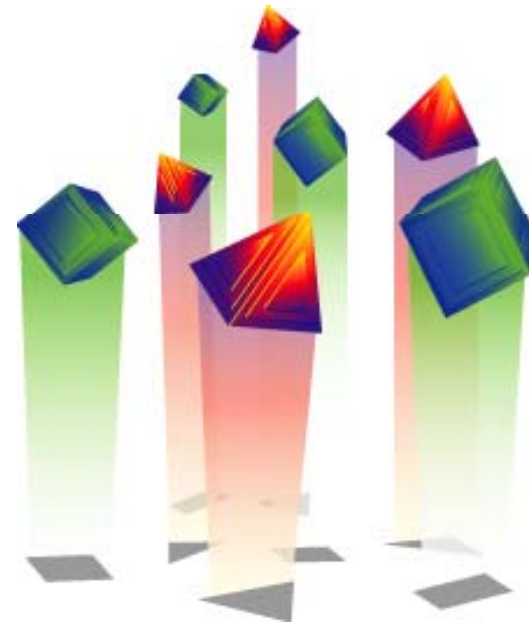


Virtualization: The Evolution of the Data Center

and the impact on resource, system, and service management
Share Session Boston

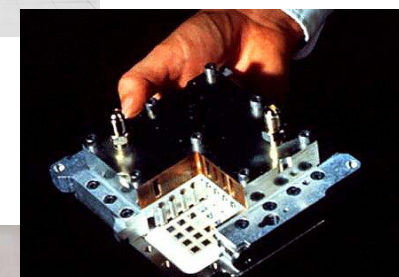


Laura Knapp
WW Business Consultant
Laurak@aesclever.com
650-617-2400

Background



Mainframe Specifics



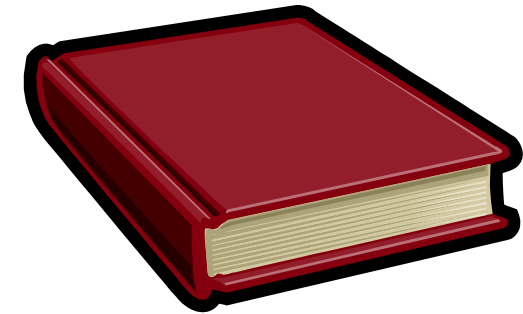
Managing the Virtualized World



Best Practices



Definitions



Real vs. Virtual

Similar essence, effect
"Formally" different

A framework that **combines** or **divides** [computing] resources to present a *transparent* view of one or more environments

Hardware/software partitioning (or aggregation)

Partial or complete machine simulation

Emulation (again, can be partial or complete)

Time-sharing (in fact, sharing in general)

In general, can be **M-to-N** mapping (M "real" resources, N "virtual" resources)

Examples: VM (M-N), Grid Computing (M-1) , Multitasking (1-N)

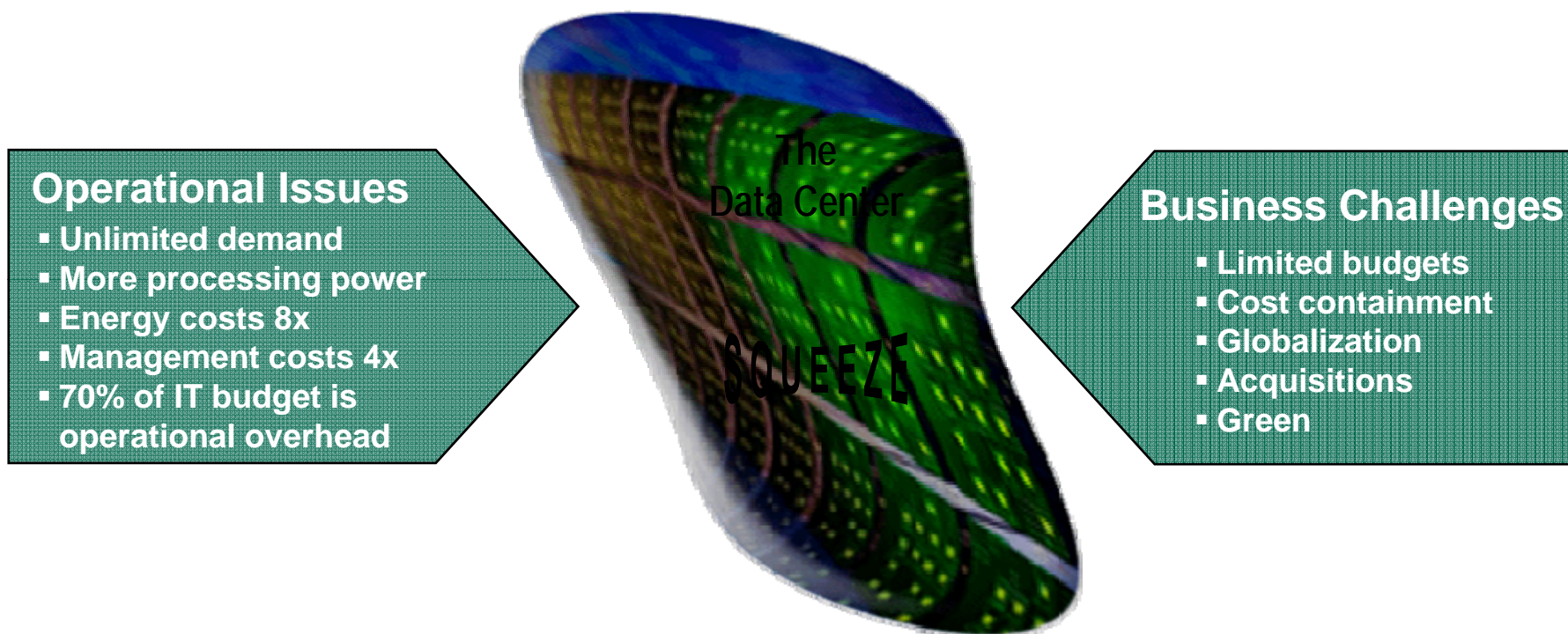
The Problem - Gartner

*Through 2007, organizations with more than 200 servers will waste between \$500,000 and \$720,000 annually supporting underutilized application/server combinations”
Gartner Research, December 2004*

- Average processor utilization is 6% to 7%
- Prime time processor utilization is only 15%
- 40% of equipment is over 3 years old
- Firms have over 20% - 50% more capacity than actually needed

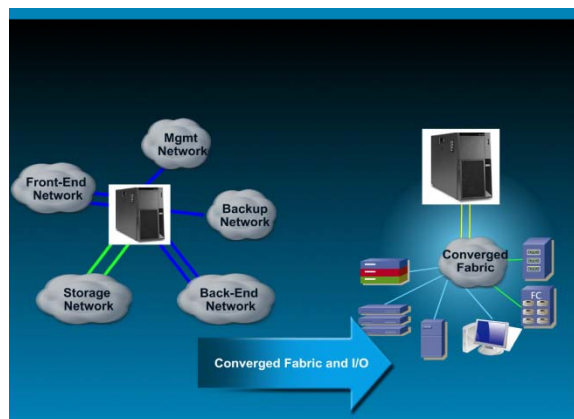


The Problem - IDC



"Over the last three years, we have seen more change in the datacenter market than the previous fifteen years. Consolidation, virtualization, power and cooling, and the aging datacenter market in mature economies is leading to a proliferation in datacenter options, both inside the walls of the datacenter as well as the construction of the datacenter itself," said Michelle Bailey, research vice-president for IDC's Datacenter Trends program

Right-Sizing IT Infrastructure

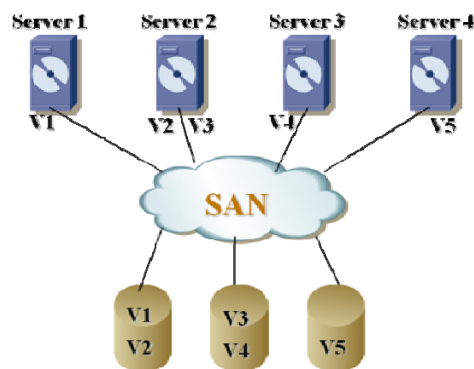


Green-Mandated efforts to.... Consolidate...entire farms of:

- Servers
- Storage
- Networks
- Etc.



...and dynamically optimize to only consume the resources you need!



...and dynamically optimize to move applications for high availability and performance!

Always On, Optimized, Energy Efficient Datacenter

Dynamic Resource Scheduling

- Balance workloads
- Right-size hardware
- Optimize real time

High Availability

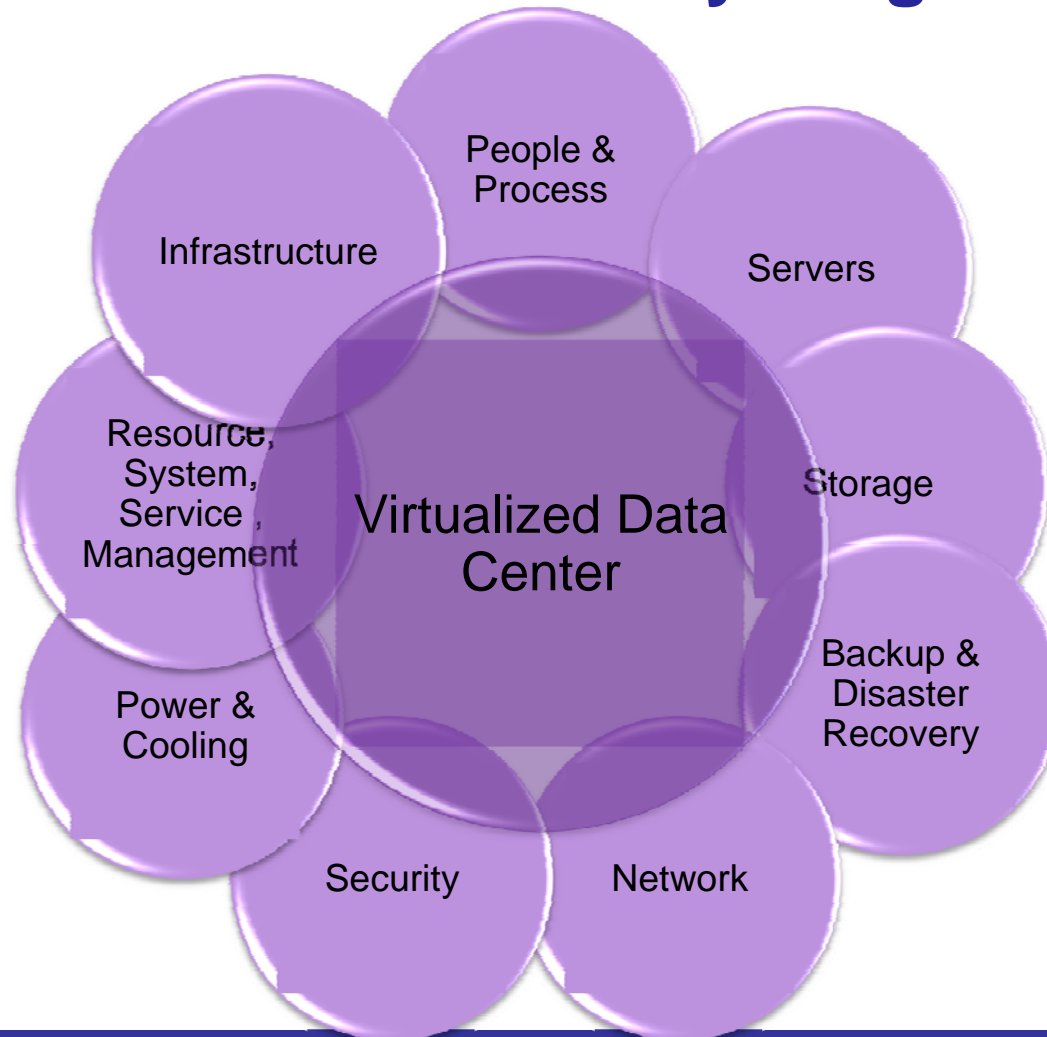
- Restart immediately when H/W or OS fail
- Protect all apps

On-demand Capacity

- Scale without disruption
- Reconfigure on the fly
- Save time



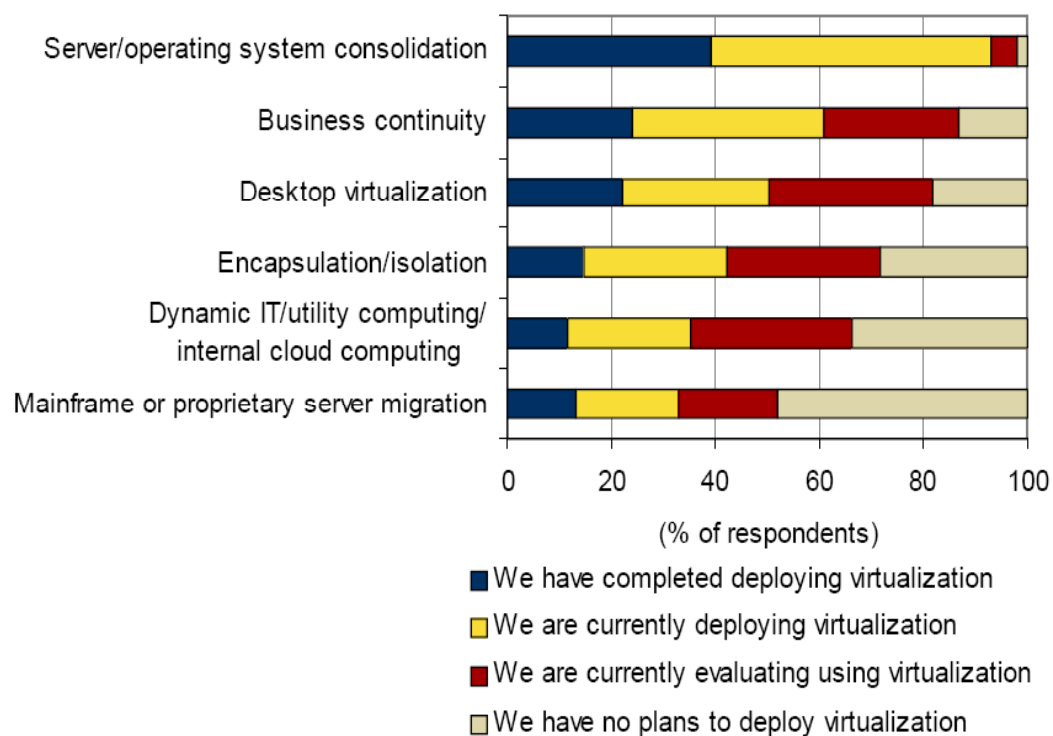
Virtualization Touches Everything



Data Center Virtualization by Use Case

Status of Current Deployment of Virtualization by Use Case

Q. Please describe your current deployment of virtualization for each of the following use cases?



n = 225

Source: IDC, 2009

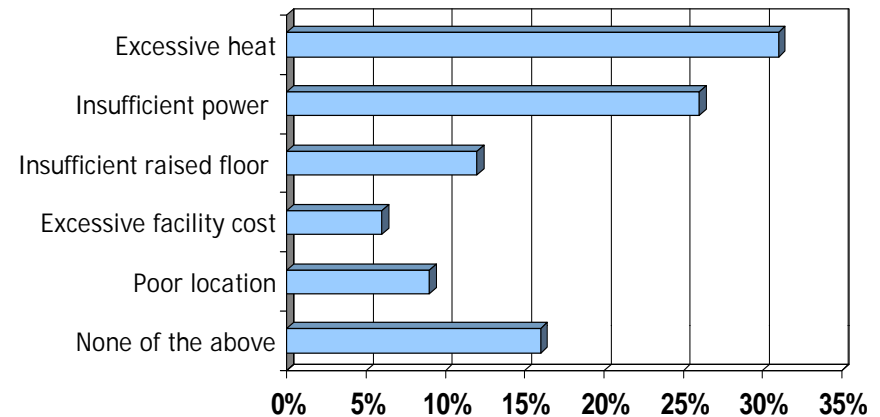
CIO View of Biggest Data Center Problem?

“Power and cooling will be a top 3 issue with all CIO’s in the next 6-12 months”

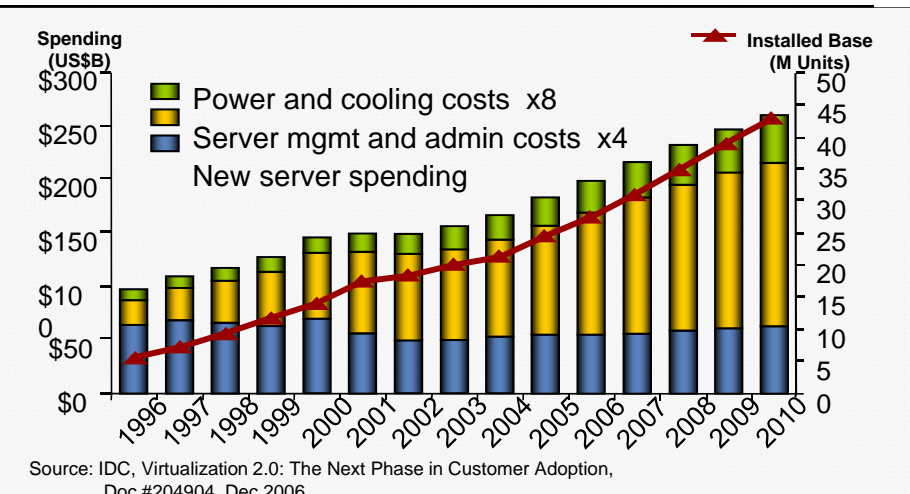
Michael Bell – Gartner Group

“Power and cooling costs will increase to more than one-third of the total IT budget”

Robert Frances Group

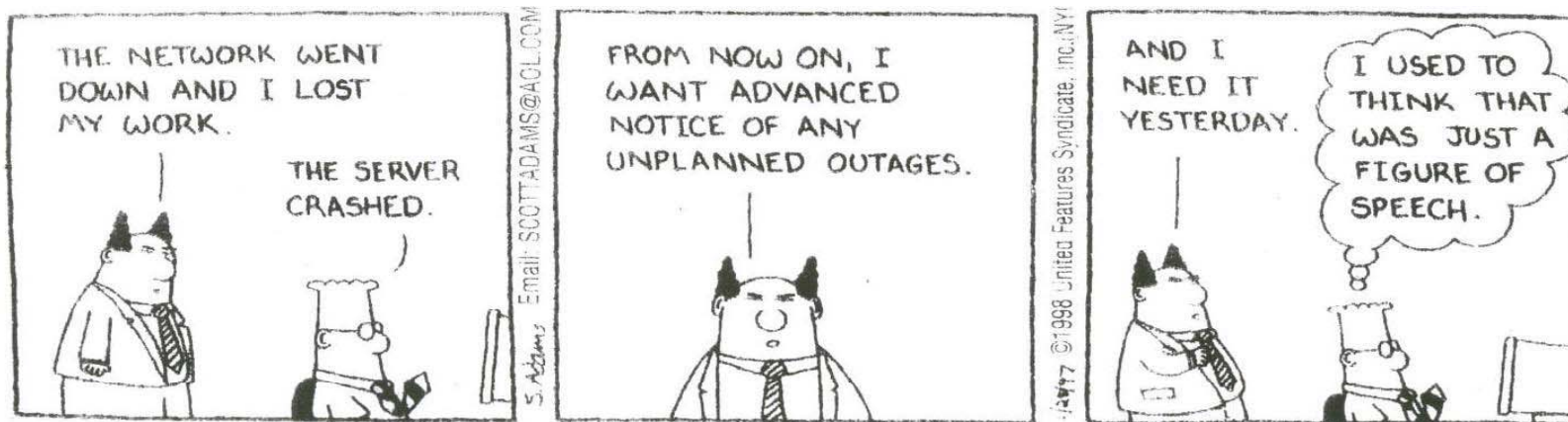


Gartner 2006



Source: IDC, Virtualization 2.0: The Next Phase in Customer Adoption, Doc #204904, Dec 2006

Truth in Cartoons!

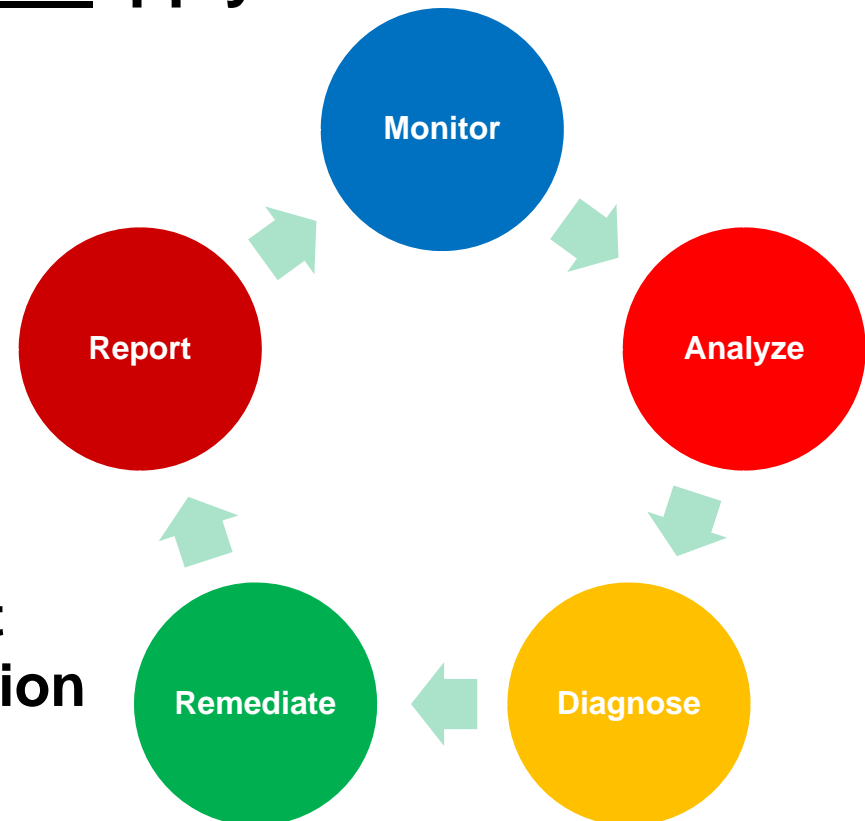


Managing Virtualized Data Center

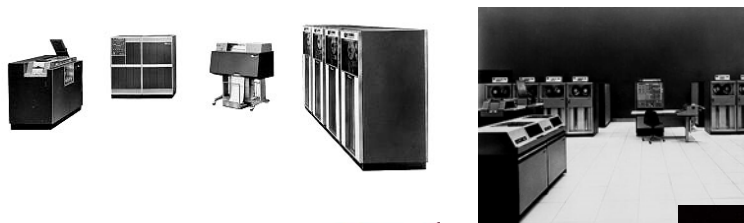
- Fundamentals of management apply FCAPS

- **F**ault
- **C**onfiguration
- **A**vailability
- **P**erformance
- **S**ecurity

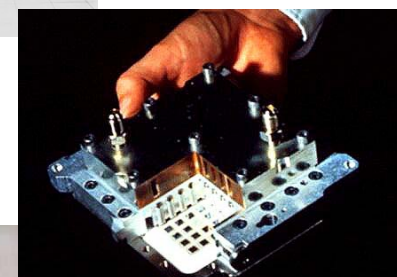
- **Leading to**
 - **Service Level Achievement**
 - **Optimum Resource Utilization**
 - **Highly available systems**
 - **High performing systems**



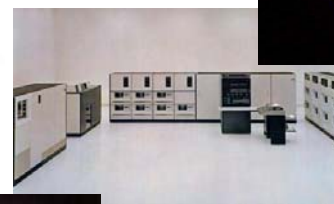
Background



Mainframe Specifics



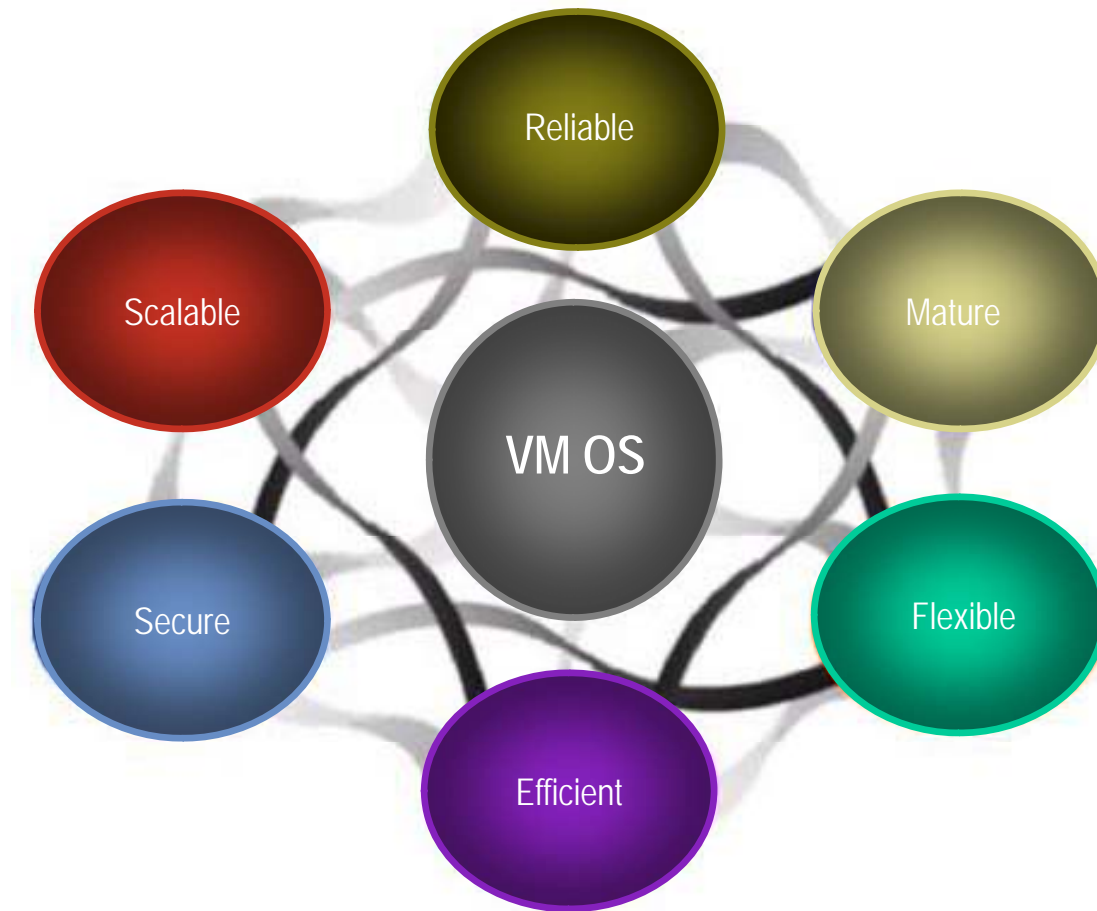
Managing the Virtualized World



Best Practices



z/VM



Use of Mainframe as VM Grows

The momentum continues:

Shipped IFL engine volumes increased 62% from 3Q07 to 3Q09

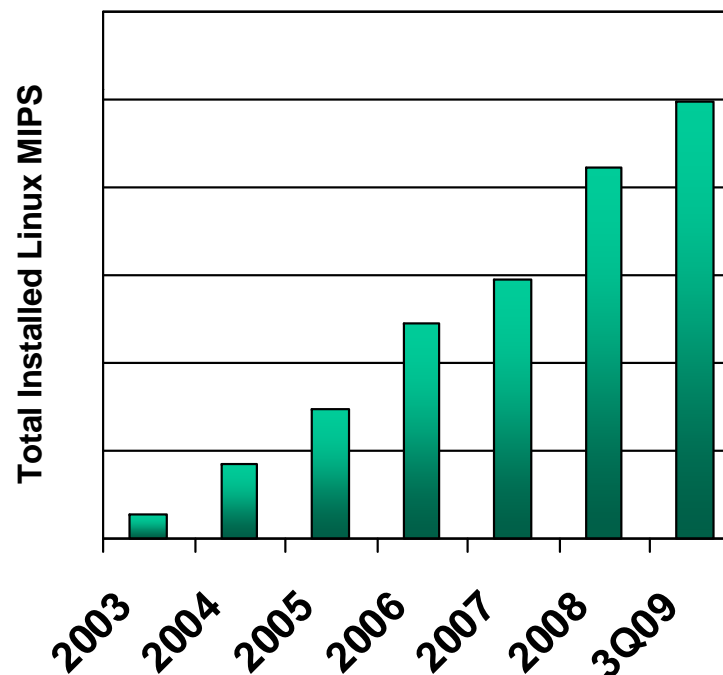
Shipped IFL MIPS increased 100% from 3Q07 to 3Q09

Linux is 16% of the System z customer install base (MIPS)

70% of the top 100 System z clients are running Linux on the mainframe

>3,000 applications available for Linux on System z

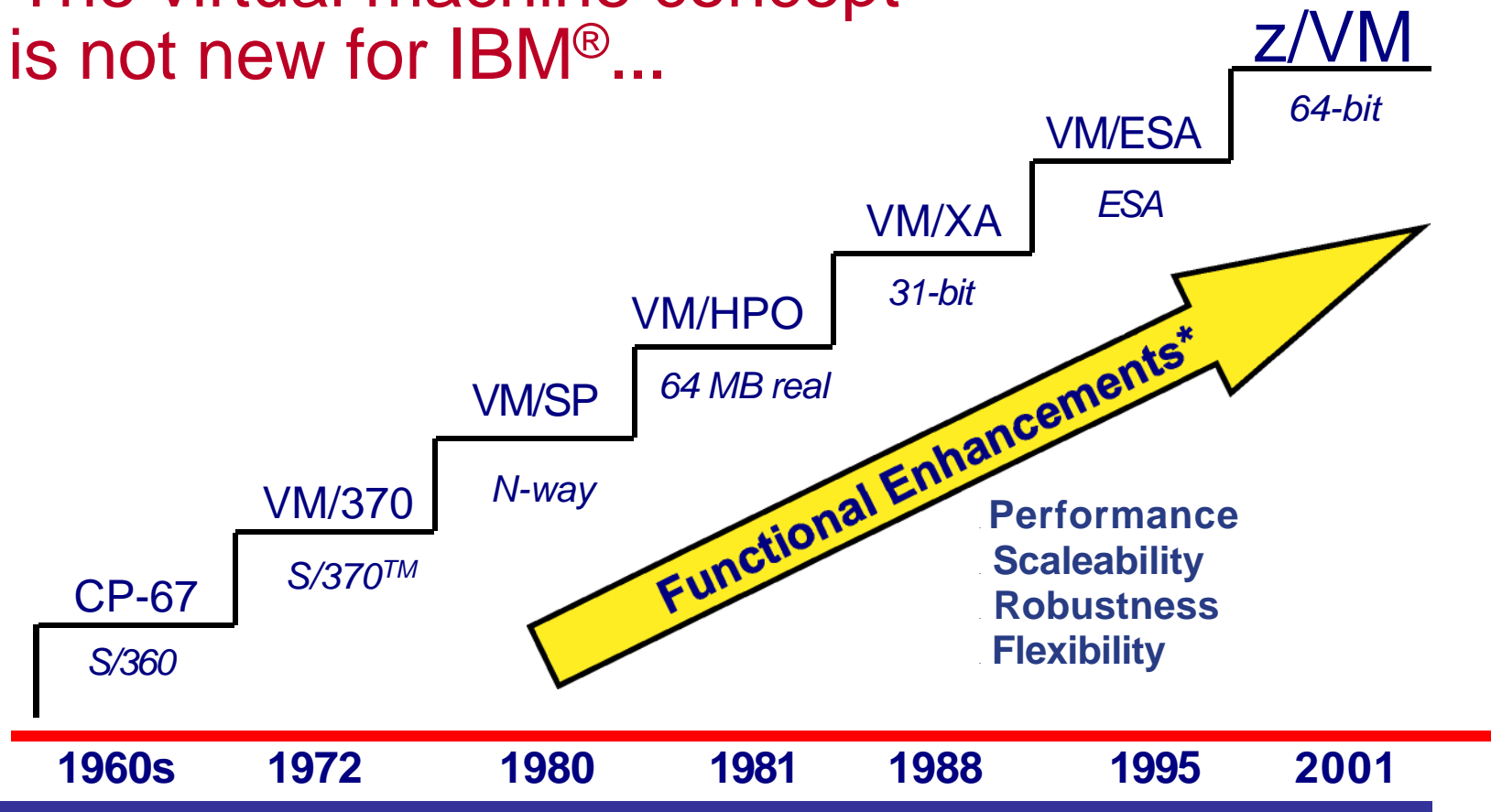
Installed Linux MIPS



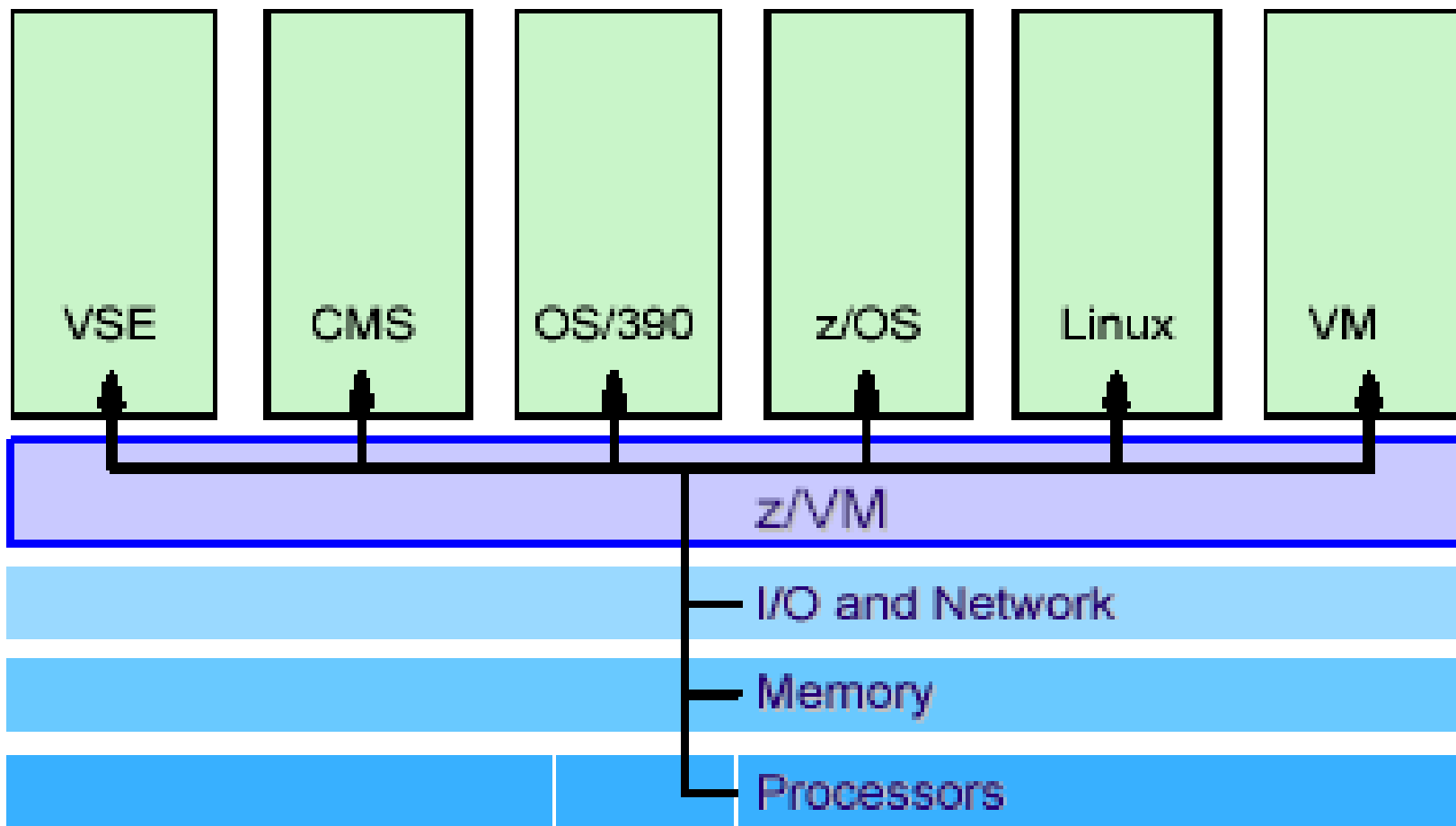
Source: Reed Mullen-IBM

IBM Virtual Machine Evolution

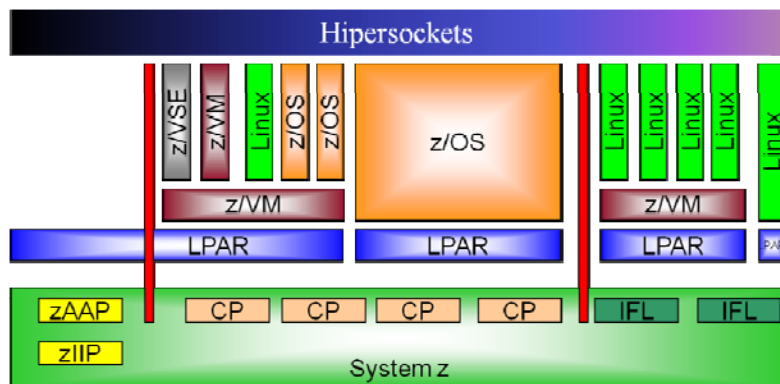
The virtual machine concept is not new for IBM® ...



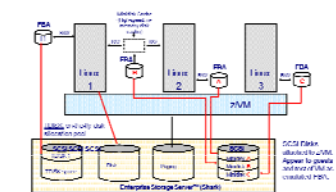
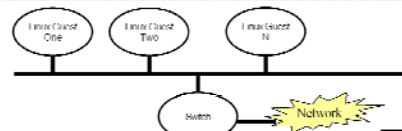
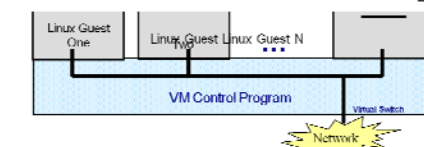
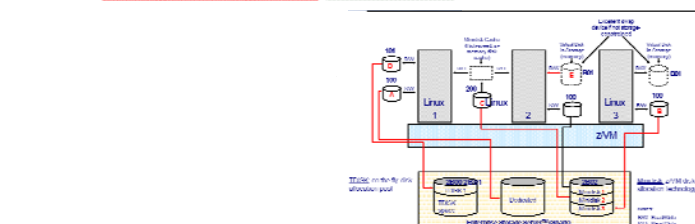
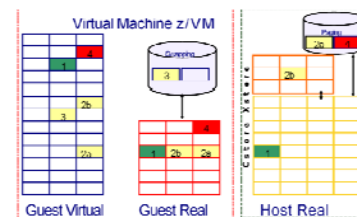
z/VM Structure



Advanced Virtualization on System z



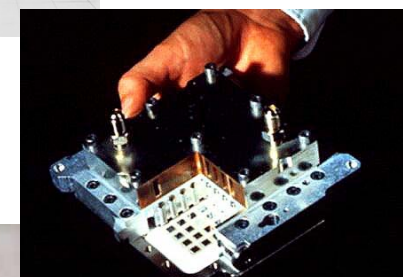
- MVS (Multiple Virtual Storage)
- VM (Virtual Machine)
- LPAR (Logical Partition)
- Load Balancing
- VIPA (Virtual IP Addressing)
- HyperSockets
- Enterprise Extender (Virtual SNA)
- Linux for z/Series
- VLAN's (Virtual LAN)
- VSwitch (Virtual Switch)



Background



Mainframe Specifics



Managing the Virtualized World



Best Practices

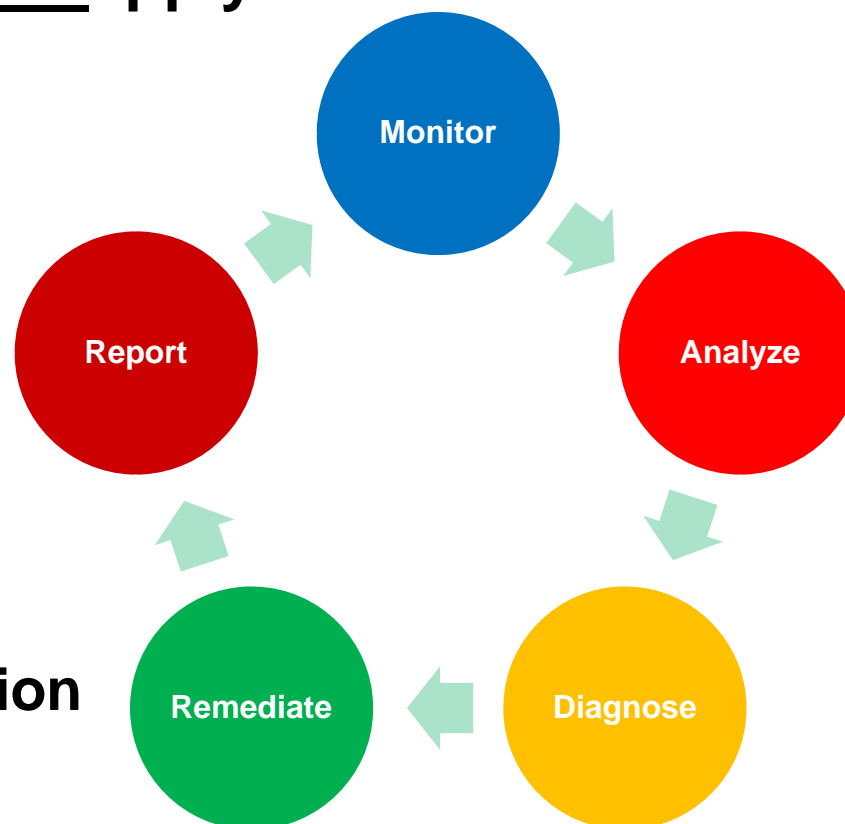


Managing Virtualized Data Center

- Fundamentals of management apply FCAPS

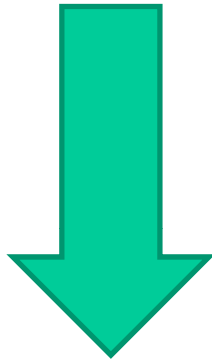
- **F**ault
- **C**onfiguration
- **A**vailability
- **P**erformance
- **S**ecurity

- **Leading to**
 - **Service Level Achievement**
 - **Optimum Resource Utilization**
 - **Highly available systems**
 - **High performing systems**

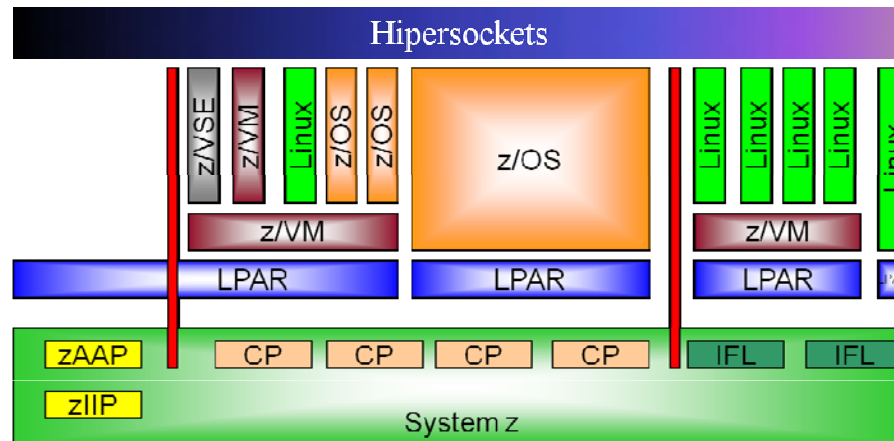


Approaches to Solving Problems

Top Down or Bottom Up doesn't matter
Consistency does

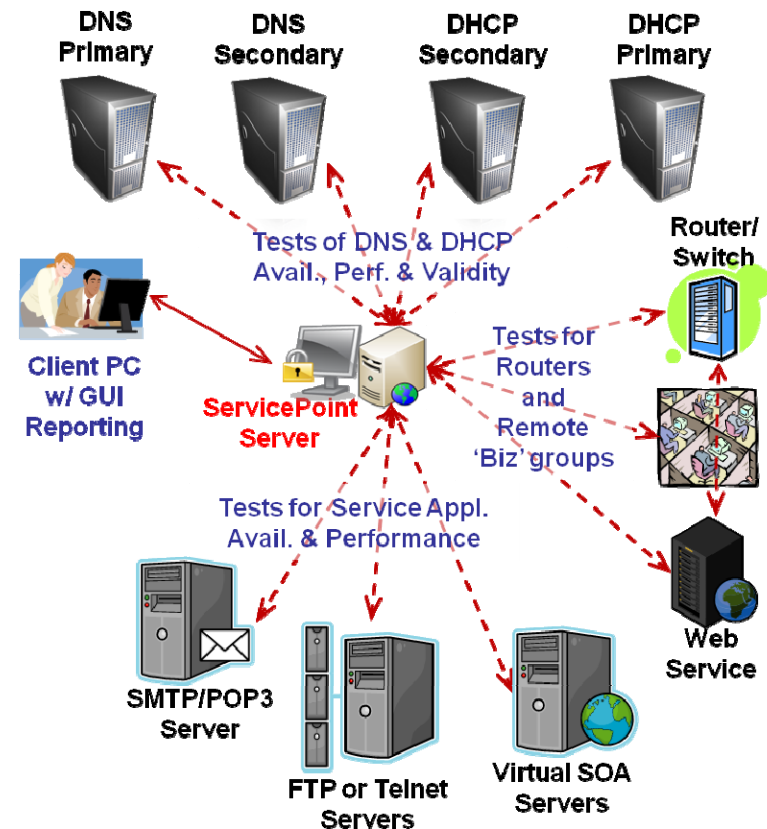


- Applications
- Middleware
- Guest OS
 - VM
- Network

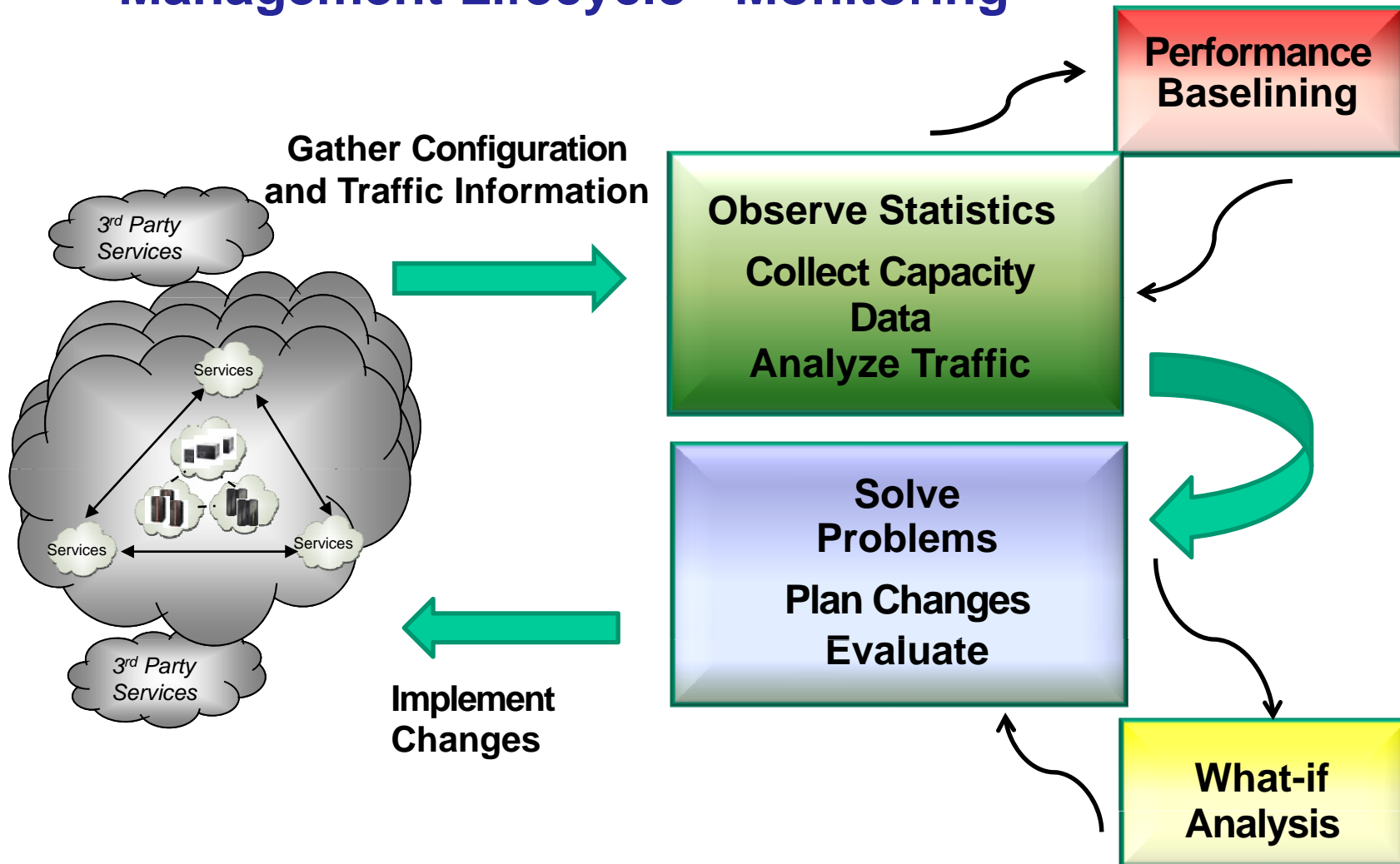


Virtualization Challenges Management Ecosystem

- **Virtualization leads to a data center that is**
 - Consolidated - Many in one place
 - Optimized – Movement to attain SLA's
 - Dynamic – Requires less operator intervention
- **How does this strain your management ecosystem**
 - Location
 - Inventory
 - Availability
 - Performance
 - Event
 - Associate to Business Service
 - Report



Management Lifecycle - Monitoring

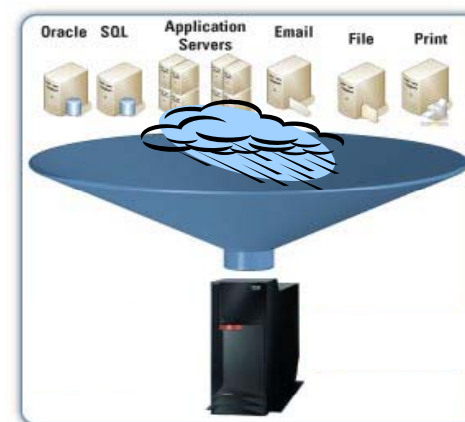
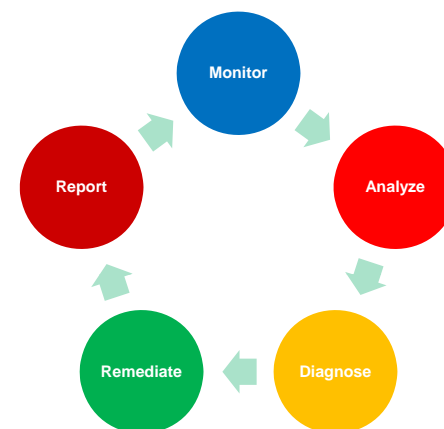


Top Service Management Mistakes when starting a Virtualization Project

- **Neglecting to collect and compare “Before and After Snapshots” of the conversions for:**
 - Physical and virtual infrastructure performance behavior
 - Performance and behavior of single-point applications vs. virtualized or “cloned” applications
 - Network flow and control of specific application conversations

- **Neglecting to define established baselines for:**
 - CPU performance
 - Storage level usage
 - Network Performance and packet/routing error rates
 - “IP Service” application error rates or outage levels
 - Key TCP-based application uptime availability or conversation Round-Trip -Time performance

- **Neglecting to periodically and consistently re-examine everything to ensure that all infrastructure components are fully optimized**



Scenario 1 –Application Behavior after Virtualization

Situation

A major virtualization project involved 5 applications. All 5 applications moved successfully, but one had major performance issues taking 11 hours to run versus 2 on the non-virtualized environment. This application was based on MySQL

Trouble Shooting

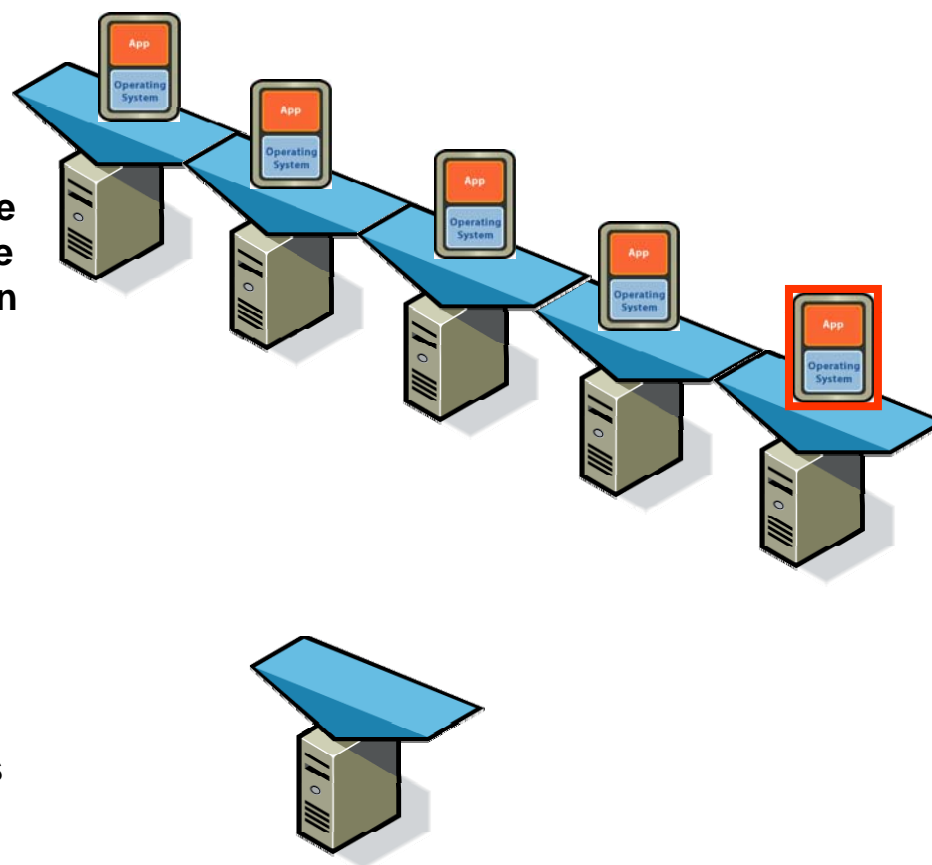
What was different about this application?

Is this application getting all the resources it needs?

Is this application using a network resource (DNS server for example) different from the other applications?

Anyone have a clue of the flows and controls before virtualization?

How do we isolate the problem to a specific area?



Scenario 1 –Application Behavior after Virtualization

Solution

Running a trace of critical applications will provide details on the interaction with infrastructure components, between the communicating elements, and provide visibility into changed environments

What was different about this application?

Look at the sequenced packet flows and response times before and after the move

Is this application using a network resource (OSA adapter for example) different from the other applications?

Look at the status of your IP service devices

Anyone have a clue of the flows and controls before virtualization?

Collect a trace of the application startup, steady state, and on closing before and after the move. Compare these side by side to quickly see differences.

The screenshot displays the 'CleverView for IP Service Performance' interface. The top section, 'MONITOR [ENG] [137.72.43.110]', shows a summary table of service performance across various groups.

Group	Last Checked	# of Resources	Network		Performance		Availability		Service		Advanced Threshold Alerts
			Alerts	%	Alerts	%	Alerts	%	Alerts	%	
Infrastructure Services											
DNS	11/26/2007 2:38:27 PM	5	0	80.00%	0	100.00%	0	40.00%	0	100.00%	N/A
Router	11/26/2007 2:38:28 PM	1	0	0.00%	0	0.00%	N/A	N/A	N/A	N/A	0
Application Services											
FTP	11/26/2007 2:39:28 PM	1	0	0.00%	0	0.00%	0	0.00%	0	0.00%	N/A
PortMon	11/26/2007 2:39:28 PM	3	0	0.00%	0	0.00%	0	0.00%	0	0.00%	N/A
Business Services											
EndPoint-Linux	11/26/2007 2:39:32 PM	2	0	100.00%	0	100.00%	N/A	N/A	N/A	N/A	N/A
EndPoint-Machrome	11/26/2007 2:38:28 PM	1	0	100.00%	0	100.00%	N/A	N/A	N/A	N/A	N/A
EndPoint-Print Farm	11/26/2007 2:39:28 PM	4	0	100.00%	0	100.00%	N/A	N/A	N/A	N/A	N/A

The bottom section, 'ServicePoint Detail for EndPoint from 11/26/2007 2:31:32 PM to 11/26/2007 2:39:32 PM', shows a detailed view of service points with columns for Group, Business Service Name, IP Address, Last Checked, Network/Avail/Alerts, and Retno.

The 'Trace Diff' window shows a list of network packets with columns for ID, Timestamp, Elapse Time (H:m:ss:ms), Datagram Size, Messages, Local Port, Direction, Ret. Port, Seq. Number, Ack. Number, and Window Size. The messages column contains DHCP-related traffic such as 'client request: discover find DHCP servers', 'server reply: offering ip address', and 'client request: request new ip address'.

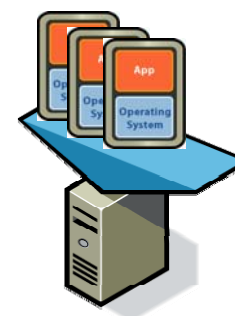
Scenario 2 – Performance Complaints

Situation

After moving an application to a virtualized environment the application development team complained that their application response times were significantly higher and that the virtualized environment was the problem.

Trouble Shooting

What is the throughput on the connection adapter?
Can it handle the load? Is there any time sensitivity?
What is the round trip TCP session time? How does this compare to your baseline before virtualization?
Are your virtualized connection LPAR, Ethernet, OSA elements optimized?
Are there any differences in the flows to support systems like DNS, DHCP, or routers?
Did you change subnets or IP network address space when you moved the system?



Scenario 2 – Performance Complaints

Solution

Baseline information is critical regarding how the application worked and utilized resources before and after the virtualization move. This needs to be compared to both real time, near real time and historical information in the virtualized environment

**What is the throughput on the connection adapter?
Can it handle the load?**

Look at the adapter details. Do you have a baseline for comparison? Remember that some baselines are ‘seasonal’ and you need to take this into consideration

What is the round trip TCP session time? How does this compare to your baseline before virtualization?

There is a lot of social emotion behind user complaints over performance. Do you have the background facts to remove emotion from the problem.

The screenshot displays several network performance metrics and charts from the AES software interface.

Thru24 Summary for All IP Links

	Throughput In (Bytes/Sec)	Throughput Out (Bytes/Sec)
Current:	515	502
Last:	0	0
Since Midnight:	515	502

Thru24 Detail for All IP Links

IP Address	Link Name	Bytes In	Throughput In (Bytes/Sec)	Bytes Out	Throughput Out (Bytes/Sec)
10.8.8.166	OSAGEF0L	120,111	200	141,284	235
10.8.8.107	VIPL07	0	0	0	0
10.8.8.114	VIPL114	0	0	0	0
10.9.8.200	IUTIQDFE	12,960	21	4,320	7
10.9.8.105	VIPL05	0	0	0	0
10.8.8.100	VIPL00	0	0	0	0
127.0.0.1	LOOPBACK	0	0	0	0
10.8.8.160	OSAGEF0L	176,452	294	156,149	260
10.9.8.105	VIPL05	0	0	0	0
10.9.8.155	VIPL05	0	0	0	0

Thru24 OSA Express LPAR Summary

Detail	Current	Last	Since Midnight
Current	0	0	0
Last	0	0	0
Since Midnight	0	0	0

Thru24 OSA Express LPAR Details

Time	Conn	Recv	Send	Recv	Send	Recv	Send	Recv	Send	Recv	Send
00	1	4	4	4	4	23	123	1	1	1	1
01	1	3	3	3	3	26	142	1	1	1	1
02	1	5	4	4	4	23	138	1	1	1	1
03	1	6	6	6	6	26	142	1	1	1	1
04	1	4	4	4	4	20	137	1	1	1	1
05	1	4	4	4	4	20	137	1	1	1	1
06	1	4	4	4	4	20	137	1	1	1	1
07	1	4	4	4	4	20	137	1	1	1	1
08	1	4	4	4	4	20	137	1	1	1	1
09	1	4	4	4	4	20	137	1	1	1	1
10	1	4	4	4	4	20	137	1	1	1	1
11	1	4	4	4	4	20	137	1	1	1	1
12	1	4	4	4	4	20	137	1	1	1	1
13	1	4	4	4	4	20	137	1	1	1	1
14	1	4	4	4	4	20	137	1	1	1	1
15	1	4	4	4	4	20	137	1	1	1	1
16	1	4	4	4	4	20	137	1	1	1	1
17	1	4	4	4	4	20	137	1	1	1	1
18	1	4	4	4	4	20	137	1	1	1	1
19	1	4	4	4	4	20	137	1	1	1	1
20	1	4	4	4	4	20	137	1	1	1	1
21	1	4	4	4	4	20	137	1	1	1	1
22	1	4	4	4	4	20	137	1	1	1	1
23	1	4	4	4	4	20	137	1	1	1	1

Average Network Response Time

Maximum Network Response Time

Scenario 3 – Erratic Application Behavior

Situation

After moving an application to a virtualized environment the application accessing the application had very uneven response times. What was the cause?

Trouble Shooting

How did the application access DNS servers?

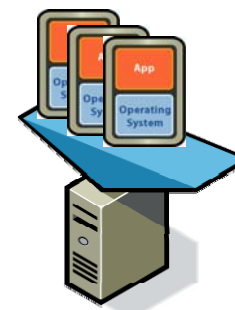
What was the status of the DNS servers?

Did the virtualized environment begin to overwhelm an individual server?

Were the uneven response times occurring at specific times or in a repeatable pattern?

Were any new applications/images moved or brought up on the virtualization server about the time the erratic behavior occurred?

Is this behavior reported by end users, the application team, or tools? If end users, is it one segment or are they located at various locations? If the application team, what tool are they using? What is it showing? If a tool reported the behavior how is it gathering information, analyzing and reporting that information?



Scenario 3 – Erratic Application Behavior

Solution

Using tracing tools a clear understanding of the way the application environment used DNS servers could be understood along with details on exactly which servers were being utilized. Comparing before and after traces would show any differences in these flows. Using monitoring tools with alerting to show the availability and performance of your DNS (and other infrastructure elements) would alert operations to overloaded or non-response DNS servers

How did the application access DNS servers?

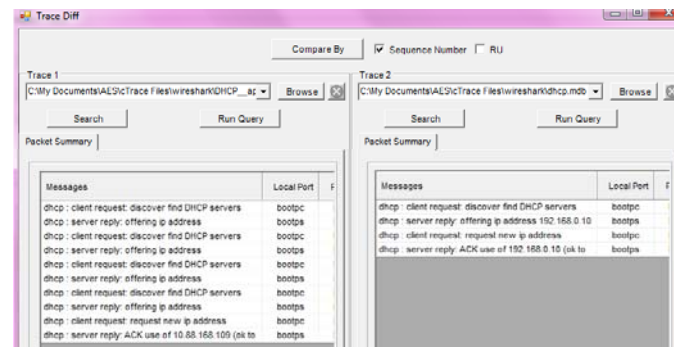
Running a trace before and after the move would allow you to understand if there were any differences in the flows.

What was the status of the DNS servers?

Monitoring your critical components provides quick status checks by network operations.

Did the virtualized environment begin to overwhelm an individual server?

Monitoring the critical components through all layers provides a snapshot of overall status.

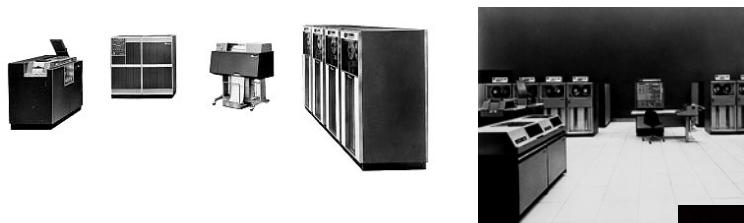


MONITOR [DOTNETDEVLT] [DOTNETDEVLT.137.72.43.42]

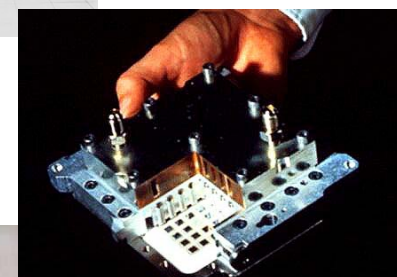
Group	Last Checked	# of Resources	Network				Service				Advanced Threshold Alerts
			Availability		Performance		Availability		Performance		
			Alerts	%	Alerts	%	Alerts	%	Alerts	%	
Infrastructure Services											
DHCP	6/27/2006 10:53:11 AM	3	0	19.05%	0	100.00%	N/A	N/A	N/A	N/A	0
DNS	6/27/2006 10:53:12 AM	5	0	0.00%	0	0.00%	0	0.00%	0	0.00%	N/A
Router	6/27/2006 10:53:19 AM	1	0	0.00%	0	0.00%	N/A	N/A	N/A	N/A	0
Application Services											
FTP	6/27/2006 10:53:13 AM	3	0	0.00%	0	0.00%	0	0.00%	0	0.00%	N/A
PortMon	6/27/2006 10:53:13 AM	2	0	50.00%	0	100.00%	0	90.57%	0	100.00%	N/A
Telnet	6/27/2006 10:53:13 AM	1	0	87.50%	0	100.00%	0	100.00%	0	100.00%	N/A
Business Services											
EndPoints-AES	6/27/2006 10:53:13 AM	4	0	0.00%	0	0.00%	N/A	N/A	N/A	N/A	N/A
EndPoints-MSHOME	6/27/2006 10:53:13 AM	1	0	0.00%	0	0.00%	N/A	N/A	N/A	N/A	N/A

Business Service Name	Group	Last Checked	Name of Resources	Network				Service				Advanced Threshold Alerts
				Availability		Performance		Availability		Performance		
				Alerts	Percent	Alerts	Percent	Alerts	Percent	Alerts	Percent	
Infrastructure Service	DHCP	5/09/2006 02:49:00 PM	3	0	0.00%	0	0.00%	n/a	n/a	n/a	n/a	0
Infrastructure Service	DNS	5/09/2006 02:49:00 PM	5	0	0.00%	0	0.00%	0	0.00%	0	0.00%	n/a
Infrastructure Service	MG	5/09/2006 02:49:00 PM	2	0	100.00%	0	100.00%	0	100.00%	0	100.00%	n/a
Infrastructure Service	ROUTER	5/09/2006 02:49:00 PM	2	0	100.00%	0	100.00%	n/a	n/a	n/a	n/a	0
Business Service	ENDPOINT	5/09/2006 02:49:00 PM	7	0	100.00%	0	0.00%	n/a	n/a	n/a	n/a	n/a
Application Service	EMAIL	5/09/2006 02:49:00 PM	2	0	0.00%	0	0.00%	0	0.00%	0	0.00%	n/a
Application Service	FTP	5/09/2006 02:49:00 PM	1	0	93.33%	0	0.00%	0	93.33%	0	93.33%	n/a
Application Service	PORTMON	5/09/2006 02:49:00 PM	3	0	100.00%	0	100.00%	n/a	n/a	n/a	n/a	0
Application Service	TELNET	5/09/2006 02:49:00 PM	1	0	100.00%	0	0.00%	0	0.00%	0	0.00%	n/a

Background



Mainframe Specifics



Managing the Virtualized World



Best Practices



Evaluate Many Facets of Virtualization

Options	Virtualization Infrastructure	Private Host OS and VM control	Reduction in space, power use and cooling	Reduction in Network and SAN Infrastructure	Consolidated hardware management and KVM
Consolidation of applications on existing servers	NO	NO	POOR	NO	NO
Virtualization of applications on existing servers	YES	YES	FAIR	FAIR	NO
Virtualization of applications on consolidated servers	YES	YES	EXCELLENT	EXCELLENT	YES

Optimal solution may be achieved by combining the virtual solutions

Have a Report Card

Server Report Card	PASS/ FAIL	Virtual Infrastructure Report Card	PASS/ FAIL
Create a base Server template and create new VMs		Server Consolidation	
Baseline existing server, application, and infrastructure (DNS, routers, etc) elements for key KPI's		Increased host resource utilization	
Deploy Infrastructure on VMs		Zero Downtime Upgrades	
Perform virtual machine "internal move"		Baseline core network elements before and after	
Perform virtual machine "external move"		Datacenter relocation with no moving trucks	
Repeatedly perform a physical to virtual operation		Increased server to administrator ratio	
Simulated power supply failure testing		Reduced server deployment times	
Failover testing of the management modules		Infrastructure cost savings	
Failover testing of the network switches		Labor cost savings	
		Centralized management of virtual infrastructure	

Did you consider

- Architect your virtual infrastructure carefully
 - Review with network, application, middleware, development and facility teams
- Construct a roadmap, 3 years out if possible
- Is there a Technical Account Manager
 - Single point of contact internally
 - Single point of contact for external vendors
- Not all workloads should be virtualized
 - Users and workloads differ by environment
 - Not every application is ready to be virtualized
- Spread the Virtualization story internally (to IT!)
 - Virtualization for most is still a new and unknown technology



The Future

Enhanced Disaster Recovery Solutions

- Replication of individual virtual machines or VM file systems between sites
- Manual / Auto restart of replicated virtual machines at time of test / disaster
- Centralized management of the distributed virtual infrastructure

Enhanced VDI Solutions

- Leverage distributed replicated infrastructure for VDI at time of test or disaster
- Support for multi video head virtual desktops

Enhanced Application GRID

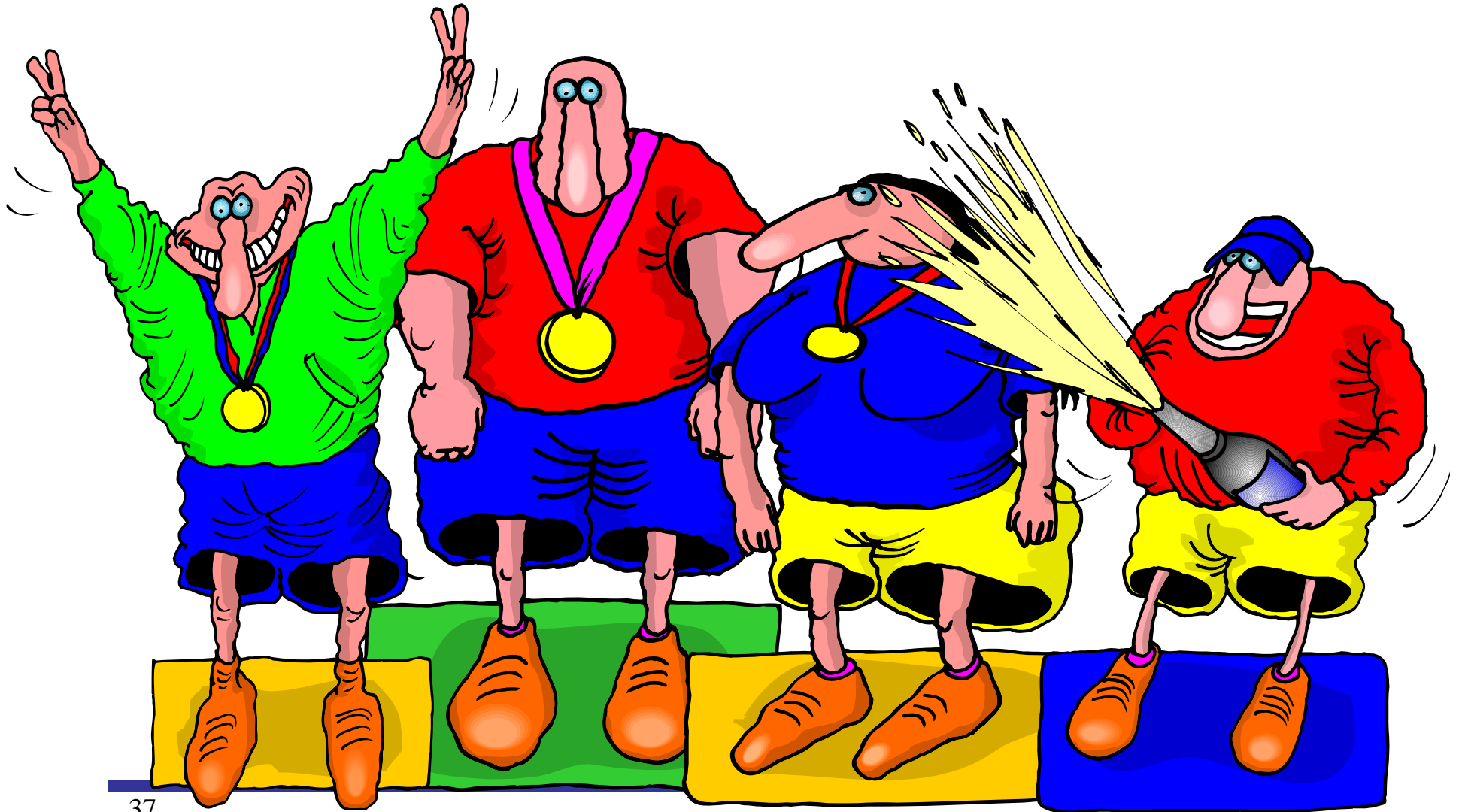
Geographically dispersed application GRID



Truth in Cartoons!



Join the Winners – Virtualize



Vielen
Dank

Obrigado!

Gracias

धन्यवाद

Eυχαριστώ

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QUESTIONS?

Köszönettel

Bedankt

Díky

THANK YOU

Merci

شكراً

Hvala

Teşekkürler

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Our other presentations:

Monday, 3:00 am - 4:00 am: Introduction to TCP/IP

Tuesday, 11:00 am – 12:00 pm: What every network manager needs to know about security

Tuesday 1:30 pm – 2:30 pm: Diagnosing Mainframe Network Problems with Packet Trace

Wednesday 11:00 am – 12:00 pm: Cloud Computing Environment

Wednesday 1:30 pm – 2:30 pm: Hot Topics in Networking and Security

Wednesday 4:30 pm – 5:30 pm: Wireless Security Challenges

Thursday 11:00 am – 12:00 pm: Virtualization – The Evolution of the Data Center