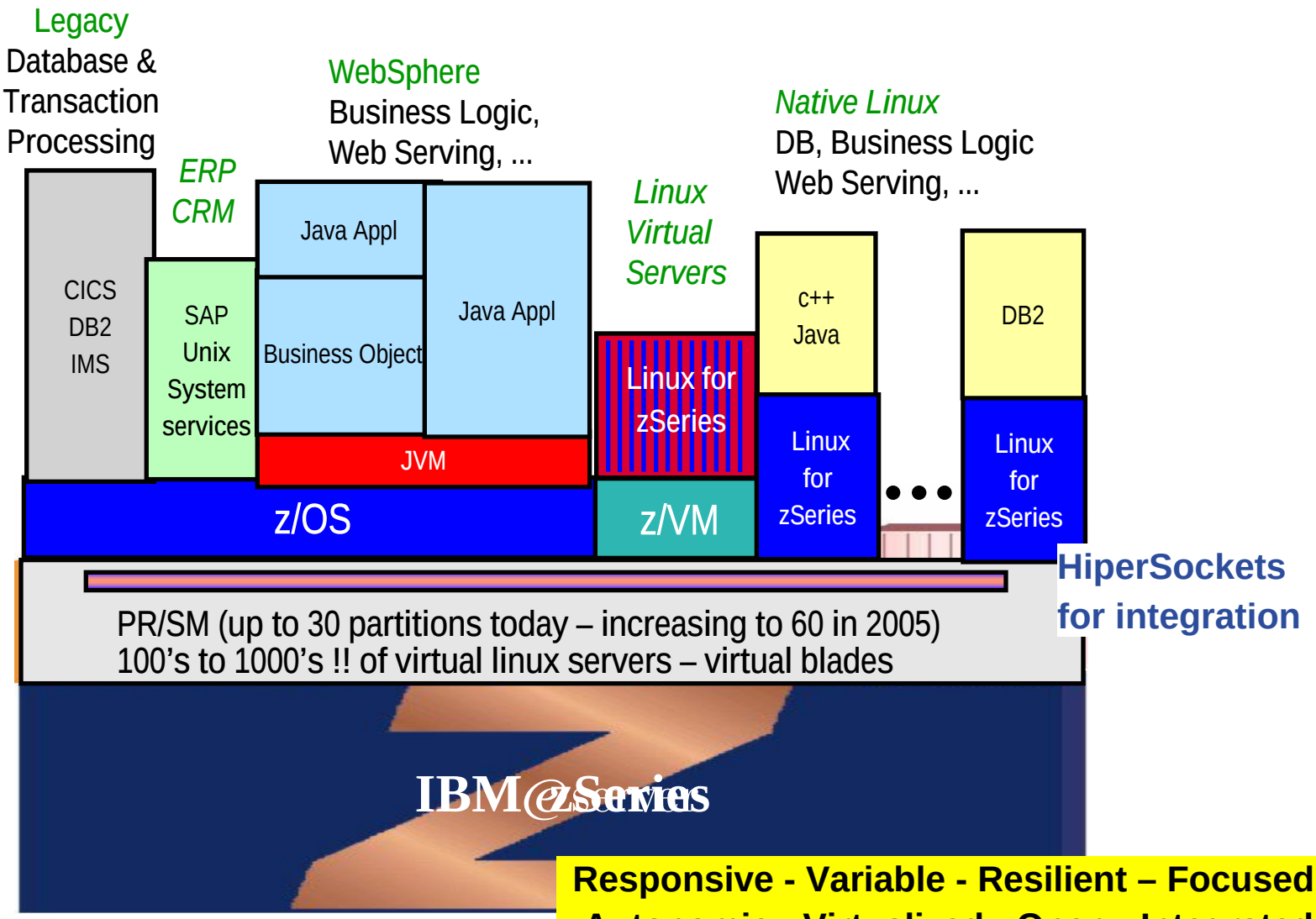
Hypervisor Point-to-Point Example



Hypervisor Virtual IP Switch Example

zSeries Virtualization – massive consolidation

even beyond a single footprint, when using clustering



HiperSockets for integration

Responsive - Variable - Resilient – Focused
Autonomic - Virtualized - Open - Integrated

Server Virtualization

xSeries

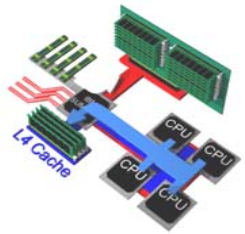
IBM x445 type of systems and VMware

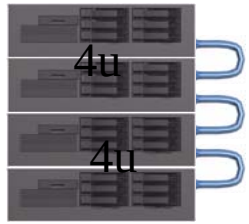
Pay as you grow – 2, 4, 8, 12, 16, 32 engines

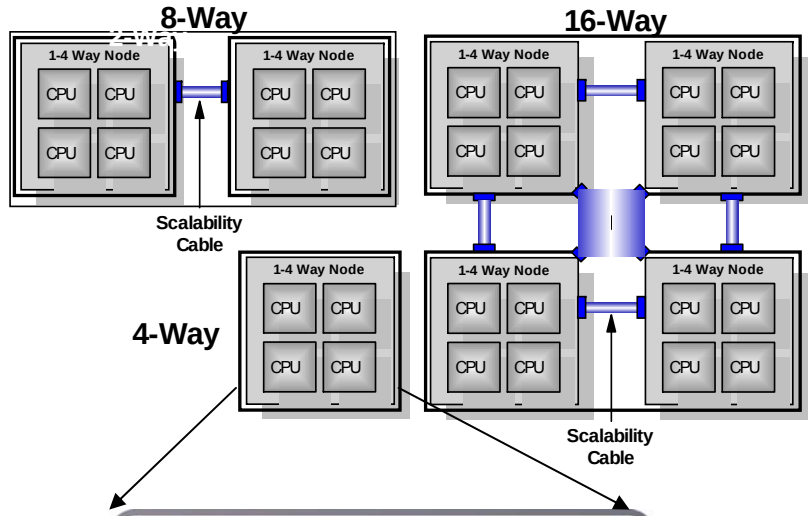
Physical Partitioning at system node level

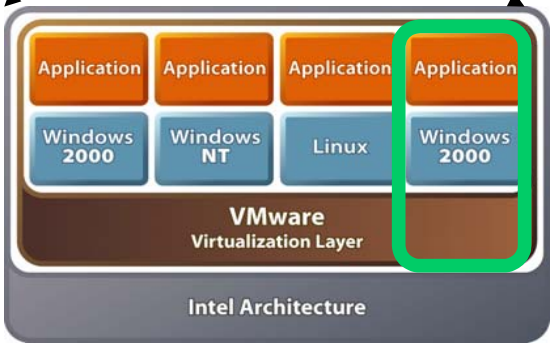
VMware ESX Hypervisor

IBM Chipset – xArchitecture



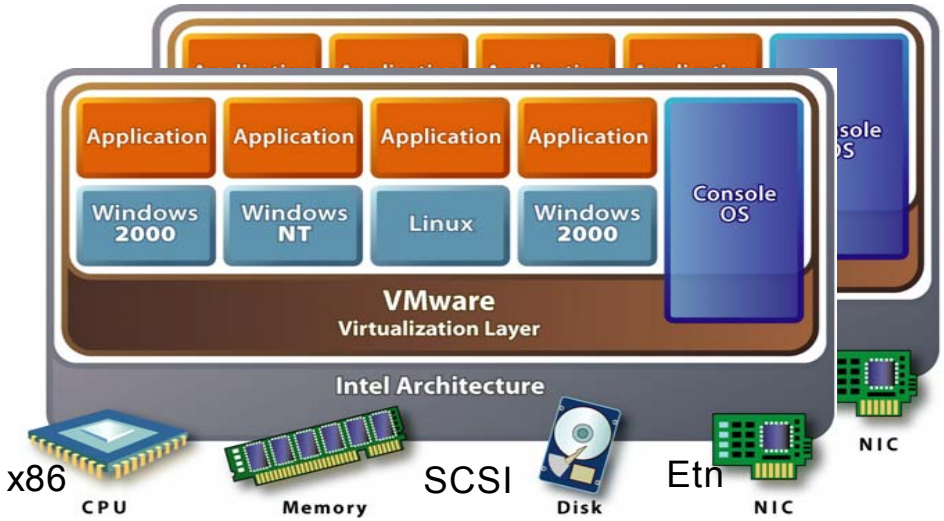






VMware ESX Technology

Flexible - Responsive - Variable



RESOURCE CONTROL & SHARE

- Virtualization layer maps VMs directly on HW
  - ✓for performance and isolation
- 1 – 2way Virtual Machines (VMs)
- CPU - share, capping, dedicate
- No wasted CPU resources
- Memory Dedicate - Memory Sharing
- Network Bandwidth – priority controlled
- Shared I/O & Network Interfaces
- Sharing of external infrastructure
  - ✓Cables & SAN/LAN-switches
- Dynamic Move (demotion) of virtual servers
  - ✓state of VMs encapsulated - may be saved on disk
  - ✓VM's can be moved in time/space

EXPERIENCES – (LEGO, others…)

- **10- 20 Virtual Machines (servers) per 4WAY**
- **IBM x445 (xArchitecture) and Blade Center**
- **AVERAGE Utilization above 50% - (from below 5%)**
- **May provide significant cost savings**
- **Reliable – no service issues**
- **Virtual SMP, - Virtual Center, - VM Dashboard, P2V for migration**

SOLUTIONS

- Server Consolidation
- Server Cloning via templates
- High Availability via clustering and Dynamic Server Demotion
- Backup & Disaster Recovery
- SW testing & Development
- Demo Systems & Training

VMware and VE - positioning

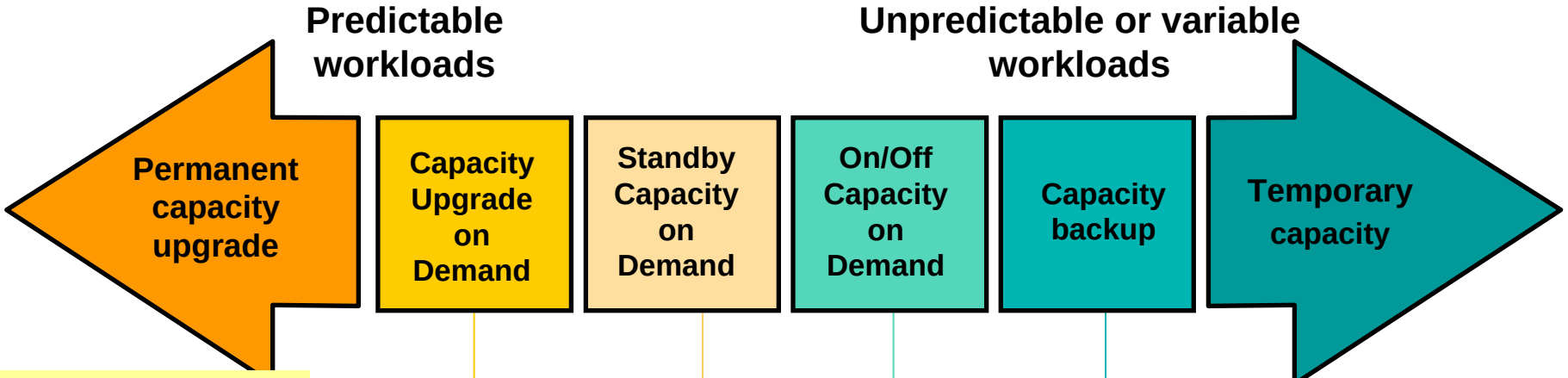
- **What is VMware?**
  - Software that provides virtual infrastructure solutions for Intel compatible systems
- **What is VMware's relationship with IBM?**
  - Strong partnership to deliver industry leading virtualization solutions for IBM eserver xSeries and BladeCenter
  - Joint Development Agreement to provide enhanced management in VMware environments and optimization for IBM xSeries and BladeCenter systems
- **IBM resells VMware VirtualCenter and ESX Server software**

Server Virtualization

combined with
Capacity Upgrade on Demand

Capacity on Demand

a must in a consolidated and simplified on demand infrastructure



- Enables scale up on same hardware
- Little impact on current operations
- Predictable pricing model

Provides non-disruptive growth, limited downtime and payment when activated

- Assures capacity is always available and allows for reduced purchased or financed capacity

- Provides processing for planned and unplanned spikes to improve cost control

- Cost-effective disaster recovery resources

- Protects business continuity
- Cost efficient
- Rapidly available

Matching resource acquisition to business needs - dynamically

Server Virtualization

Summary

Server Virtualization Technologies - positioning

Server Virtualization

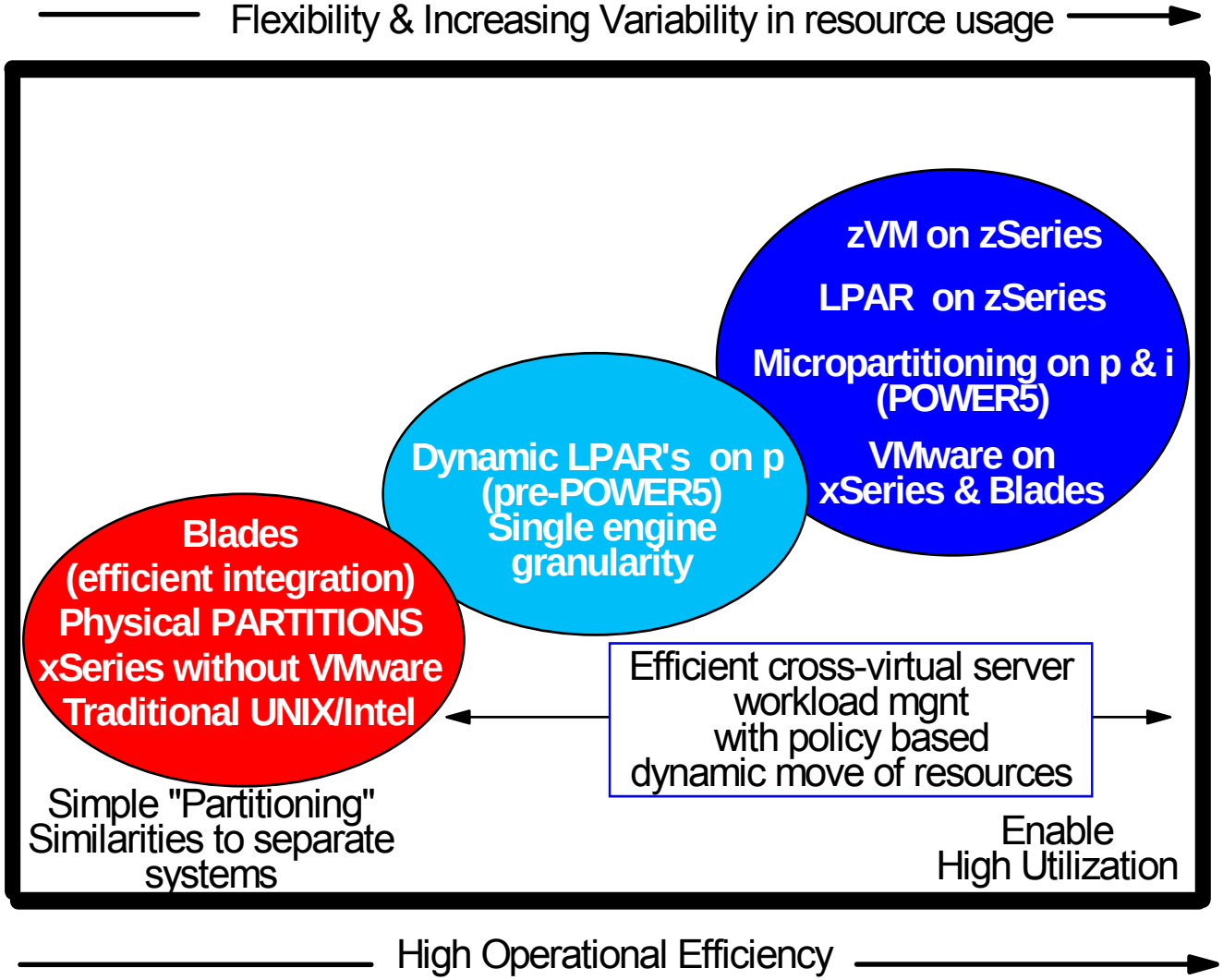
zSeries
- LPAR's - most advanced
- zVM - virtual servers

pSeries
- LPAR's - micropartitioning
- zSeries-like capabilities
- convergence with iSeries

iSeries
- LPAR's - micropartitioning
- zSeries-like capabilities
- convergence with pSeries

xSeries
- physical partitions
- Virtual servers - VMware ESX

Traditional UNIX/Intel
- mostly physical partitioning
- some software partitioning, but with workload mgnt and isolation issues

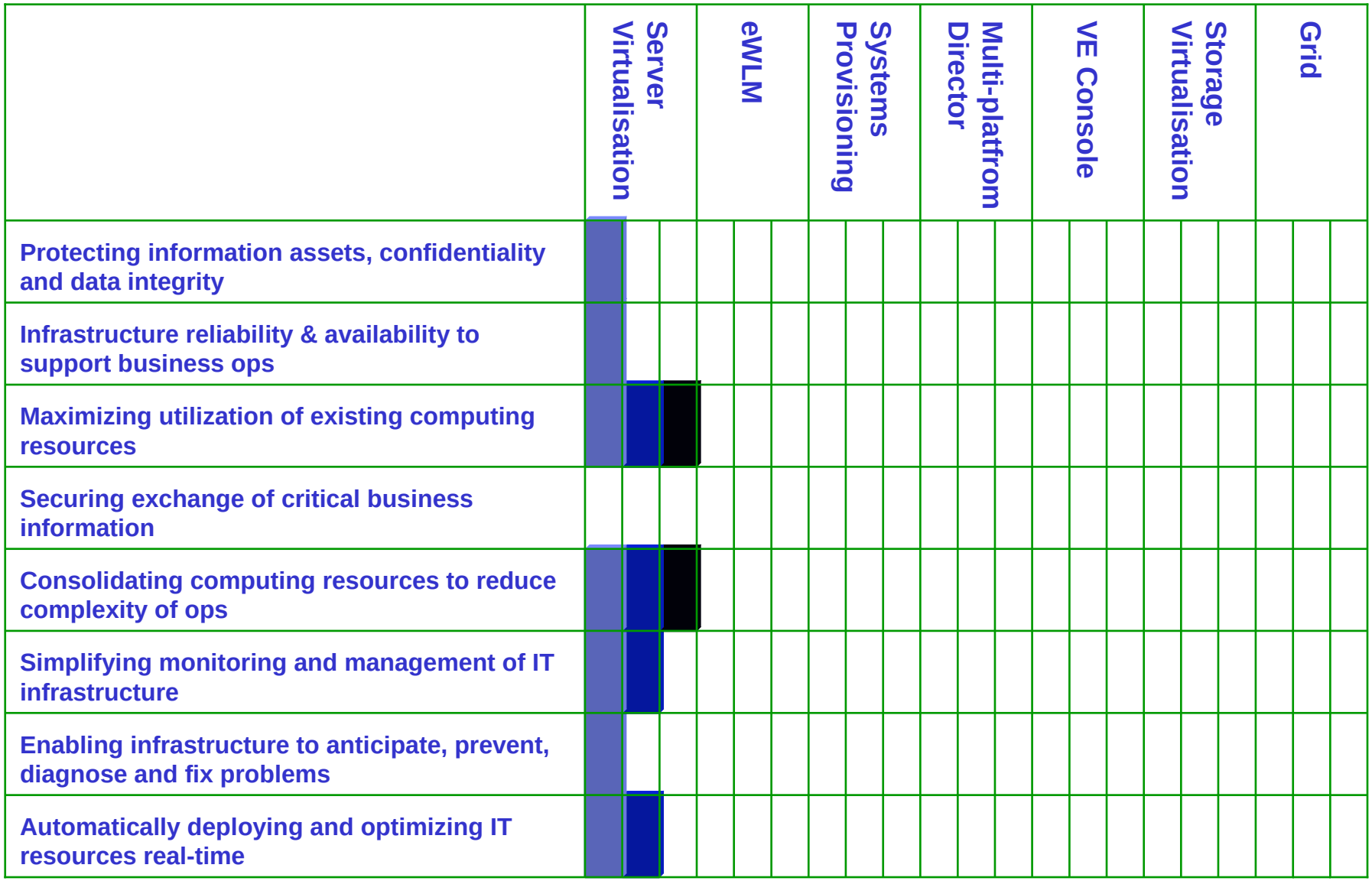


Responsive - Variable - Resilient – Focused
Autonomic - Virtualized - Open - Integrated

Server Virtualization and Partitioning Technology Capabilities

Platform / Capability	iSeries	pSeries	xSeries	zSeries	BladeCenter
Physical Partitioning			X445/x455 4-way “bricks” via Partition Manager		Blades sharing a switch and network infrastructure
LPAR with 1 ENGINE granularity	POWER4 & 5 with dedicated engines	POWER4 & 5 with dedicated engines		LPAR with dedicated engines	
LPAR With sub-engine granularity	POWER5 Hypervisor Micropartitioning	POWER5 Hypervisor Micropartitioning		PR/SM™	
Software Hypervisor			* VMware ESX on the bare” HW * Virtual Server on “top of Windows”	z/VM w. HW support for perf. & isolation	* VMware ESX on the “bare” HW * Virtual Server “on top of Windows”
Virtual I/O and Network	YES	YES	YES via VMware	YES pervasive support	YES via VMware
Inter-Partition WLM	i5/OS WLM	AIX WLM	Windows Resource Mgr	z/OS WLM	Windows Resource Mgr
Cross-Partition WLM		AIX PLM	VMware workload mgnt	IRD	VMware workload management
Cross-Server WLM	EWLM monitoring	EWLM monitoring	EWLM monitoring	EWLM Monitoring (4Q/04)	EWLM Monitoring

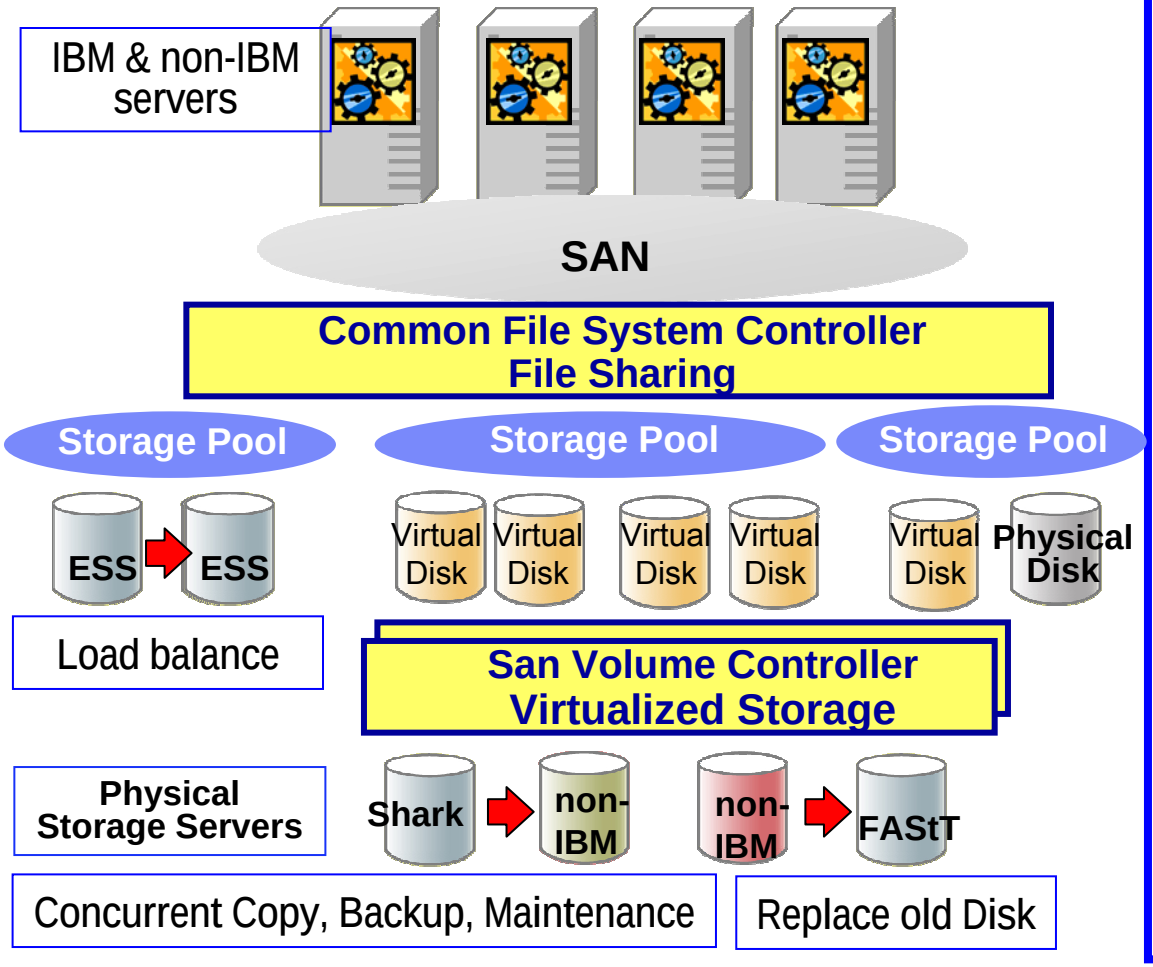
Virtualization Engine - Value Matrix



Storage Virtualization

IBM Storage Virtualization infrastructure…

Support heterogeneous infrastructures
Support changing business requirements
Non-disruptive operational business support
Investment protection and reduced cost / TCO

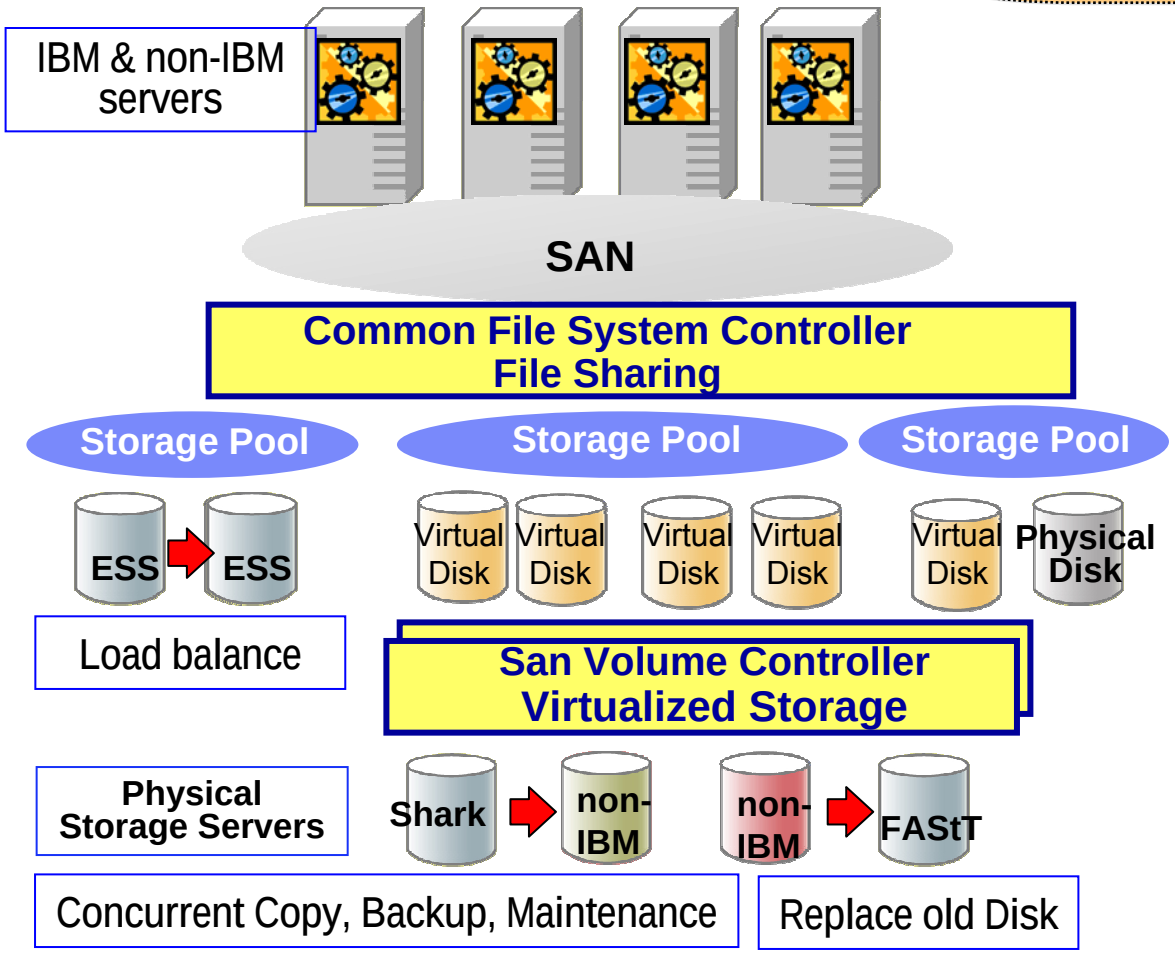


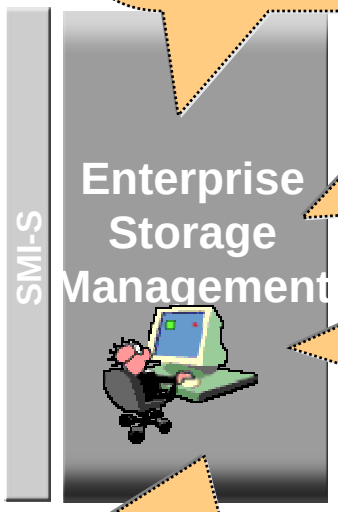
- **MULTIPLE Multi-vendor multi-type disk storage boxes appear as a SINGLE SHARED resource**
- **Data placement is TRANSPARENT to application**
- **Improved resource utilization**
- **Cost reduction & investment protection**
- **File Sharing between different platforms for integration of services**
- **Storage Pools with different QoS for policy based data placement**
- **Load balancing – improved QoS**
- **Eliminate need for multiple platform dependent management products - efficiency and cost reduction**
- **Practically eliminate downtime for planned and unplanned changes**
- **Supports a low risk approach to Business Transformation**

IBM Storage Management capabilities…

Policy based management
Administrators become more productive
Single unified interface
Life cycle Management of Data

A powerful picture
An administrator can get a lot done without maintaining detailed skill on heterogeneous disk controllers, operating systems, file systems and management tools





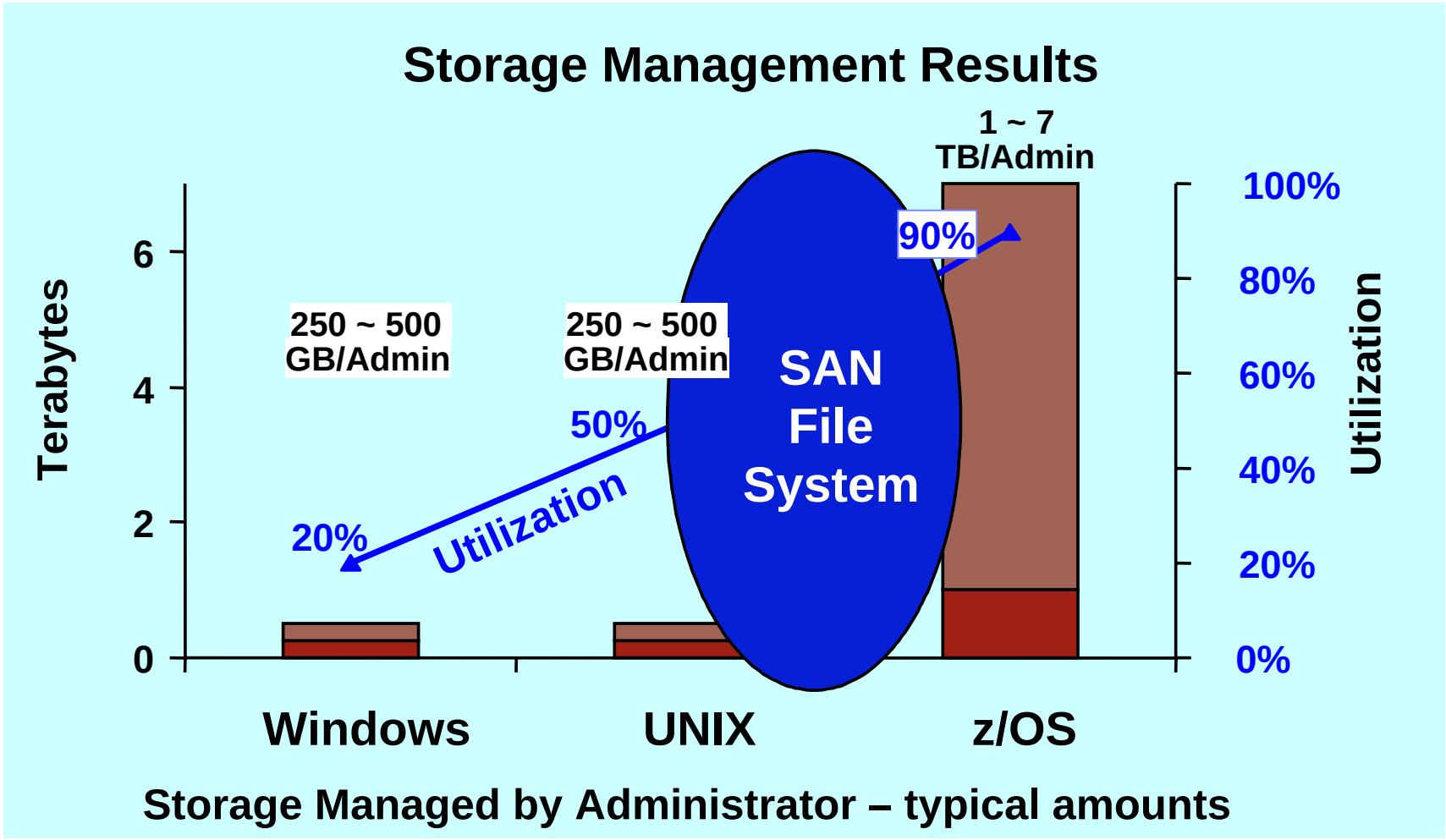
Managing the infrastructure
Storage Infrastructure Management

Controlling growth
Hierarchical Storage Management

Managing cost
Archive Management

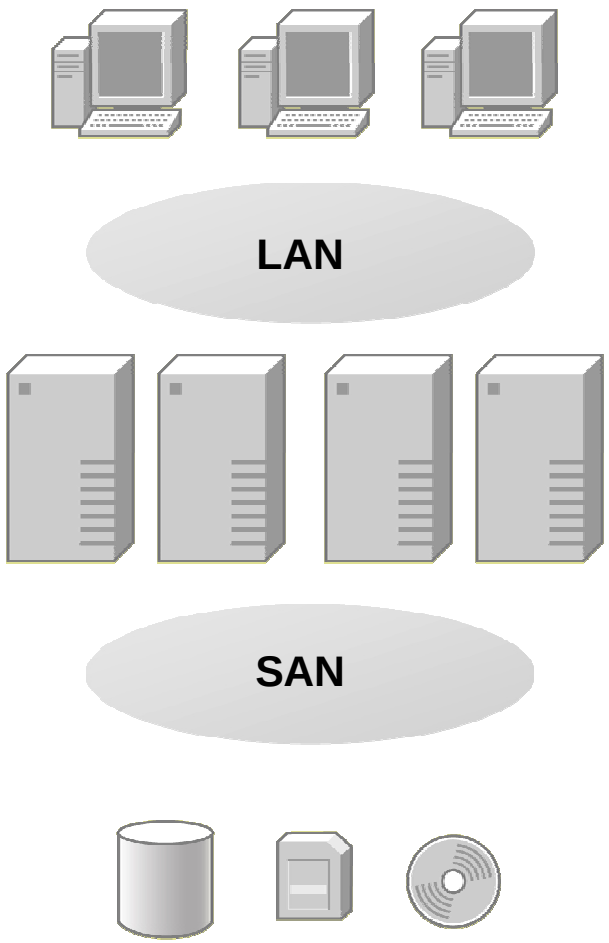
Ensuring recoverability
Recovery Management

Value of IBM System Managed Storage



IBM Storage - Open Solutions

Supporting the heterogeneous environments that business run on*



* Supported vendors as of 9/2003

Platforms

Microsoft Windows Server 2003 · Novell · Microsoft Windows xp · hp invent · AIX 5L · Linux for IBM eserver xSeries · Linux for IBM eserver zSeries · Linux for IBM eserver pSeries · SOLARIS · z/OS · z/VM · IBM eserver iSeries

Applications

WebSphere software · Lotus software · DB2 Information Management Software · Informix · Microsoft SQL Server · Microsoft Exchange Server · SYBASE · SAP · ORACLE

Networks

EMULEX We network storage · CROSSROADS at the Intersection of Business and Information · ECNT · ATTO · qlogic · jni · adaptec · ICOM SYSTEMS · McDATA · BROCADE · NISHAN SYSTEMS · INRANGE · gadzoox NETWORKS · Cisco Systems

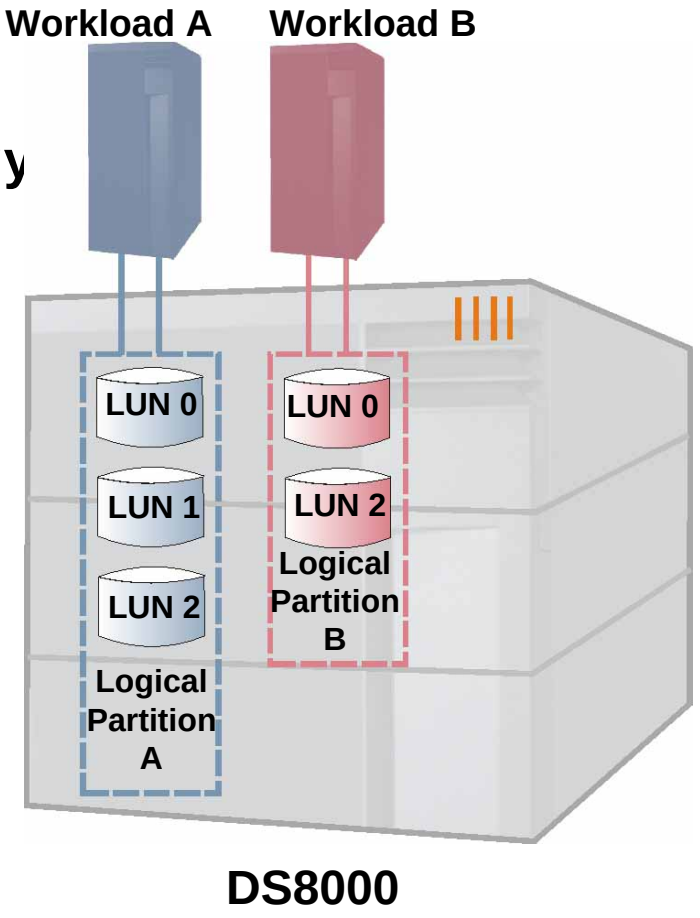
Storage

IBM TotalStorage® · EMC² where information lives · Storage by Sony · adic · DELL POWERVAULT™ · Quantum · dot HILL · EXABYTE · hp invent StorageWorks · QUALSTAR · HITACHI DATA SYSTEMS · Overland STORAGE · Seagate · Sun StorEdge · Plasmon · STORAGETEK · FalconStor · SPECTRA LOGIC

IBM Storage System Virtualization - emerging capabilities

POWER5 Logical Partitions

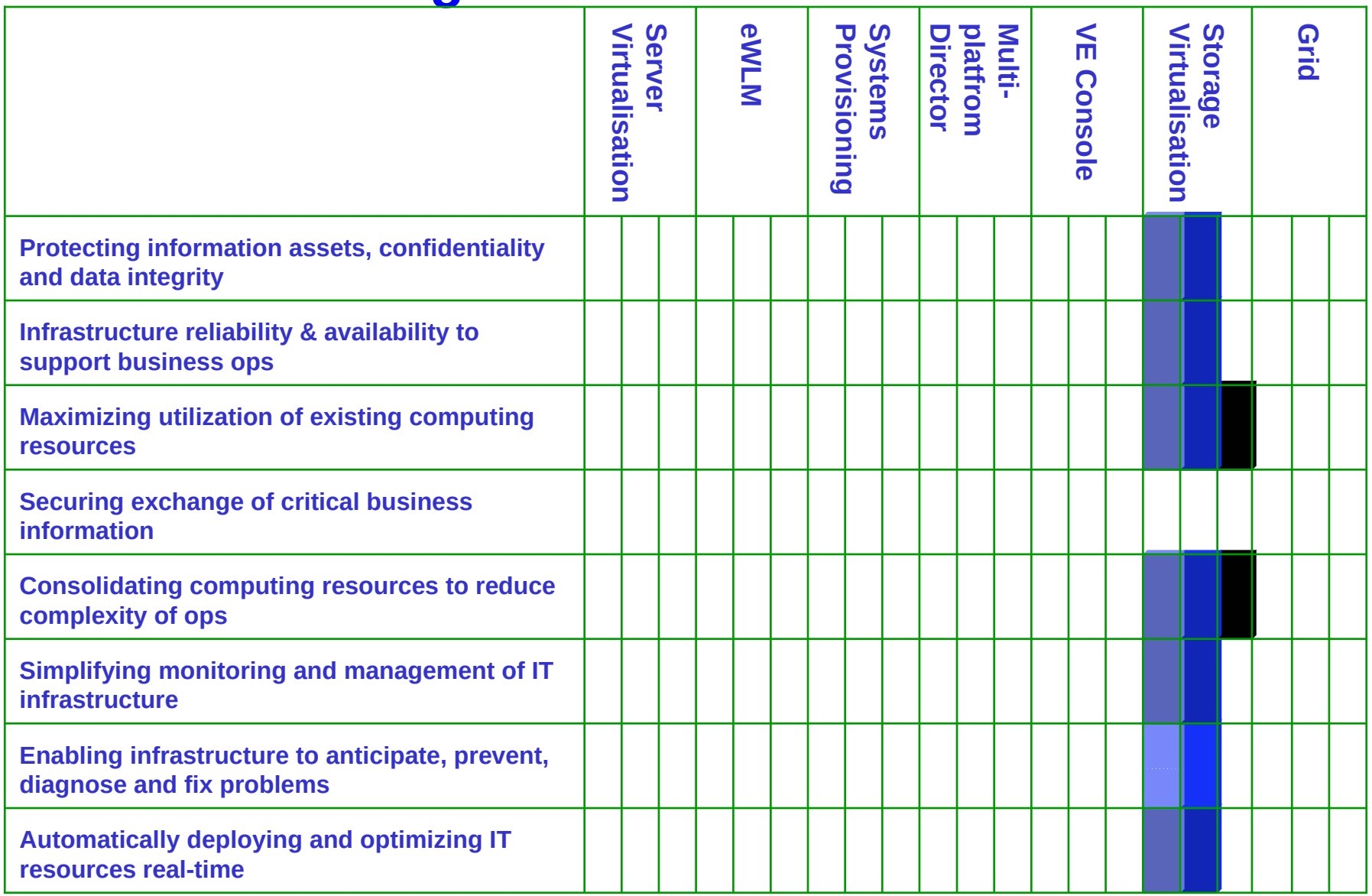
- **Convergence of server & storage technology**
  - ► DS8000 exploits POWER5 & P5 Virtualization
  - ► DS6000 use BladeCenter technology
- **Create virtual storage subsystems**
  - ► Scalability/performance leverage
  - ► Improved TCO over “singular” sub systems
- **Heterogeneous workload support**
- **System (hardware) based implementation of virtualization ensures data integrity**
- **Added flexibility/performance optimization**
  - ► Performance optimization/tailoring
  - ► Reduced manual tuning



IBM Storage Subsystems - *Dual Partition value*

- **Support of 2 different production workloads**
  - **Production splits by OS, application, organizational boundaries**
- **Production and development partitions**
  - **Application development**
  - **Change control, test, education**
- **Dedicated partition resources to meet Service Level Agreements**
- **Production and data mining**
- **Business continuance (secondary) within the same physical box**
  - **Test environment**
  - **Production for multiple copy scenarios**
- **Information Lifecycle Management partition with fewer resources, slower drives . . .**
- **Other special purpose**
- **Future plans for increased flexibility and convergence of functionality**

Virtualization Engine - Value Matrix



IBM based Virtualization

a real customer example

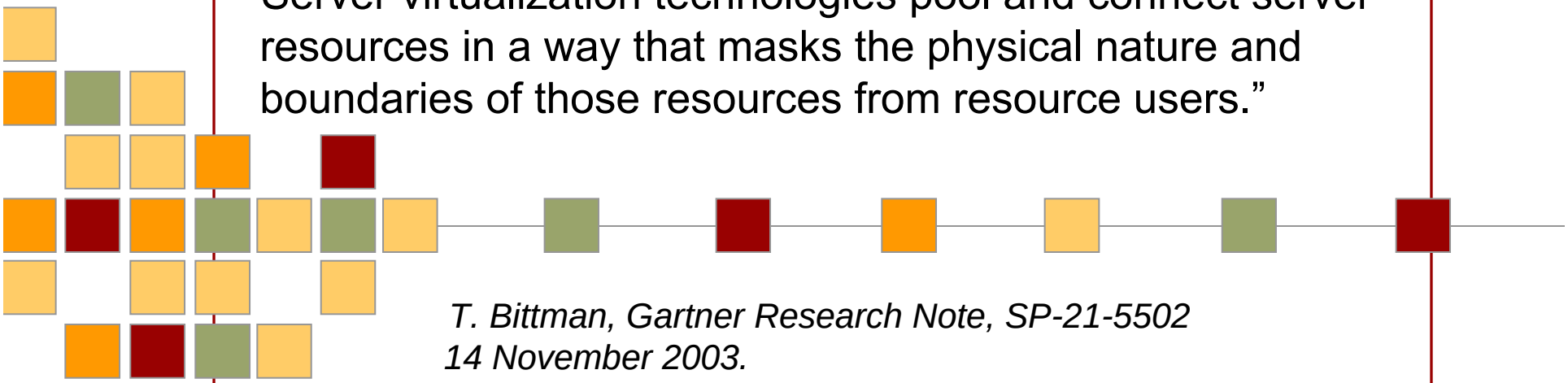
Conclusion

the enabler of
on demand operating environment

IBM virtualization technologies…
are designed to provide more business value… than server consolidation alone…

"Enterprises should change their thinking about consolidation and pursue a server virtualization strategy rather than a server consolidation project.

Server virtualization technologies pool and connect server resources in a way that masks the physical nature and boundaries of those resources from resource users."



T. Bittman, Gartner Research Note, SP-21-5502 14 November 2003.

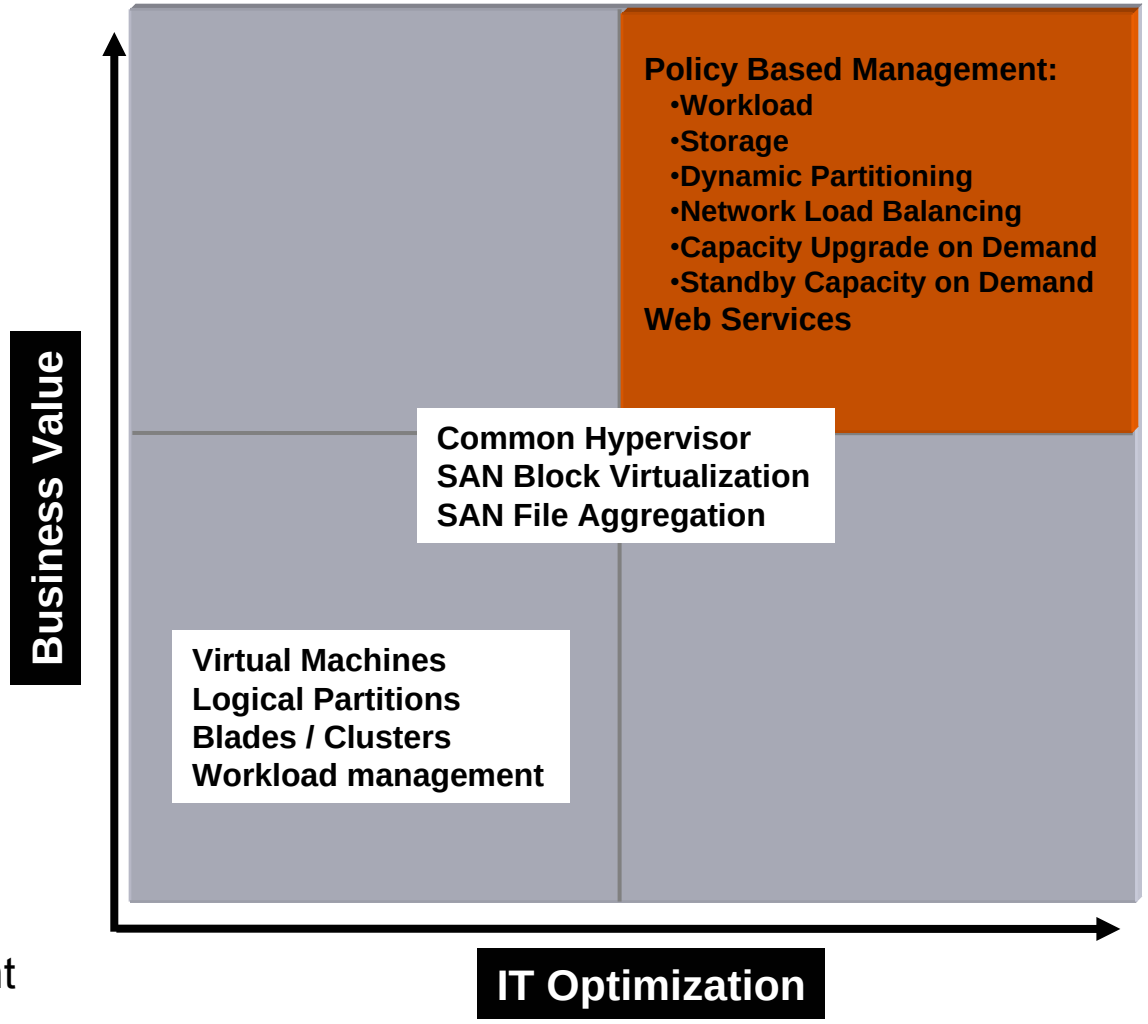
Virtualization - *enabling technologies for on demand infrastructures for deployment of on demand business processes*

Flexibility & Responsiveness
- Dynamic deployment/redeployment
- Time to Market
- Variable cost structures
- Competitive Differentiation

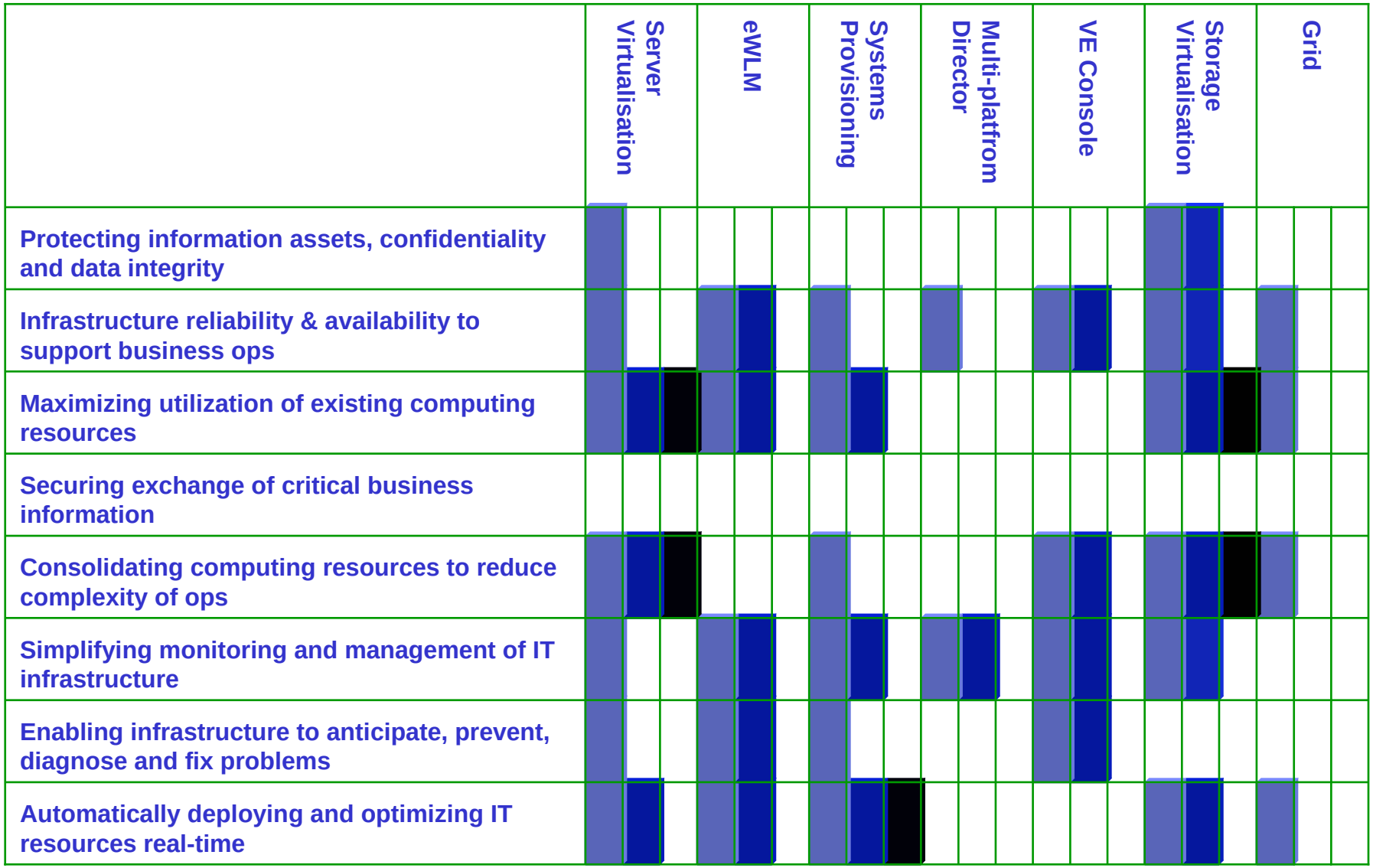
Efficiency
- Simplified Management
- Optimal Utilization
- Quality of Services
- Autonomic/Automation

Cost Savings
- Systems Capital
- Human Capital
- TCO

Open standards
- Support Heterogeneous Platfoms
- Convergence of System Management



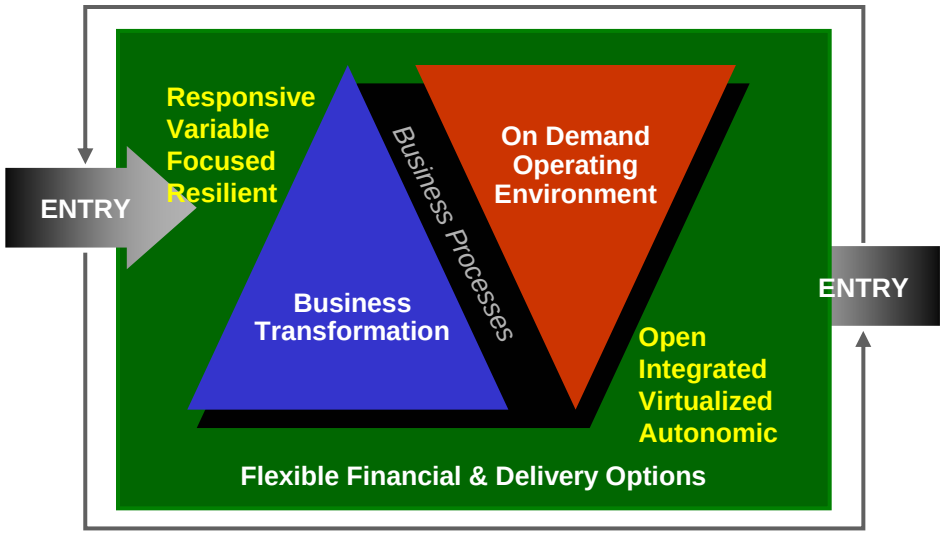
Virtualization Engine - Value Matrix



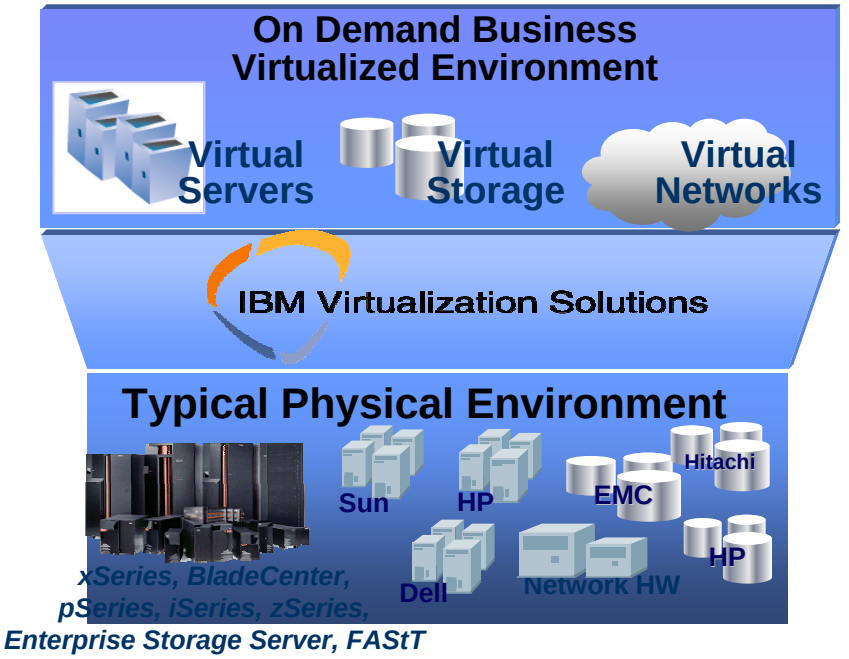
Additional charts

how to sell
where to start
additional material

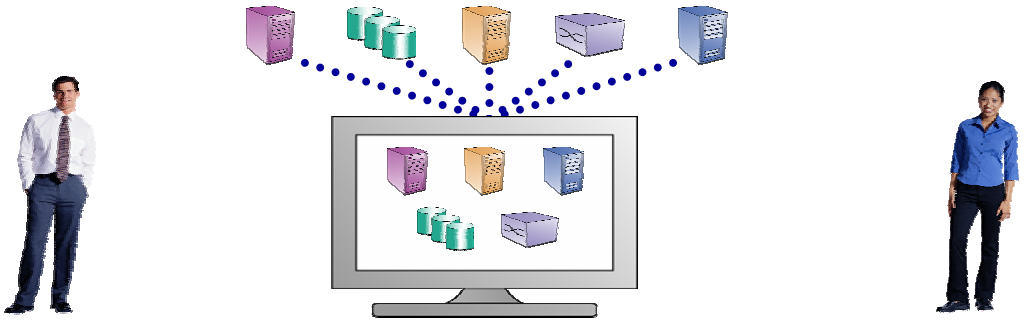
Three Selling approaches of Virtualization and VE



1) On Demand led



2) Product led



3) Technology partnership

IBM Virtualization Engine™ -

an essential part of IBM's Operating Environment OD strategy, - where to start

Simplify and Optimize infrastructure – prepare for on demand activities

- **Run a Zodiac study to justify Server and Storage virtualization projects**
  - **Implement IBM Server Virtualization** - zSeries LPAR, zVM, p & i Hypervisor, VMware on xSeries and xBlade
  - **Implement IBM Storage virtualization**
- combine above with readiness studies for on demand and autonomic capabilities
- may provide the needed overall cost justification for more steps
- provide a base for new infrastructure on demand T&C's - variability and flexibility

Implement IBM Automation Blueprint

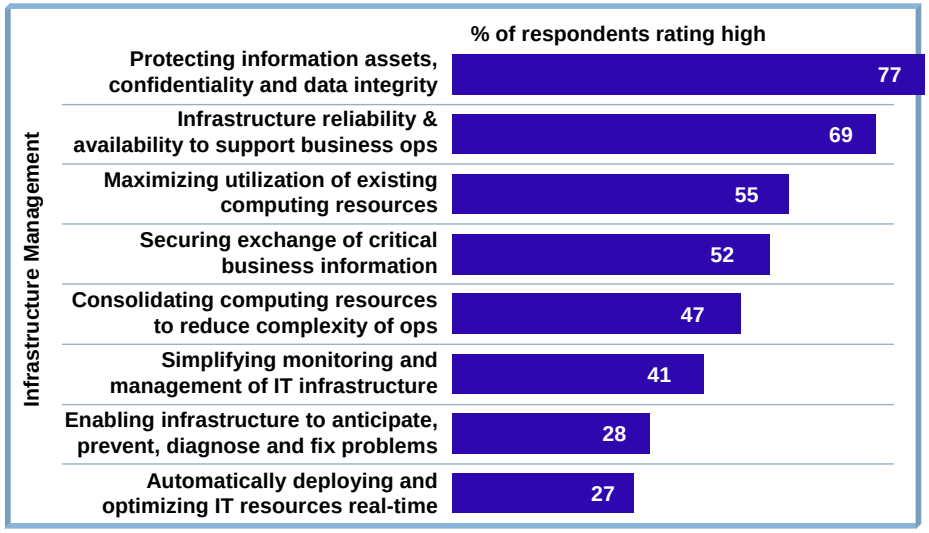
- **start with IBM Provisioning** and combine with IBM Orchestration at a relevant point
- **evaluate VE console and IBM Director** in respect to overall Tivoli strategy
- **consider integration** with other Tivoli monitoring and configuration products
- consider to use VE as the starting point…

Start the initial implementation of EWLM

- **initiate monitoring of supported server environments**
- initiate network management capabilities
- **evaluate integration with related Tivoli products**
- high value activity - both short term and long term

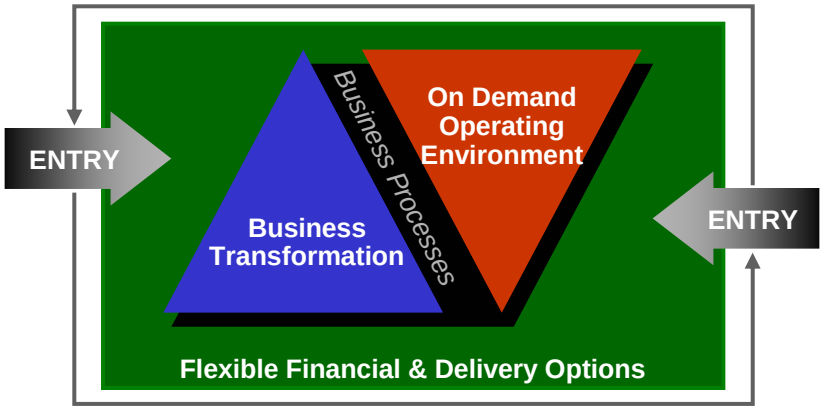
Virtualization Engine … *is developed to become a key ingredient to help establish an on demand infrastructure for an on demand business*

Customer Needs" demand new capabilities



Source: IBM Corporate Market Intelligence

Where you start depends on YOUR organization's priorities.



Increasing flexibility is the key…
Business models, processes, infrastructure, plus T&C's

Responsive - Variable - Resilient – Focused
Autonomic - Virtualized - Open - Integrated

The usage of Virtualization, Automated Management and Standardized Interfaces are becoming increasingly important to provide an on demand type of Infrastructure enabling the execution of the business processes for an on demand business

Additional material

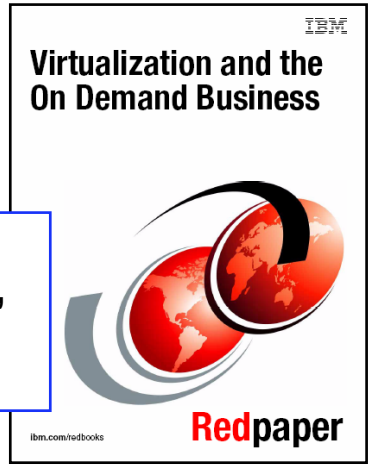
to position VE
to describe the value of Virtualization and VE
to find more info about Virtualization, VE and on demand

To engage the STG Sales Project Office for IBM Virtualization Engine Suite for Servers, please send a Lotus Note to **VSPO@us.ibm.com** or **Virtualization Solutions Project Office/Poughkeepsie/IBM**.

IBM VE Documentation & Planning Advisor
Virtualization Engine documentation is available in the eServer Software Information Center at:
http://www.ibm.com/servers/library/infocenter

Start Your Engines (SYE) Workshops –
- **2days workshop MOP/Gaithersburg**
- **1st. workshop: October/2004**
- **Audience: Technical decisions makes**
- **Platforms: xSeries initially later on other platforms**

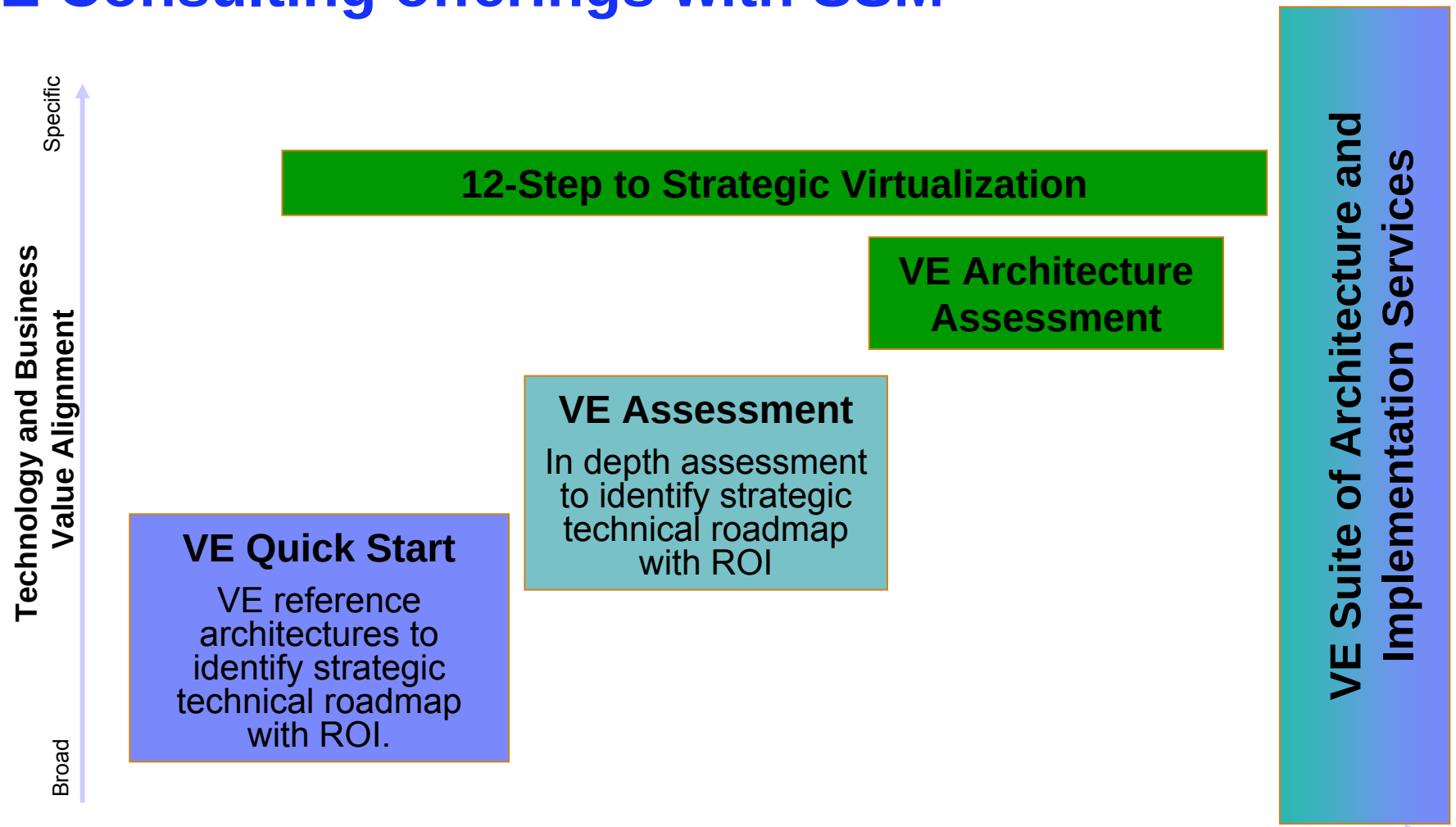
Virtualization and the On Demand Business
Redpaper addressing Virtualization and VE. It discusses current technologies, the vision and the business value of virtualization
http://www.redbooks.ibm.com/abstracts/redp9115.html?Open



Virtualization Engine Additional Information

- For Ordering, Planning, and Deploying IBM Virtualization Engine Suite for Servers use the Planning Advisor
- Get your customer involved with Start Your Engine Workshop
- Virtualization Basic Sales Education
- VE Technical Sales Education (suggested on line courses)
- VE Suite for Servers mastery exam
- IBM Dynamic Infrastructure Enterprise Edition for mySAP™ Business Suite (link pending- will have by Jan 5th)
- VE Consulting Offerings (link pending)

VE Consulting offerings with SSM



For further information: Katalin K. (Kati) Bartfai-Walcott kkwalcot@us.ibm.com or Donna McClary mcclaryd@us.ibm.com

For more information and copy of this presentation

The Virtualization Engine Resource Kit 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, Education resources and **copy of this presentation**, 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)

Other useful links

On Demand Business resource guide
IBM Systems Group Messaging Architecture
On Demand Business Reference database
Virtualization Engine Planning Advisor

Additional Resources

- **zSeries**
  - System Sales Site – search on: 'zvirtpres' – zSeries Virtualization Presentation
  - Systems Sales Site - 'zvm51sk.skit' – z/VM V5.1 Sales Kit
  - Redbook: OS/390 Workload Manager Implementation and Exploitation, SG24-5326-00
  - Redbook: z/OS Intelligent Resource Director, SG24-5952-00
  - Redbook: zSeries HiperSockets, SG24-6816-00
- **pSeries**
  - Redbook: AIX 5L Workload Manager (pre-POWER5), SG24-5977-01
  - Power Up for POWER5 Training Call (Virtualization specific presentation June 23rd) http://w3-1.ibm.com/sales/systems/portal/_s.155/254?navID=f340s260&geoID=AM&prodID=pSeries&docID=psedsquadcalls0616
  - IBM System Sales Site – 'psvesk.skit' - IBM eServer p5 Virtualization Sales Kit
  - Redbook: SG24-7940 Introduction to Advanced POWER Virtualization on IBM p5 Servers
  - Redbook: SG24-5768 IBM p5 Virtualization Performance Considerations
  - System Sales Site – search on: 'psvesk.skit' - IBM eServer p5 Virtualization Sales Kit
  - AIX 5.3 Advanced Accounting SubSystem Guide: SC23-4882-00

Additional Resources

iSeries

- Redbook: LPAR Configuration and Management Working with IBM iSeries Logical Partitions, SG24-6251-00
- Redbook: Capacity Planning for logical partitioning on the IBM eServer iSeries Server. SG24-6209-00
- Redbook: AS/400 Consolidation Strategies and Implementation, SG24-5186-00
- http://www.ibm.com/servers/eserver/iseries/lpar/
- IBM System Sales Site – search on: 'i5lparfaq' IBM eServer i5 and iSeries logical partitioning FAQs
- Redbook: SG24-8000 Logical Partitions on IBM IBM PowerPC® A guide to working with LPAR on Power5 i5 servers

POWER5

- Systems Sales, search on itg071304' - ITG 07/04: Cost/Benefit Case for POWER5 Micro-Partitioning

Additional Resources

xSeries and BladeCenter

- Redbook: Server Consolidation with the IBM xSeries 440 and VMware ESX Server, SG24-6852-00
- IBM System Sales Site – search on:
  - 'xsvmwarevefaq' – Virtualization Engine and VMware FAQs
  - xvmwaresk.skit - xSeries with VMware ESX Server Sales Kit
  - 'Xsssvmsg' - VMware ESX Server Sales Guide
- IBM VMware website: http://www.pc.ibm.com/ww/eserver/xseries/vmware.html

TotalStorage

- IBM System Sales Site – search on:
  - 'ssvirtsk.skit' - IBM TotalStorage Virtualization sales kit
- Redbooks:
  - SG24-7098 Understanding the IBM TotalStorage Open Software Family

Additional Resources - Competitive

Sun

- D.H. Brown Report: Solaris 9 vs. AIX 5L V5.2 Resource Management, 2/25/04
- COMP Sun Portlet

http://w3-3.ibm.com/sales/competition/compdlib.nsf/pages/Sun+portlet?Opendocument

HP

- COMP HP Portlet:

http://w3-3.ibm.com/sales/competition/compdlib.nsf/pages/hp+portlet?Opendocument

General

- Marketing Intelligence: STG Virtualization Strategy Competitive Outlook