Introduction to Mainframe (z/OS) Network Management
Share Anaheim Session 14501

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Agenda

Introduction

Why Monitor IP in the Mainframe?

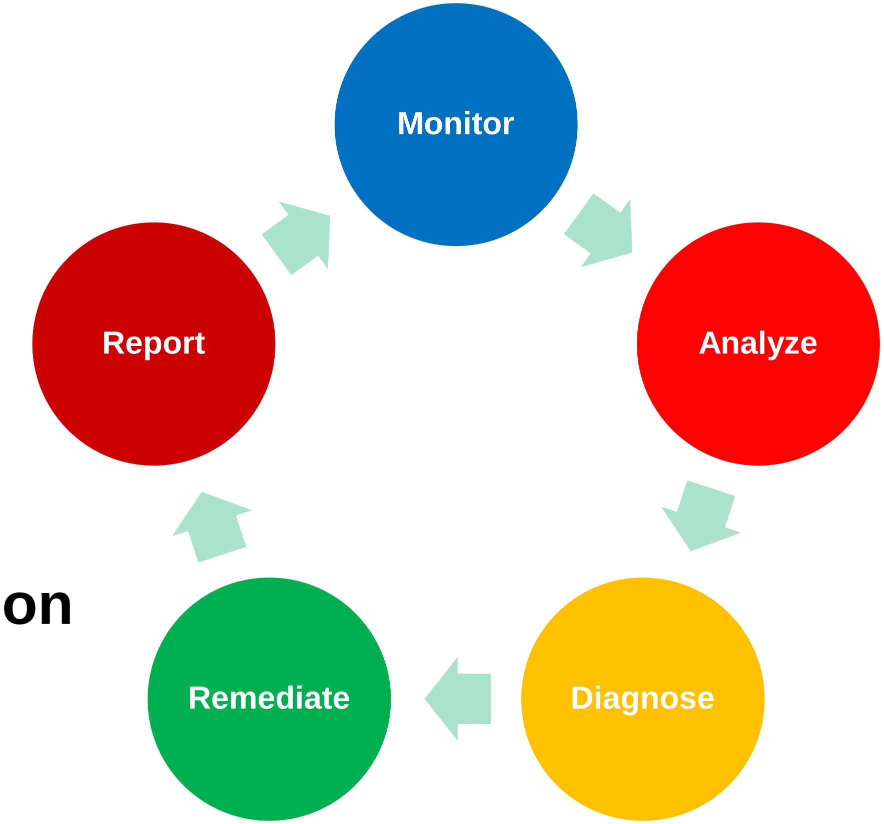
IP Monitoring Tools and Technologies

Best Practices

Managing Fundamentals

- FCAPS
  - Fault
  - Configuration
  - Availability
  - Performance
  - Security

- Leading to
  - Service level achievement
  - Optimum resource utilization
  - Highly available systems
  - High performing systems



FCAPS

Fault Management

What is the Status?

Configuration Management

What is the configuration?

Availability Management

What's down? What's available?

What's up?

Performance Management

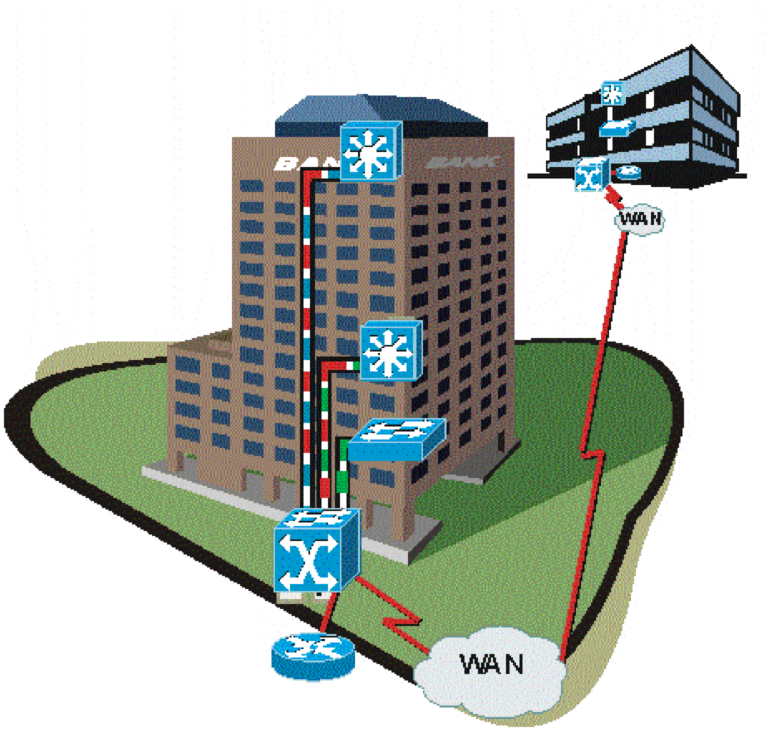
How consistent? How many?

How much? How fast?

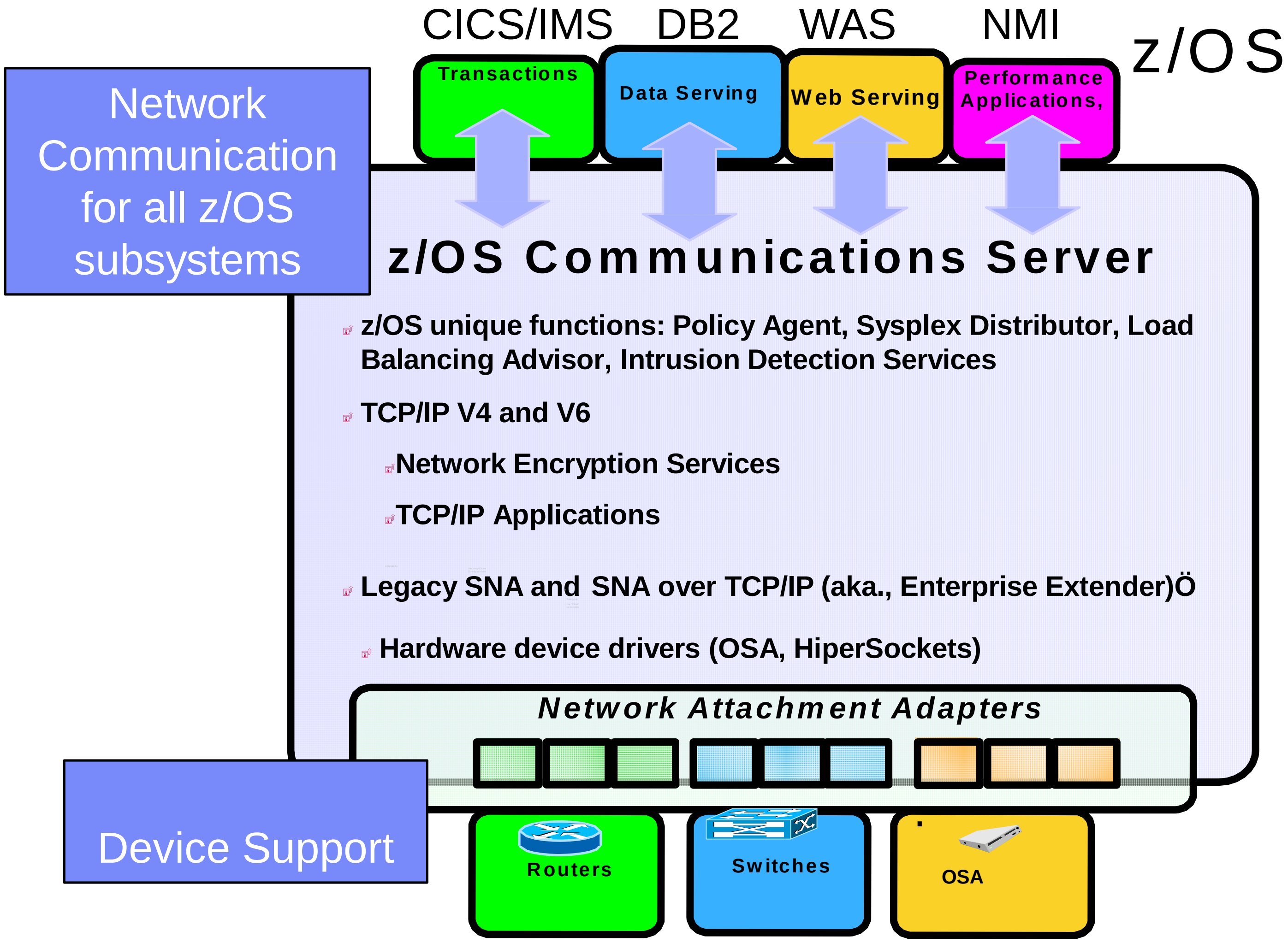
Security Management

Who can access? Identify yourself?

Can everyone see it?



z/OS Communication Server


CICS/IMS
DB2
WAS
NMI
z/OS
Transactions
Data Serving
Web Serving
Performance Applications,
Network Communication for all z/OS subsystems
z/OS Communications Server
Network Attachment Adapters
Routers
Switches
OSA
Device Support

- z/OS unique functions: Policy Agent, Sysplex Distributor, Load Balancing Advisor, Intrusion Detection Services
- TCP/IP V4 and V6
  - Network Encryption Services
  - TCP/IP Applications
- Legacy SNA and SNA over TCP/IP (aka., Enterprise Extender)Ö
- Hardware device drivers (OSA, HiperSockets)

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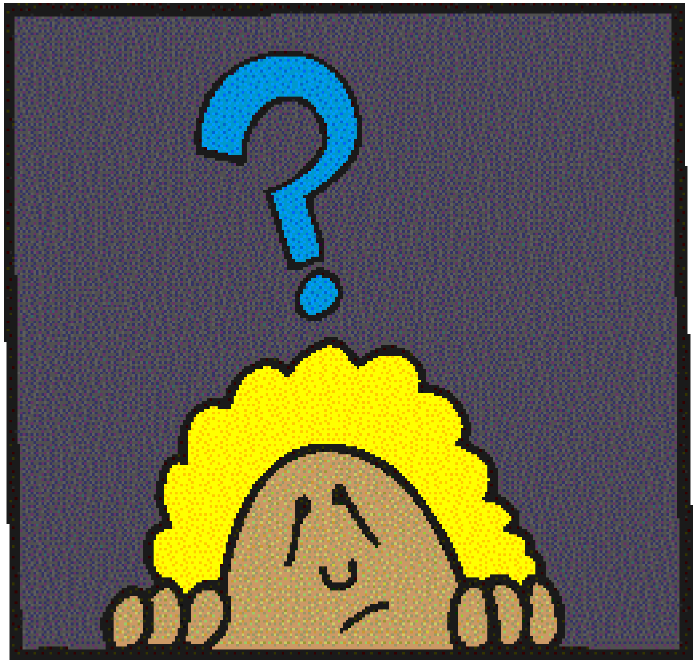
Murphy’s Law

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



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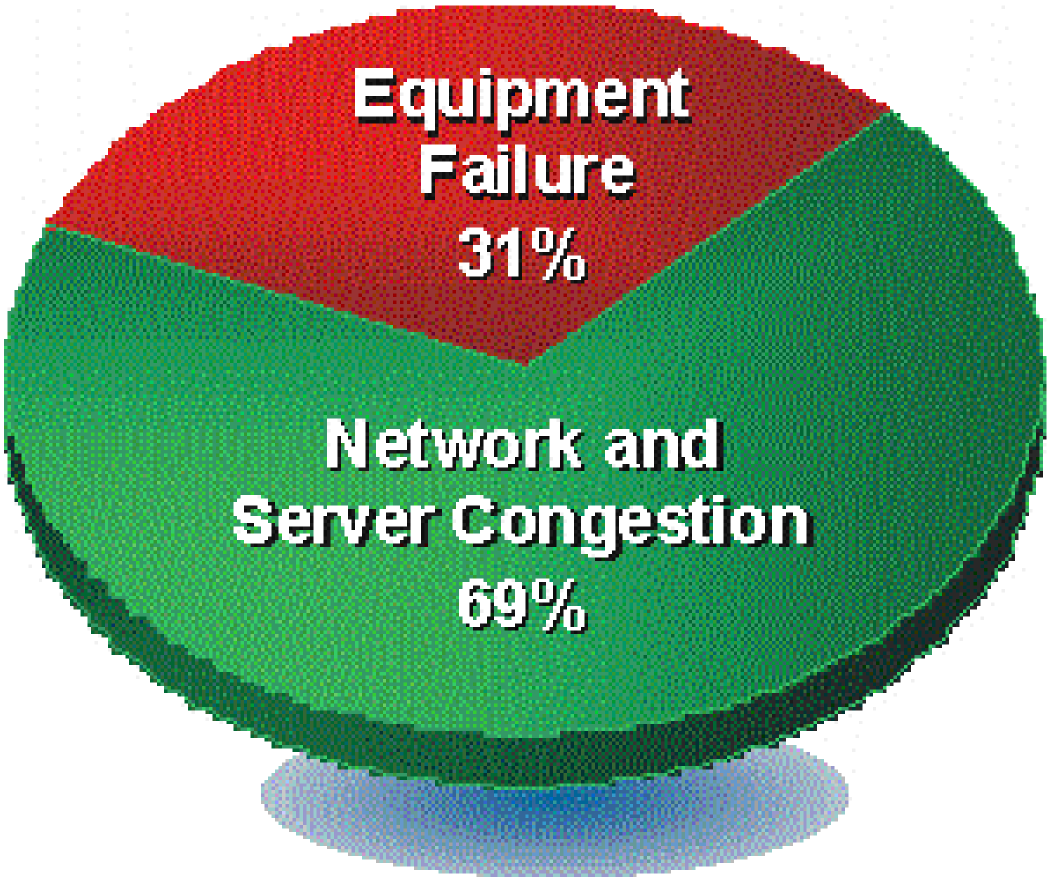
Congestion and Performance Degradation



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Common Problems

Hardware failure
Configuration change
Firmware change
Traffic rate change
New application deployment
Network failure
Security attack
Routing changes
Buffer shortages
Resource shortage
Spanning Tree problems
Illegal access to resources

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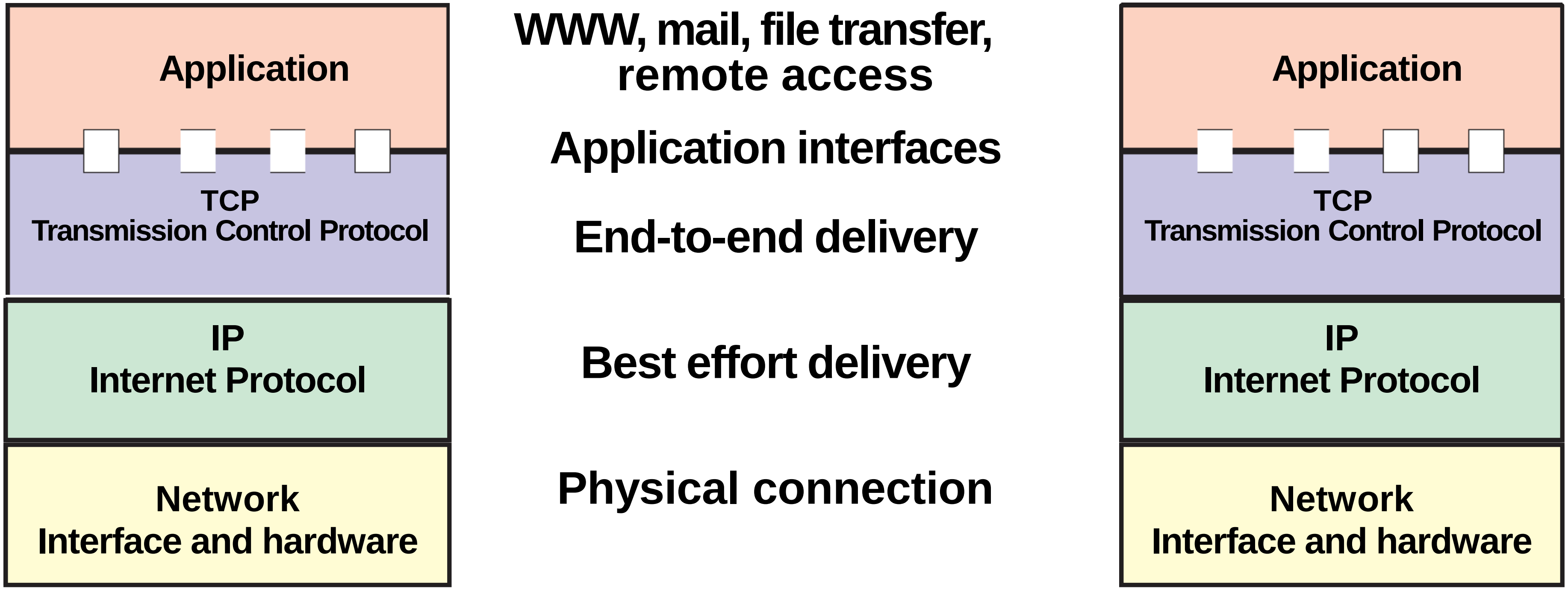
Why Monitor IP?

Browser

Server



Application

TCP
Transmission Control Protocol

IP
Internet Protocol

Network
Interface and hardware

WWW, mail, file transfer,
remote access

Application interfaces

End-to-end delivery

Best effort delivery

Physical connection

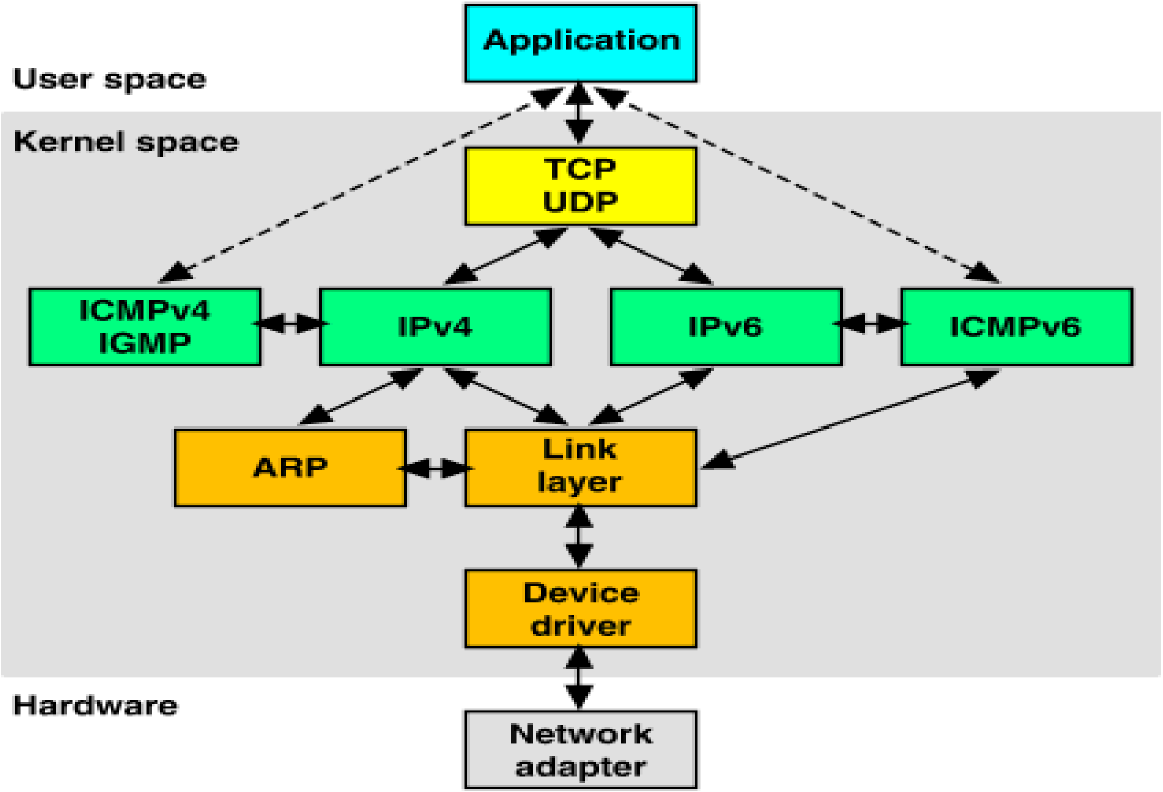
Application

TCP
Transmission Control Protocol

IP
Internet Protocol

Network
Interface and hardware

A View of IP



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Introduction and goals

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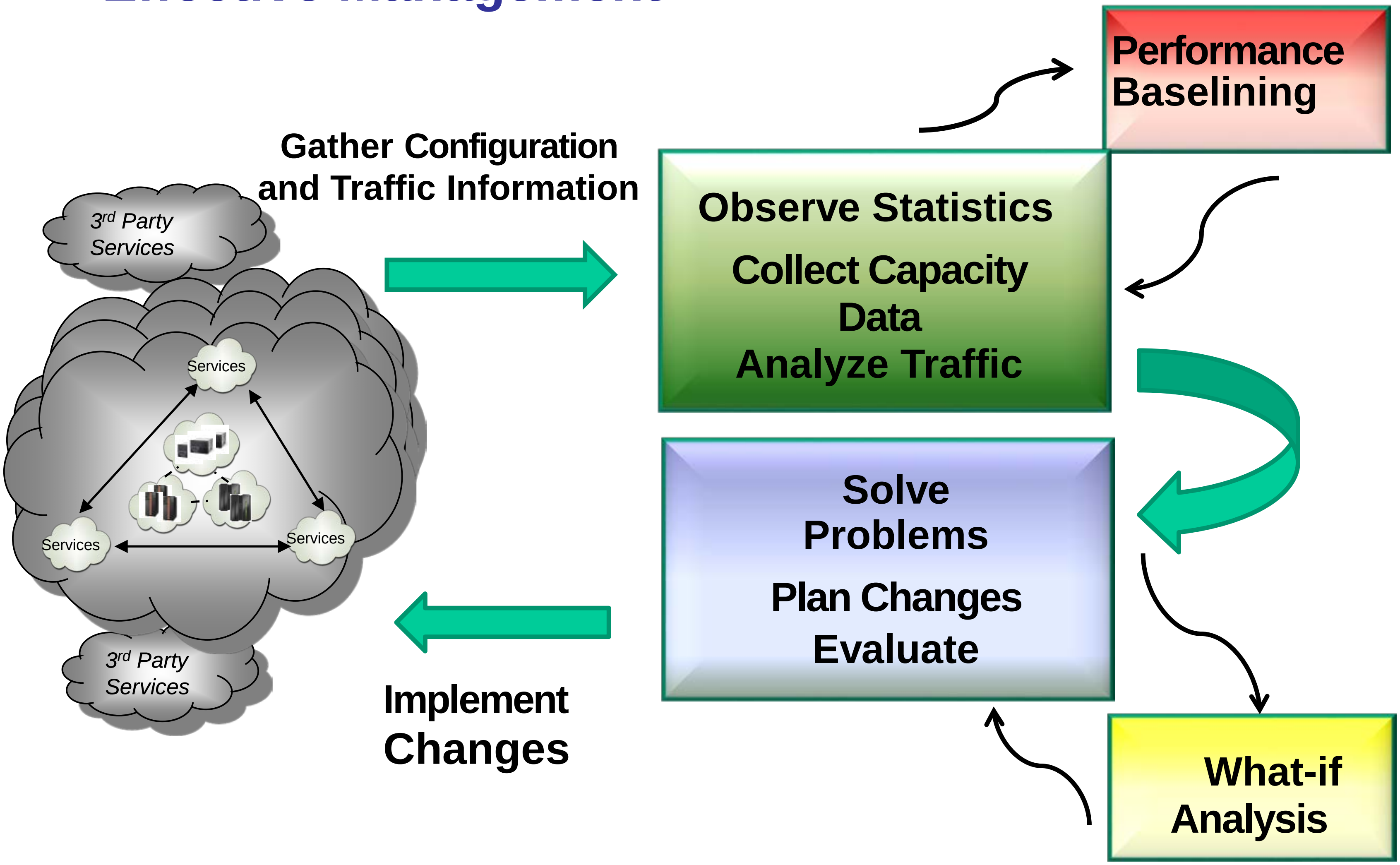
Effective Management



Gather Configuration and Traffic Information

Performance Baselining

Observe Statistics

Collect Capacity Data

Analyze Traffic

Solve Problems

Plan Changes

Evaluate

What-if Analysis

Implement Changes

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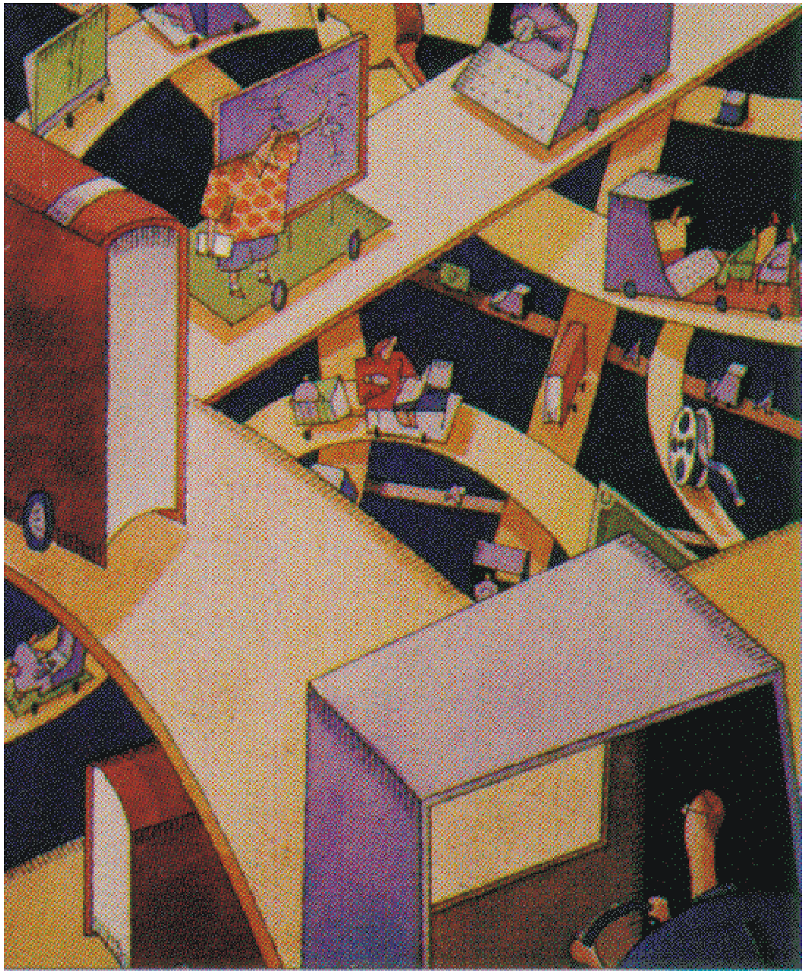
IP Resource Bottlenecks

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

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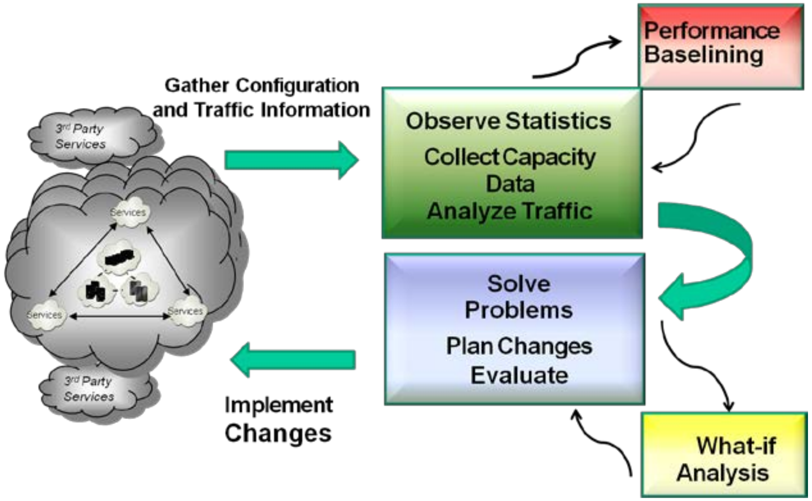
Information to Collect and Resources to Monitor

- 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



- TCP/IP stacks
- Interfaces (OSA, Links, devices…)
- Services (ports)
- Gateways
- Remote hosts
- Unix System Services
- zBX services

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Management Plan Purpose

Develop information collection plan

- Define parameters to be monitored/measured and the thresholds
- Acquire proper authority to collect and monitor/measure
- Acquire proper authority to change thresholds
- Determine frequency of monitoring and reporting
- Define parameters that trigger alert mechanism

Define performance areas of interest

Report and interpret results

Determine tools for collecting information

Determine tools for analyzing information

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Performance Management Practices

Sampling

Active — Passive

Source

Embedded — External

Scope

Device/Link — End-to-End/Path

Perspective

User — Network

Core Mainframe IP Tools

TRACEROUTE

PING

NETSTAT

SNMP

NMAPI

Operating system or device specific
SMF for z/OS

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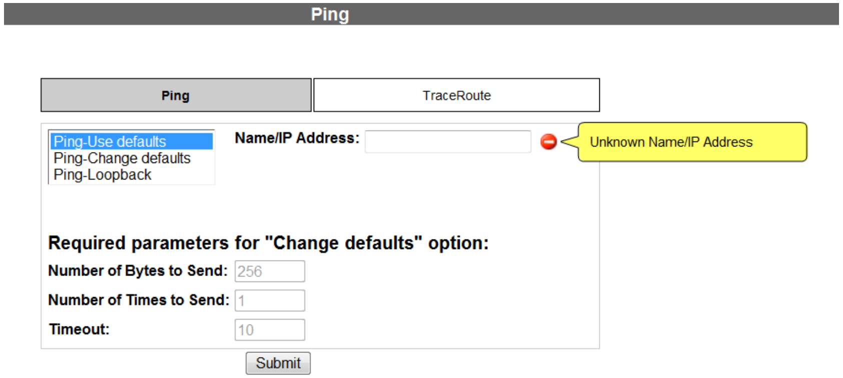
Basic Tools : PING

Tests connectivity to an IP device

Sends an ICMP frame to the destination



Name/IP Address:

Unknown Name/IP Address

Required parameters for "Change defaults" option:

Number of Bytes to Send: 256

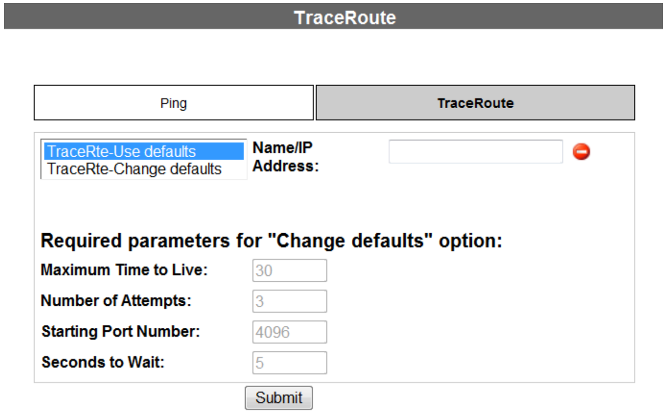
Number of Times to Send: 1

Timeout: 10

Basic Tools: Traceroute

Shows most likely path to an IP device and transmit times

Sends an ICMP frame to the destination



TraceRoute

Ping | TraceRoute

TraceRte-Use defaults
TraceRte-Change defaults

Name/IP Address:

Required parameters for "Change defaults" option:

Maximum Time to Live:	30
Number of Attempts:	3
Starting Port Number:	4096
Seconds to Wait:	5

Submit

Netstat

Gathers information from buffers relating to the IP functions

Common functions
Network drivers
Interface cards
Router tables
Active server processes
Statistics by protocol

Vendors implement different functions

What is SNMP?

Simple Network Management Protocol

Internet standard

Initially tied to TCP/IP protocol

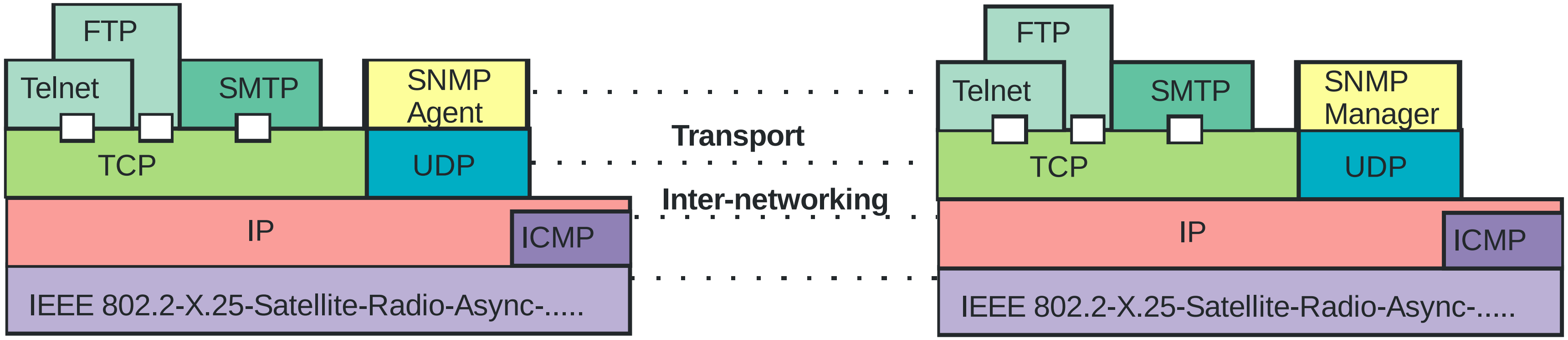
Routers, switches, Unix hosts, bridges, hubs, agents for many operating systems, etc

Set of functions

- monitor network elements
- control network elements

MAC Header	IP Header	UDP Header	SNMP Message	Mac Trailer

SNMP Layering



ICMP - Internet Control Message Protocol
UDP - User Datagram Protocol
Telnet Remote Access

- NFS Network File System
- RPC Remote Procedure Call
- SMTP Simple Mail Transfer Protocol

Manager/Agent Model

Agent acts as "server"
Manager acts as "client"
Manager polls agents for information
Agent keeps information and responds
Agent may proactively send information as traps
Opens UDP port 161, 162, 391, 1993

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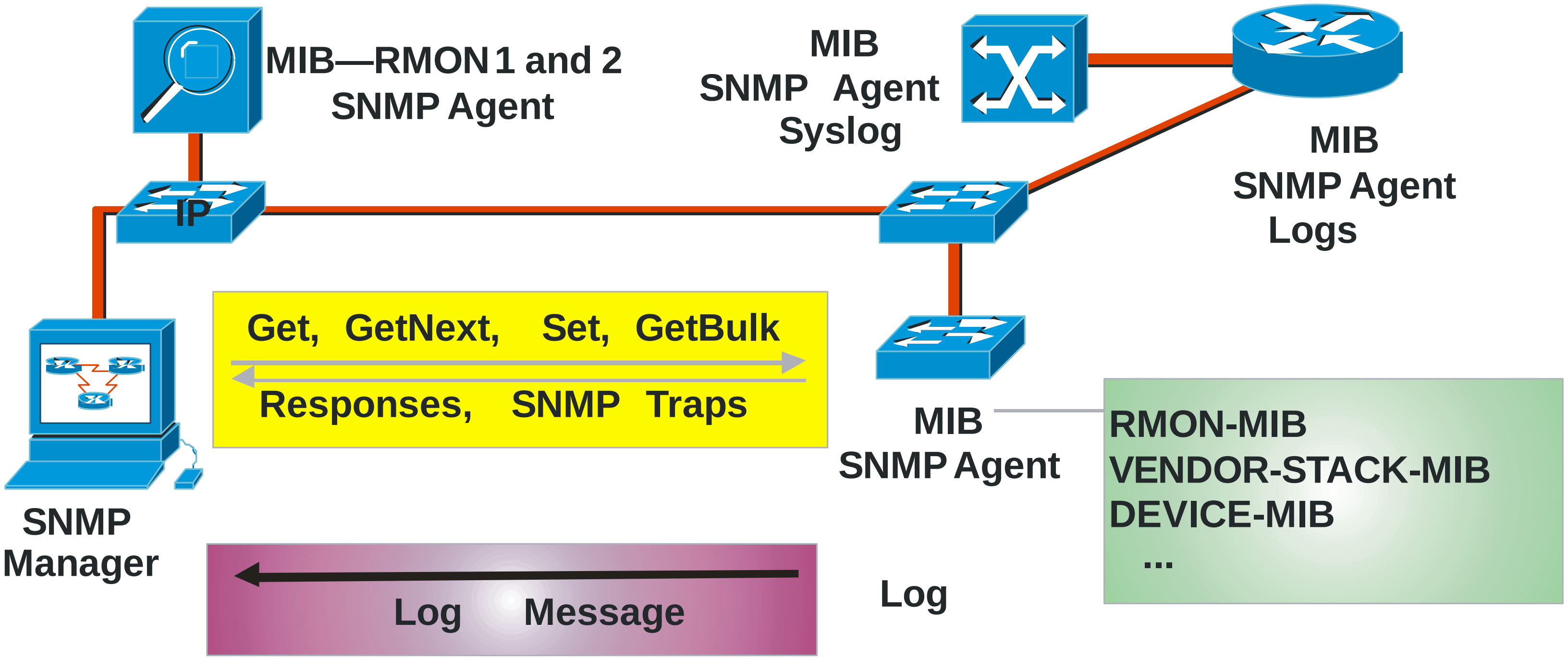
SNMP Flows



IP Connectivity

SNMP Traps/RMON

Log

Network Time Protocol

Vendor Specific

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Management Information Base - MIB

How do the agents keep the information ?

Universe of network manageable objects is called the Management Information Base (MIB).

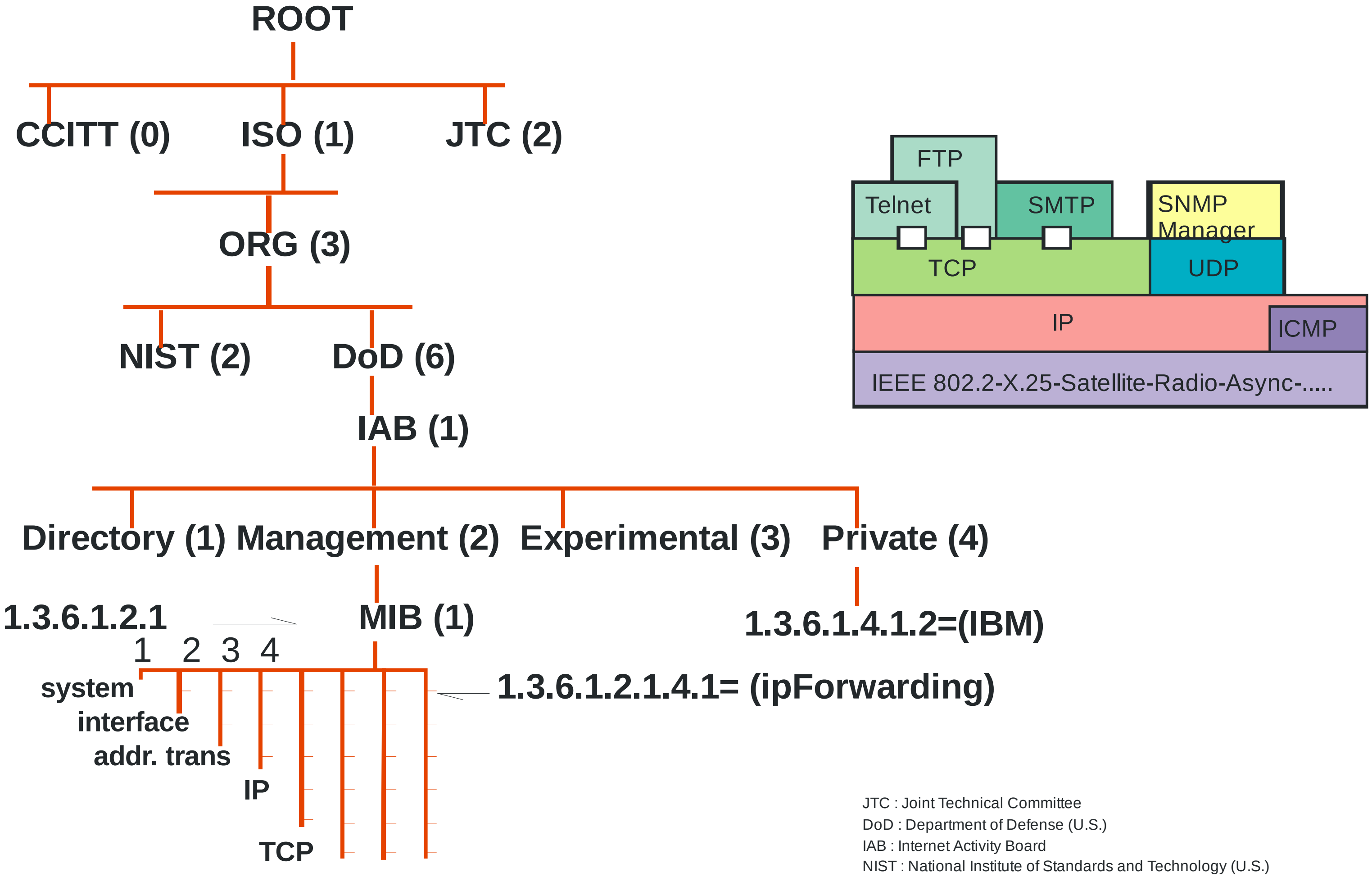
Items within the network elements which are manageable are called managed objects

Objects within the MIB are organized into the following groups:

MIB ....(114)
1) System
2) Interface
3) Address Translation
4) IP
5) ICMP
6) TCP
7) UDP
8) EGP

MIB-2 ....(171)
1) System
2) Interface
3) Address Translation
4) IP
5) ICMP
6) TCP
7) UDP
8) EGP
9) CMOT
10) Transmission
11) SNMP I

Object Registration Hierarchy



ROOT

CCITT (0)

ISO (1)

JTC (2)

ORG (3)

NIST (2)

DoD (6)

IAB (1)

Directory (1)

Management (2)

Experimental (3)

Private (4)

1.3.6.1.2.1

MIB (1)

1.3.6.1.4.1.2=(IBM)

1 2 3 4

system

interface

addr. trans

IP

TCP

1.3.6.1.2.1.4.1= (ipForwarding)

FTP

Telnet

SMTP

SNMP Manager

TCP

UDP

IP

ICMP

IEEE 802.2-X.25-Satellite-Radio-Async-.....

JTC : Joint Technical Committee
DoD : Department of Defense (U.S.)
IAB : Internet Activity Board
NIST : National Institute of Standards and Technology (U.S.)

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SNMP : Review

Agents maintain management information in their MIB

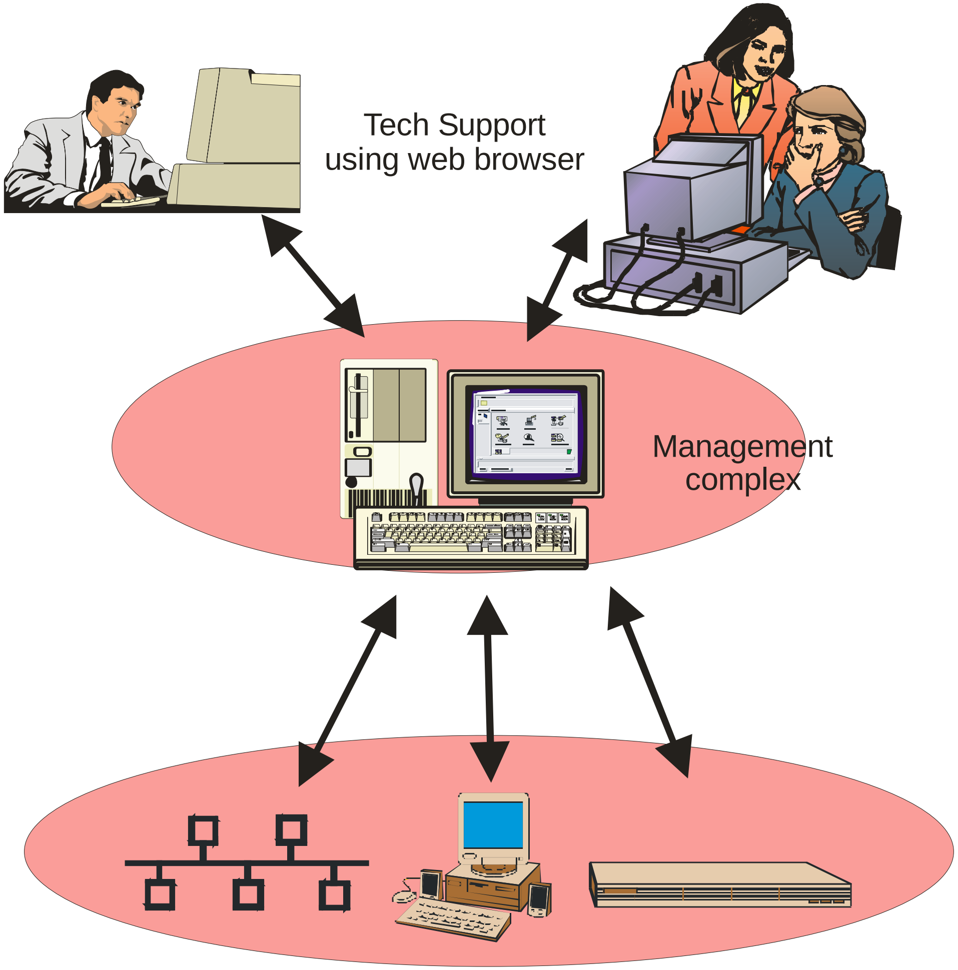
Management stations poll agents for MIB values

Multiple polls required to determine data

Agents may also send traps

Community names used for authentication

RMON allows distributed management functions



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Operating Specific Data Collection

Operating system data collection

- Log files
- Vendor specific storage

System Management Facility

- SMF on z/OS
- Standard way to collect z/OS system activity
- Network activity, I/O, software usage, ….
- Each SMF record has a numbered type ‘SMF 89’
- IBM uses SMF numbers 1-127
- Vendors specific SMF records begin at 128
- Data is stored in VSAM files
- TCP/IP statistics are captured in SMF 109, 118, 119

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SMF Record Type Examples

•RMF records are in the range 70 through to 79. RMF's records are generally supplemented - for serious performance analysis - by Type 30 (subtypes 2 and 3) address space records.

•RACF type 80 records are written to record security issues, i.e. password violations, denied resource access attempts, etc. Other security systems such as ACF2 also use the type 80 and 81 SMF records.

•Products use SMF type 89 records indicate software product usage and are used to calculate reduced sub-capacity software pricing.

•DB2 writes type 100, 101 and 102 records, depending on specific DB2 subsystem options.

•CICS writes type 110 records, depending on specific CICS options.

•Websphere MQ writes type 115 and 116 records, depending on specific Websphere MQ subsystem options.

•WebSphere Application Server for z/OS writes type 120. Version 7 introduced a new subtype to overcome shortcomings in the earlier subtype records. The new Version 7 120 Subtype 9 record provide a unified request-based view with lower overhead

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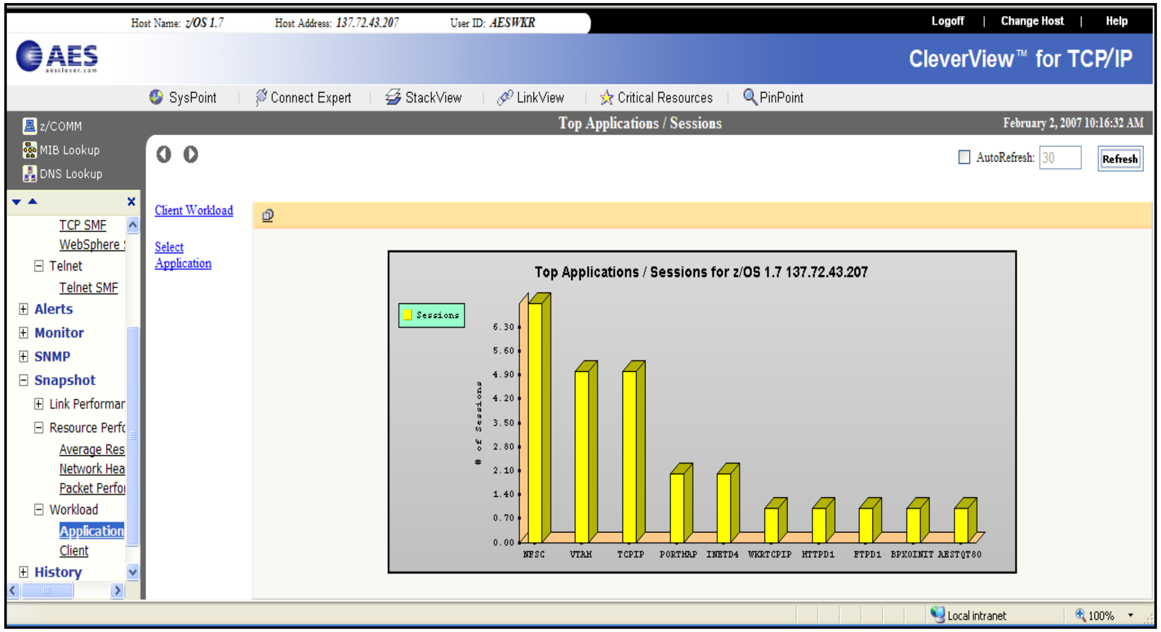
SMF 119 TCP/IP Statistics

Type of information collected

- Device and Link
- Interface
- VIPA
- Port details
- IKE
- IPSEC
- OMPROUTE
- SNALINK
- Buffer usage
- VTAM
- TN3270
- FTP
- Remote Print
- and more……



Host Name: z/OS 1.7 Host Address: 137.72.43.207 User ID: AESWKR

CleverView™ for TCP/IP

Top Applications / Sessions

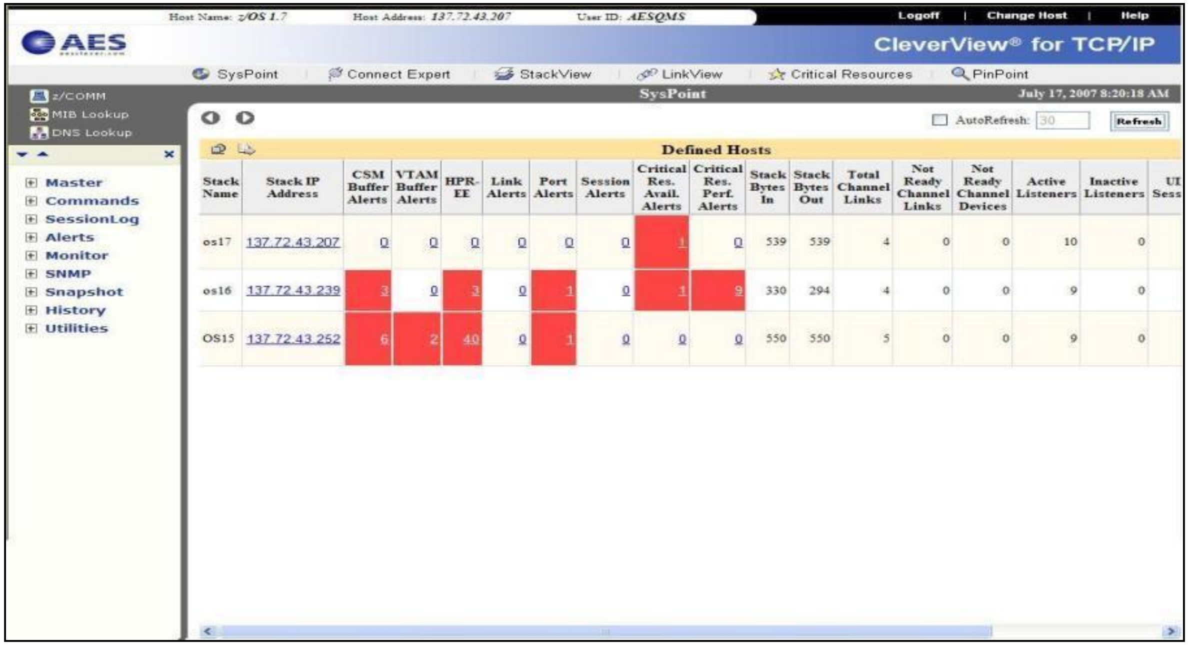
February 2, 2007 10:16:32 AM

□ AutoRefresh: 30

Vendor Specific Tools

Vendors utilize these base functions to provide integrated usable tools

- Single screen access to information gathered from multiple sources
- Correlation functions often provided
- Tabular and graphical displays
- Analysis
- Reporting
- Usable interfaces
- Alerting
- Historical data
- Real time data
- Exception reporting
- Baseline definition



Host Name: z/OS 1.7 Host Address: 137.72.43.207 User ID: AESQMS

SysPoint July 17, 2007 8:20:18 AM

□ AutoRefresh: 30

Defined Hosts

Stack Name	Stack IP Address	CSM Buffer Alerts	VTAM Buffer Alerts	HPR-EE	Link Alerts	Port Alerts	Session Alerts	Critical Res. Avail. Alerts	Critical Res. Perf. Alerts	Stack Bytes In	Stack Bytes Out	Total Channel Links	Not Ready Channel Links	Not Ready Channel Devices	Active Listeners	Inactive Listeners	UI Sess
os17	137.72.43.207	0	0	0	0	0	0	1	0	539	539	4	0	0	10	0	
os16	137.72.43.239	3	0	3	0	1	0	1	9	330	294	4	0	0	9	0	
OS15	137.72.43.252	6	2	40	0	1	0	0	0	550	550	5	0	0	9	0	

Today's Reactive Management

Dedicated level-1 personnel

24x7 coverage

Answer phone calls

Monitor an event control desk

Isolate problem

Log trouble tickets

Refers to level 2

Level 2 Reactive Challenges

Experienced personnel

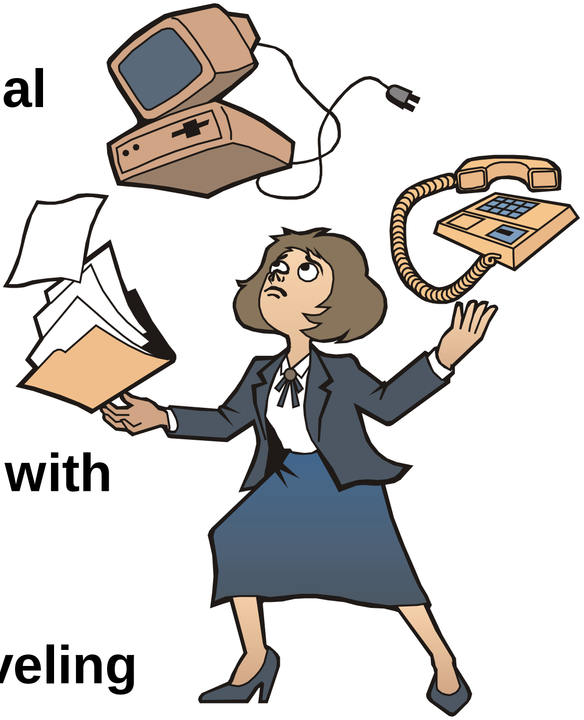
Operates from personal desk or mobile

Little to no access to management station

Dispatched by level-1 with little information

Often wastes time traveling to remote site

No time for pro-active network analysis



Need

- Historical data
- Base lining
- Threshold exceptions
- Event notification
- Smart agents
- Real-time data

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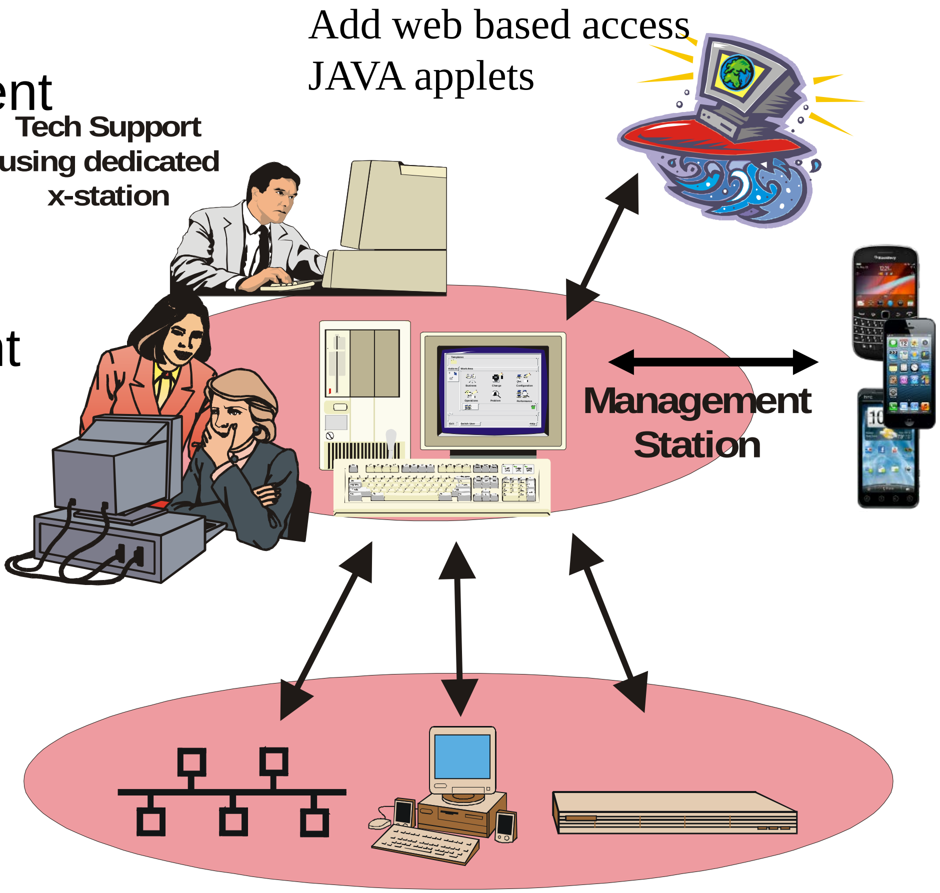
Pro-active Web and Mobile Based Management

Extends access to management station to all personal with Workstations and cell phones

Reduces load on management stations processor

Web and cell based performance tools allows greater visibility to level-2 and level 3 no matter where they are



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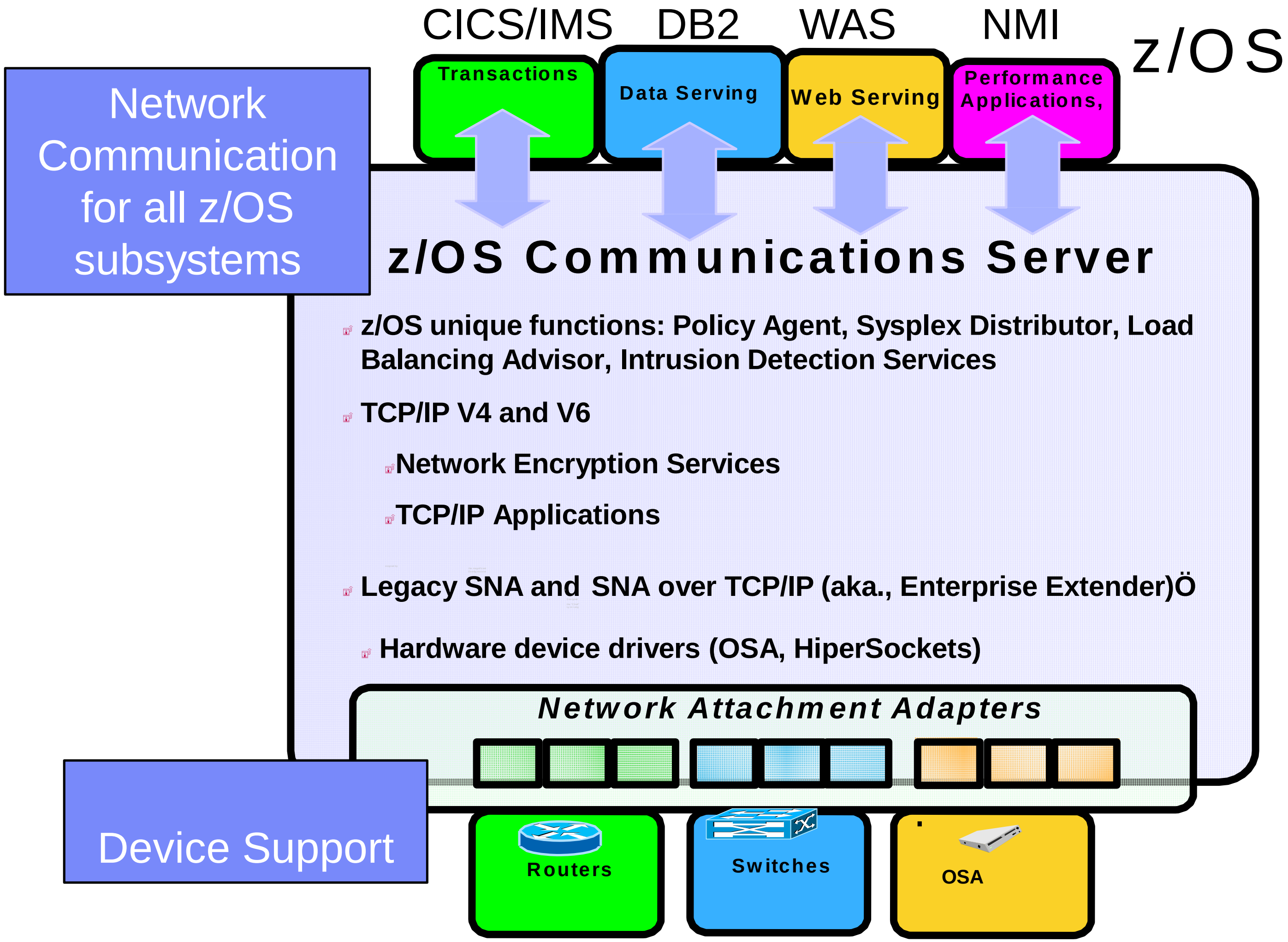


CICS/IMS DB2 WAS NMI

z/OS

Transactions

Data Serving

Web Serving

Performance Applications,

Network Communication for all z/OS subsystems

z/OS Communications Server

- z/OS unique functions: Policy Agent, Sysplex Distributor, Load Balancing Advisor, Intrusion Detection Services
- TCP/IP V4 and V6
  - Network Encryption Services
  - TCP/IP Applications
- Legacy SNA and SNA over TCP/IP (aka., Enterprise Extender)Ö
- Hardware device drivers (OSA, HiperSockets)

Network Attachment Adapters

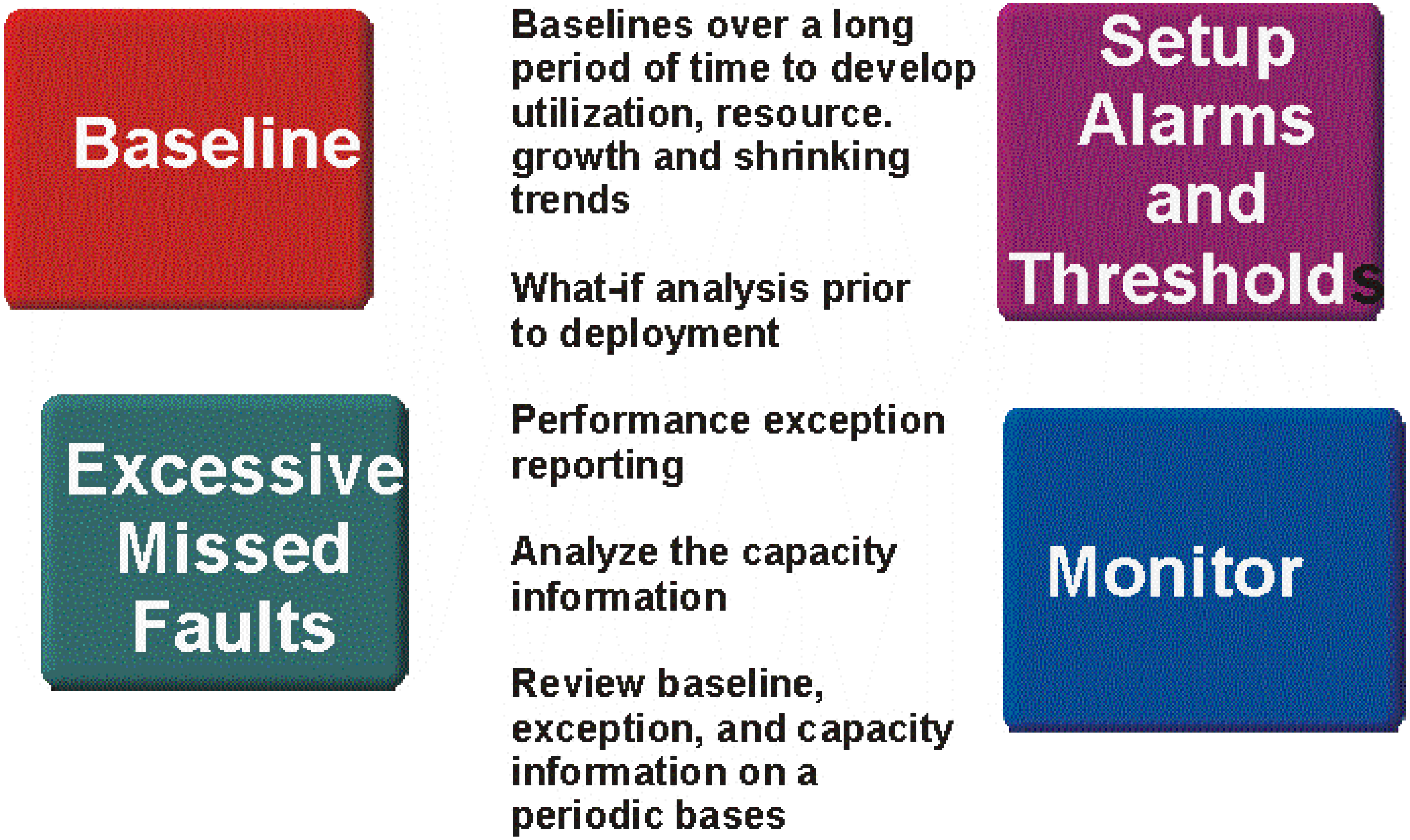
Device Support

Routers

Switches

OSA

Steps to Effective Management



Baseline

Setup Alarms and Thresholds

Excessive Missed Faults

Monitor

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

What-if analysis prior to deployment

Performance exception reporting

Analyze the capacity information

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

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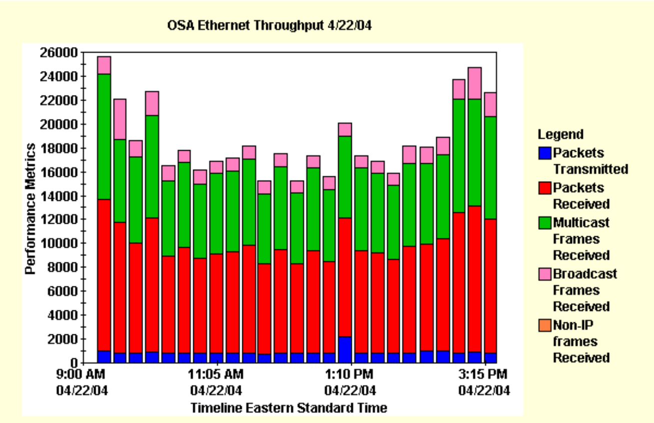
Baseline Your Environment



Gather inventory information

Gather statistics at a given time(s)

Monitor statistics over time and study traffic flows

Have logical maps of network, server and application views

Know the protocols and traffic profiles

Document physical and logical network

Document detailed and measurable SLAs

Have a list of variable collected for your baseline

Be part of change control system

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Introduction and goals

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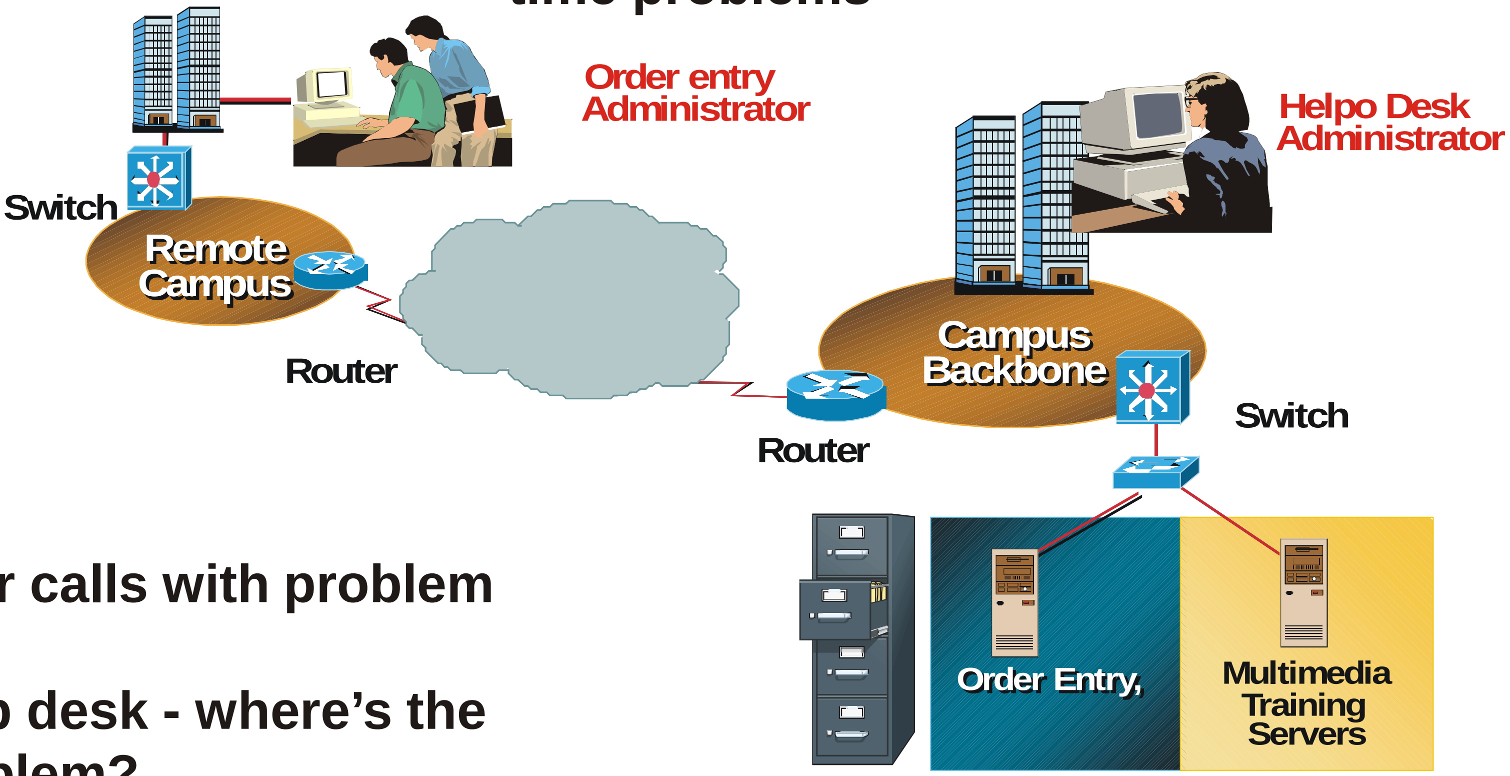
Best Practices

Performance Case Study

Catalog order processing system with TN3270E response time problems



User calls with problem

Help desk - where’s the problem?

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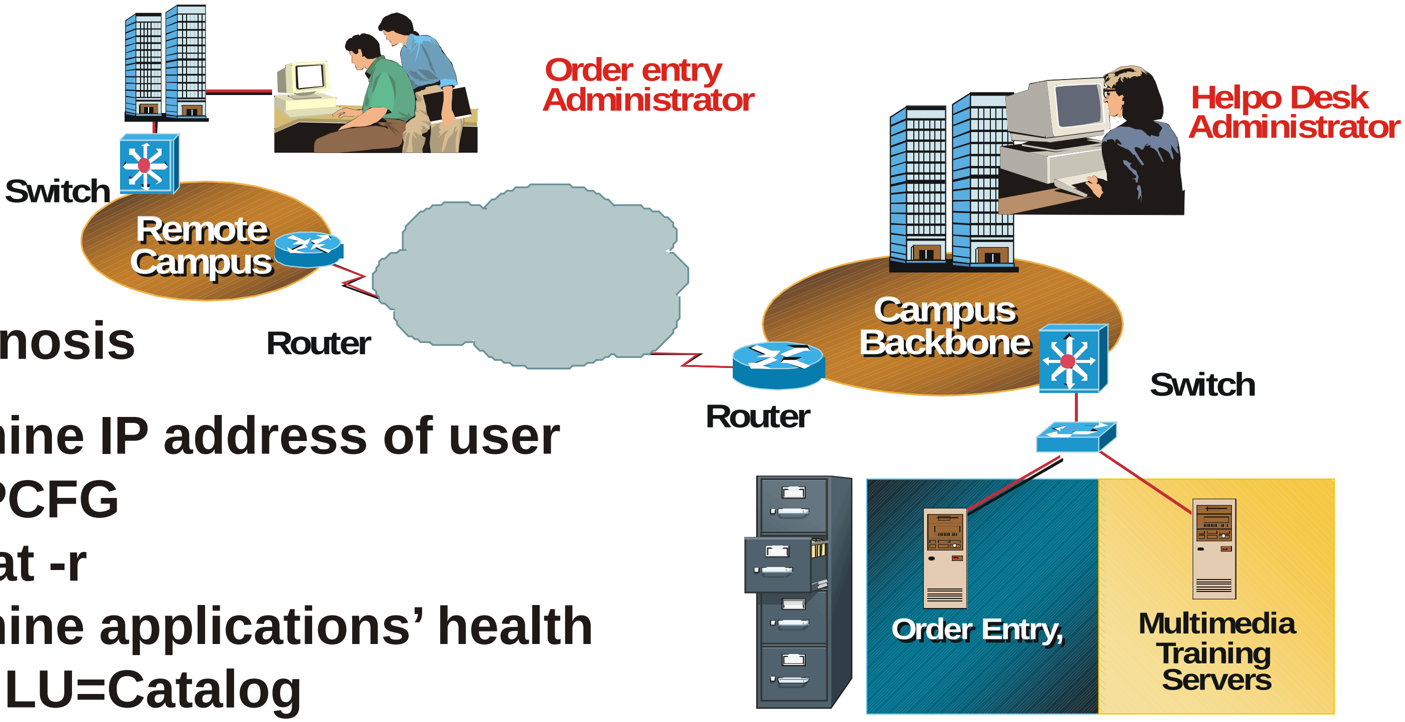
Case Study Reaction



Problem diagnosis

Determine IP address of user

WINIPCFG

Netstat -r

Determine applications' health

V Net LU=Catalog

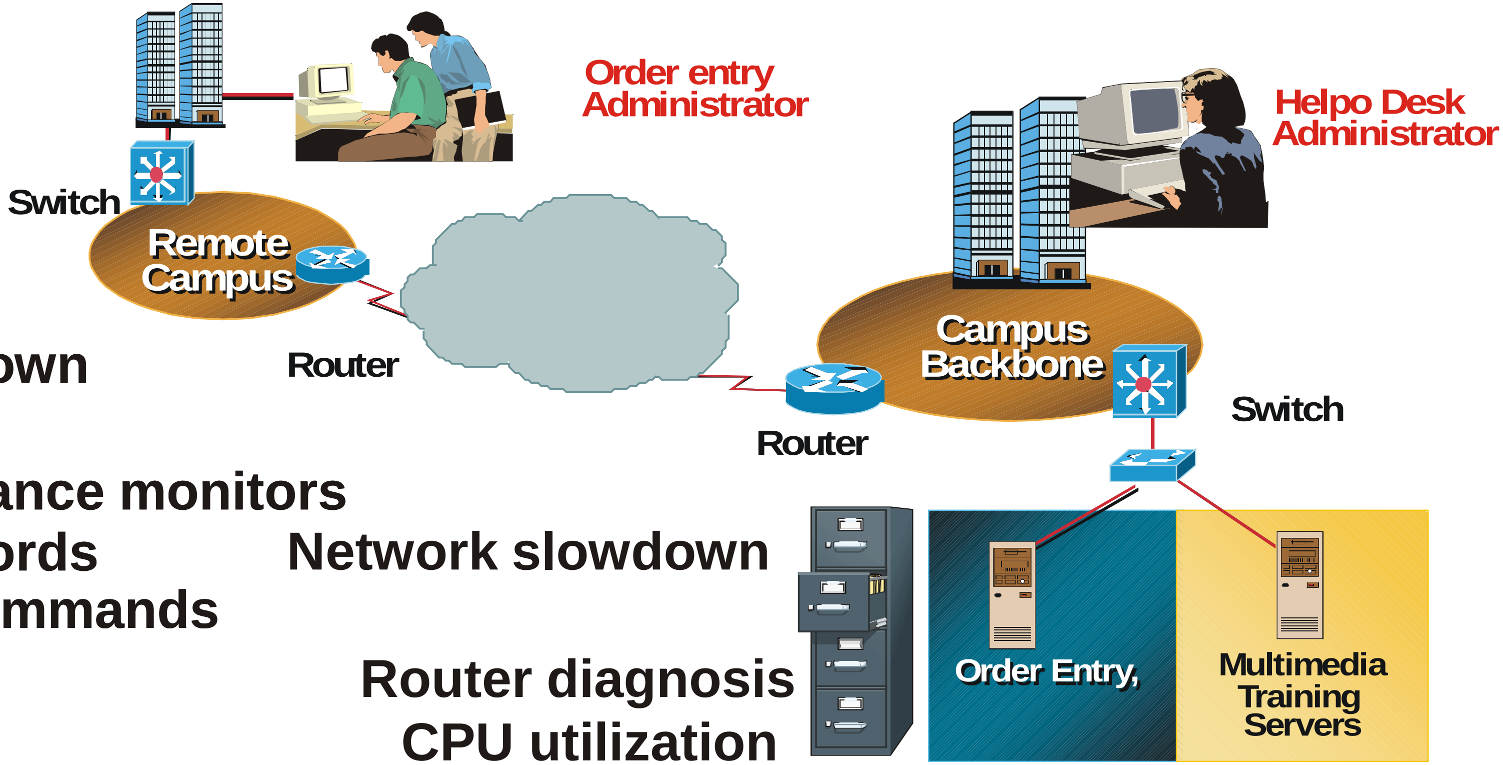
Can help desk log on to application

What is network response time

Traceroute to determine path

Ping nodes in path to determine bottlenecks

Case Study – Bottleneck Diagnosis



SNA slowdown

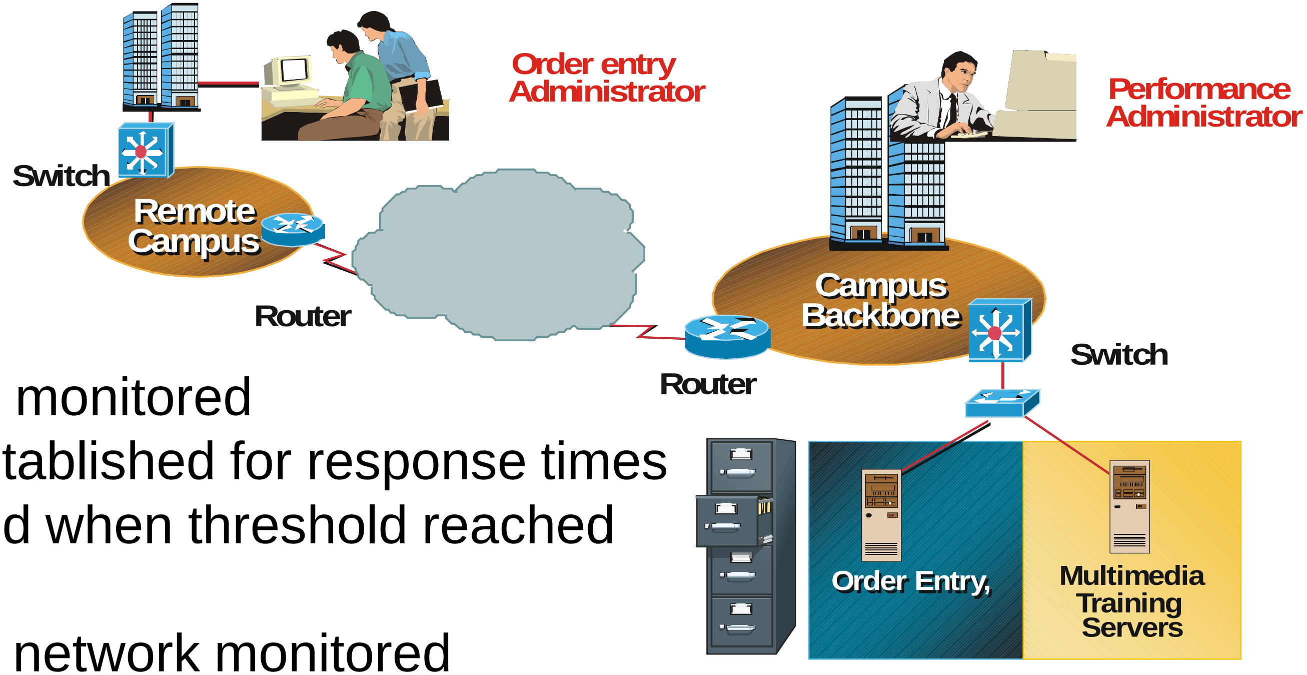
Performance monitors
SMF records
VTAM commands

Network slowdown

Router diagnosis
CPU utilization
Memory utilization
Packet errors
Interface status
IP stack analysis

Case Study - Proactive Solution

Administrator alerted to the impending problem.....

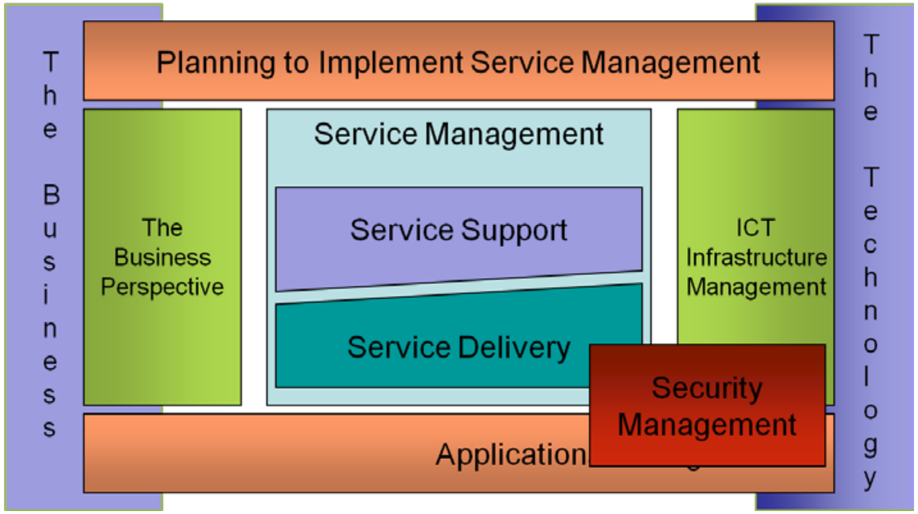

Order entry Administrator
Performance Administrator
Switch
Remote Campus
Router
Campus Backbone
Switch
Router
Order Entry,
Multimedia Training Servers

TN3270 traffic monitored
Thresholds established for response times
Alert generated when threshold reached

Routers in the network monitored
Alerts generated for exceeded limits

Trend analysis information produces baseline
Review to determine need for more resources, network changes

Performance Interaction with Fault Management



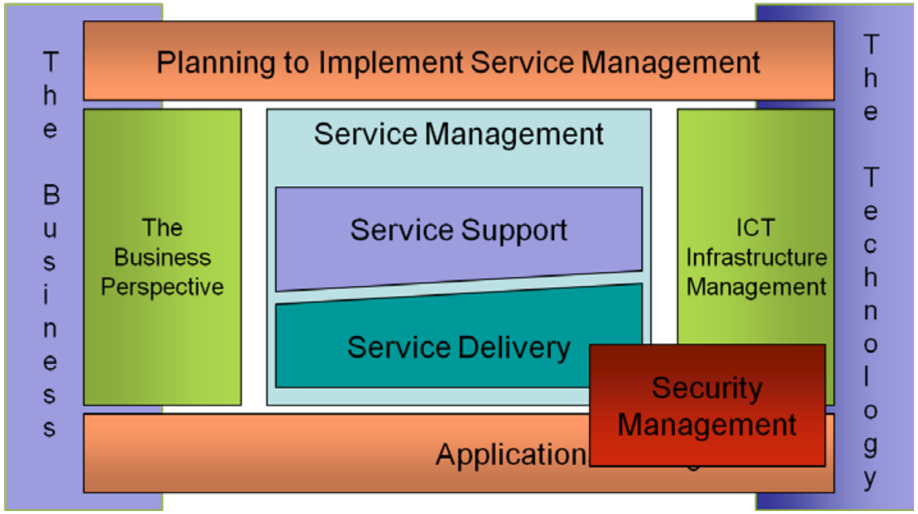
Proactive fault management is the area that ties together fault, performance and change management into an ideal network management system

Processing performance data may uncover network faults

Excessive or repeated faults may lead to change of monitored resources

Real-time notifications of performance related items

Performance Interaction with Configuration Management



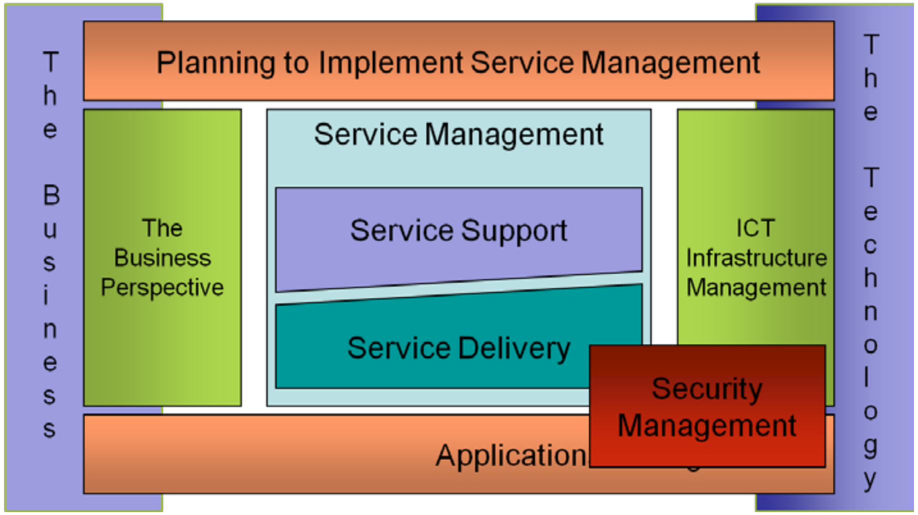
Analysis of performance data may lead to configuration changes

Define and validate protocol usage by systems, servers, applications

Ensure management protocols are appropriately defined

Ensure correct interaction with management subsystems like DNS, NTP, etc.

Performance Interaction with Security Management



Read only access to devices

Use of SNMP views to restrict unauthorized use of SNMP information

Don’t make performance data collection a Denial of Service attack against the network or systems

Security logs may be used during performance analysis

Mainframe Management

Problems continue to evolve as business services evolve

Always new technologies to with which to contend (cloud, mobile, big data, IPv6….)

Emerging applications demand high performance

Problem determination data readily available … But the interpretation and action plans are lax

Performance data readily available .... But the interpretation and action plans are lax

Complexity increases with each new application, network device, or other change

Questions?

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