# Keeping Your Network at Peak Performance as You Virtualize the Data Center

## Share Orlando Session 9288

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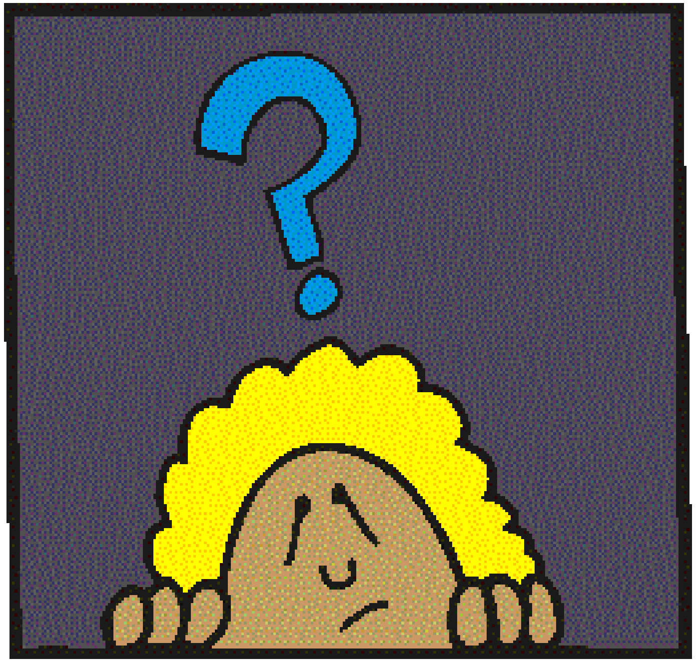
## Background

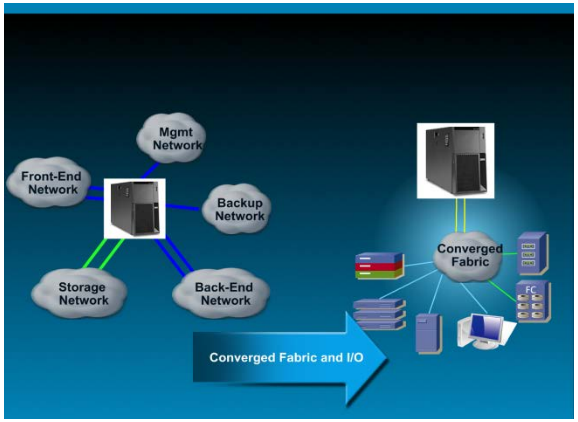
## The Physical Network

## Inside the IP Stack

## Summary



# Right-Sizing IT Infrastructure




**Consolidate…**

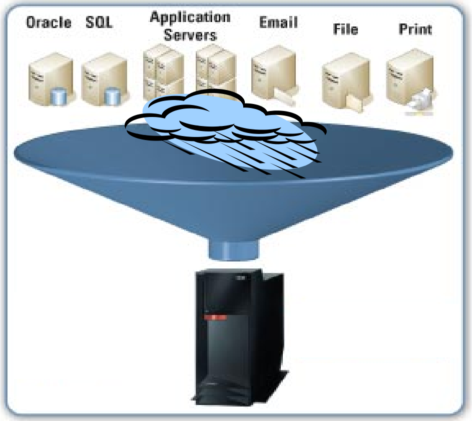
**entire farms of**

**…..servers …**

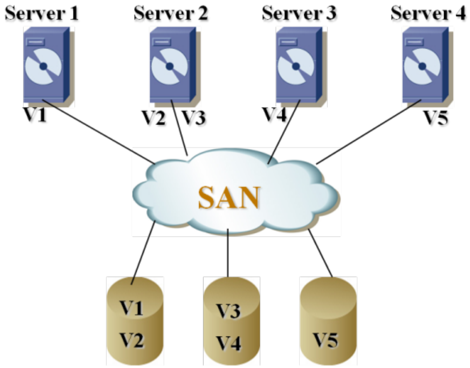
**…..storage…**

**…..network….**

**…..etal**




…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

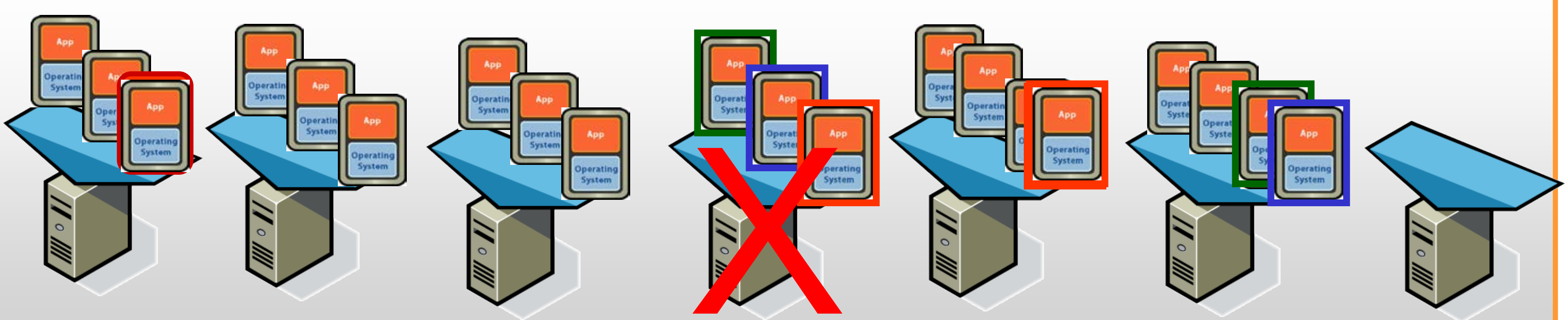
- Balance workloads
- Right-size hardware
- Optimize real time

### High Availability

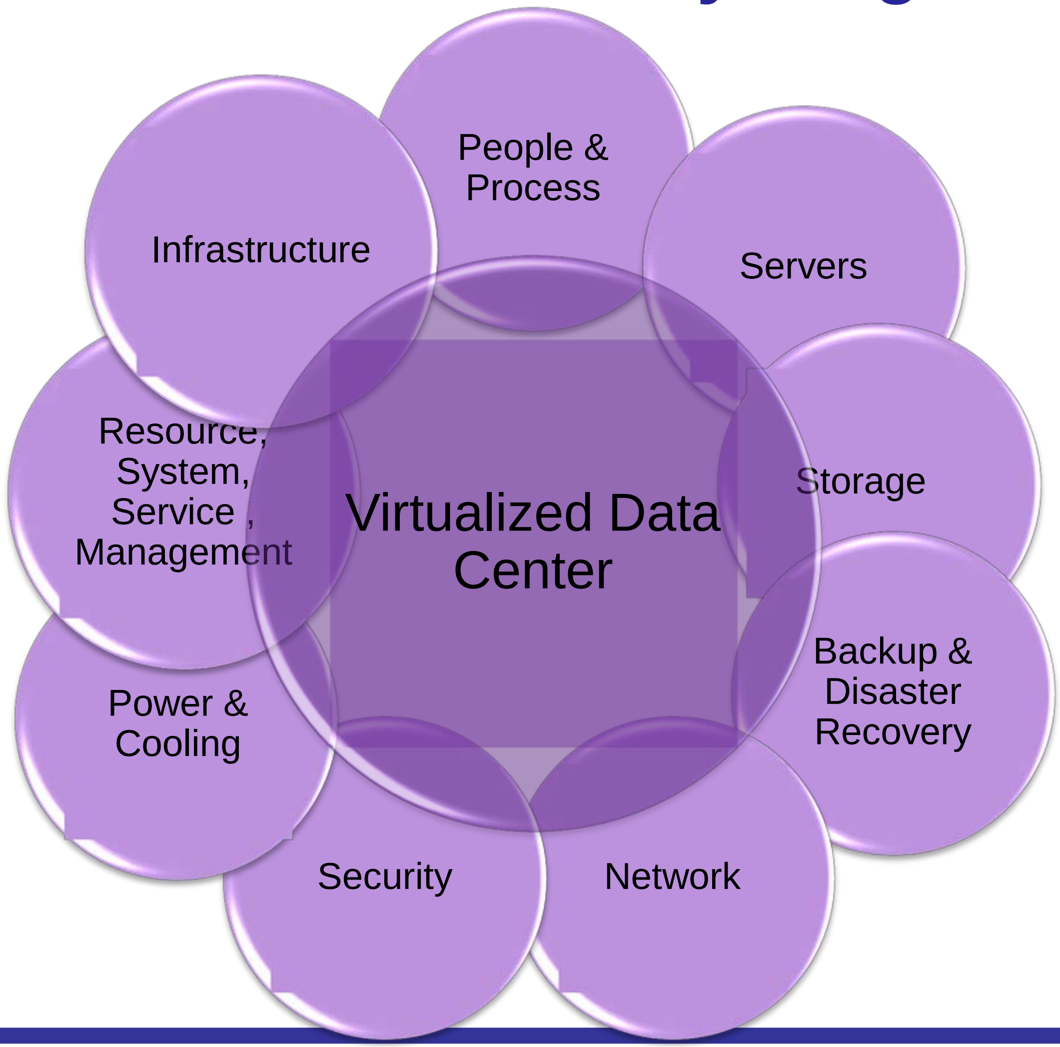
- Restart immediately when H/W or OS fail
- Protect all apps

### On-demand Capacity

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

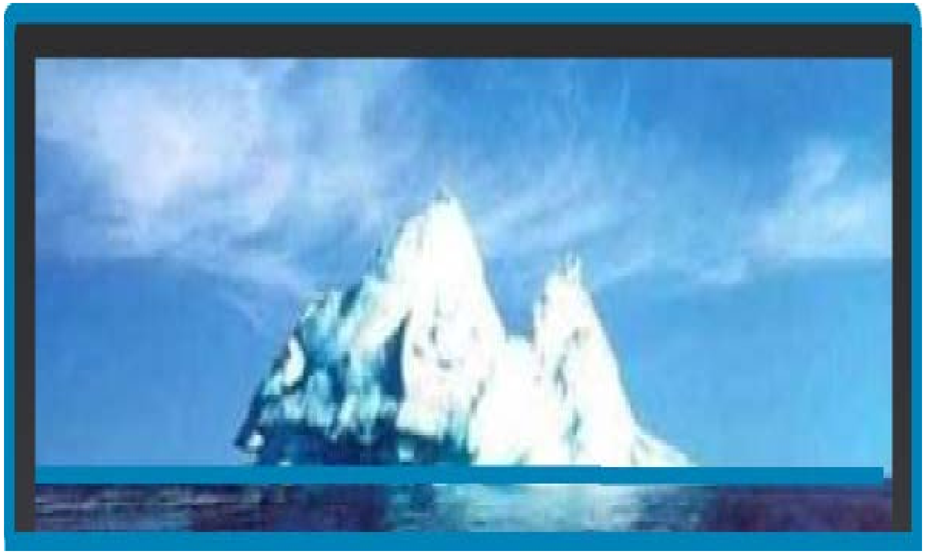


# Virtualization Touches Everything

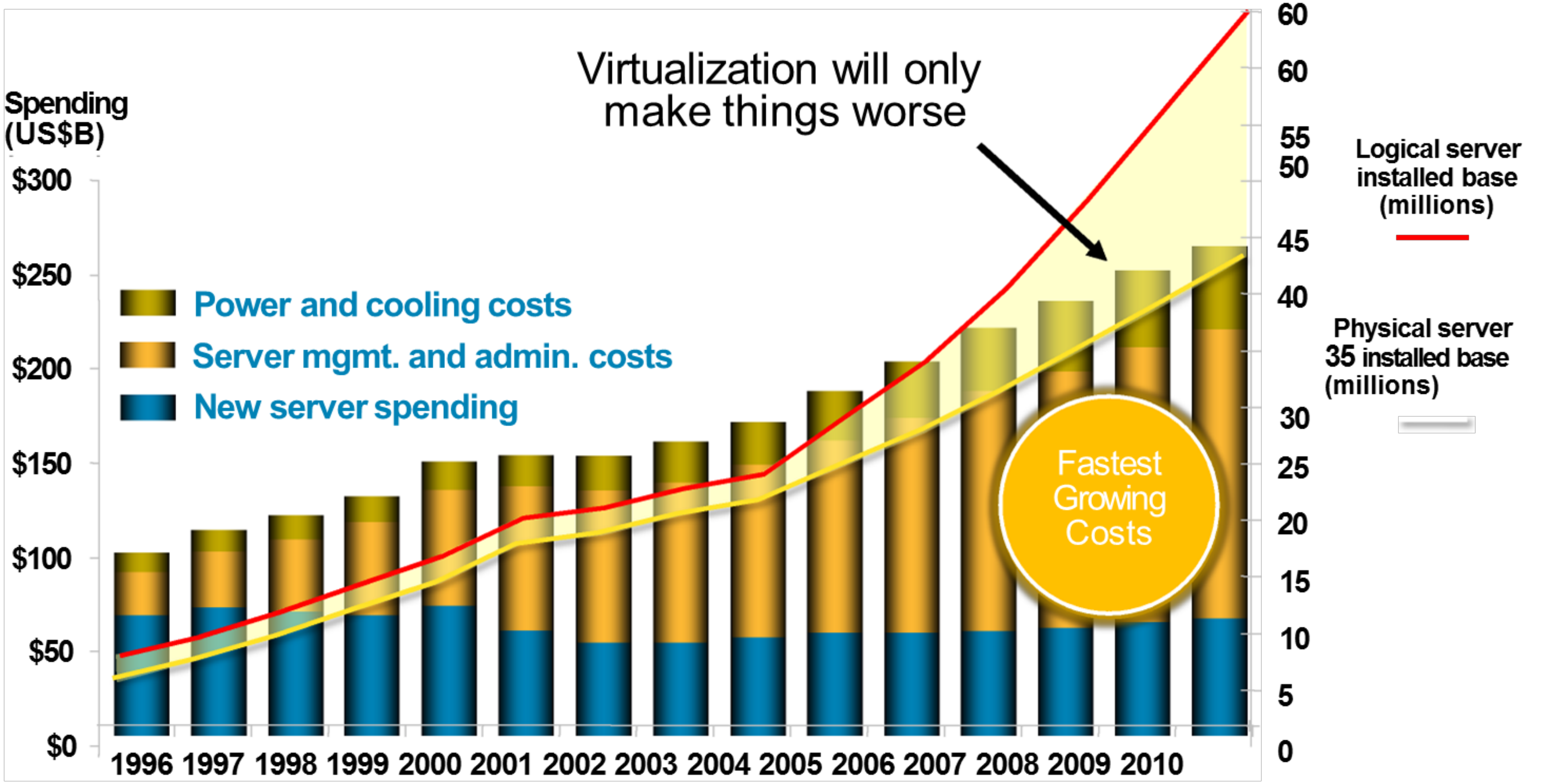


# What's Breaking

- Infrastructure sprawl
- Scaling virtualization
- Sustainable energy efficiency
- Operational complexity
- Intolerance for downtime

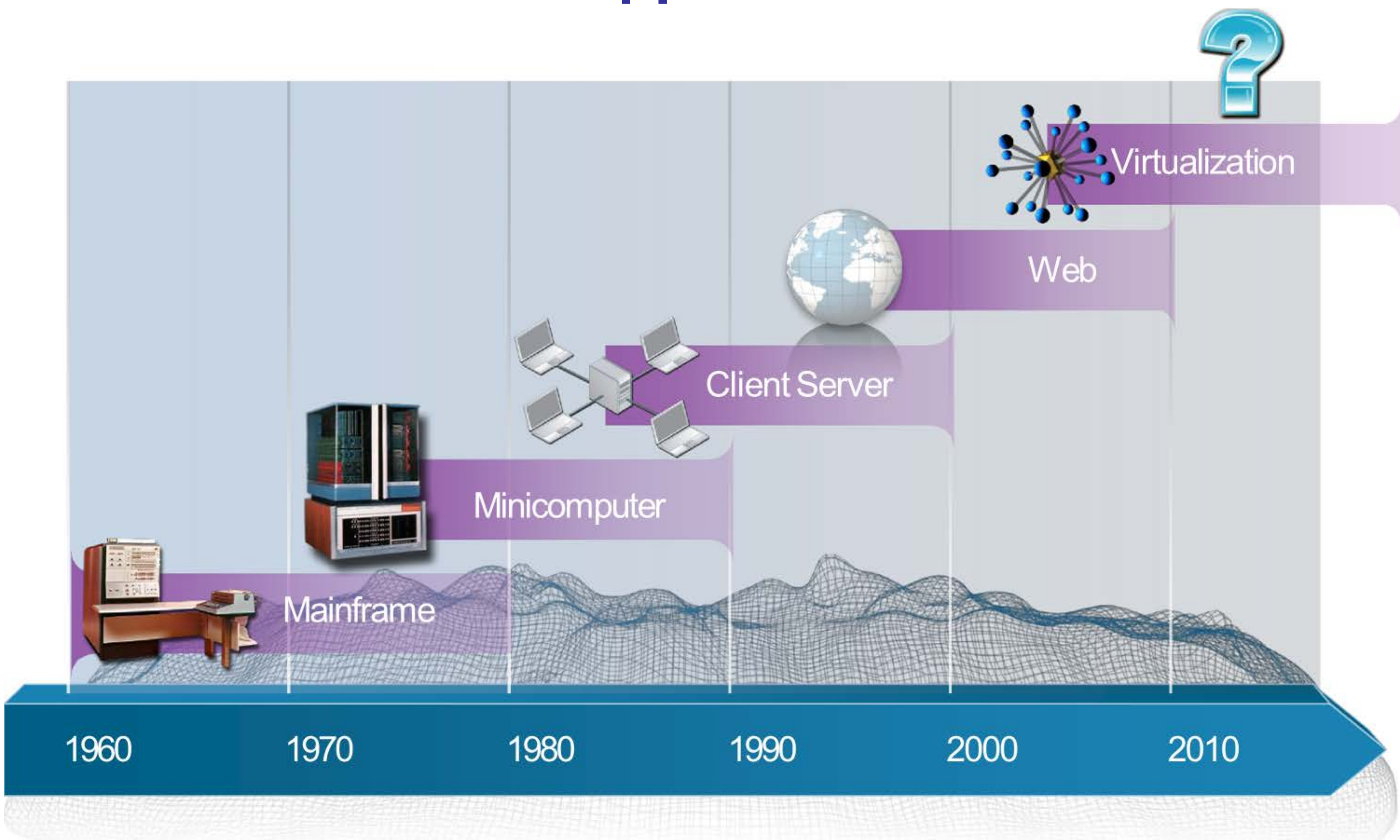


# Operations and Maintenance Growth




Source IDC 2009

# Network Architecture Approach Evolution




Network is a system with applications as objects moving through it

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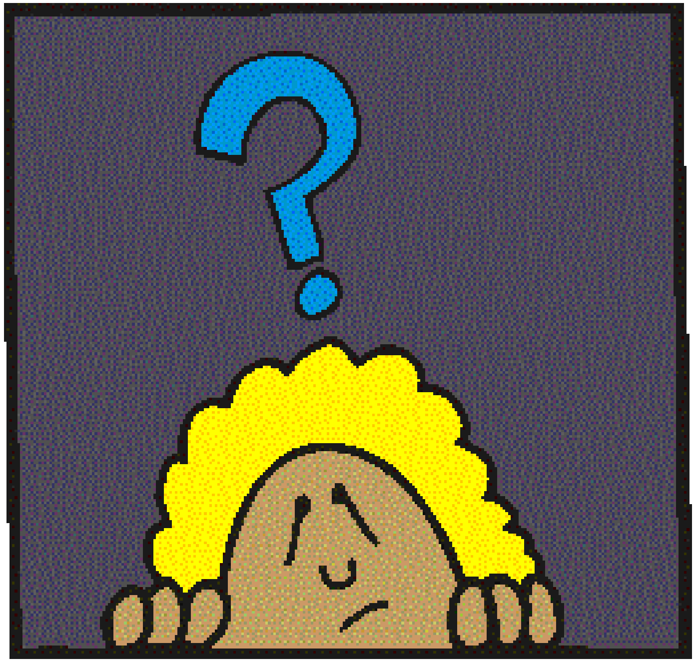
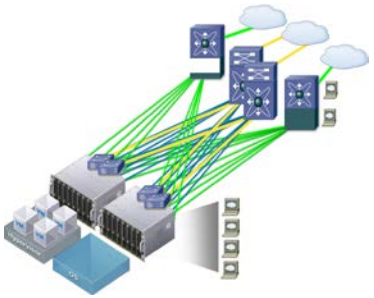
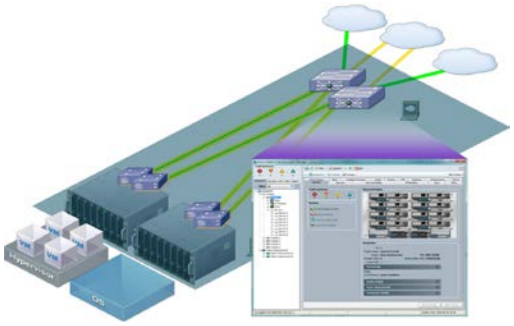


# The Network as a System

- Embedded management and provisioning
- Comprehensive API for integration
- Visibility of network attributes
- Control of network attributes
- Portability of network attributes
- Wire once
- Virtualization aware (no matter what type of virtualization
- Reduce the number of components



OLD



New

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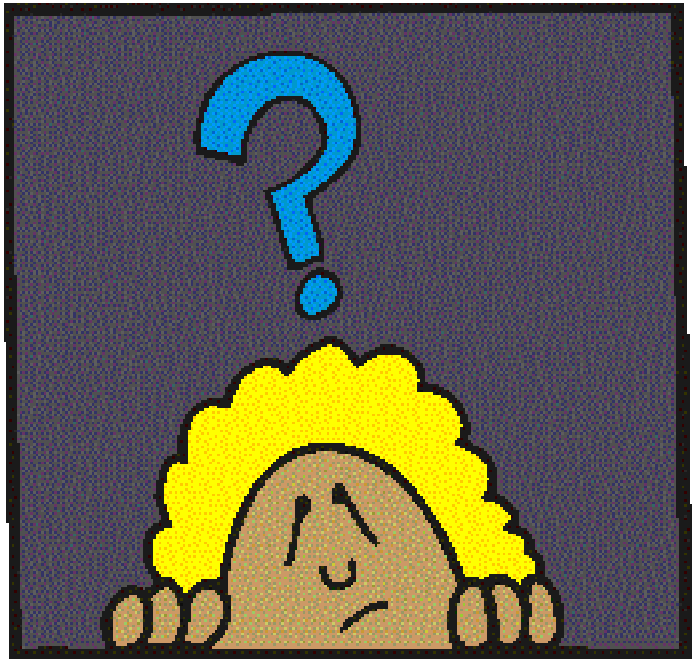
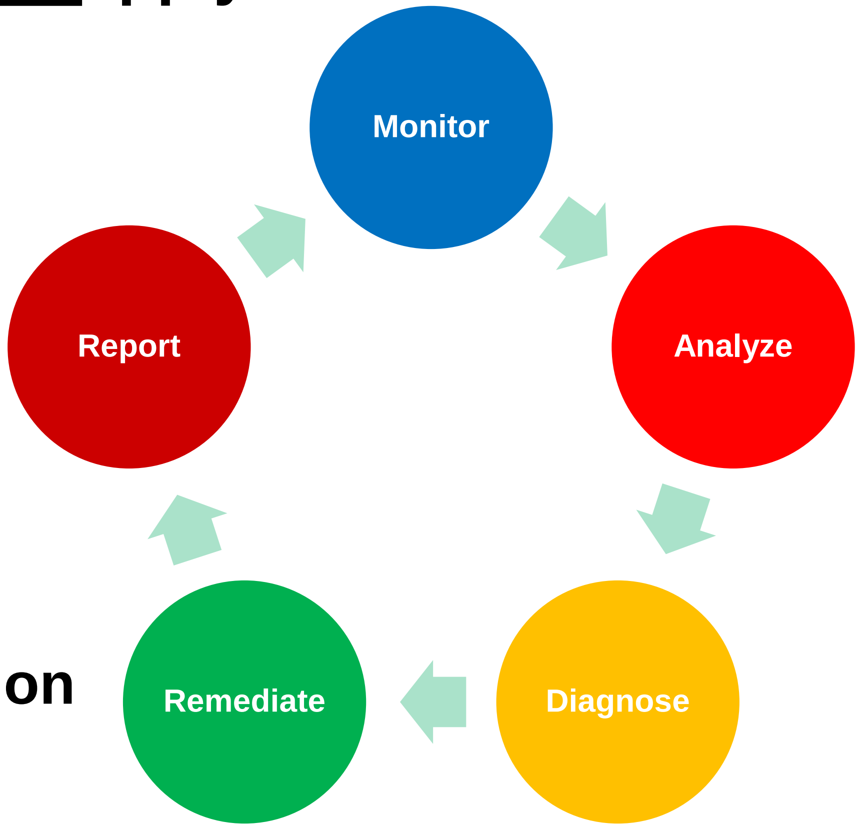


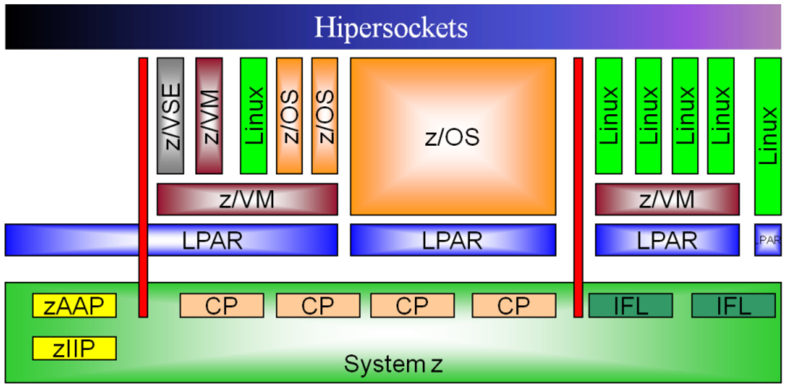
# Managing Virtualized Data Center

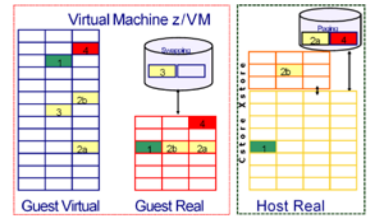
- Fundamentals of management apply FCAPS
  - Fault
  - Configuration
  - Availability
  - Performance
  - Security

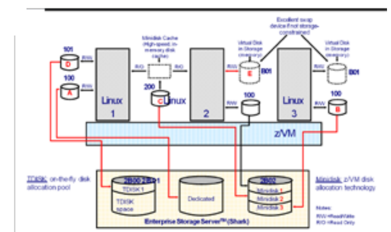


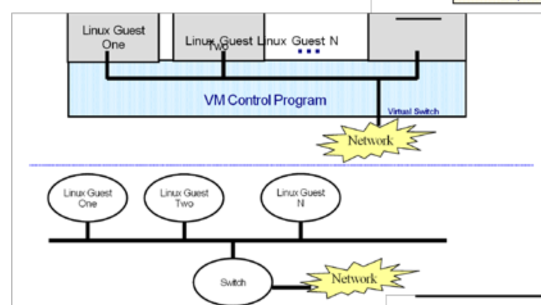

- Leading to
  - Service Level Achievement
  - Optimum Resource Utilization
  - Highly available systems
  - High performing systems

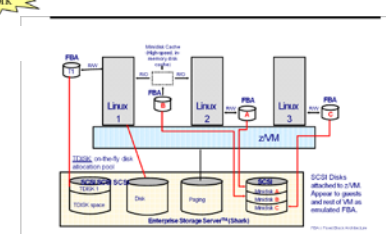
# Advanced Virtualization on System z





- **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)**

# Management Lifecycle - Monitoring

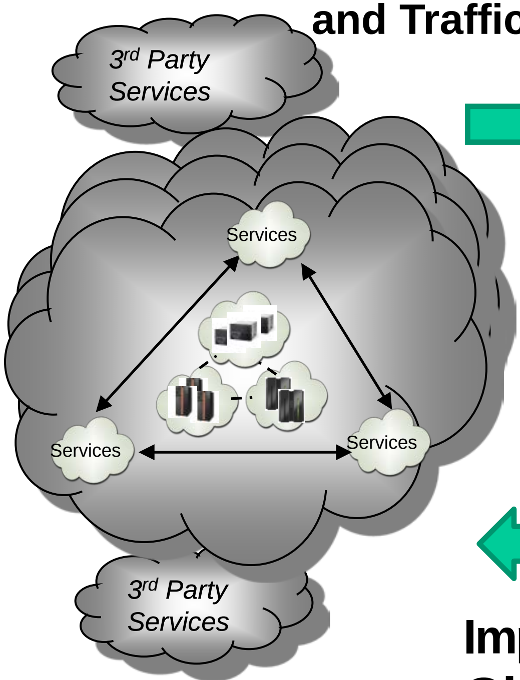
Performance Baselining

Gather Configuration and Traffic Information

Observe Statistics

Collect Capacity Data

Analyze Traffic




Solve Problems

Plan Changes

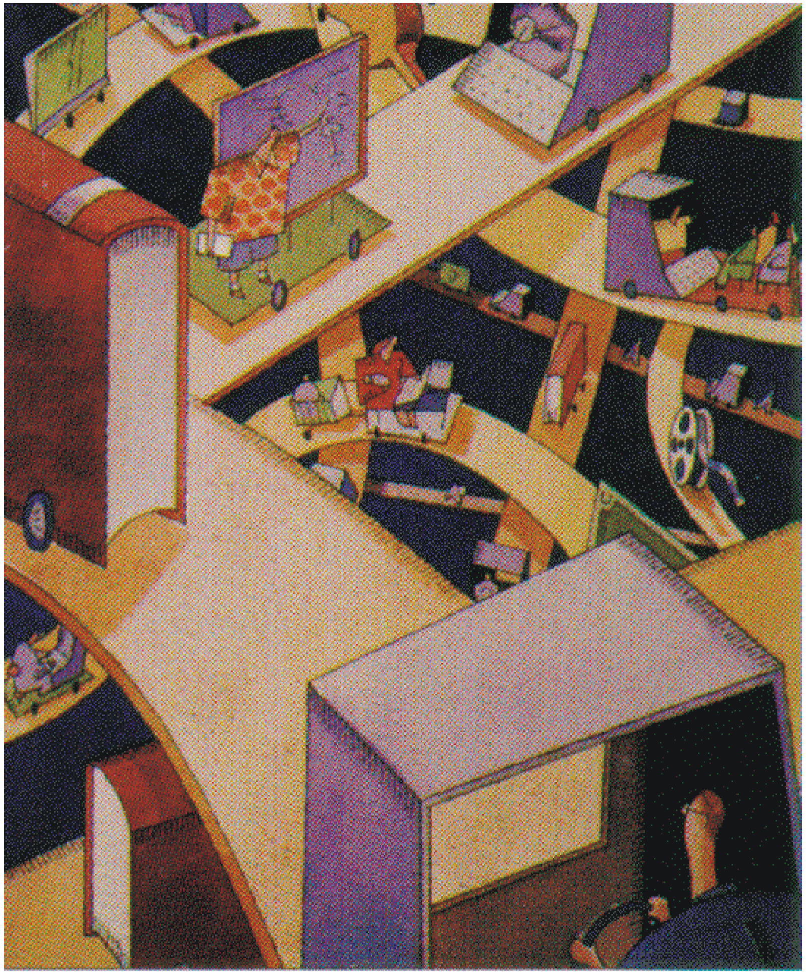
Evaluate

Implement Changes

What-if Analysis

# IP Resource Bottlenecks

CPU
Memory
Buffering, queuing, and latency
Interface and pipe sizes
Network capacity
Speed and Distance
Application Characteristics

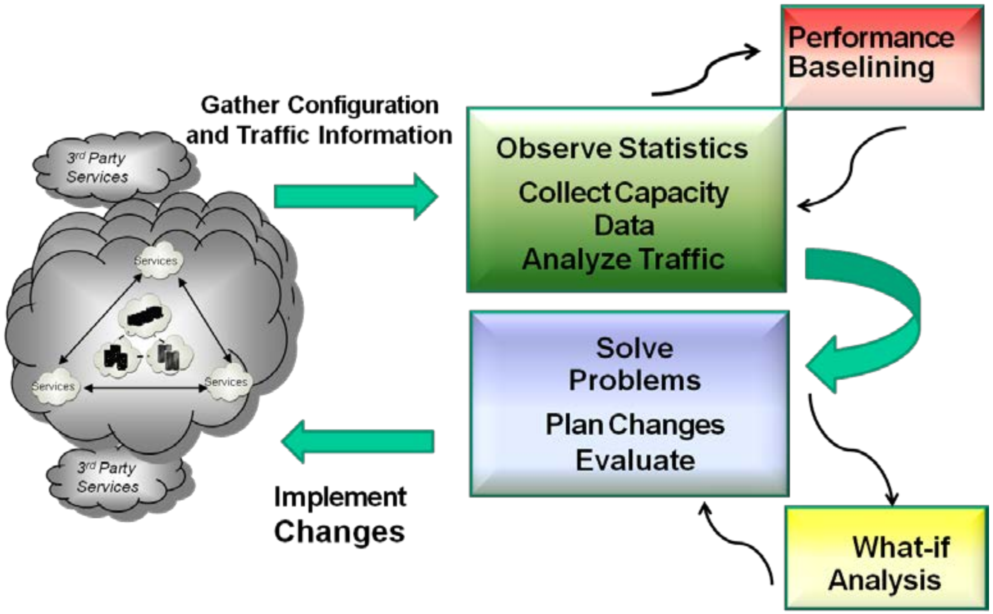


Results in:

Network capacity problems
Utilization overload
Application slowdown or failure

# Information to Collect

- Link/segment utilization
- CPU Utilization
- Memory utilization
- Response Time
- Round Trip Time
- Queue/buffer drops
- Broadcast volumes
- Traffic shaping parameters
- RMON statistics
- Packet/frame drop/loss
- Environment specific



# CPU Utilization

In Virtualized systems CPU utilization can be misleading

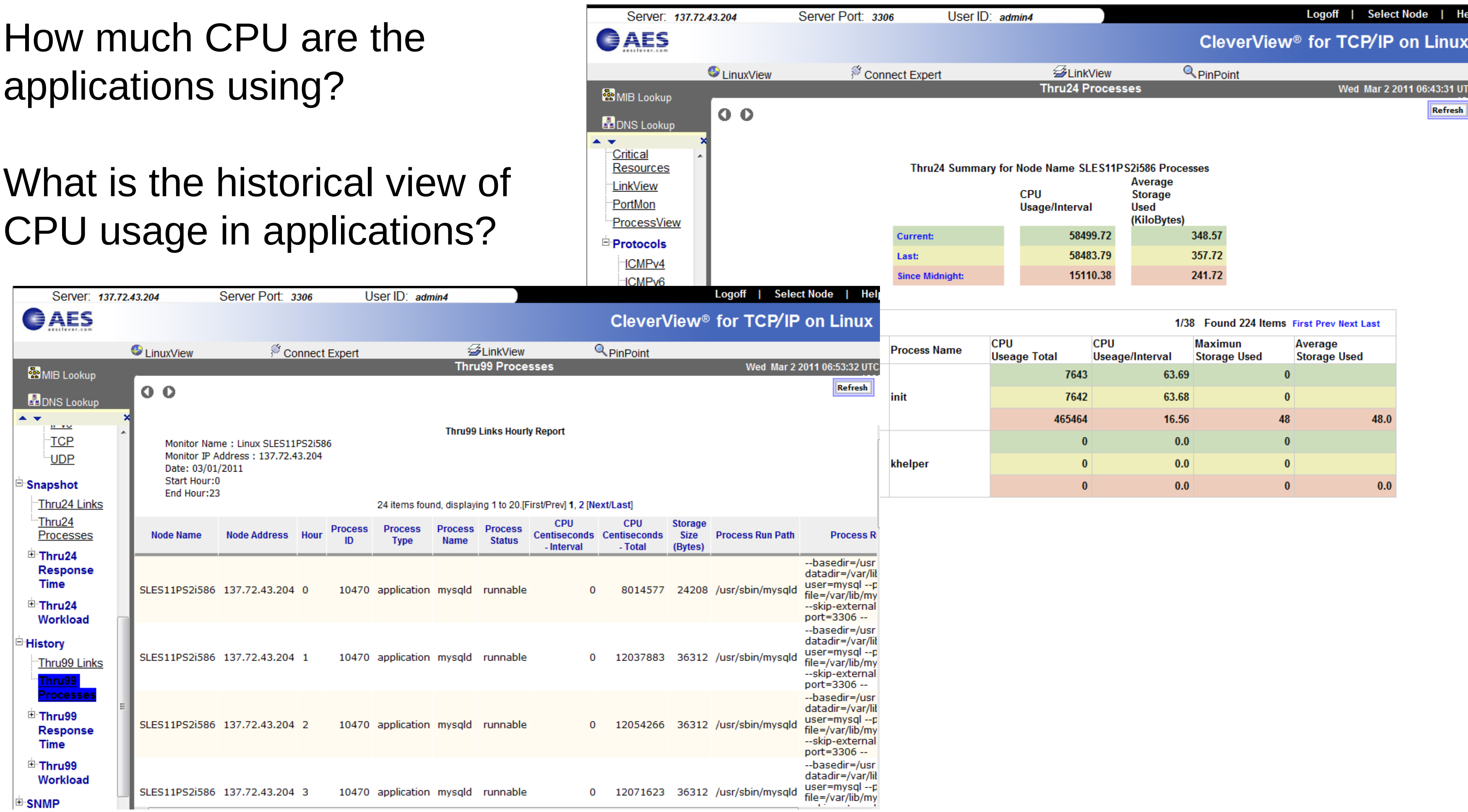
Running low on CPU any system can cause
- immediate application failure
- system slowdown impacting all applications
- need to restart system

Running low on CPU can
- cause immediate application failure
- domino effect on related resources and applications
- intermittent application oddities

# Questions to Answer on CPU Utilization

How much CPU are the applications using?

What is the historical view of CPU usage in applications?



# Scenario 1 – Linux CPU Usage High

## Situation

**A client had a very successful beta with Linux on system z. As they added additional workloads onto the Linux systems overall CPU was increasing much higher then when the application was running on a standalone server.**

## Trouble Shooting

**Using a Linux TCP/IP Monitor check the overall flow of information through both the IP and TCP layers. The CPU utilization was viewed over time. Verify that listeners are available for the applications. View alerts and determine if any would suggest the problem being seen. Check the buffer count. In this system the buffer count had never been raised and was still set at 16.**

## Solution

**Increasing the buffer to 50 reduced the CPU utilization for this linux server as we added more applications.**

As you increase the buffer additional memory will be used

**SUSE SLES11: in /etc/udev/rules.d/51-qeth-0.0.f200.rules add ACTION=="add", SUBSYSTEM=="ccwgroup", KERNEL=="0.0.f200", ATTR{buffer_count}="128"**

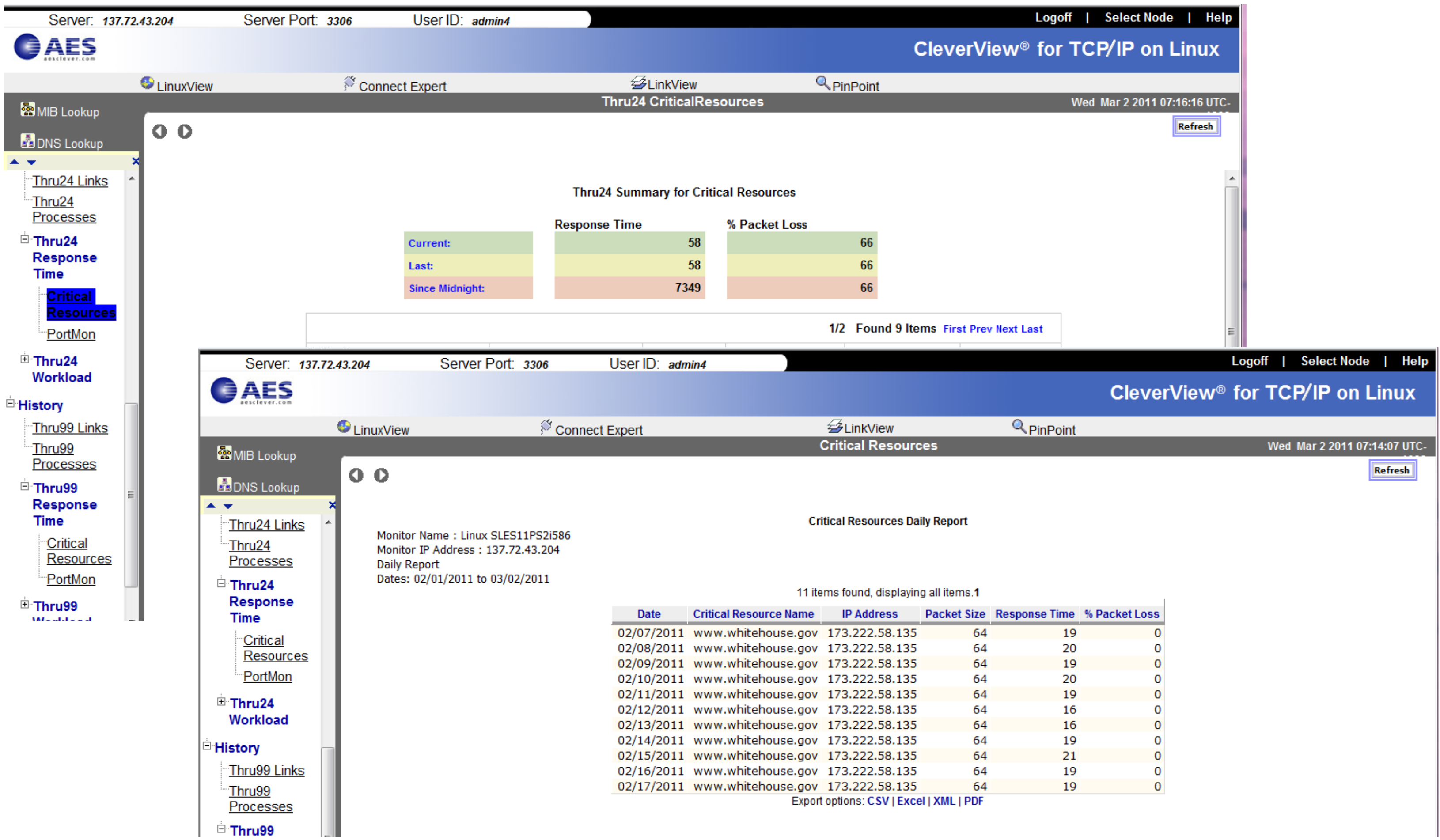
# Response Time

No one is ever happy with what they get

External customers may go elsewhere

Where is the problem?
- Network?
  - Router have long ques?
  - Is the LAN to slow?
  - Is the route long?
- Operating system?
  - Too long to queue for transmit?
- Application?
- Protocol?
  - Window size improperly set?
  - MTU size improperly set?

# Now and Historical Response Time



# Scenario 2– Slow Application Response

## Situation

**A client had a Linux on system environment and they were about ready to grow the production use of Linux. One of the applications accessed an outside website which was critical to the service the application provided. As they moved the application to a virtualized system they noticed a decline in response time. What was causing the added time?**

## Trouble Shooting

**Using a Linux TCP/IP Monitor check the overall flow of information through both the IP and TCP layers. Since outside resources were required they were set up as critical resources and monitored for packet loss and response time. The response times were measured before the move and after the move.**

## Solution

**It was determined that after the move the firewall in front of the virtualized server needed to be reconfigured in order to return the overall response time to normal.**

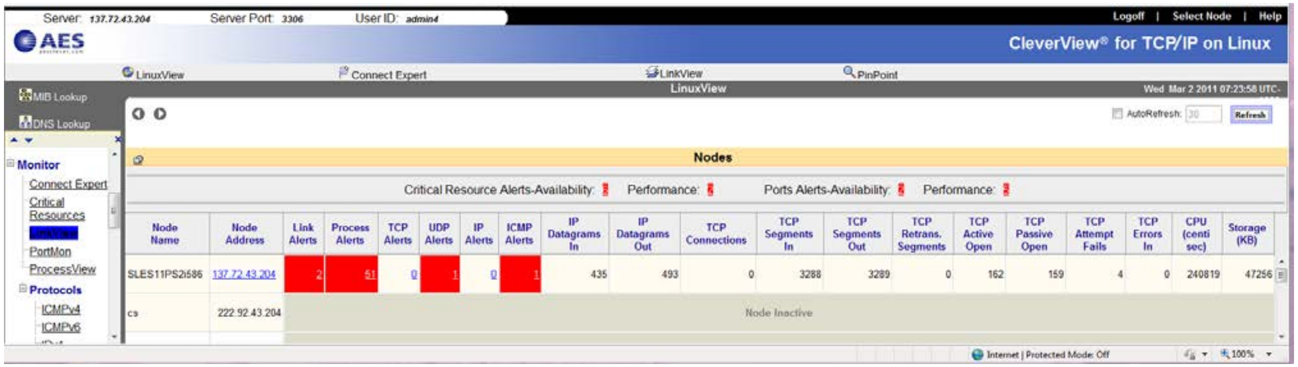
# System Utilization

Since you cannot over-provision your system ( add as much memory as you want, as much DASD, etc) you need to optimize

Determining what is currently being used on the system will assist in determining how much you can grow the system

An application behaving poorly may be due to improper design, improper setting of system resources to use, or application configuration

Sluggishness of a system may be due to not enough CPU, I/O overloads, or queue latencies



# Scenario 3– Can I Add more Applications

## Situation

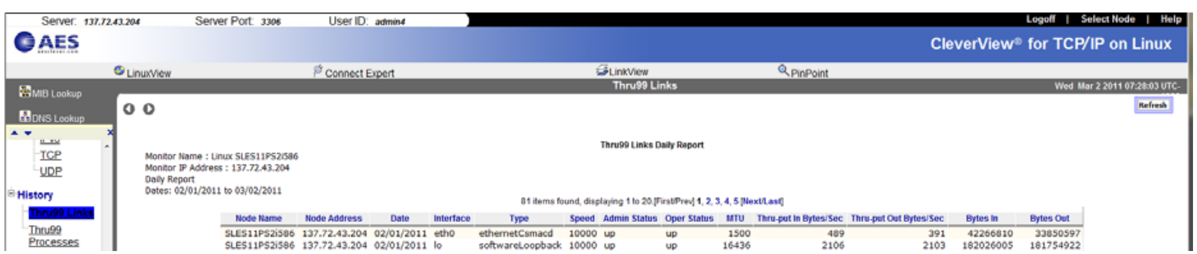
**A task force was recommending adding additional applications to the virtualized mainframe. The initial move went well and they wanted to increase the usage of Linux and decrease their distributed servers. The task force approved the move without looking at any data to see if the system could handle the workload.**

## Trouble Shooting

**Due to the environment OSA was inspected to see if it could handle the traffic. CPU utilization was investigated on both the VM and Linux partitions. On the Linux system the ethernet interface was checked to see how loaded it was. While the task force made a broad and quick decision a lot of worked followed to ensure a tuned system.**

## Solution

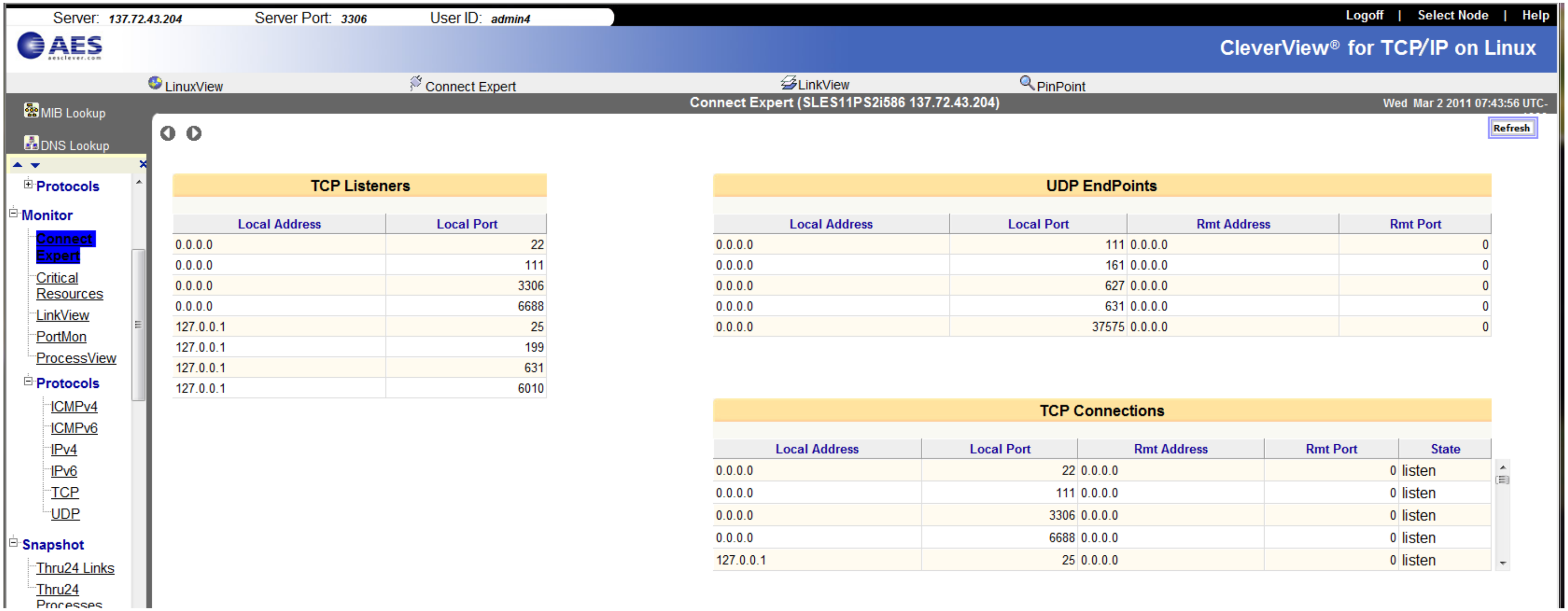
**In order to prevent future fragmentation issues we reset the MTU size to 1492 and defined that as the standard for their linux systems. While this didn't cause an issue when the workload on Linux was small over time it could be a major problem.**



# Overall Connections

Most Resources, applications, network components connect with either TCP or UDP

If a TCP listen is not available then a service will not be able to function




**TCP Listeners**

| Local Address | Local Port |
|---|---|
| 0.0.0.0 | 22 |
| 0.0.0.0 | 111 |
| 0.0.0.0 | 3306 |
| 0.0.0.0 | 6688 |
| 127.0.0.1 | 25 |
| 127.0.0.1 | 199 |
| 127.0.0.1 | 631 |
| 127.0.0.1 | 6010 |

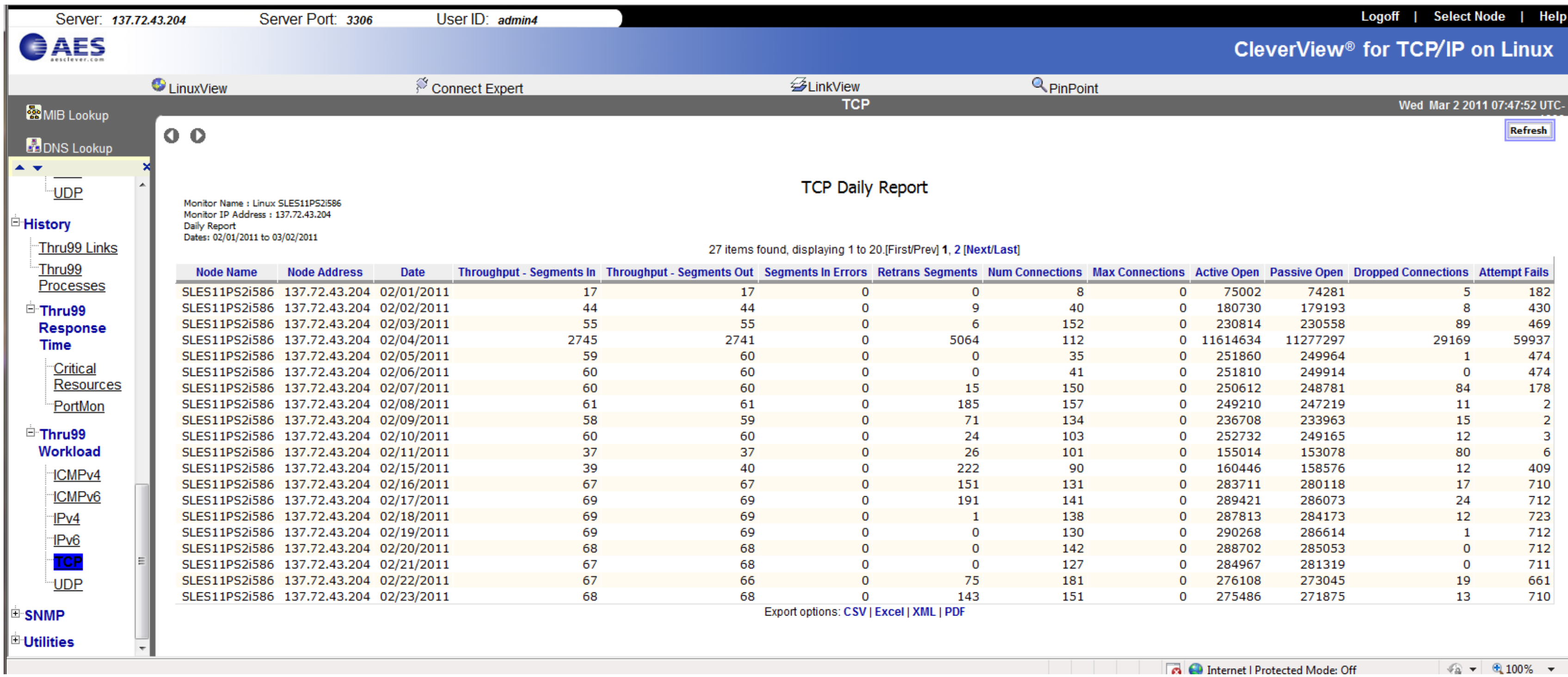
**UDP EndPoints**

| Local Address | Local Port | Rmt Address | Rmt Port |
|---|---|---|---|
| 0.0.0.0 | 111 | 0.0.0.0 | 0 |
| 0.0.0.0 | 161 | 0.0.0.0 | 0 |
| 0.0.0.0 | 627 | 0.0.0.0 | 0 |
| 0.0.0.0 | 631 | 0.0.0.0 | 0 |
| 0.0.0.0 | 37575 | 0.0.0.0 | 0 |

**TCP Connections**

| Local Address | Local Port | Rmt Address | Rmt Port | State |
|---|---|---|---|---|
| 0.0.0.0 | 22 | 0.0.0.0 | 0 | listen |
| 0.0.0.0 | 111 | 0.0.0.0 | 0 | listen |
| 0.0.0.0 | 3306 | 0.0.0.0 | 0 | listen |
| 0.0.0.0 | 6688 | 0.0.0.0 | 0 | listen |
| 127.0.0.1 | 25 | 0.0.0.0 | 0 | listen |

# Connections




TCP Daily Report

Monitor Name : Linux SLES11PS2i586
Monitor IP Address : 137.72.43.204
Daily Report
Dates: 02/01/2011 to 03/02/2011

27 items found, displaying 1 to 20.[First/Prev] 1, 2 [Next/Last]

| Node Name | Node Address | Date | Throughput - Segments In | Throughput - Segments Out | Segments In Errors | Retrans Segments | Num Connections | Max Connections | Active Open | Passive Open | Dropped Connections | Attempt Fails |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SLES11PS2i586 | 137.72.43.204 | 02/01/2011 | 17 | 17 | 0 | 0 | 8 | 0 | 75002 | 74281 | 5 | 182 |
| SLES11PS2i586 | 137.72.43.204 | 02/02/2011 | 44 | 44 | 0 | 9 | 40 | 0 | 180730 | 179193 | 8 | 430 |
| SLES11PS2i586 | 137.72.43.204 | 02/03/2011 | 55 | 55 | 0 | 6 | 152 | 0 | 230814 | 230558 | 89 | 469 |
| SLES11PS2i586 | 137.72.43.204 | 02/04/2011 | 2745 | 2741 | 0 | 5064 | 112 | 0 | 11614634 | 11277297 | 29169 | 59937 |
| SLES11PS2i586 | 137.72.43.204 | 02/05/2011 | 59 | 60 | 0 | 0 | 35 | 0 | 251860 | 249964 | 1 | 474 |
| SLES11PS2i586 | 137.72.43.204 | 02/06/2011 | 60 | 60 | 0 | 0 | 41 | 0 | 251810 | 249914 | 0 | 474 |
| SLES11PS2i586 | 137.72.43.204 | 02/07/2011 | 60 | 60 | 0 | 15 | 150 | 0 | 250612 | 248781 | 84 | 178 |
| SLES11PS2i586 | 137.72.43.204 | 02/08/2011 | 61 | 61 | 0 | 185 | 157 | 0 | 249210 | 247219 | 11 | 2 |
| SLES11PS2i586 | 137.72.43.204 | 02/09/2011 | 58 | 59 | 0 | 71 | 134 | 0 | 236708 | 233963 | 15 | 2 |
| SLES11PS2i586 | 137.72.43.204 | 02/10/2011 | 60 | 60 | 0 | 24 | 103 | 0 | 252732 | 249165 | 12 | 3 |
| SLES11PS2i586 | 137.72.43.204 | 02/11/2011 | 37 | 37 | 0 | 26 | 101 | 0 | 155014 | 153078 | 80 | 6 |
| SLES11PS2i586 | 137.72.43.204 | 02/15/2011 | 39 | 40 | 0 | 222 | 90 | 0 | 160446 | 158576 | 12 | 409 |
| SLES11PS2i586 | 137.72.43.204 | 02/16/2011 | 67 | 67 | 0 | 151 | 131 | 0 | 283711 | 280118 | 17 | 710 |
| SLES11PS2i586 | 137.72.43.204 | 02/17/2011 | 69 | 69 | 0 | 191 | 141 | 0 | 289421 | 286073 | 24 | 712 |
| SLES11PS2i586 | 137.72.43.204 | 02/18/2011 | 69 | 69 | 0 | 1 | 138 | 0 | 287813 | 284173 | 12 | 723 |
| SLES11PS2i586 | 137.72.43.204 | 02/19/2011 | 69 | 69 | 0 | 0 | 130 | 0 | 290268 | 286614 | 1 | 712 |
| SLES11PS2i586 | 137.72.43.204 | 02/20/2011 | 68 | 68 | 0 | 0 | 142 | 0 | 288702 | 285053 | 0 | 712 |
| SLES11PS2i586 | 137.72.43.204 | 02/21/2011 | 67 | 68 | 0 | 0 | 127 | 0 | 284967 | 281319 | 0 | 711 |
| SLES11PS2i586 | 137.72.43.204 | 02/22/2011 | 67 | 66 | 0 | 75 | 181 | 0 | 276108 | 273045 | 19 | 661 |
| SLES11PS2i586 | 137.72.43.204 | 02/23/2011 | 68 | 68 | 0 | 143 | 151 | 0 | 275486 | 271875 | 13 | 710 |

Export options: CSV | Excel | XML | PDF

# Scenario 4– Excessive Segmentation

## Situation

**As you can see on the previous chart on 2/4/2011 there were a significant number of segmented TCP packets, dropped connections, and failed attempts. What was going on?**

## Trouble Shooting

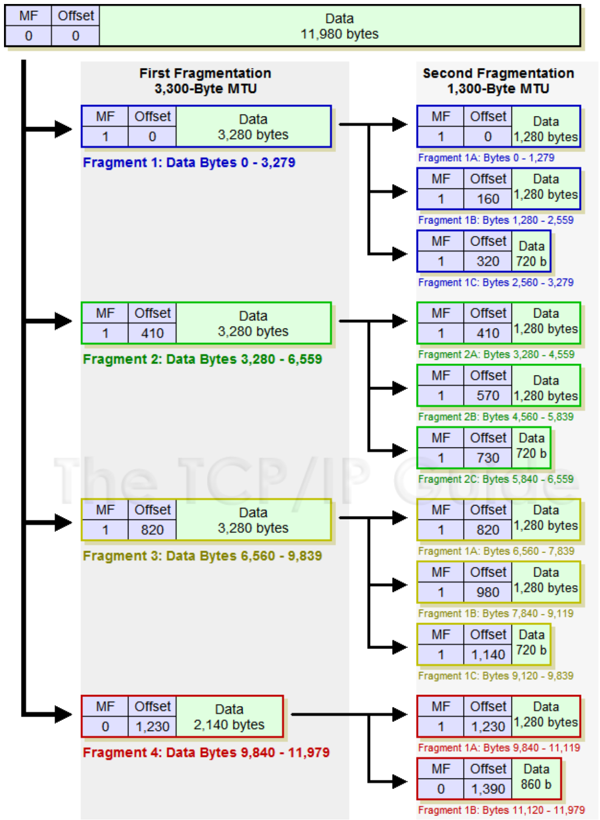
**Using a Linux TCP/IP Monitor check the overall flow of information through both the IP and TCP layers. The OSA adapter was inspected and traffic was moving through it smoothly. Look at the MTU settings on your links and the fragmentation on the IP stack. While there was not significant fragmentation, the MTU size was set at 1500. This wasn't a good value for IP fragments, but this would not impact TCP Segmentation.**

## Solution

**It was clear that this Linux system was not using 'Large-Send' The default for Linux is no. We changed this to TSO which now had segmentation done by the OSA adapter freeing up resources in the Linux system.**

# MTU Size

- Optimizing MTU size can provide optimum performance improvements
- Set the maximum size supported by all hops between the source and destination
- Traceroute can provide details on the MTU size but some router administrators block traceroute
- If you application sends
- frames <= 1400 bytes use an MTU size of 1492
- Jumbo frames use and MTU size of 8992
- TCP uses MTU size for window size calculation
- For VSWITCH an MTU of 8992 is recommended



# Scenario 6– Excessive Fragmentation

## Situation

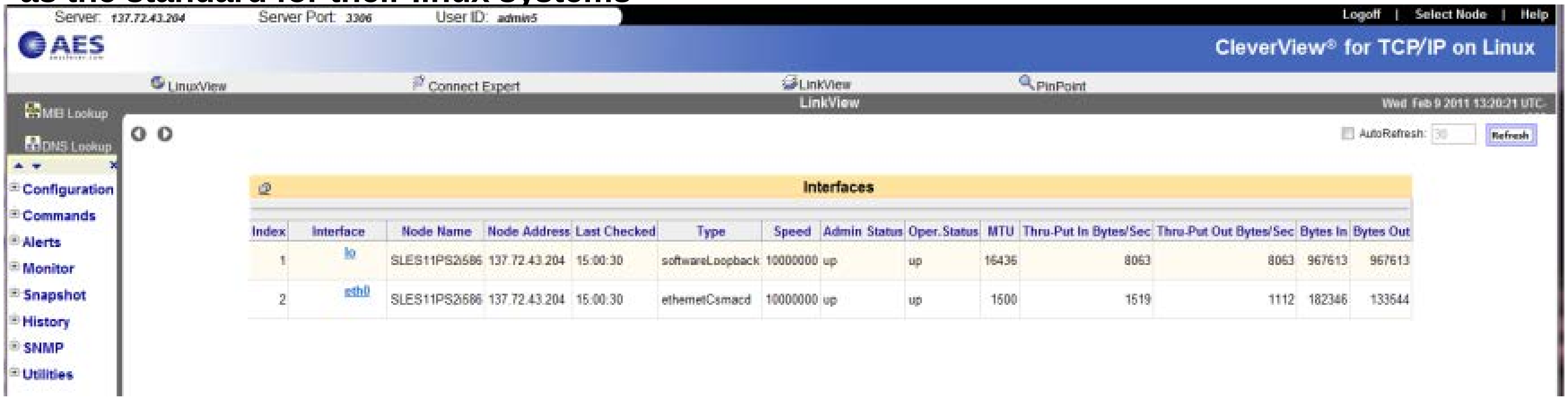
**A client had a Linux on system environment and they were about ready to grow the production use of Linux. While they did not have any major problems they new of they asked for an overall health check.**

## Trouble Shooting

**Using a Linux TCP/IP Monitor check the overall flow of information through both the IP and TCP layers. Look at the MTU settings on your links and the fragmentation on the IP stack. While there was not significant fragmentation, the MTU size was set at 1500.**

## Solution

**In order to prevent future fragmentation issues we reset the MTU size to 1492 and defined that as the standard for their linux systems**



# Linux: OSA LAN Timer or Blocking Timer

## OSA inbound blocking function

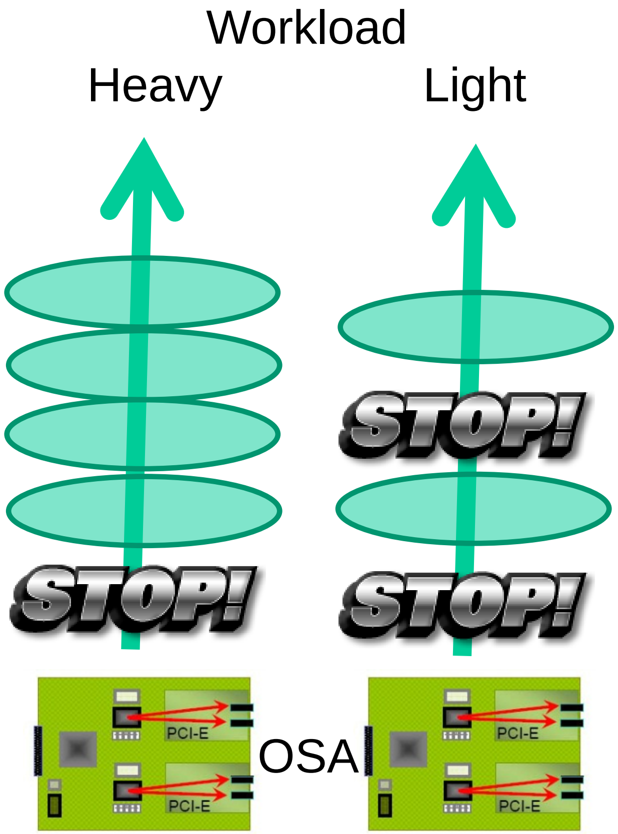
- Determines how long OSA will hold packets
- Indirectly affects
  - Frequency of host interrupt
  - Payload per interrupt

## Linux has 3 potential values for OSA2

- For frames under 1536:Time between 2 incoming packets
- For Jumbo frames: Duration of inter-packet gap
- Total duration that OSA holds a single inbound buffer
- Default mode is NO LAN idle which is a good compromise for both transactional and streaming workloads

## Linux behaves differently with OSAExpress3

- Using the default for OSA2 results in short latency but high CPU utilization



# Scenario 7 – High CPU Utilization after move to OSA3

## Situation

**A system with an even mix of transactional and streaming workloads had a hardware upgrade and was now running with an OSA3 adapter. The Linux CPU became excessively high for no clearly visible reason.**

## Trouble Shooting

**Historical data was viewed to ensure that the spike in CPU activity did occur when the OSA3 adapter was activated. In viewing the bytes in/out and other workload data no glaring inconsistencies were seen.**

## Solution

**When the change was made the original OSA2 values for BLKT were used (inter=0, inter_jumbo=0, total=0). Due to the difference in OSA2 and OSA3 behavior these numbers were changed (inter=5, inter_jumbo=15, total=250). CPU utilization returned to normal**

OSA2 default value on OSA3 results in shortest latency and highest CPU utilization

Best to use MTU size of 1492 for OSA3

Supported in
SLES10SP3+kernel update
SLES 11
RHEL 5.5

**Red Hat: /etc/sysconfig/network-scripts/ifcfg-eth0 add OPTIONS="blkt/inter=5 blkt/inter_jumbo=15 blkt/total=250"**

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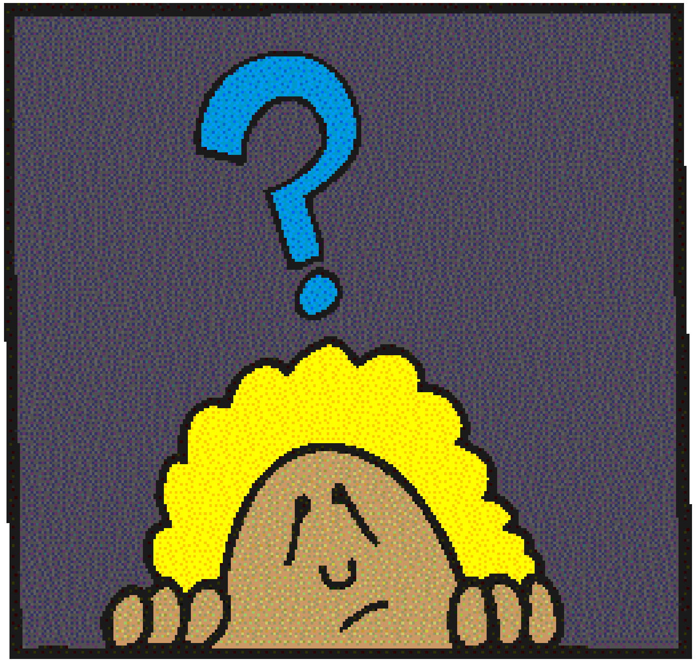
## Inside the IP Stack

## Summary



# Steps to Effective Performance Management

**Baseline**

Baselines over a long period of time to develop utilization, resource. growth and shrinking trends

**Setup Alarms and Thresholds**

What-if analysis prior to deployment

**Excessive Missed Faults**

Performance exception reporting

Analyze the capacity information

**Monitor**

Review baseline, exception, and capacity information on a periodic bases

# Murphy's Law

If anything can go wrong, it will

If anything just cannot go wrong it will

Left to themselves, things tend to go from bad to worse

If everything seems to be going well, you have obviously overlooked something

# AES Sessions at Share

Aug 8, 2011: 1:30-2:30 9288: Keeping Your Network at Peak Performance as You Virtualize the Data Center
Aug 10, 2011: 8:00-9:00 9266: IPv6 Basics
Aug 10, 2011: 4:30-5:30 9270: Managing an IPv6 Network
Aug 11, 2011: 3:00-4:00 9273: CSI Maui: Forensics in The Case of the Attacked Browsers
Aug 11, 2011: 11:00-12:00 9277: Implementing IPv6 on Windows and Linux Desktop
Aug 11, 2011: 1:30-2:30 9290: **Network Problem Diagnosis with OSA Examples**
Aug 12, 2011: 8:00-9:00 9308: TCP/IP Performance Management in a Virtualized Environment

# QUESTIONS?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