

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



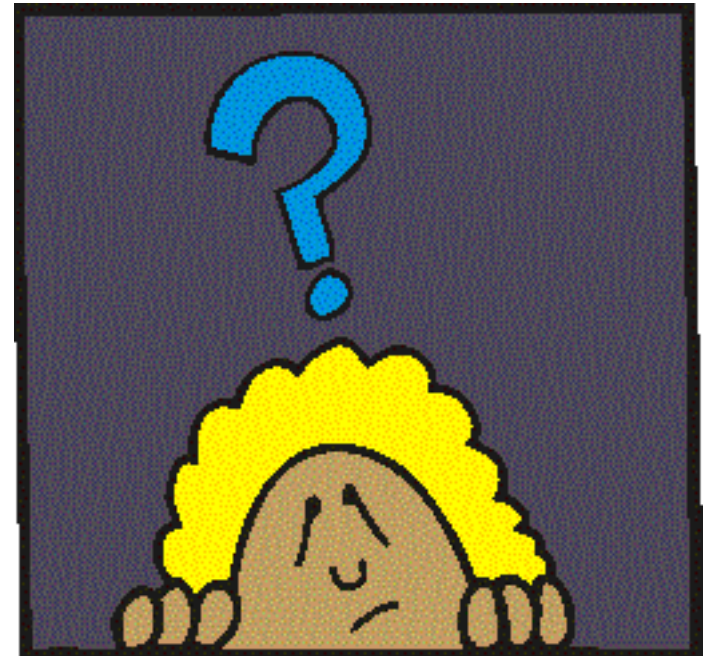
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**Laurak@aesclever.com**

## Background

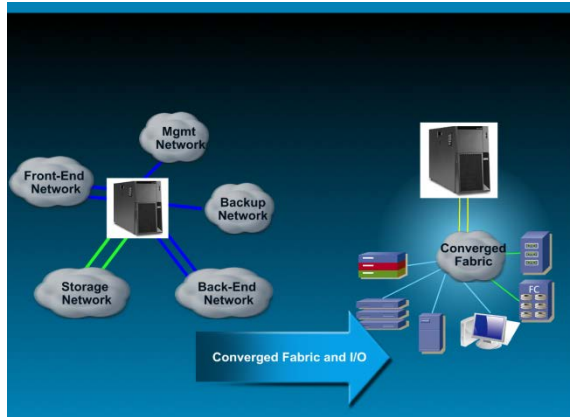
## The Physical Network

## Inside the IP Stack

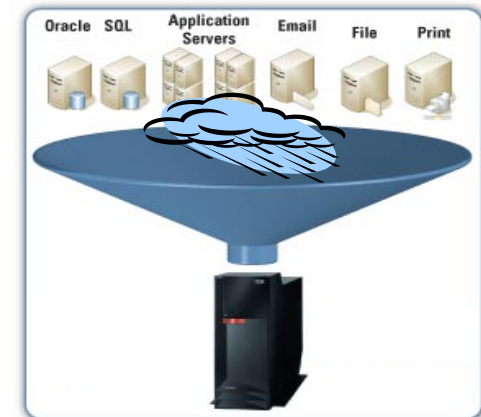
## Summary



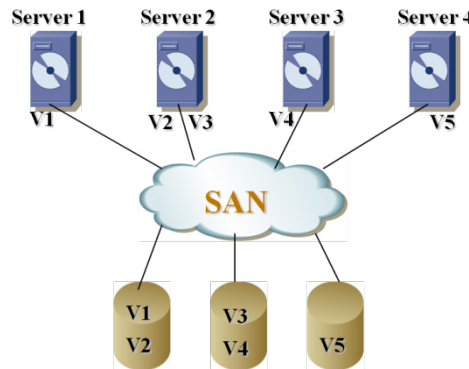
# Right-Sizing IT Infrastructure



**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

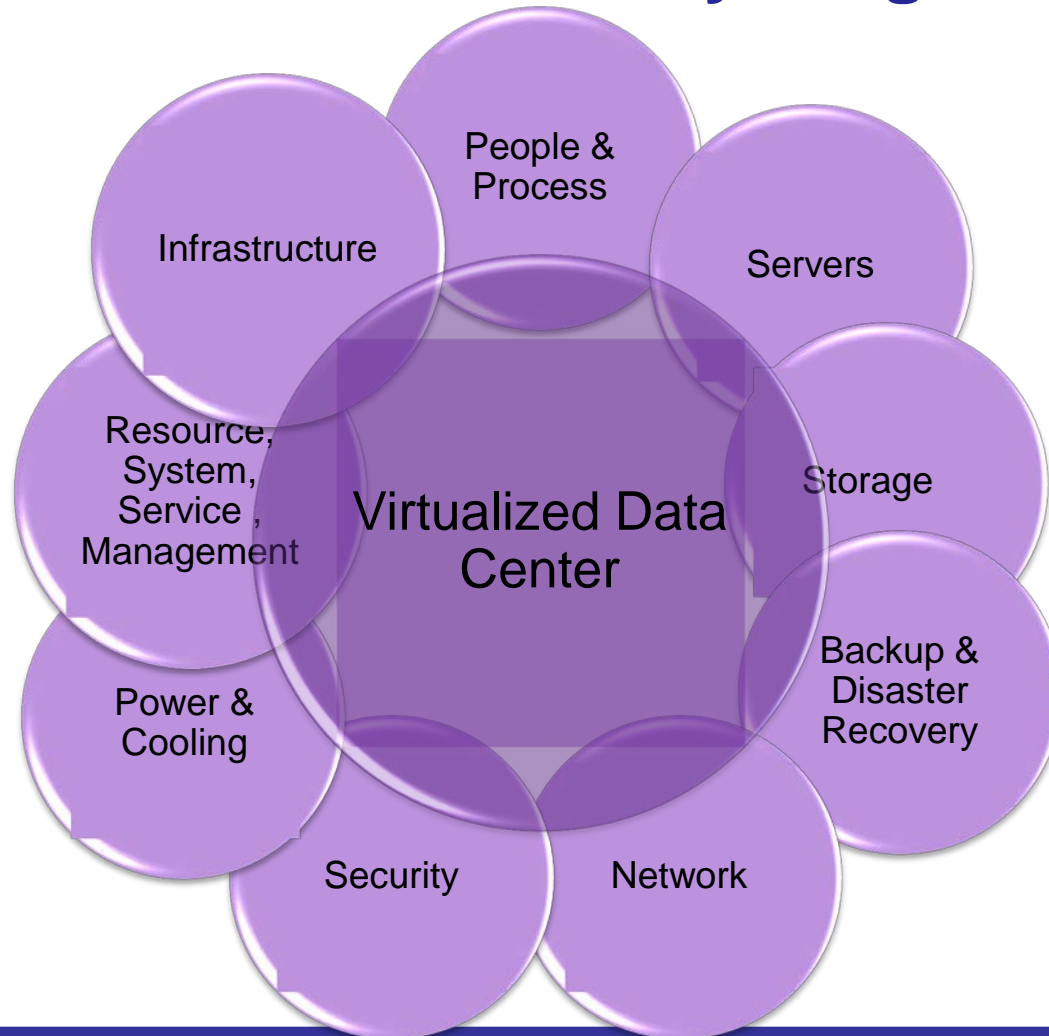
- > Restart immediately when H/W or OS fail
- > Protect all apps

## On-demand Capacity

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

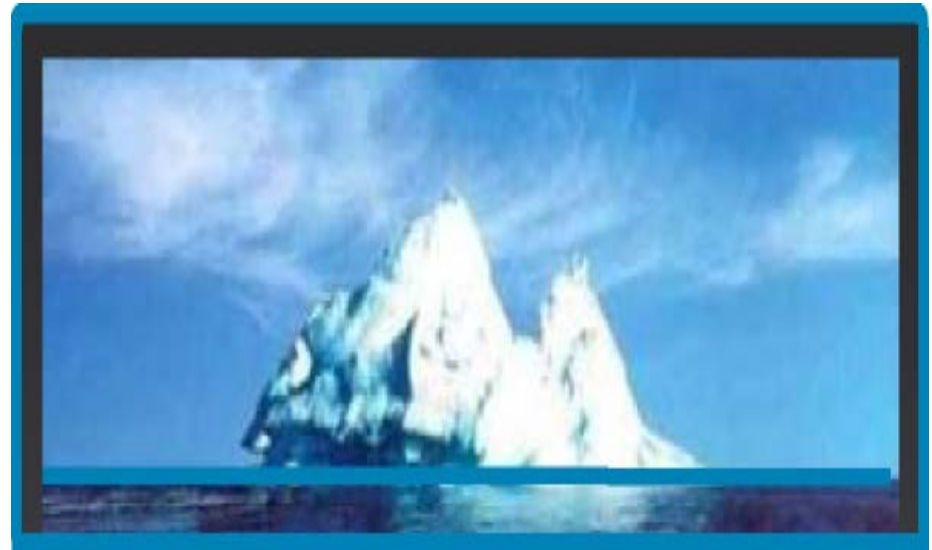


# Virtualization Touches Everything



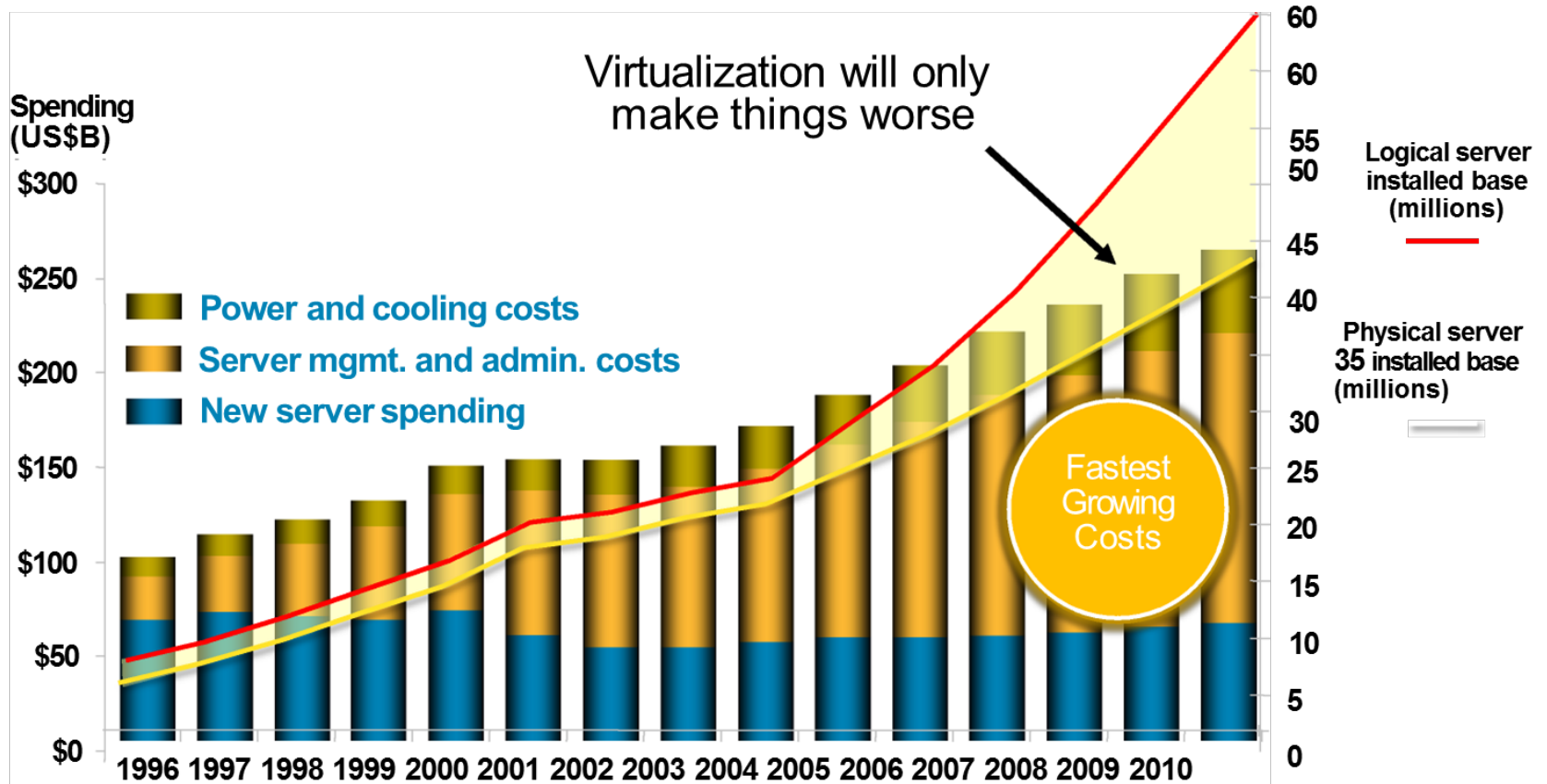
## What's Breaking

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



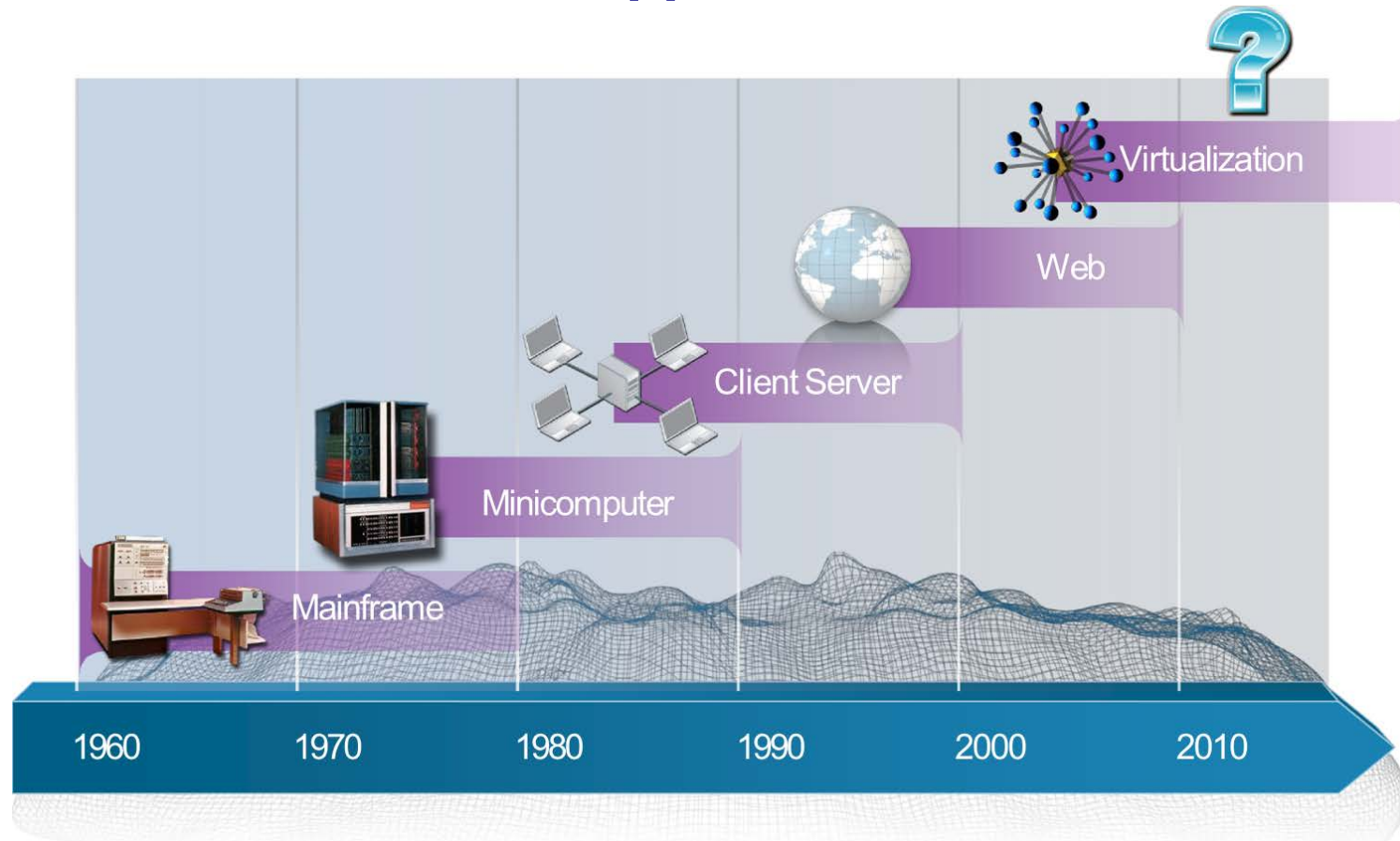


# Operations and Maintenance Growth



Source IDC 2009

# Network Architecture Approach Evolution



Network is a system with applications as objects moving through it

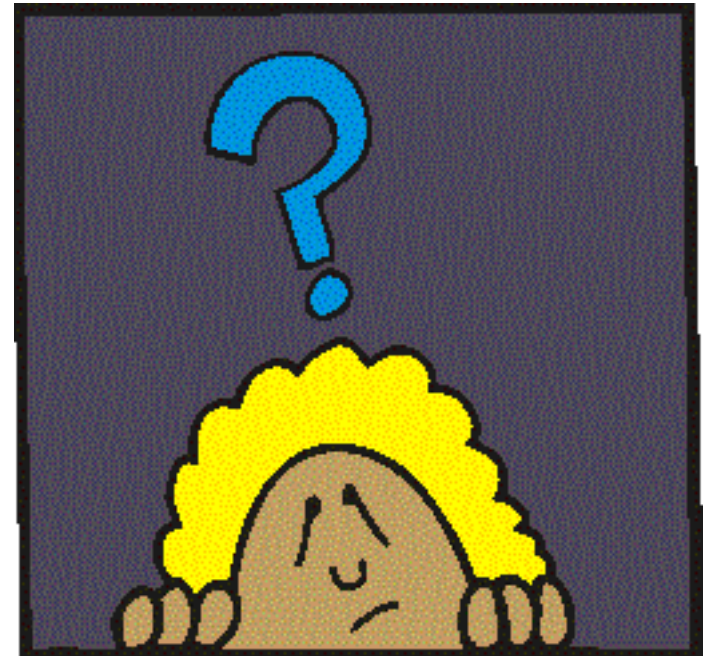


## Background

## The Physical Network

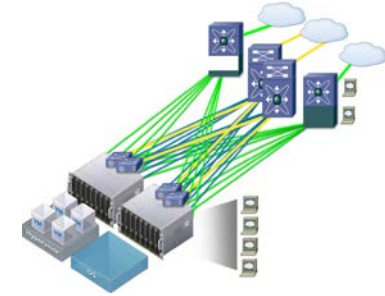
## Inside the IP Stack

## Summary

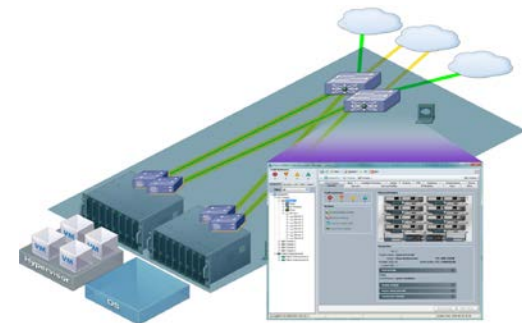


## The Network as a System

- 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



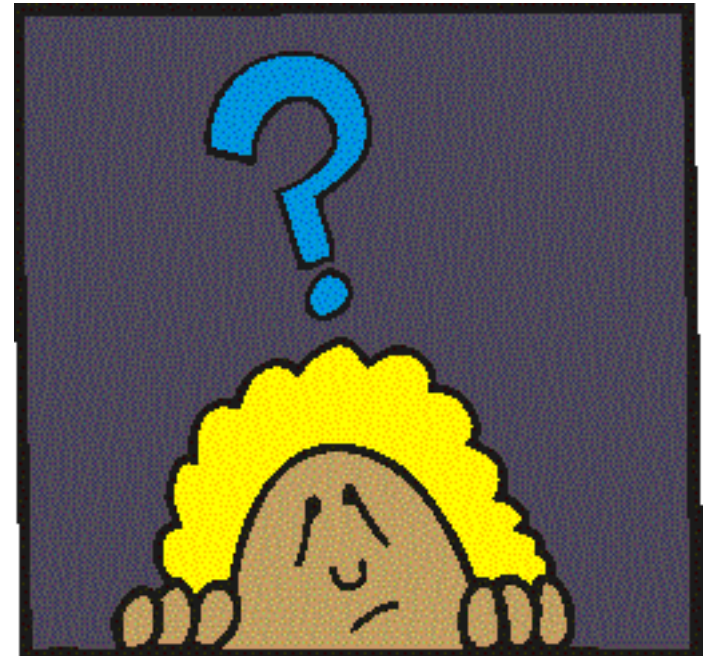
New

## Background

## The Physical Network

## Inside the IP Stack

## Summary

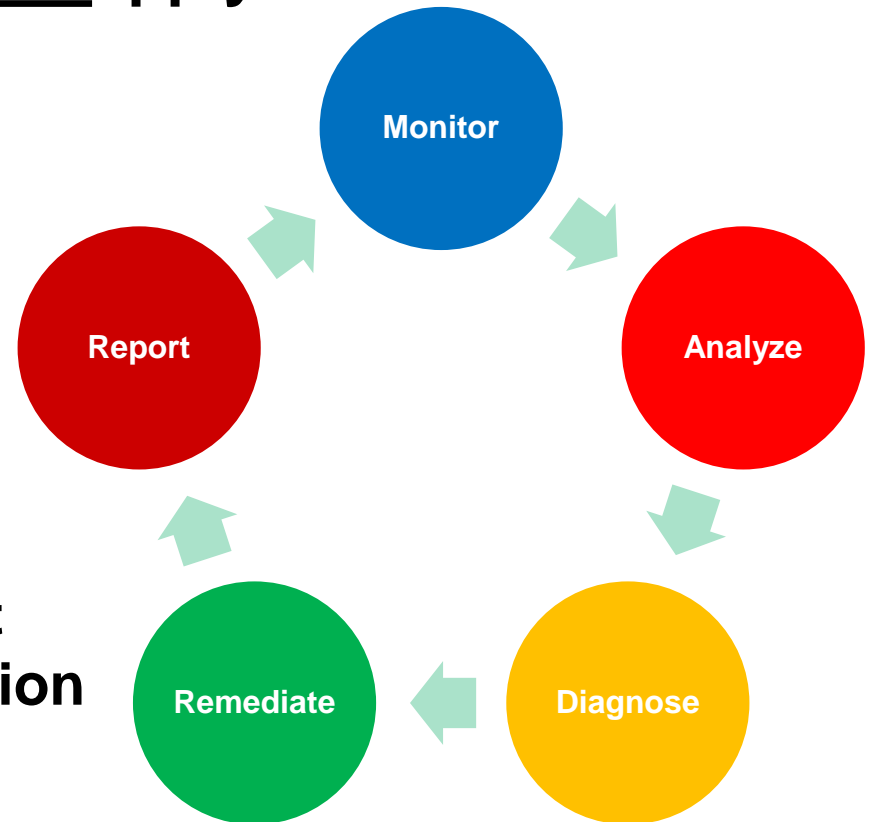


# Managing Virtualized Data Center

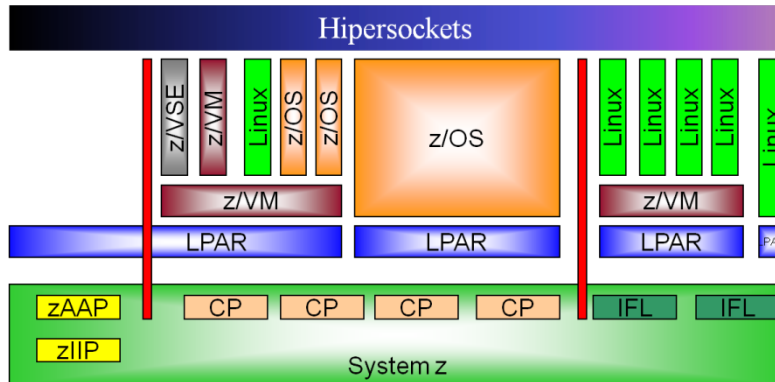
- **Fundamentals of management apply FCAPS**

- **Fault**
- **Configuration**
- **Availability**
- **Performance**
- **Security**

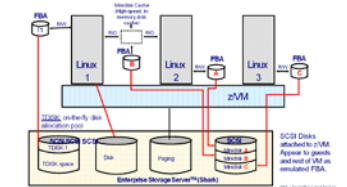
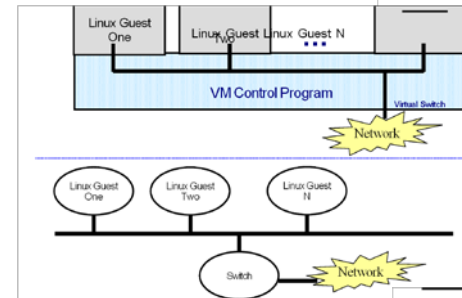
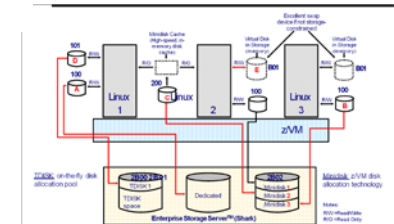
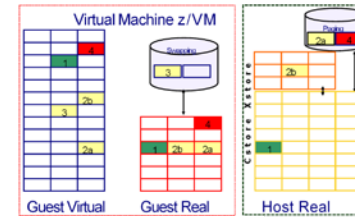
- **Leading to**
  - **Service Level Achievement**
  - **Optimum Resource Utilization**
  - **Highly available systems**
  - **High performing systems**



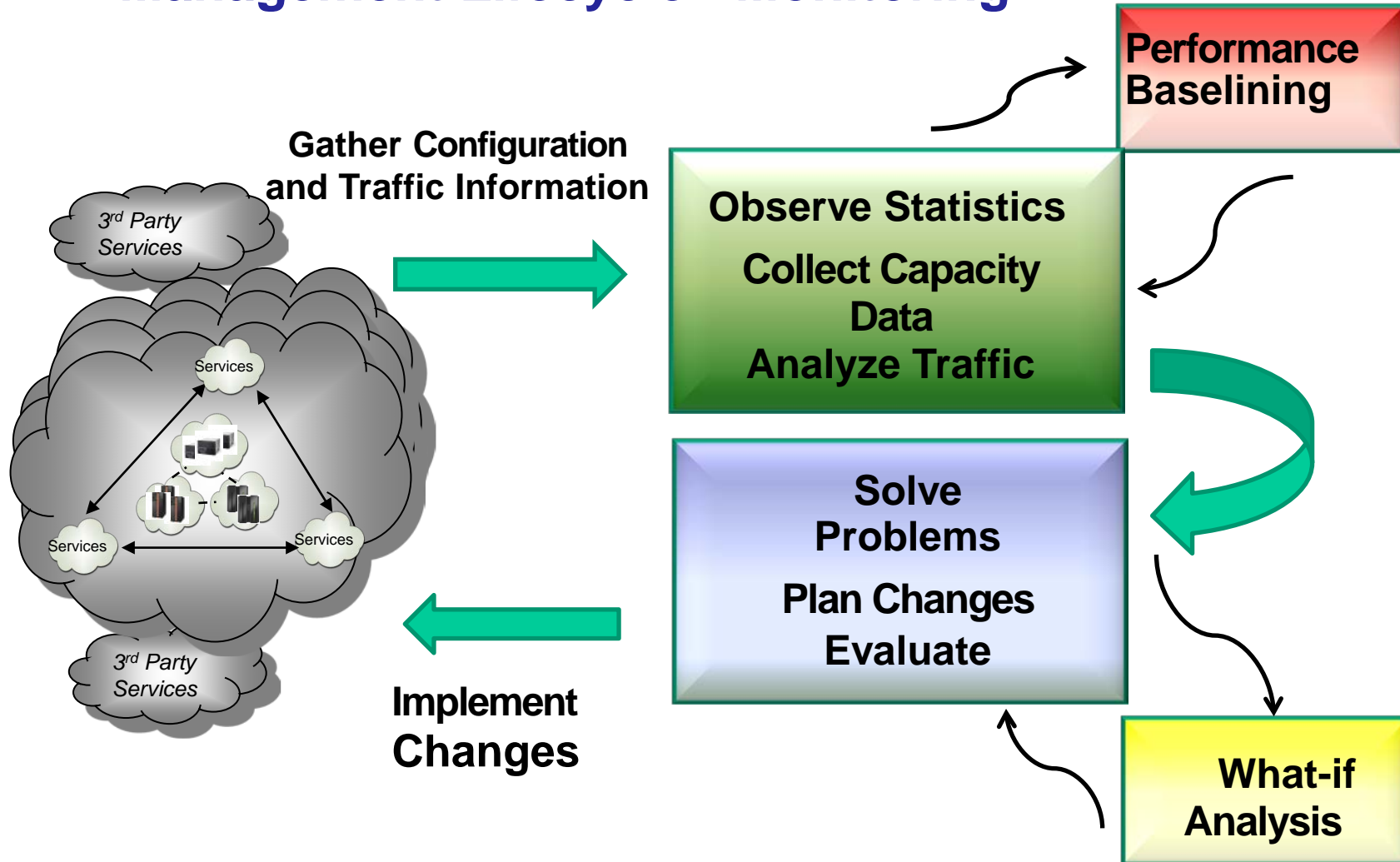
# Advanced Virtualization on System z



- 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



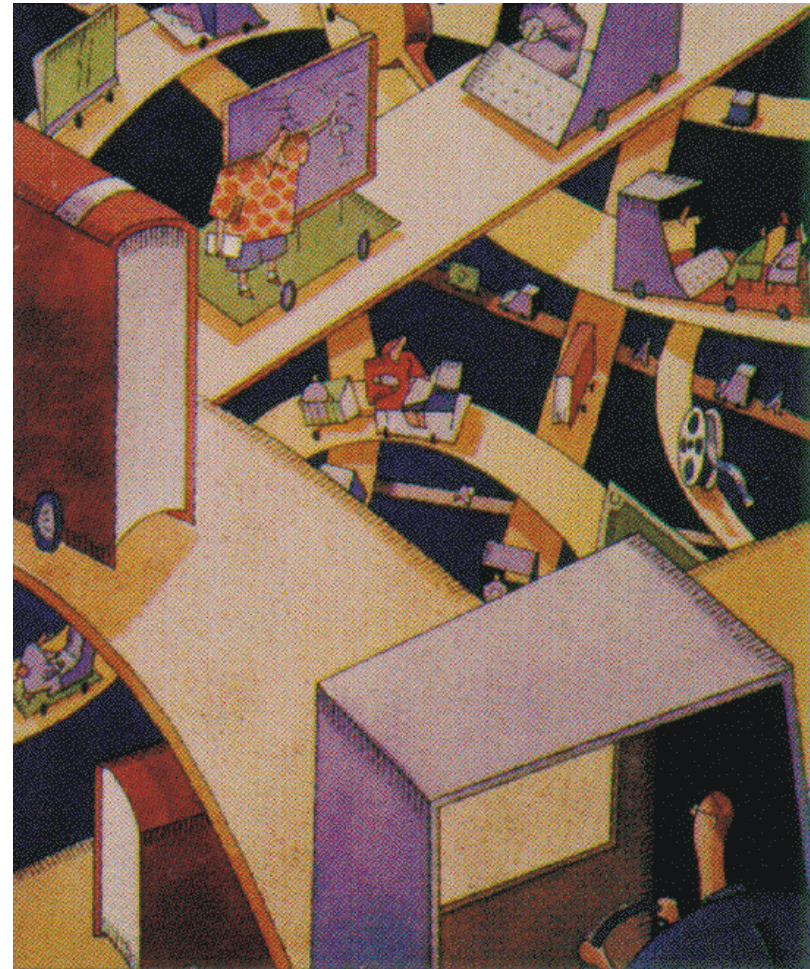


## IP Resource Bottlenecks

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

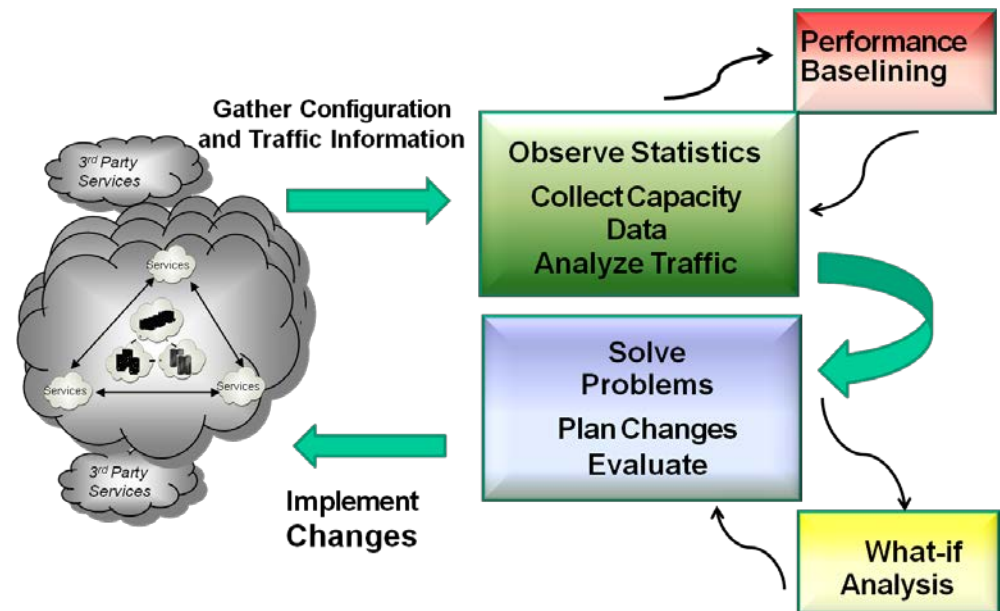
Results in:

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?

	CPU Usage/Interval	Average Storage Used (KiloBytes)
Current:	58499.72	348.57
Last:	58483.79	357.72
Since Midnight:	15110.38	241.72

Node Name	Node Address	Hour	Process ID	Process Type	Process Name	Process Status	CPU Centiseconds - Interval	CPU Centiseconds - Total	Storage Site (Bytes)	Process Run Path	Process R
SLES11PS2i586	137.72.43.204	0	10470	application	mysqld	runnable	0	8014577	24208	/usr/sbin/mysqld	--basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking --basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking
SLES11PS2i586	137.72.43.204	1	10470	application	mysqld	runnable	0	12037883	36312	/usr/sbin/mysqld	--basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking --basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking
SLES11PS2i586	137.72.43.204	2	10470	application	mysqld	runnable	0	12054266	36312	/usr/sbin/mysqld	--basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking --basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking
SLES11PS2i586	137.72.43.204	3	10470	application	mysqld	runnable	0	12071623	36312	/usr/sbin/mysqld	--basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking --basedir=/usr datadir=/var/lib/mysql user=mysql --pid-file=/var/lib/mysql/mysql.pid --skip-external-networking

Process Name	CPU Usage Total	CPU Usage/Interval	Maximum Storage Used	Average Storage Used
init	7643	63.69	0	0
khelper	465464	16.56	48	48.0
	0	0.0	0	0
	0	0.0	0	0.0

## 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 than 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?

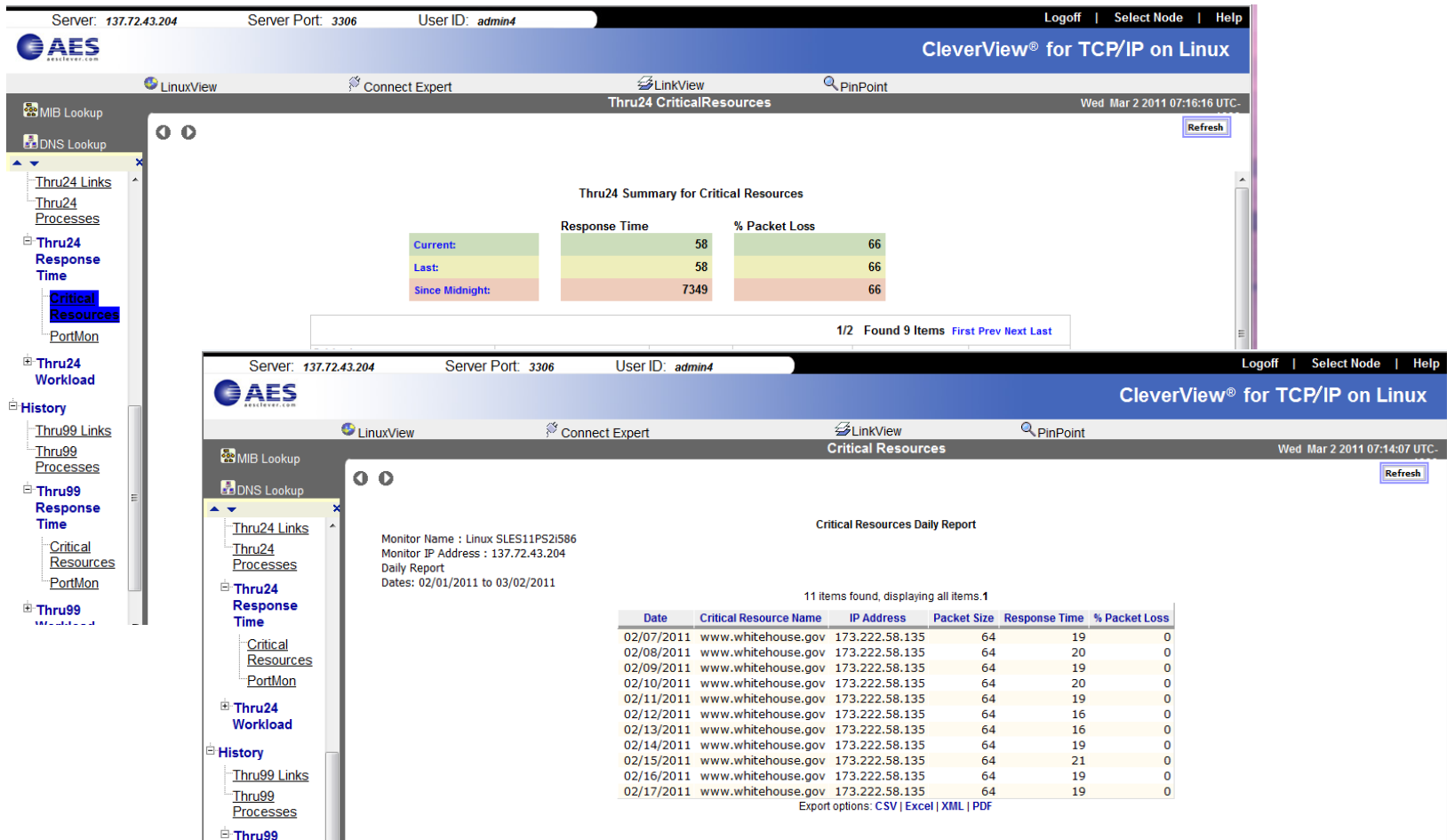
Window size improperly set?

MTU size improperly set?





# Now and Historical Response Time



The screenshot displays two overlapping windows from the AES CleverView application. The top window shows a summary of current performance metrics for critical resources over a 24-hour period. The bottom window shows a detailed daily report for the same resources, including a table of historical data.

### Thru24 Summary for Critical Resources

	Response Time	% Packet Loss
Current:	58	66
Last:	58	66
Since Midnight:	7349	66

1/2 Found 9 Items First Prev Next Last

### Critical Resources Daily Report

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

11 items found, displaying all items. 1

Date	Critical Resource Name	IP Address	Packet Size	Response Time	% Packet Loss
02/07/2011	www.whitehouse.gov	173.222.58.135	64	19	0
02/08/2011	www.whitehouse.gov	173.222.58.135	64	20	0
02/09/2011	www.whitehouse.gov	173.222.58.135	64	19	0
02/10/2011	www.whitehouse.gov	173.222.58.135	64	20	0
02/11/2011	www.whitehouse.gov	173.222.58.135	64	19	0
02/12/2011	www.whitehouse.gov	173.222.58.135	64	16	0
02/13/2011	www.whitehouse.gov	173.222.58.135	64	16	0
02/14/2011	www.whitehouse.gov	173.222.58.135	64	19	0
02/15/2011	www.whitehouse.gov	173.222.58.135	64	21	0
02/16/2011	www.whitehouse.gov	173.222.58.135	64	19	0
02/17/2011	www.whitehouse.gov	173.222.58.135	64	19	0

Export options: CSV | Excel | XML | PDF

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## 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.

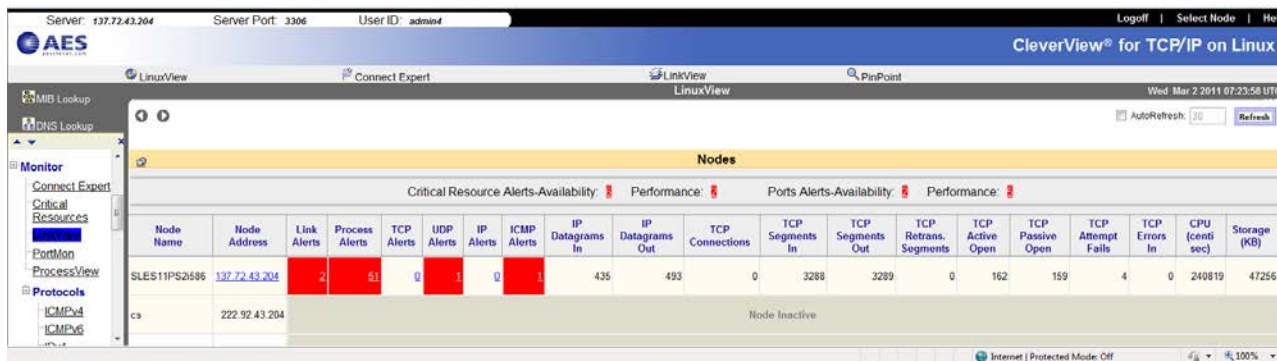
## System Utilization

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



Node Name	Node Address	Link Alerts	Process Alerts	TCP Alerts	UDP Alerts	IP Alerts	ICMP Alerts	IP Datagrams In	IP Datagrams Out	TCP Connections	TCP Segments In	TCP Segments Out	TCP Retrans. Segments	TCP Active Open	TCP Passive Open	TCP Attempt Fails	TCP Errors In	CPU (centi sec)	Storage (KB)
SLES11PS2i586	137.72.43.204	2	51	0	1	0	1	435	493	0	3288	3289	0	162	159	4	0	240819	47256
cs	222.92.43.204	Node Inactive																	

# Scenario 3– Can I Add more Applications

## Situation

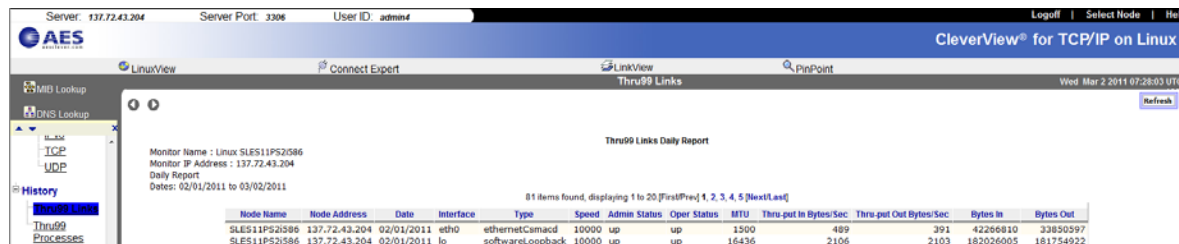
A task force was recommending adding additional applications to the virtualized mainframe. The initial move went well and they wanted to increase the usage of Linux and decrease their distributed servers. The task force approved the move without looking at any data to see if the system could handle the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



The screenshot shows the AES CleverView interface for TCP/IP on Linux. It displays a 'Thru99 Links Daily Report' for a monitor named 'Linux SLES11P52/S86'. The report includes a table of network links with the following data:

Node Name	Node Address	Date	Interface	Type	Speed	Admin Status	Oper Status	MTU	Thru-put In Bytes/Sec	Thru-put Out Bytes/Sec	Bytes In	Bytes Out
SLES11P52/S86	137.72.43.204	02/01/2011	eth0	ethernetCamaacd	10000	up	up	1500	489	42206810	33850597	
SLES11P52/S86	137.72.43.204	02/01/2011	lo	softwareLoopback	10000	up	up	16436	2106	2103	162026005	161754922

# 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

Server: 137.72.43.204    Server Port: 3306    User ID: admin4    Logoff | Select Node | Help

**CleverView® for TCP/IP on Linux**

LinuxView    Connect Expert    LinkView    PinPoint

Connect Expert (SLES11PS2i586 137.72.43.204)    Wed Mar 2 2011 07:43:56 UTC-    Refresh

MIB Lookup

DNS Lookup

**Protocols**

Monitor

- Connect Expert
- Critical Resources
- LinkView
- PortMon
- ProcessView

Protocols

- ICMPv4
- ICMPv6
- IPv4
- IPv6
- TCP
- UDP

Snapshot

- Thru24 Links
- Thru24 Processes

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

Server: 137.72.43.204 Server Port: 3306 User ID: admin4 Logoff | Select Node | Help

**AES** CleverView® for TCP/IP on Linux

LinuxView Connect Expert LinkView PinPoint

TCP Wed Mar 2 2011 07:47:52 UTC Refresh

### 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	280268	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



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## 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

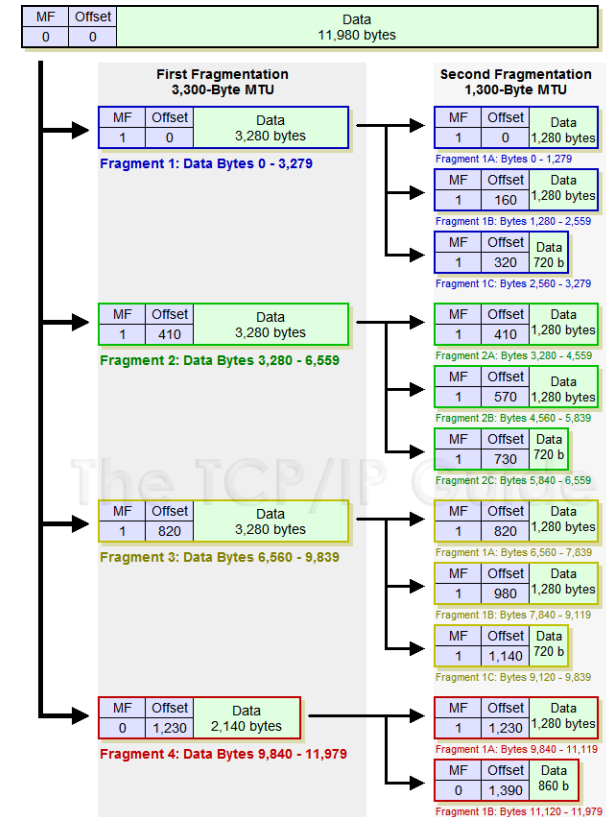
Using a Linux TCP/IP Monitor check the overall flow of information through both the IP and TCP layers. The OSA adapter was inspected and traffic was moving through it smoothly. Look at the MTU settings on your links and the fragmentation on the IP stack. While there was not significant fragmentation, 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  $\leq 1400$  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

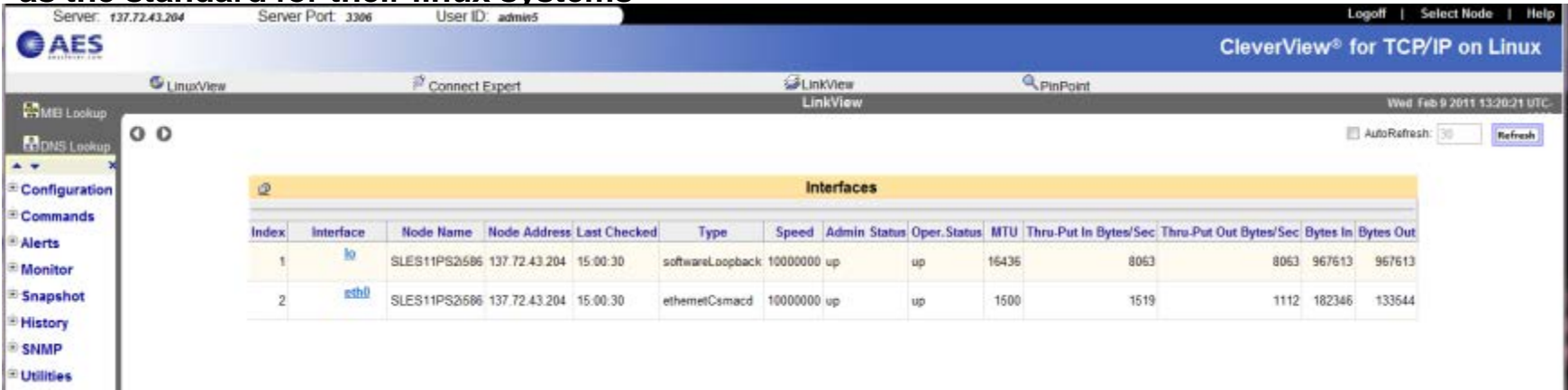
A client had a Linux on system environment and they were about ready to grow the production use of Linux. While they did not have any major problems they new of they asked for an overall health check.

### 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



Server: 137.72.43.204 Server Port: 3306 User ID: admin

Logoff | Select Node | Help

CleverView® for TCP/IP on Linux

LinuxView Connect Expert LinkView LinkView PinPoint

Wed Feb 9 2011 13:20:21 UTC

AutoRefresh: 30 Refresh

Index	Interface	Node Name	Node Address	Last Checked	Type	Speed	Admin Status	Oper. Status	MTU	Thru-Put In Bytes/Sec	Thru-Put Out Bytes/Sec	Bytes In	Bytes Out
1	lo	SLES11PS2696	137.72.43.204	15:00:30	softwareLoopback	10000000	up	up	16436	8063	8063	967613	967613
2	eth0	SLES11PS2696	137.72.43.204	15:00:30	ethernetCsmacd	10000000	up	up	1500	1519	1112	182346	133544

## Linux: OSA LAN Timer or Blocking Timer

### OSA inbound blocking function

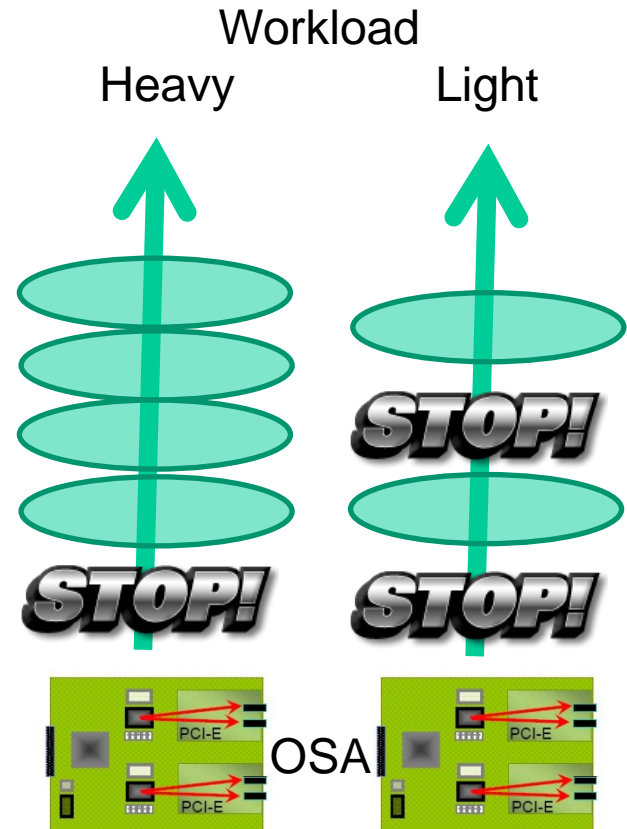
- Determines how long OSA will hold packets
- Indirectly affects
  - Frequency of host interrupt
  - Payload per interrupt

### 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

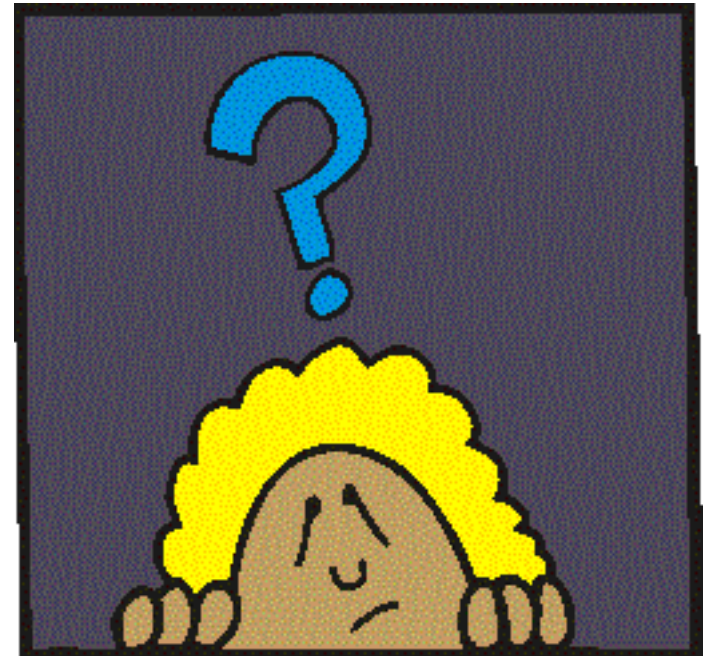
Red Hat:  
/etc/sysconfig/network-  
scripts/ifcfg-eth0 add  
OPTIONS="blkt/inter=5  
blkt/inter\_jumbo=15  
blkt/total=250"

## Background

## The Physical Network

## 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

What-if analysis prior to deployment

**Setup Alarms and Thresholds**

**Excessive Missed Faults**

Performance exception reporting

Analyze the capacity information

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

**Monitor**

## 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

Mar 12, 2012: 1:30-2:30 10715: [Keeping Your Network at Peak Performance as You Virtualize the Data Center](#)

Mar 14, 2012: 8:00-9:00 10397: [IPv6 Basics](#)

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Mar 15, 2012: 3:00-4:00 10401: [IPv6 Transitioning](#)

Mar 16, 2012 9:30-10:30 10393: [CSI Maui: The Case of the Compromised Server](#)

Mar 16 2012 11:00-12:00 10414 [IPv6 Deep Dive](#)

*Vielen*  
**Dank**

# QUESTIONS?

*Köszönettel*

*Obi* Спасибо

**Bedankt**

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شكراً

**Gracias**

Ευχαριστώ

شكراً

धन्यवाद

**THANK YOU**

*Merci*

*Díky*

Grazie

Danke

*Hvala*

ขอบคุณ

תודה

ありがとうございました

Merci

Teşekkürler

धन्यवाद  
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Obrigado