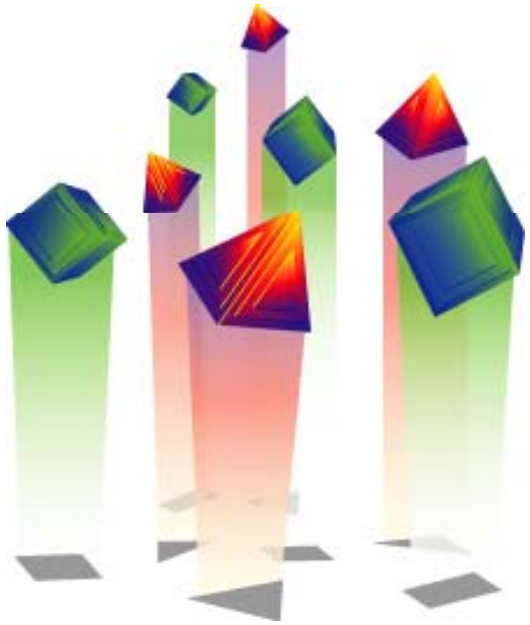
Virtualization:
The Evolution of the Data Center

and the impact on resource, system, and service management

Share Session Boston



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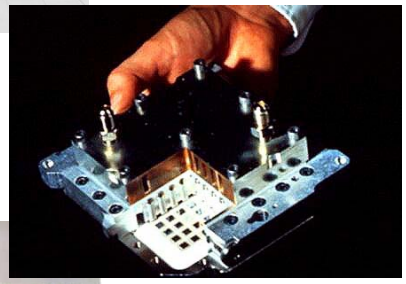
Background

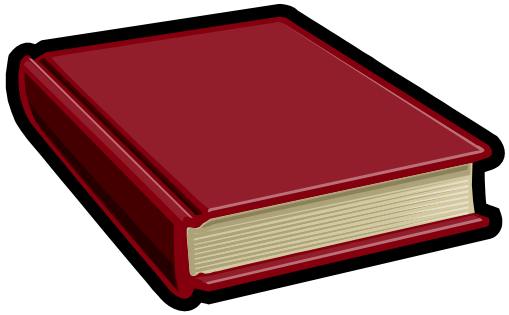


Mainframe Specifics

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)

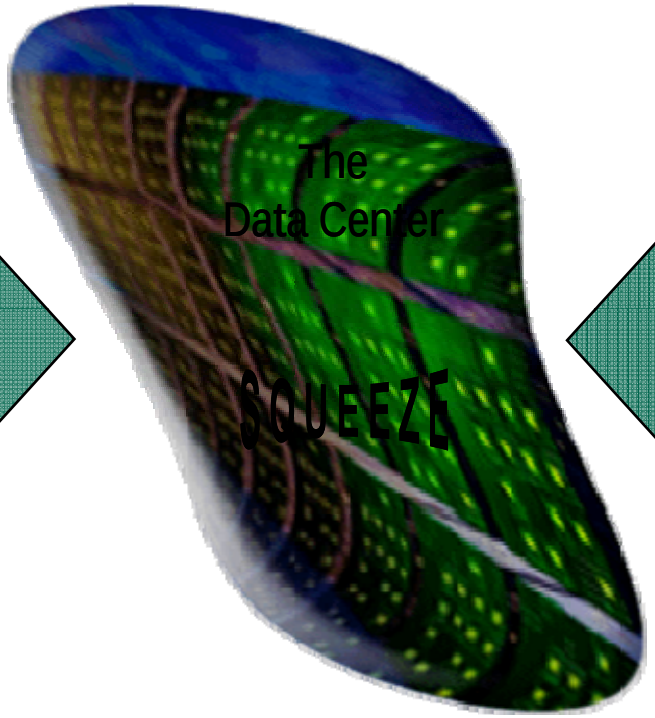
The Problem - Gartner

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

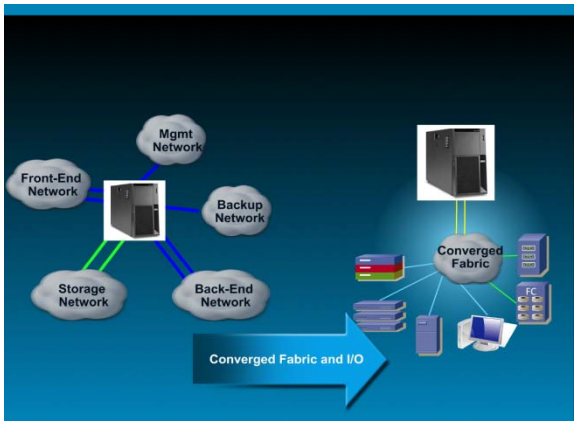
Operational Issues
- Unlimited demand
- More processing power
- Energy costs 8x
- Management costs 4x
- 70% of IT budget is operational overhead



Business Challenges
- Limited budgets
- Cost containment
- Globalization
- Acquisitions
- Green

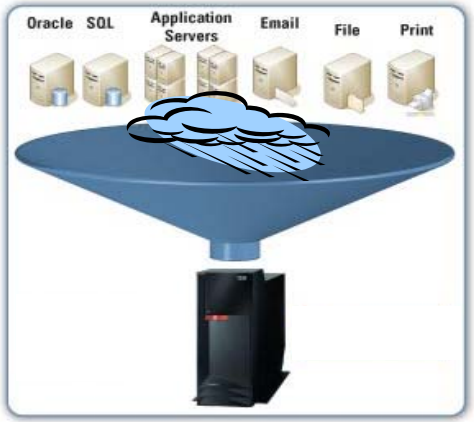
"Over the last three years, we have seen more change in the datacenter market than the previous fifteen years. Consolidation, virtualization, power and cooling, and the aging datacenter market in mature economies is leading to a proliferation in datacenter options, both inside the walls of the datacenter 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

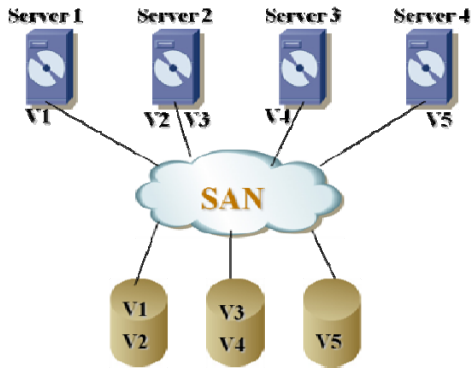


Green-Mandated efforts to….
Consolidate…entire farms of:

- **-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

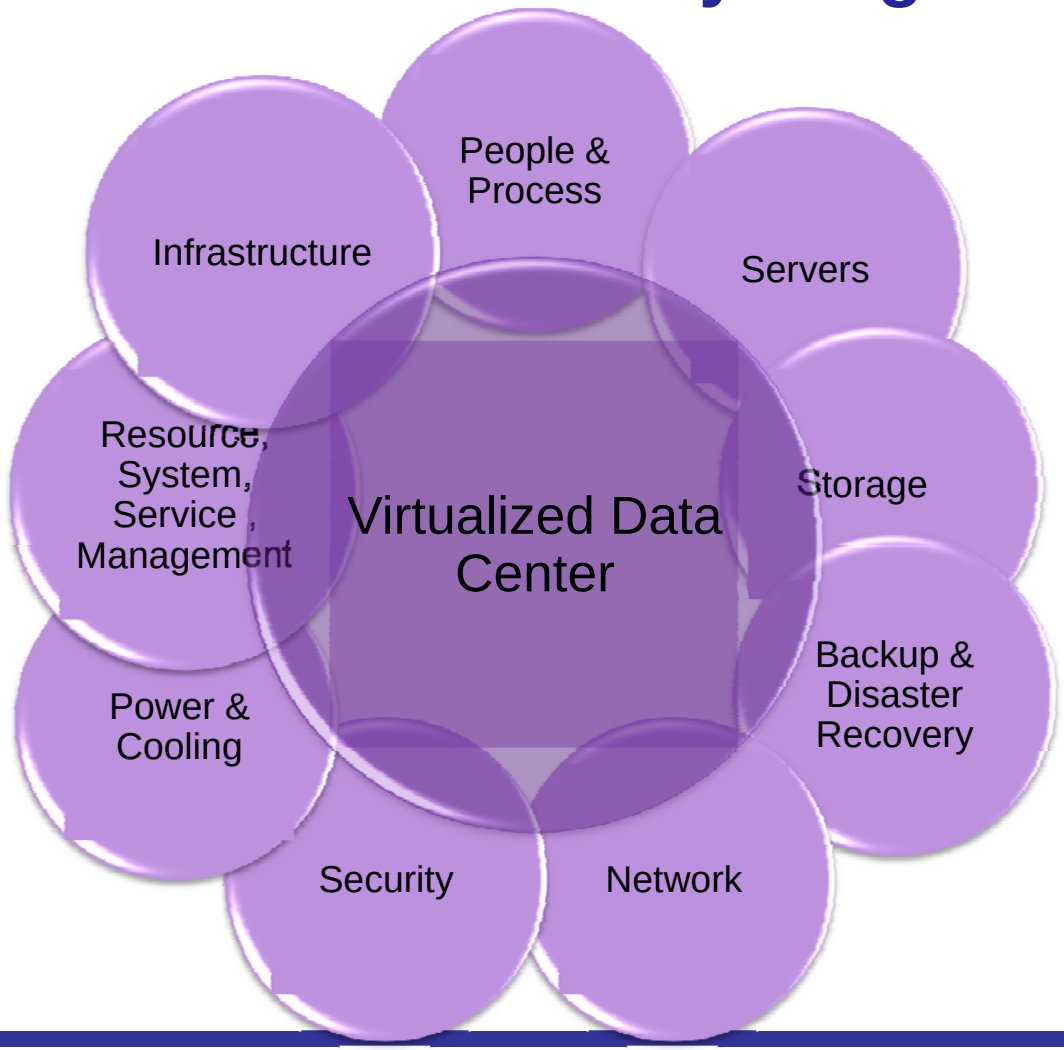
High Availability

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

On-demand Capacity

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

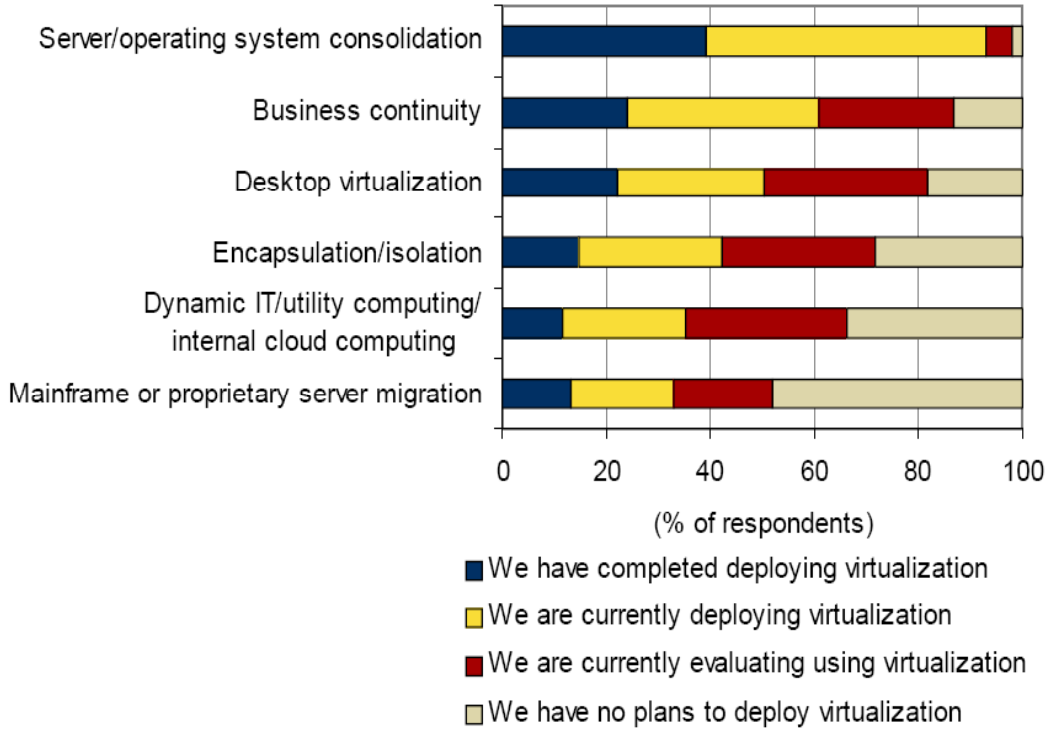
Virtualization Touches Everything



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

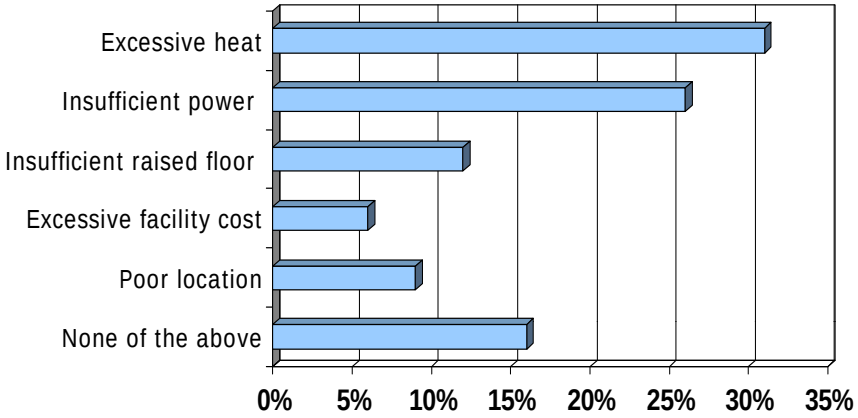
CIO View of Biggest Data Center Problem?

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

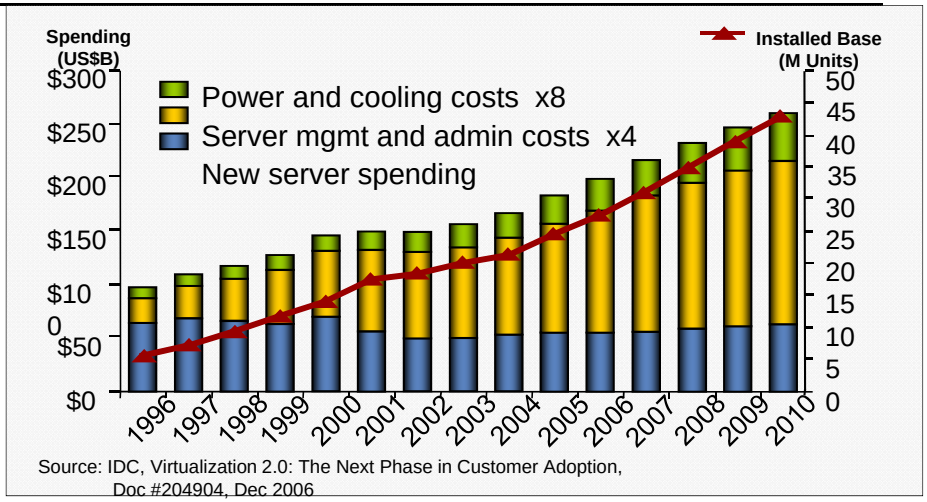
Michael Bell – Gartner Group

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

Robert Frances Group



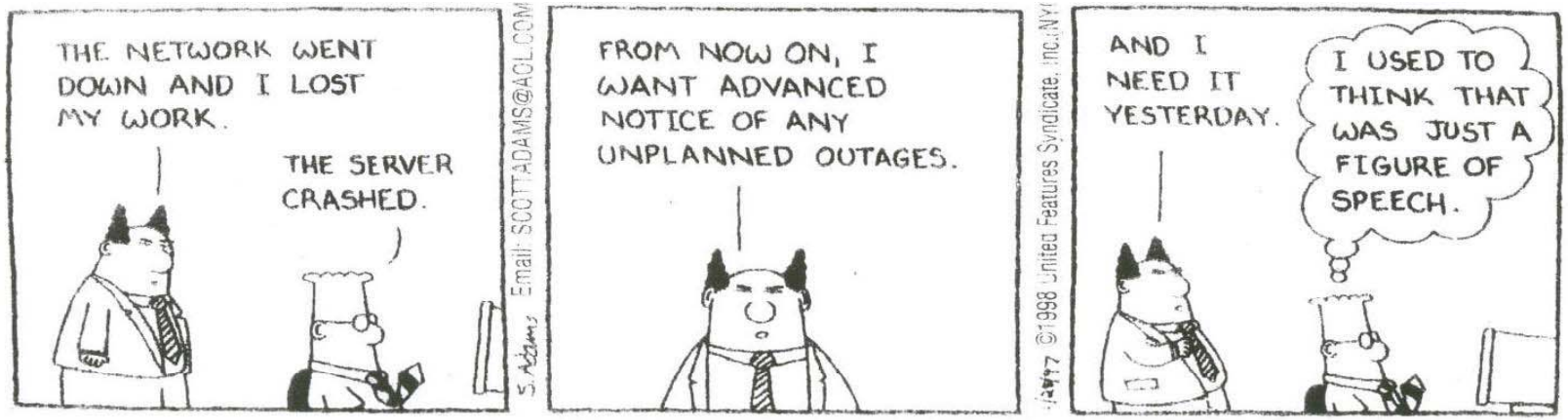
Gartner 2006



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

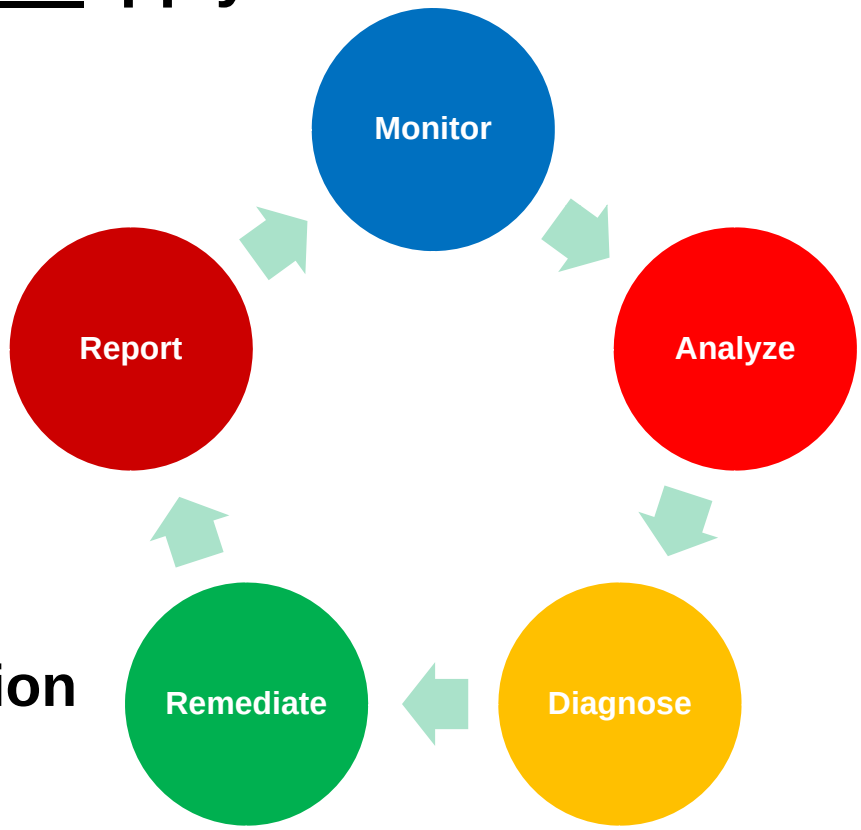
IDC 2006

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**



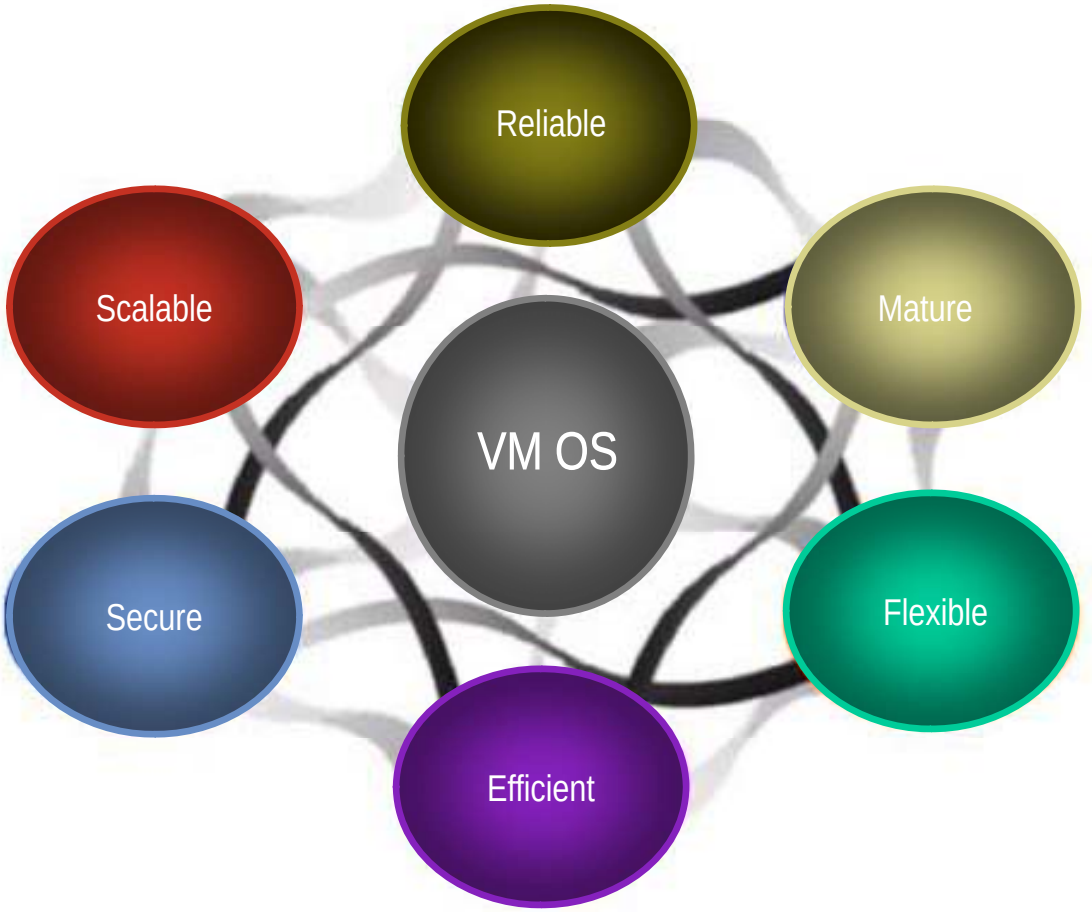
Background

Mainframe Specifics

Managing the Virtualized World

Best Practices

z/VM



Use of Mainframe as VM Grows

The momentum continues:

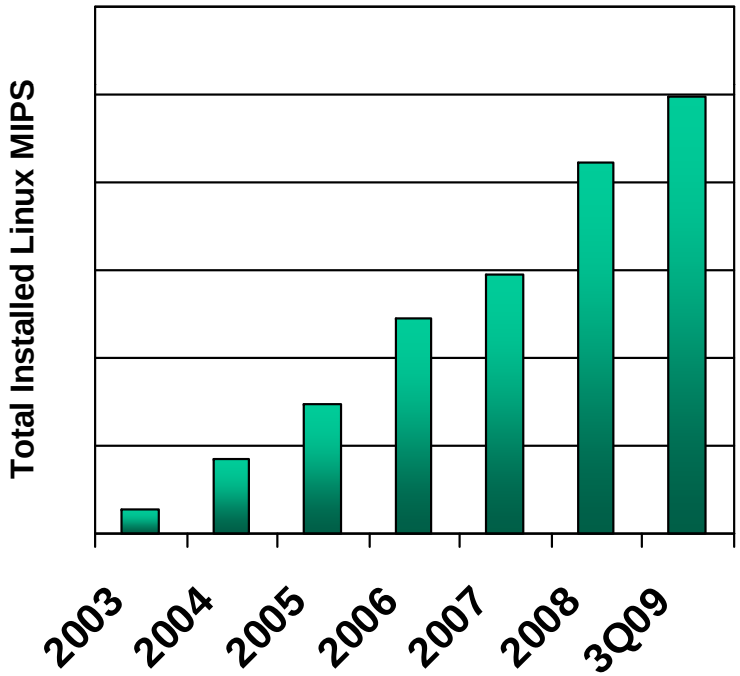
- Shipped IFL engine volumes increased 62% from 3Q07 to 3Q09
- Shipped IFL MIPS increased 100% from 3Q07 to 3Q09

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

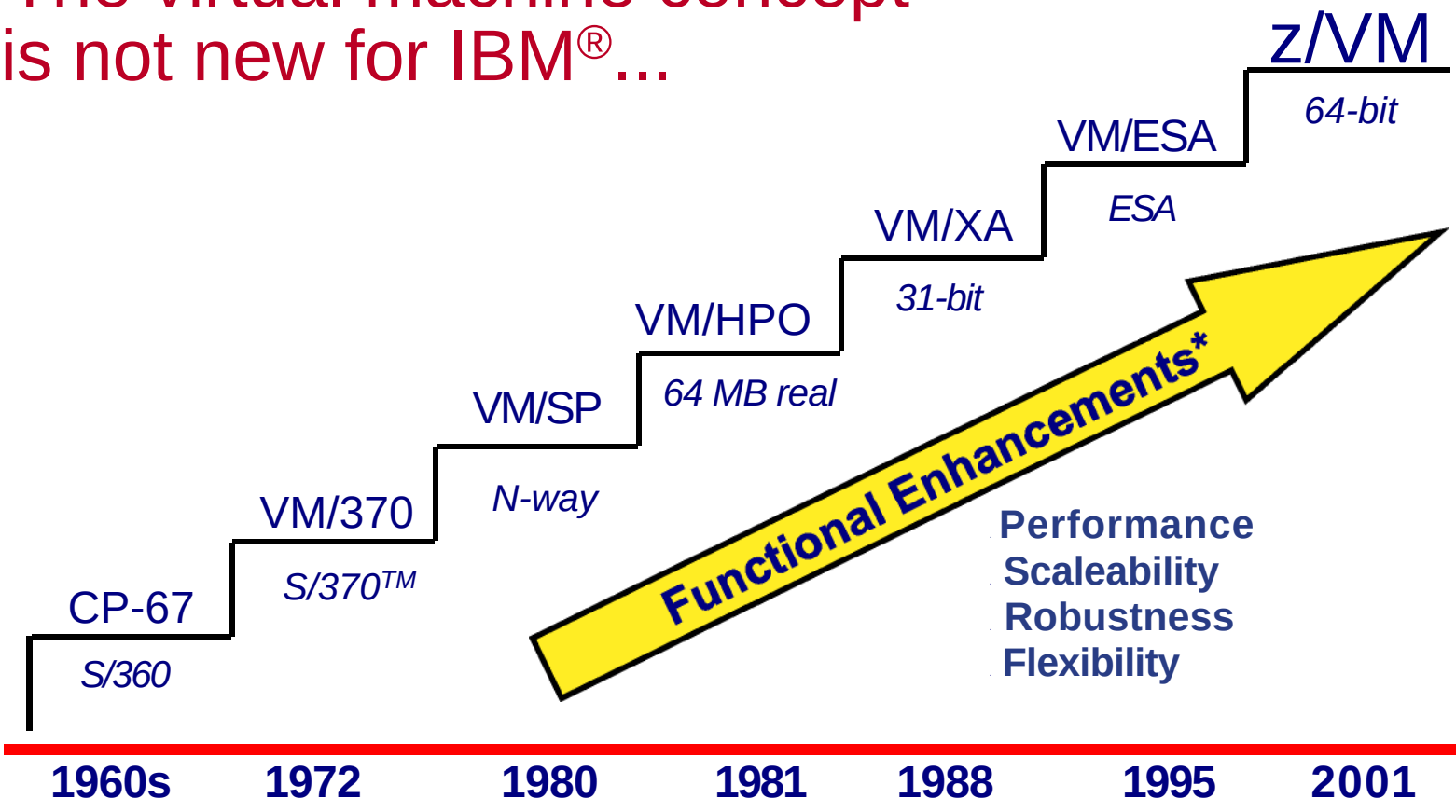
Installed Linux MIPS



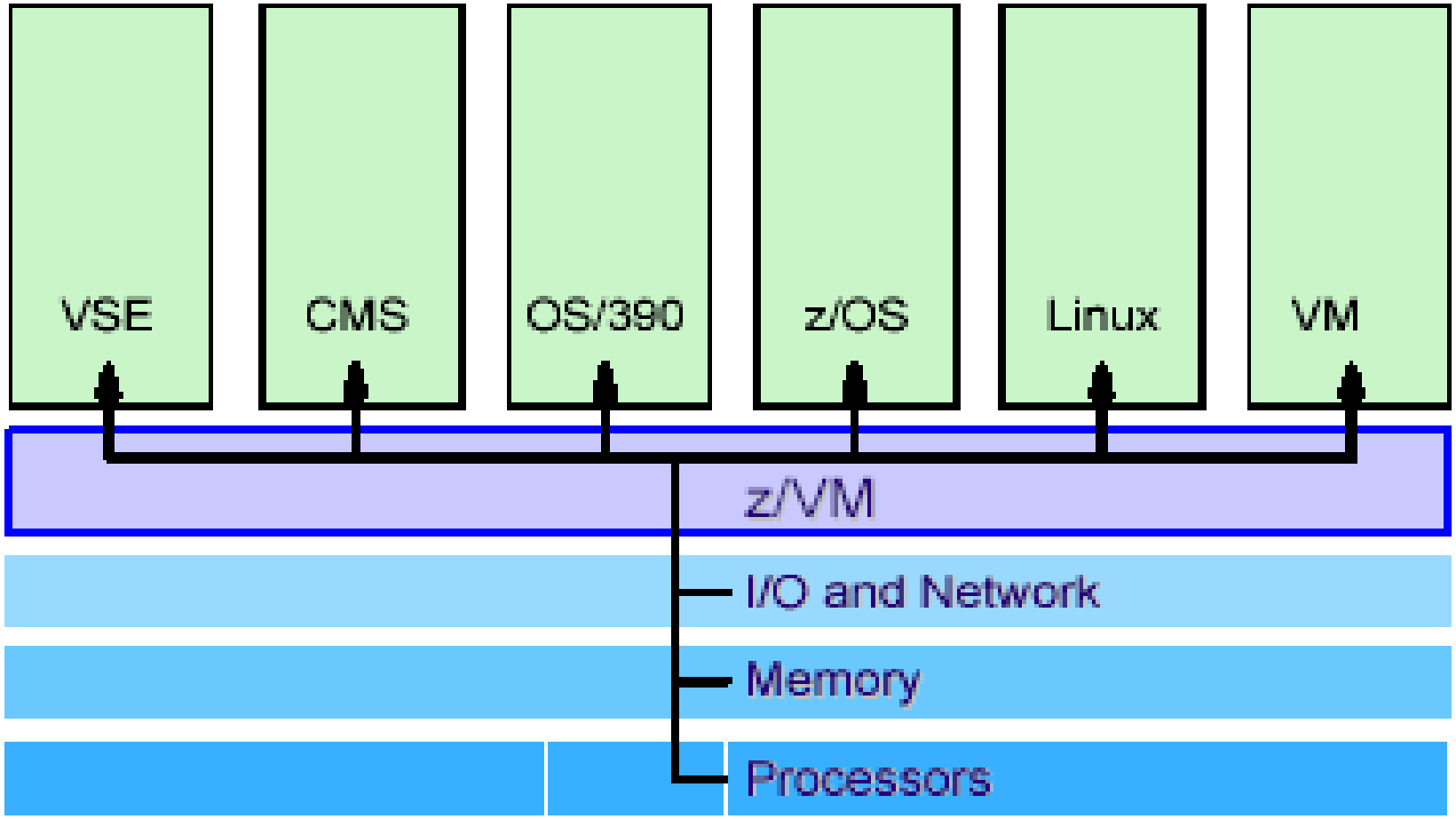
Source: Reed Mullen-IBM

IBM Virtual Machine Evolution

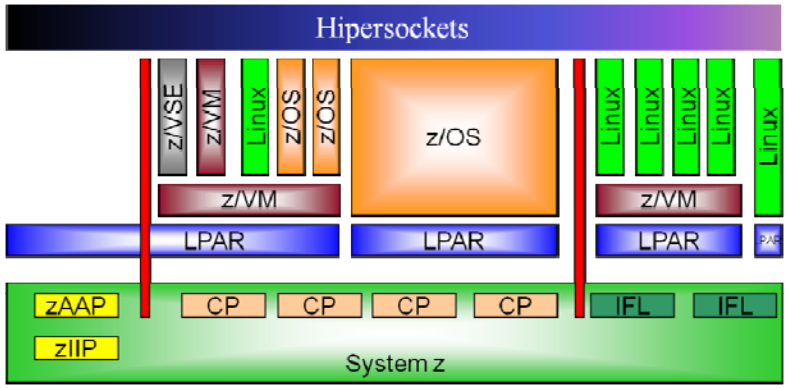
The virtual machine concept is not new for IBM®...

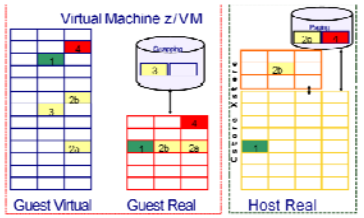


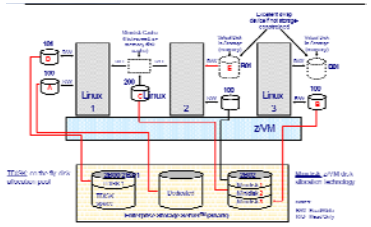
z/VM Structure

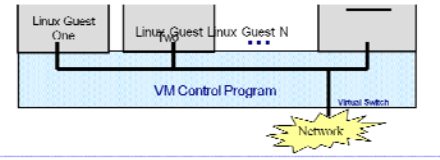


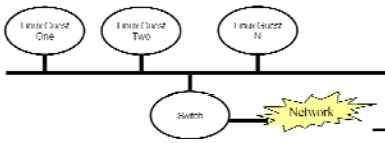
Advanced Virtualization on System z

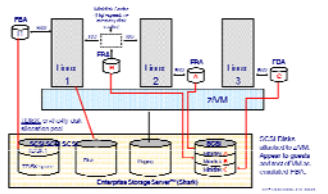






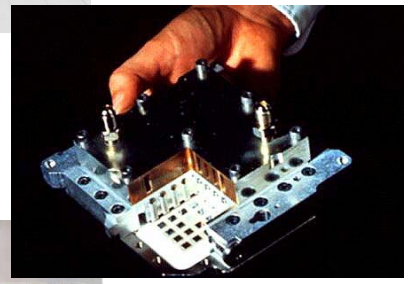




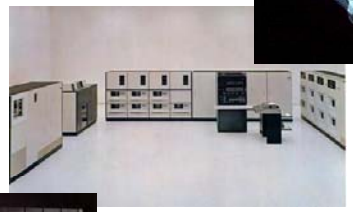


- **MVS (Multiple Virtual Storage)**
- **VM (Virtual Machine)**
- **LPAR (Logical Partition)**
- **Load Balancing**
- **VIPA (Virtual IP Addressing)**
- **HiperSockets**
- **Enterprise Extender (Virtual SNA)**
- **Linux for z/Series**
- **VLAN's (Virtual LAN)**
- **VSwitch (Virtual Switch)**

Background



Mainframe Specifics



Managing the Virtualized World

Best Practices

Managing Virtualized Data Center

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  - **Configuration**
  - **Availability**
  - **Performance**
  - **Security**
- **Leading to**
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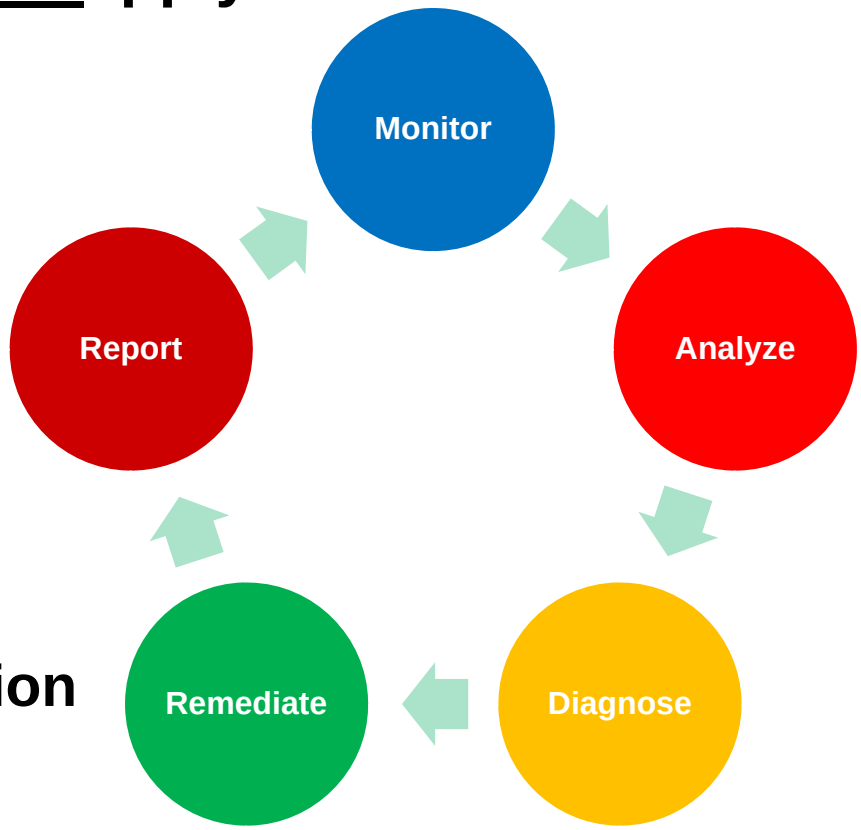
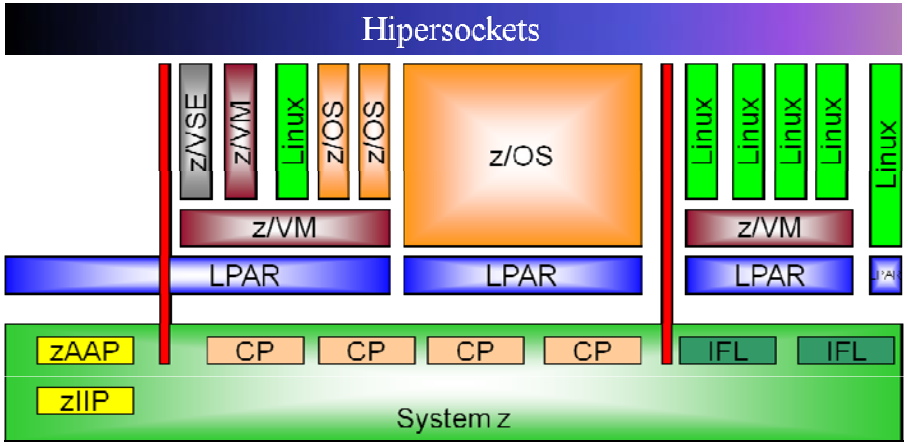


Approaches to Solving Problems

Top Down or Bottom Up doesn't matter
Consistency does

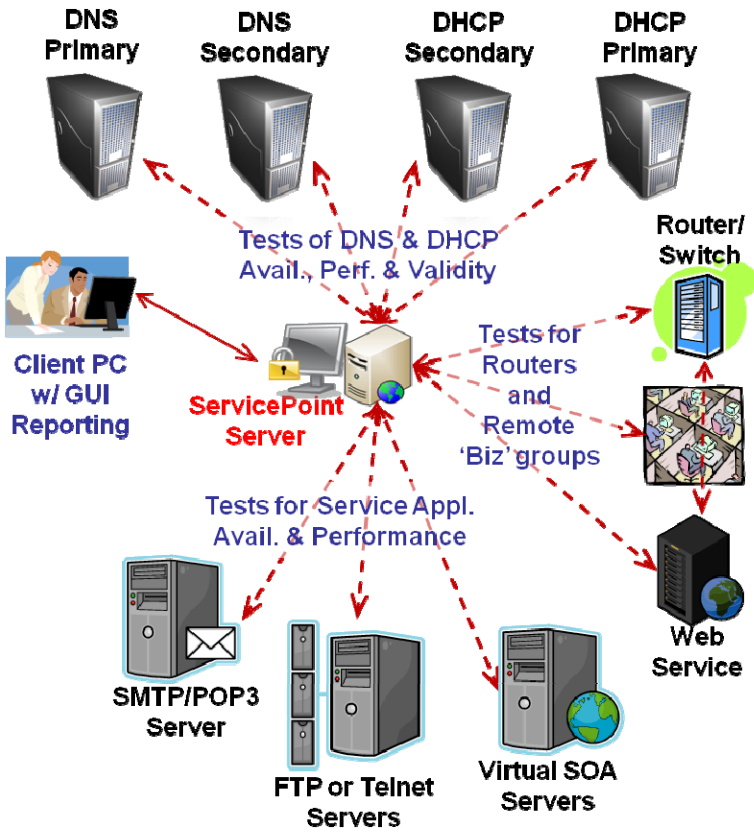
- **Applications**
- **Middleware**
- **Guest OS**
- **VM**
- **Network**



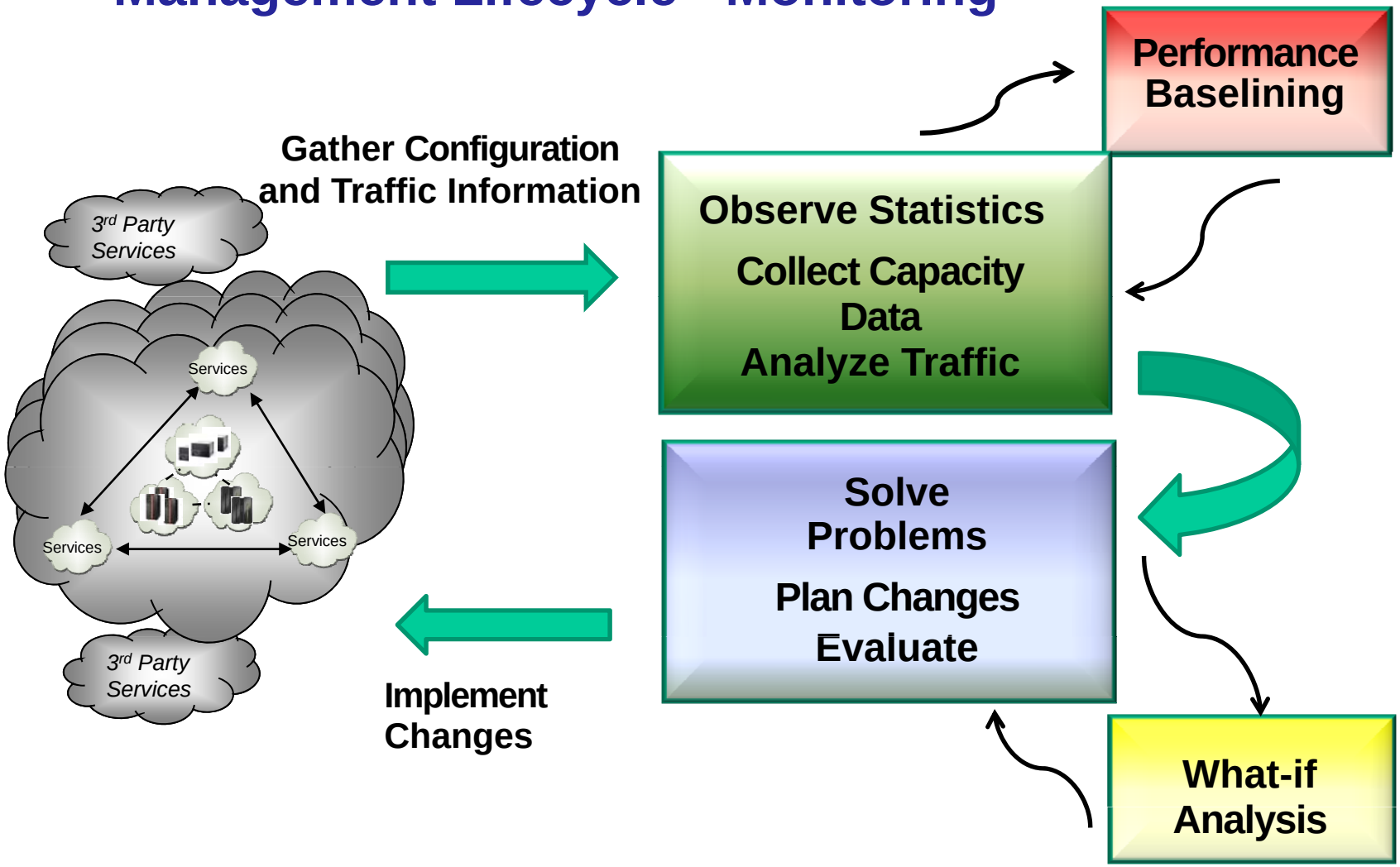
Virtualization Challenges Management Ecosystem

- **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**



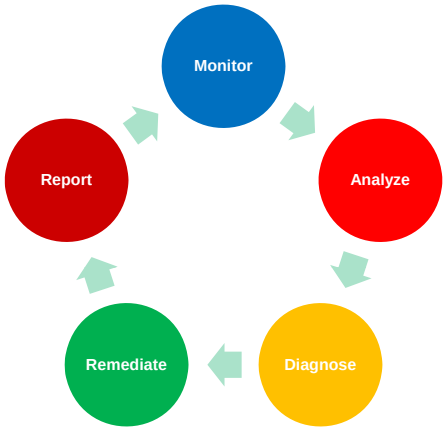
Management Lifecycle - Monitoring



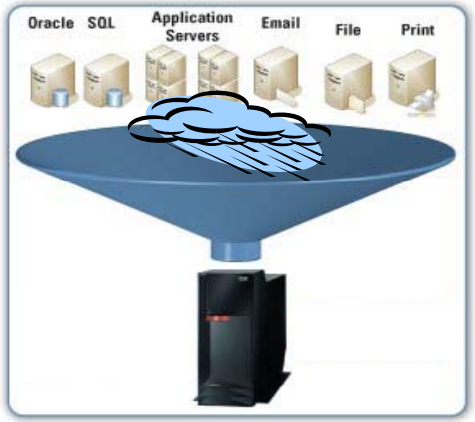
Top Service Management Mistakes

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**

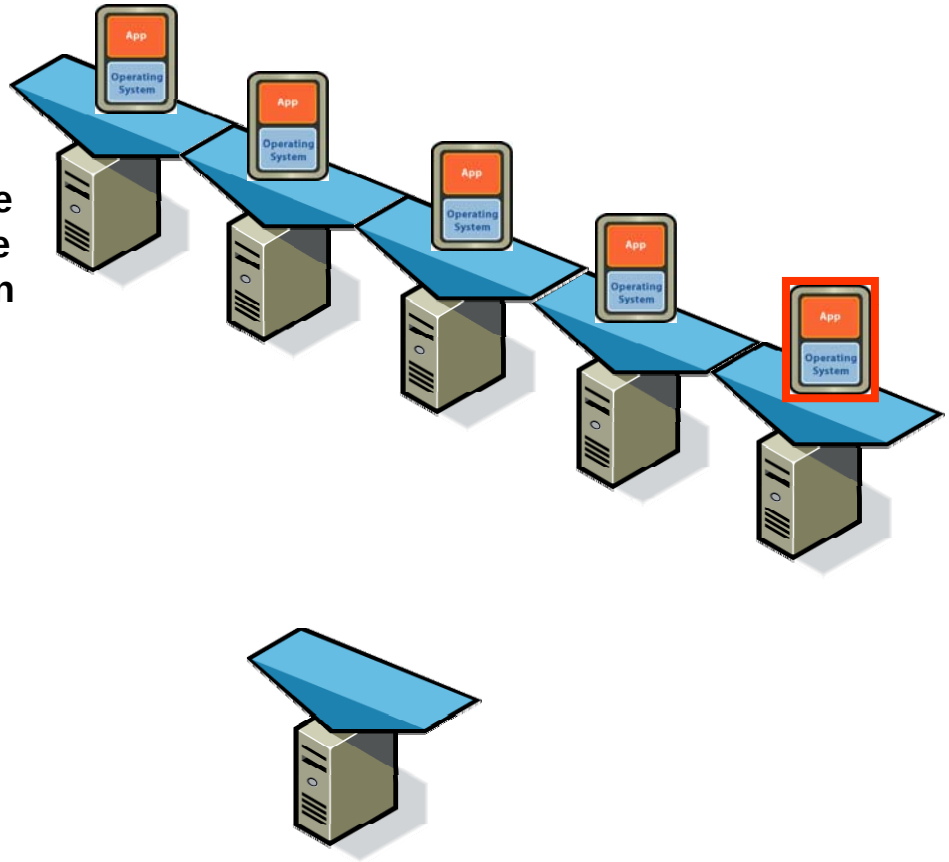


- **Neglecting to periodically and consistently re-examine everything to ensure that all infrastructure components are fully optimized**

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?

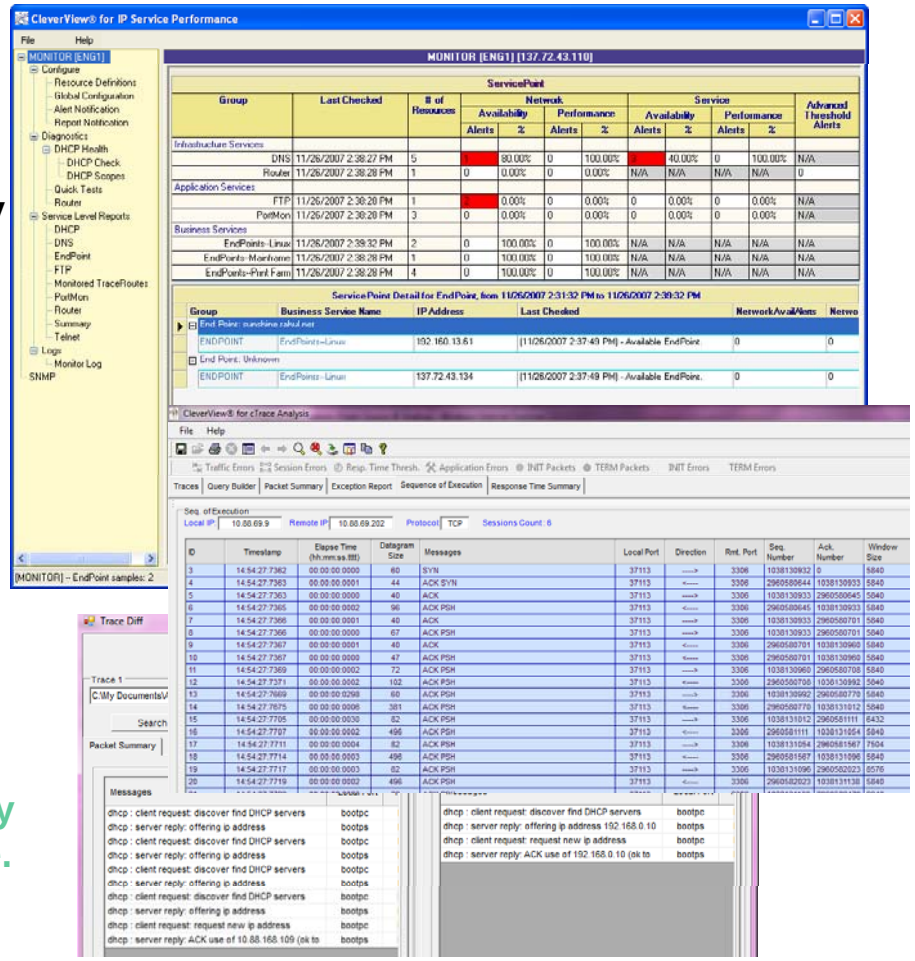
Look at the sequenced packet flows and response times before and after the move

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.



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

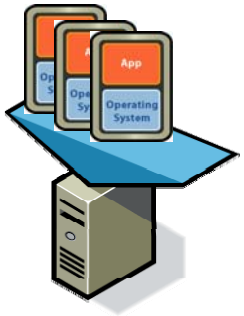
What is the throughput on the connection adapter? Can it handle the load? Is there any time sensitivity?

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

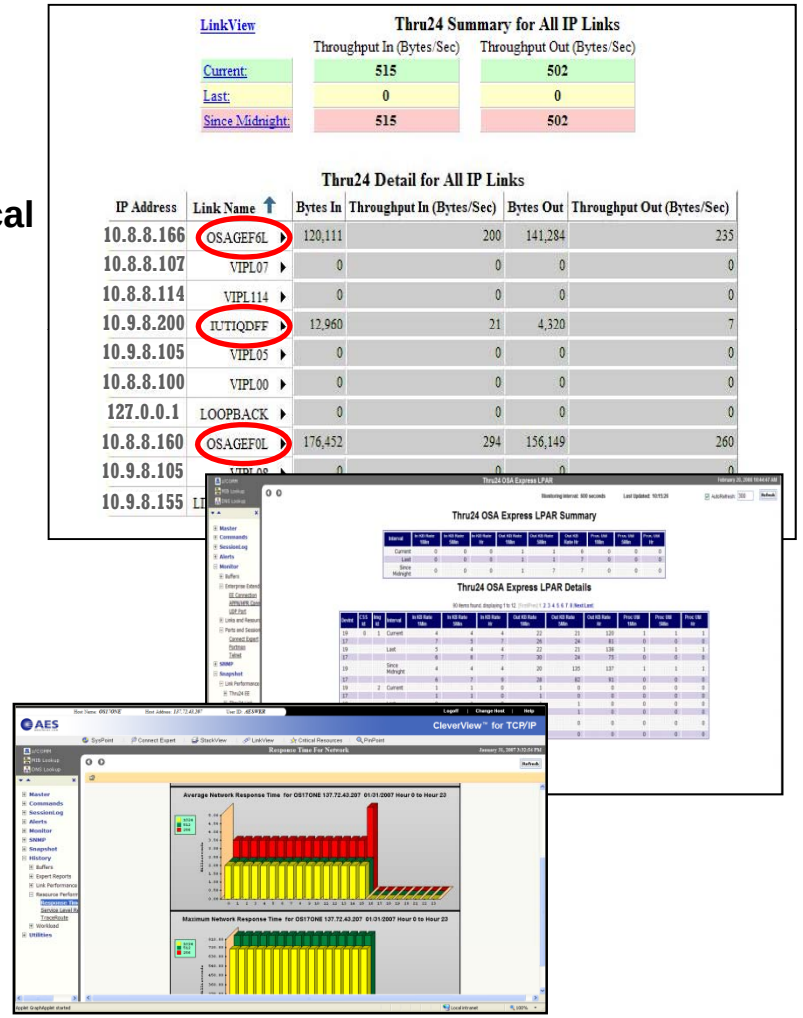
Baseline information is critical regarding how the application worked and utilized resources before and after the virtualization move. This needs to be compared to both real time, near real time and historical information in the virtualized environment

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.

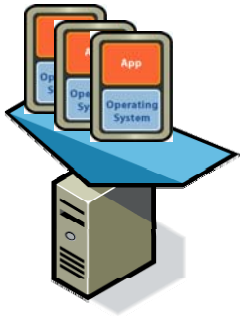


Scenario 3 – Erratic Application Behavior

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?

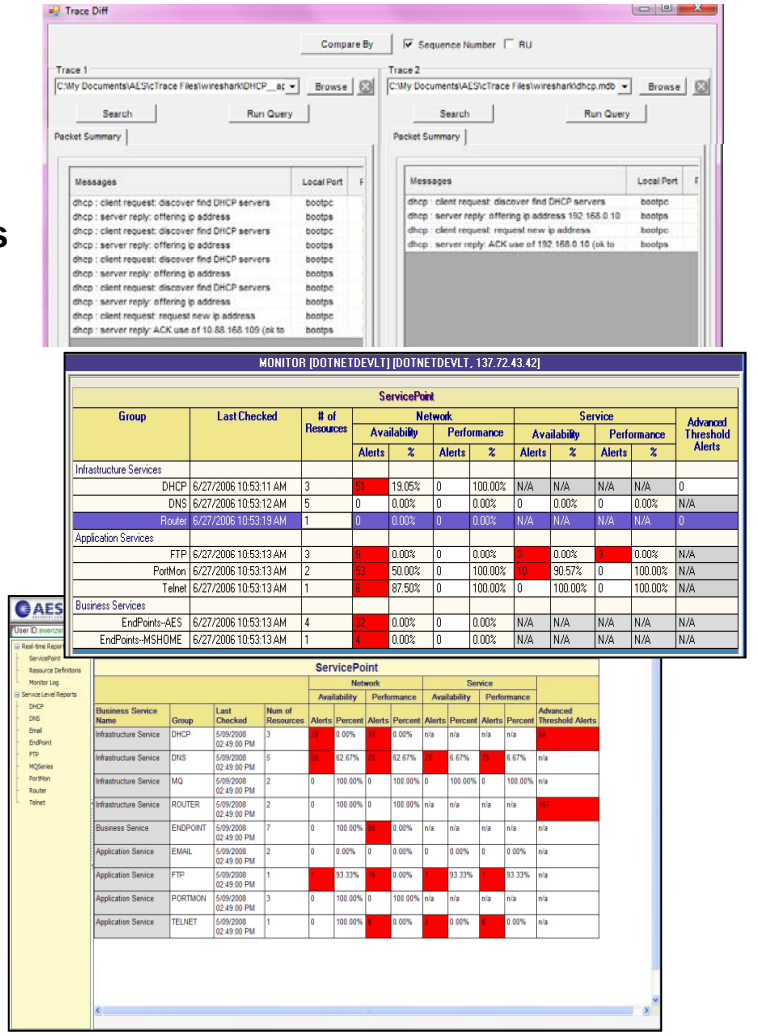
Running a trace before and after the move would allow you to understand if there were any differences in the flows.

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.



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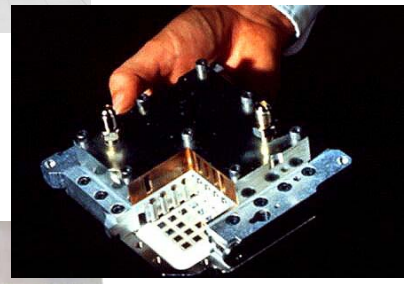


Mainframe Specifics

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
Create a base Server template and create new VMs	
Baseline existing server, application, and infrastructure (DNS, routers, etc) elements for key KPI's	
Deploy Infrastructure on VMs	
Perform virtual machine "internal move"	
Perform virtual machine "external move"	
Repeatedly perform a physical to virtual operation	
Simulated power supply failure testing	
Failover testing of the management modules	
Failover testing of the network switches	

Virtual Infrastructure Report Card	PASS/ FAIL
Server Consolidation	
Increased host resource utilization	
Zero Downtime Upgrades	
Baseline core network elements before and after	
Datacenter relocation with no moving trucks	
Increased server to administrator ratio	
Reduced server deployment times	
Infrastructure cost savings	
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

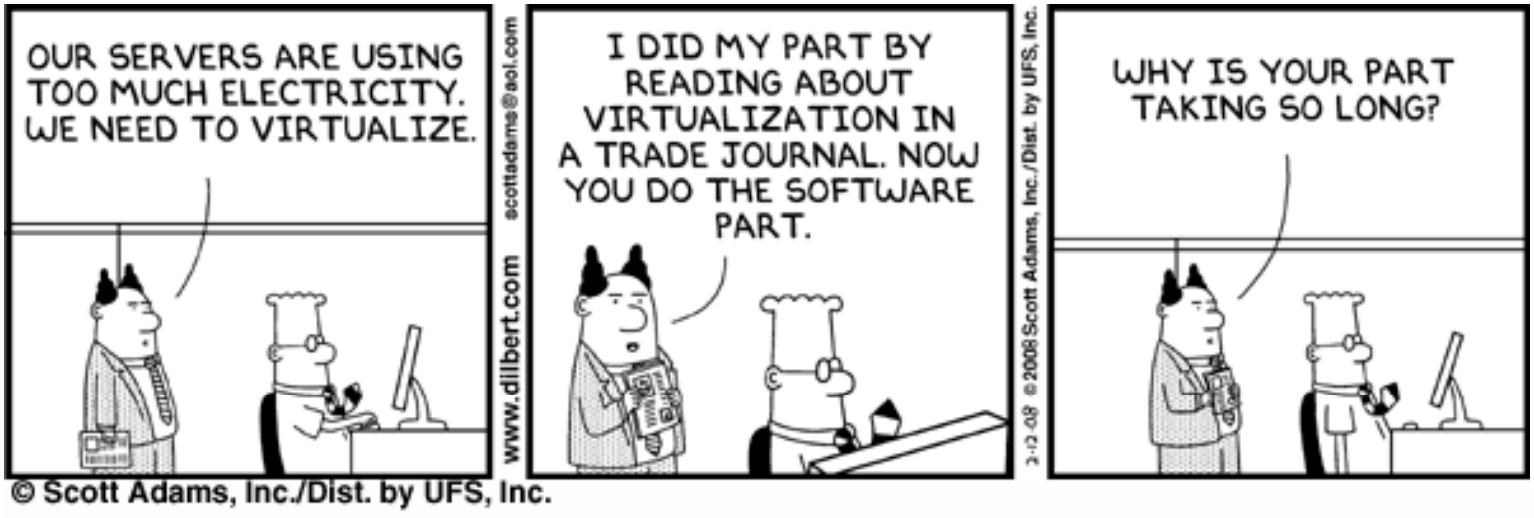
Enhanced VDI Solutions

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

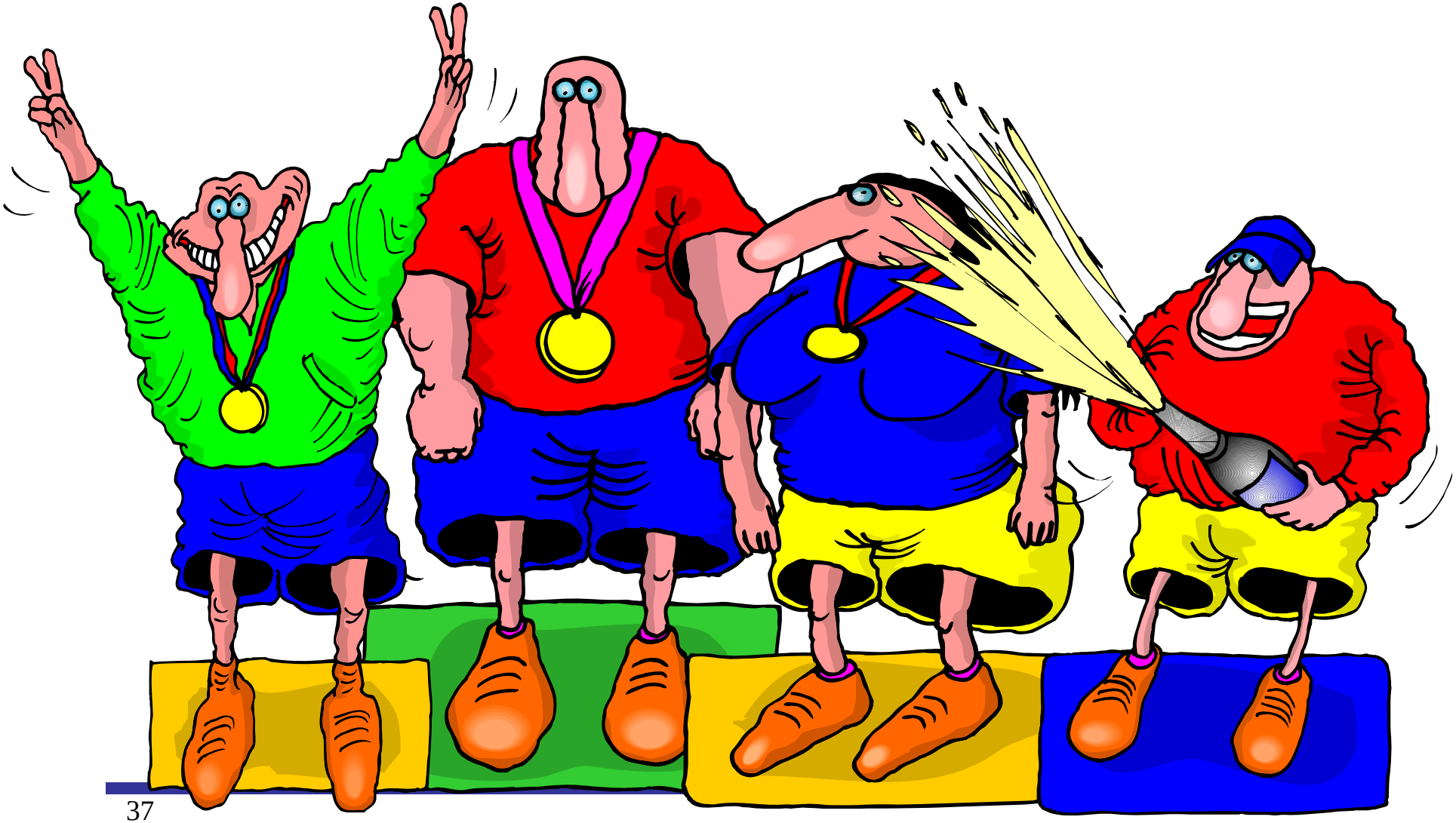
Enhanced Application GRID

- Geographically dispersed application GRID

Truth in Cartoons!



Join the Winners – Virtualize



QUESTIONS?

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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