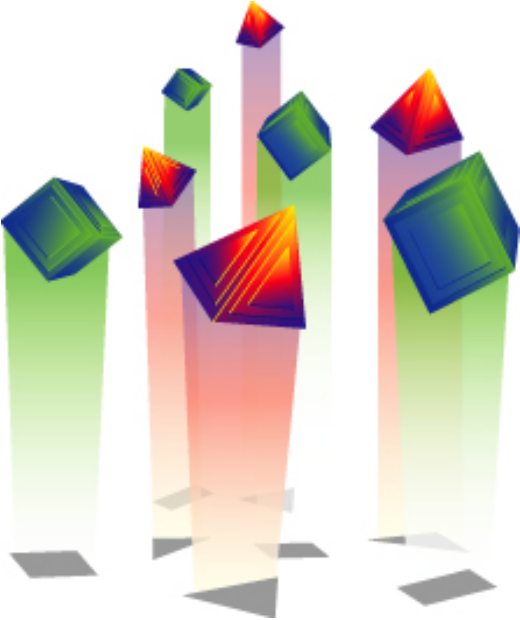


Performance Management 101

Share Session Anaheim



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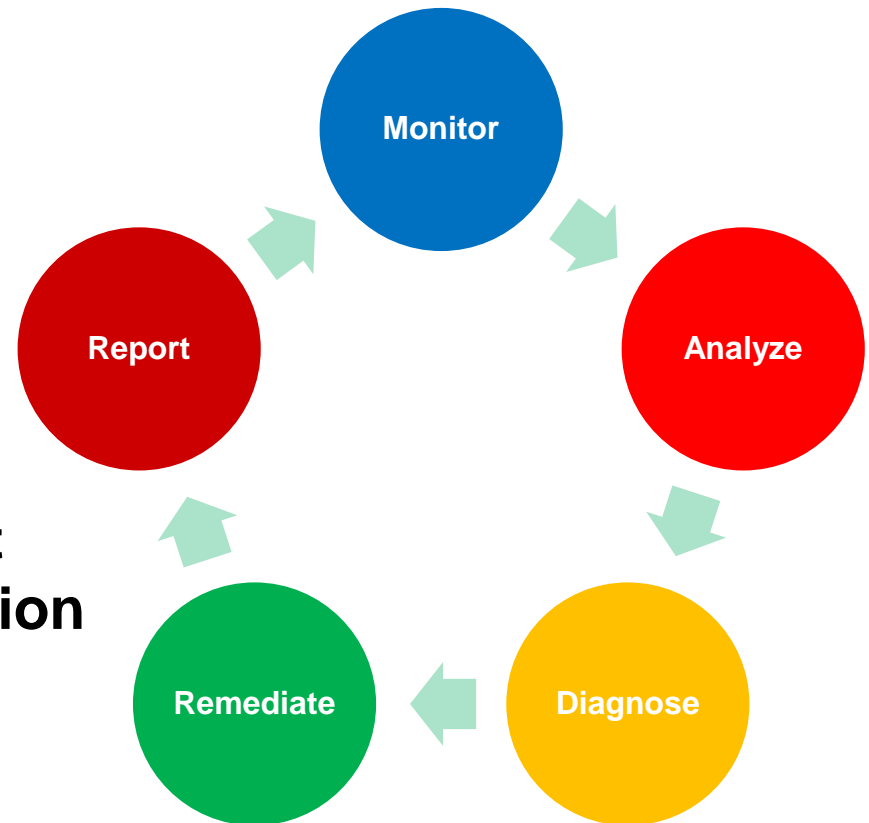
Managing Fundamentals

- **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

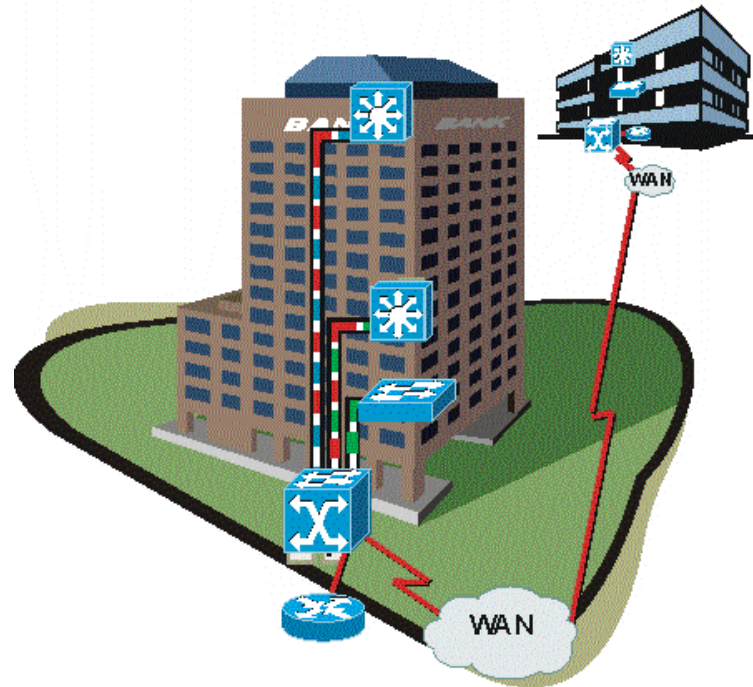
What's down? What's available?
What's up?

Performance Management

How consistent? How many?
How much? How fast?

Security Management

Who can access? Identify yourself?
Can everyone see it?



Agenda

Introduction and goals

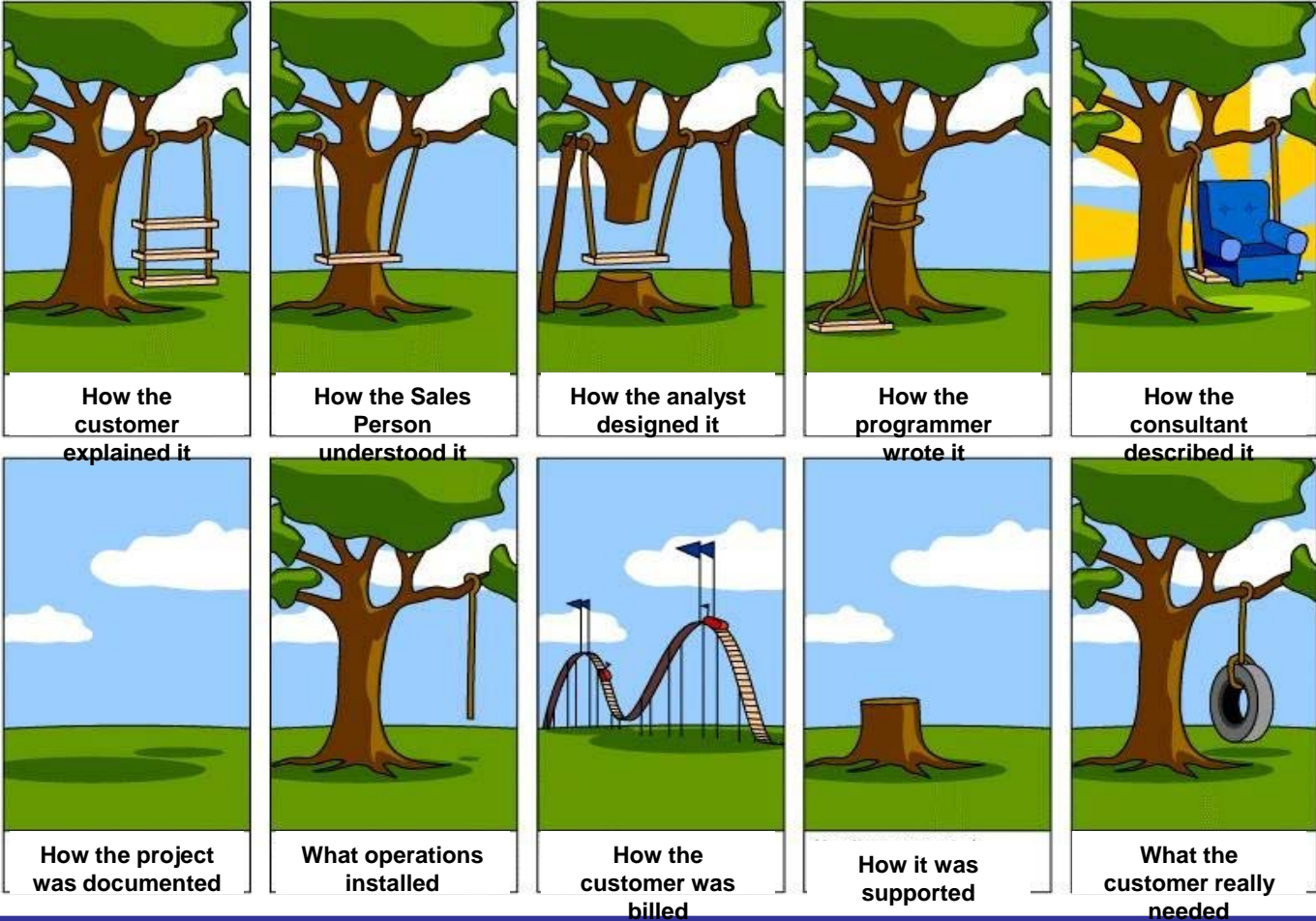
Performance planning model

Practices for performance planning

Best Practices



Recognize This?



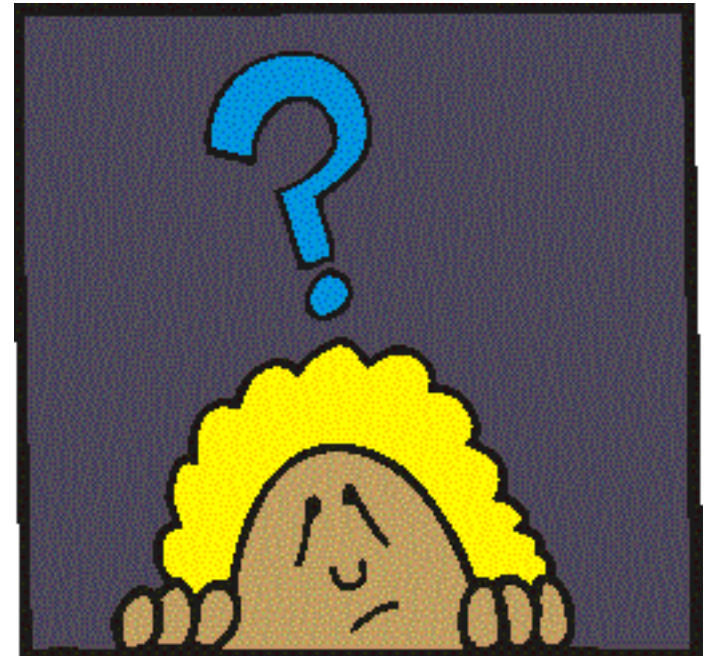
Murphy's Law

If anything can go wrong, it will

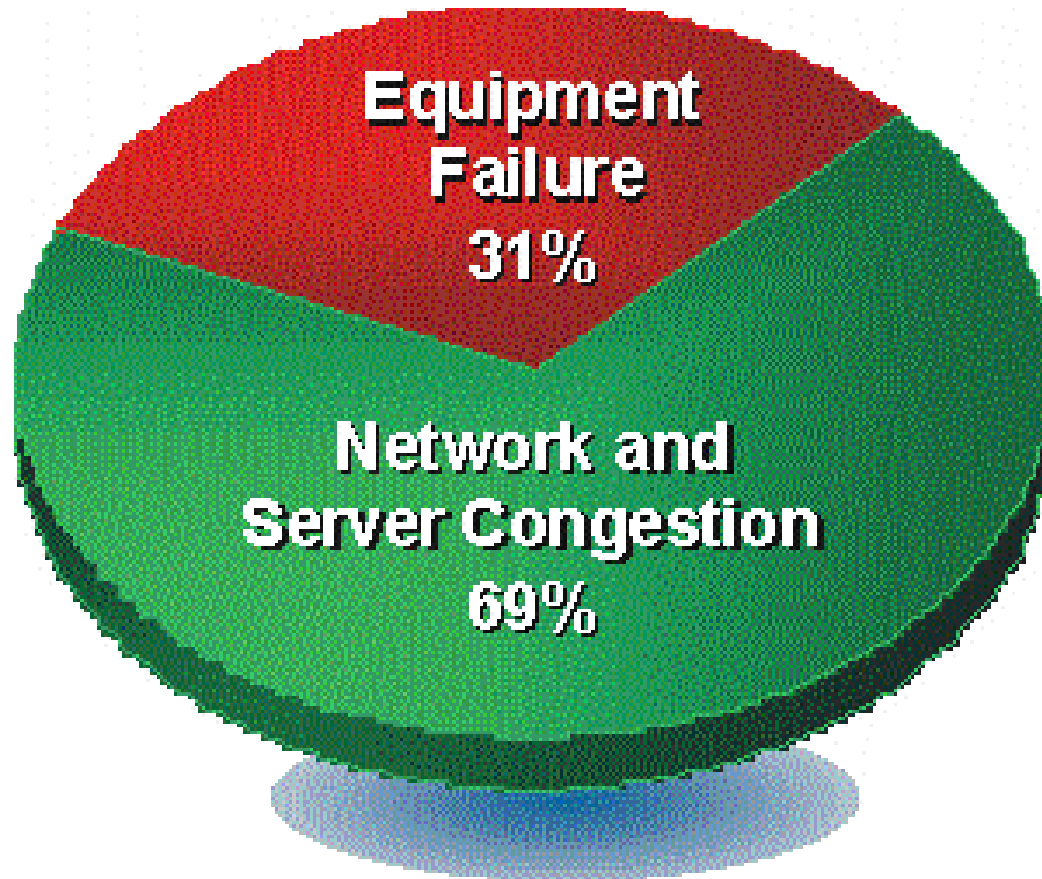
If anything just cannot go wrong it will

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

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



Congestion and Performance degradation



Performance Management

The practice of managing network service response time, consistency and quality for individual services, and services overall

Performance Related Risks

- Network degradation and failure
- Application timeouts and failure
- Application degradation

Performance Identifiers

- Normal baseline of performance
- Current or potential utilization problems
- Slow response time
- Application, server, network availability
- Optimum data transfer times
- Violation of SLAs, QoS policies, or CoS guarantees

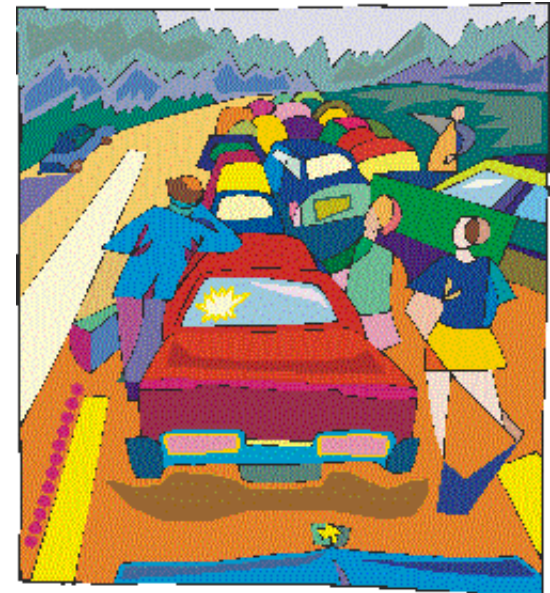


The Performance Problem

Over – Provisioning

Lots of provisions (rare)

More resources than can be consumed
Food on cruise line
Congressional parking spaces

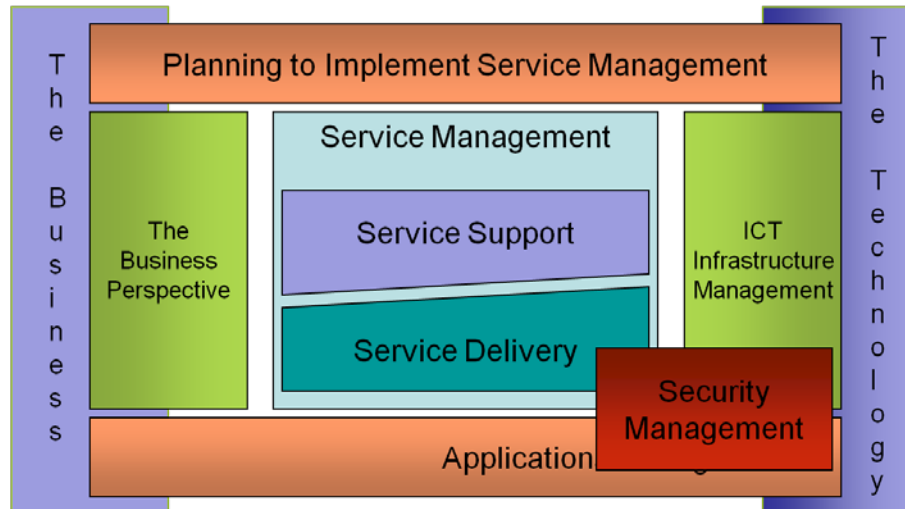


Over – Subscribing

Lots of subscribers (common)

Many users consume all the resources
Phone calls on Mother's day
Milk and bread if an ice storm hits the south

Performance Interaction with Fault Management



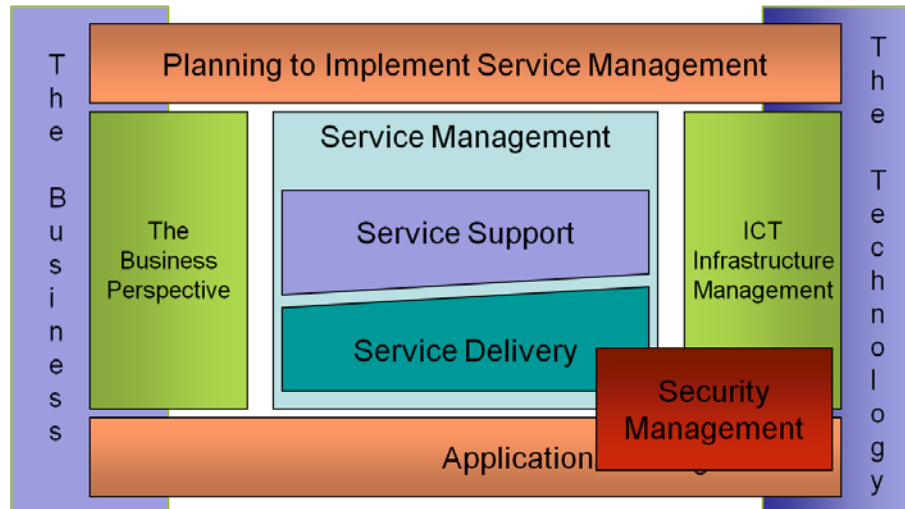
Proactive fault management is the area that ties together fault, performance and change management into an ideal network management system

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



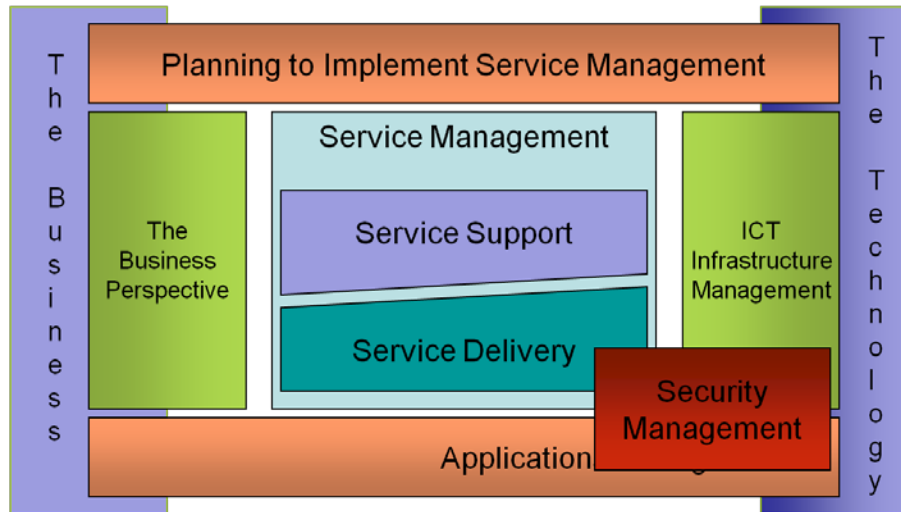
Analysis of performance data may lead to configuration changes

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

Agenda

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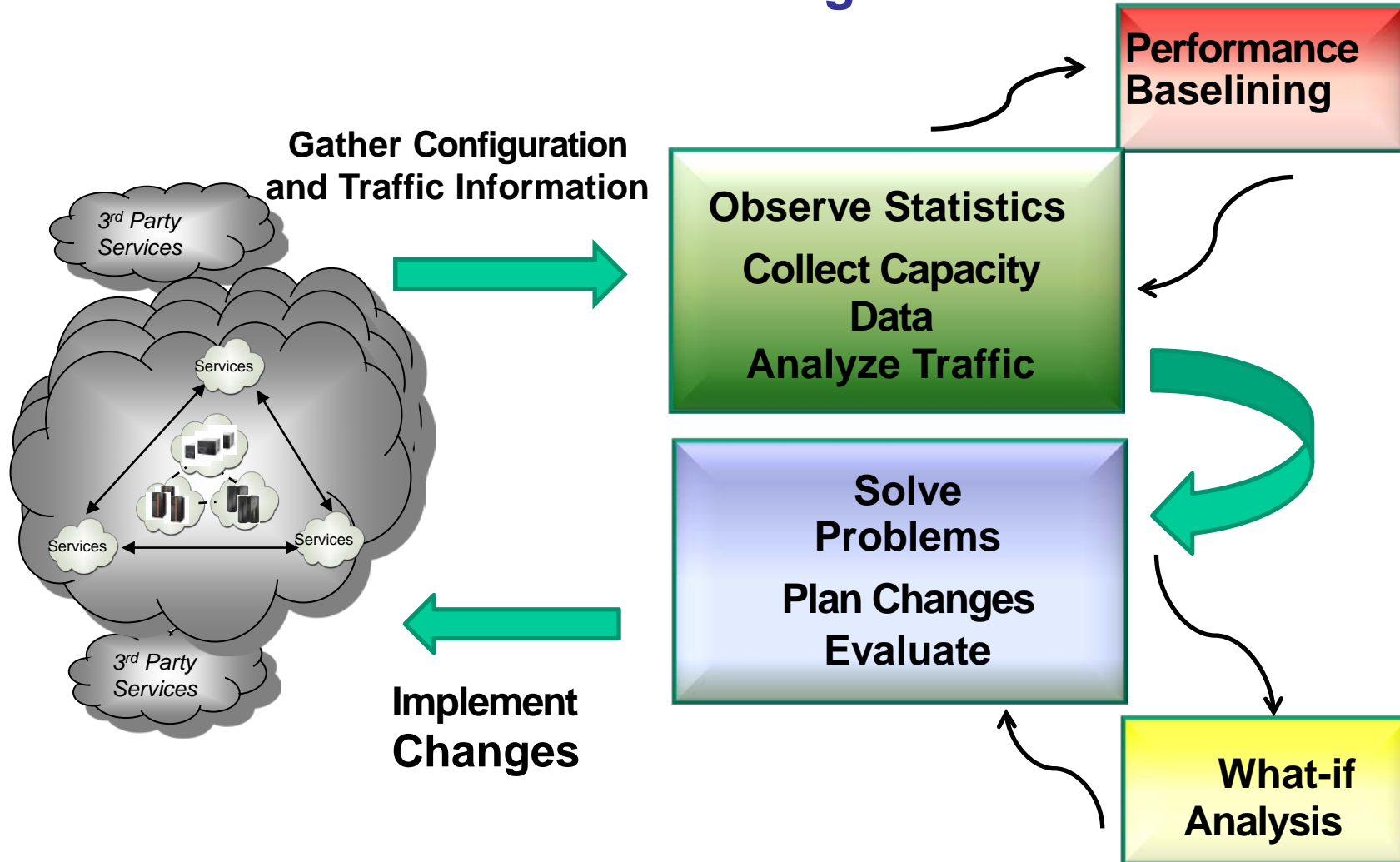
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Effective Performance Management

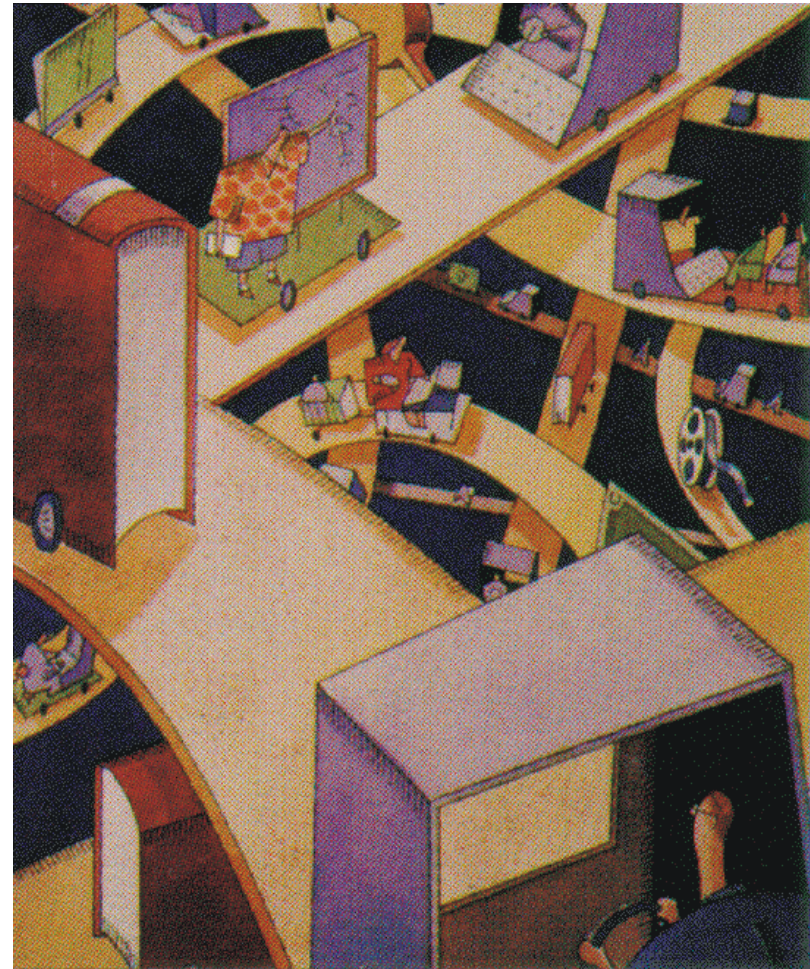


IP Resource Bottlenecks

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

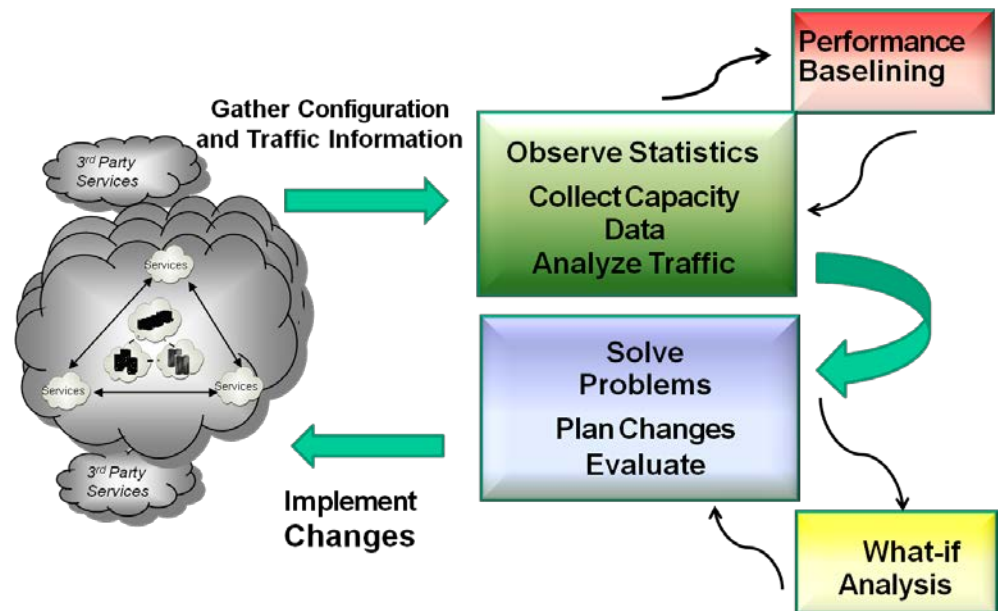
Results in:

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



Performance Plan

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



Agenda

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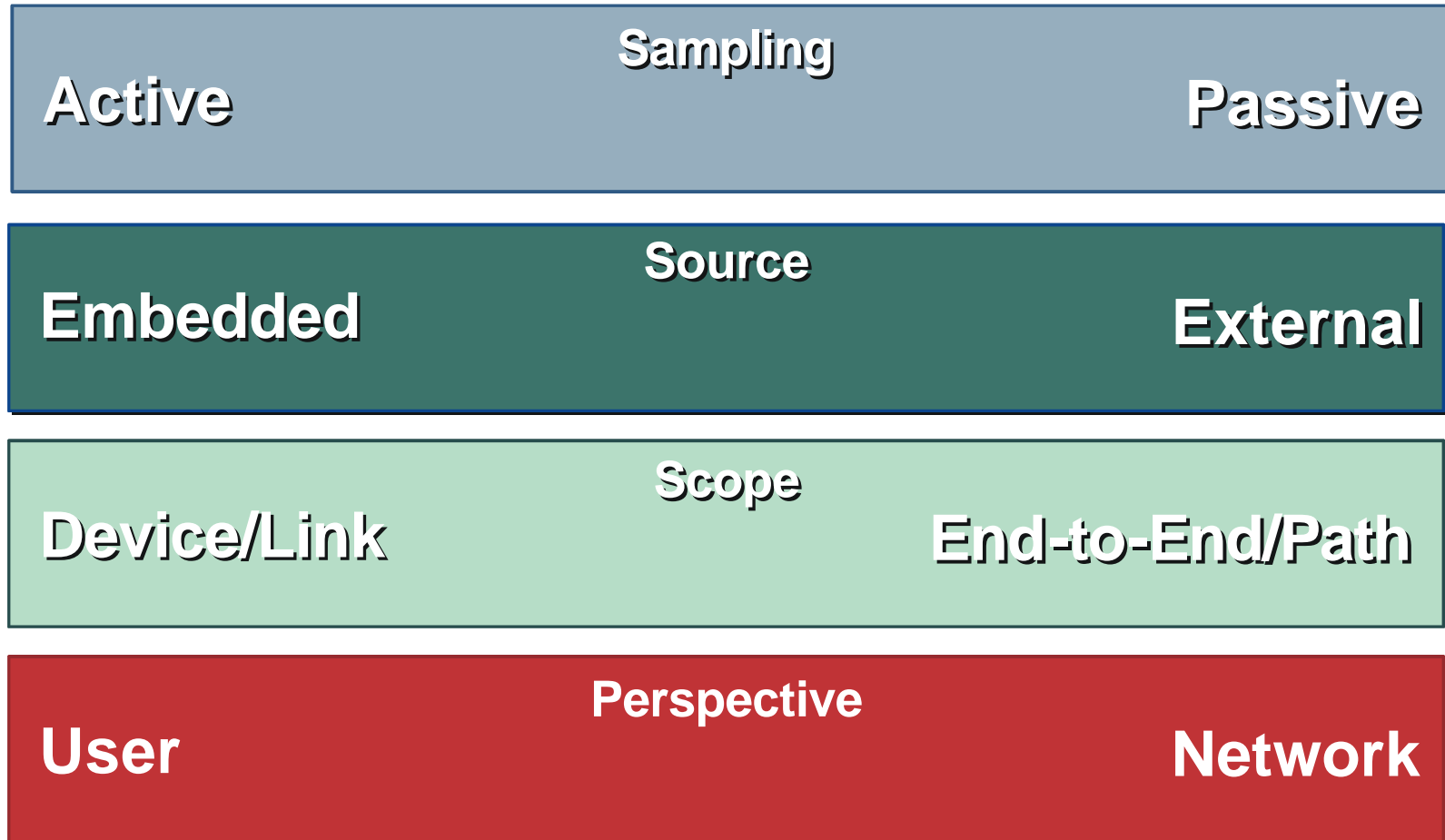
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Performance Management Practices



Active and Passive Performance Management

Passive	Active
<ul style="list-style-type: none">• Definition Actual end-user network traffic where performance is measured by timing specific application traffic flows• Advantages Most accurate for live application traffic on a specified link• Disadvantages Limited to measuring:<ul style="list-style-type: none">Existing traffic types, which may not be present on the network at all timesExisting traffic patterns, which may not reflect patterns for new or future applications	<ul style="list-style-type: none">• Definition Network traffic generated strictly for the purpose of measuring a network performance characteristic• Advantages Measures performance:<ul style="list-style-type: none">Between any two points in the networkControllable, on a continuous basisBy traffic class based on IP Precedence marking• Disadvantages Only an approximation for performance of live traffic

Embedded or External Sourcing

Embedded

- **Definition**

Mechanisms for collection of network statistics are integrated into the network communication device (e.g., router or switch), itself

- **Advantages**

Follows network infrastructure
Gathers metrics that cannot be observed externally

- **Disadvantages**

Performance monitoring has device-level performance implications

External

- **Definition**

Mechanisms for collection of network statistics are provided by a stand-alone device specifically designed to collect network performance statistics

- **Advantages**

Validation of performance performed independent of the devices that transmit network traffic

- **Disadvantages**

More hardware to administer
Observed statistics limited to points of deployment

Scoping Practices

Device or Link Oriented

- **Definition**

Performance measurement based on analysis of specific device or device interface, and typically based on utilization rates
- **Advantages**

Detailed application performance monitoring of critical network links
- **Disadvantages**

When network-wide performance problems exist, how does one select which device or link to evaluate?

End-to-End

- **Definition**

Performance measurement based on analysis of response time across two or more network devices, and typically based on latency
- **Advantages**

Starting point performance troubleshooting
Reflects end-user experience
- **Disadvantages**

Prior knowledge of relevant end-to-end paths is needed

User or Network Perspective

User	Network
<ul style="list-style-type: none">• Definition Measurement based on performance statistics measured at the end-user workstation• Advantages Accurate measurement of end-user experience• Disadvantages Scale and distribution issues Intrusive on the desktop	<ul style="list-style-type: none">• Definition Measurement based on performance statistics measured in network devices• Advantages Easy to deploy, and non-intrusive to the desktop Identifies network performance issue• Disadvantages Imperfect understanding of end-user experience

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

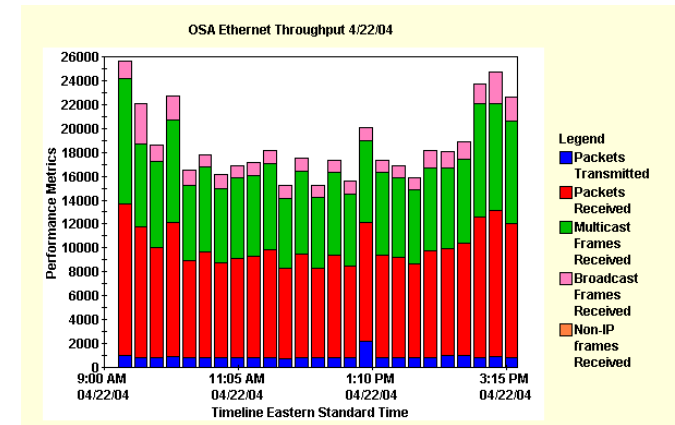
Monitor

Baseline Your Network

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

Agenda

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Statistics and Performance Management

Statistical analysis is part of Performance Management

Measuring network and service availability

Analyzing performance data

Aggregating raw data

Key statistical methods used

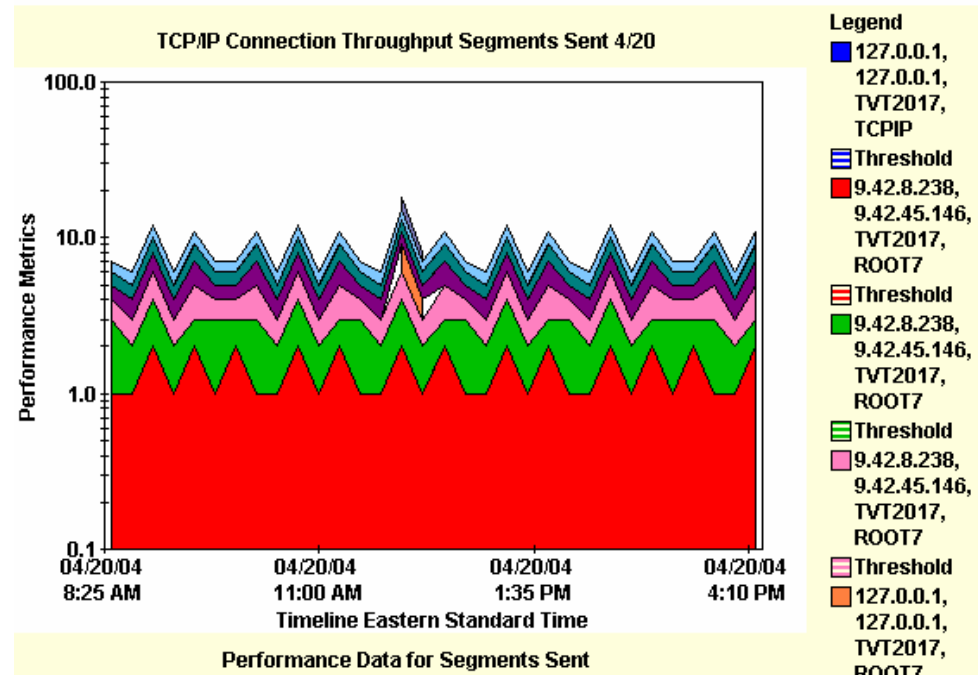
Average

Mode

Media

Standard Deviation

Variance



Availability Types

Calculated availability

Mean Time Between Failure (MTBF)
(Average time between failures)

Mean Time to Repair (MTTR)
(Time between when something broke and it was restored to service)

Monitored availability

Monitoring

Trouble ticketing

Probes

$$\text{Device Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} \quad (1)$$

$$\text{Unavailability} = 1 - \text{Availability} \quad (2)$$

$$A_{\text{Serial}} = \prod_{i=1}^N A_i = A_1 \cdot A_2 \cdot \dots \cdot A_N \quad (3)$$

$$A_{\text{Parallel}} = 1 - \prod_{i=1}^N (1 - A_i) = 1 - (1 - A_1) \cdot \dots \cdot (1 - A_N) \quad (4)$$

Statistical Measures

Analyze and condense data collected

Predict what will be

Basic statistical applications

- Sample size and polling interval

- Measure of tendency (average)

- Measure of spread (standard deviation)

- Probability and cumulative density

Ensure good data collected

- Need to collect enough data points for accuracy

- Sample at a high enough rate to provide the detail required (but not flood the network)

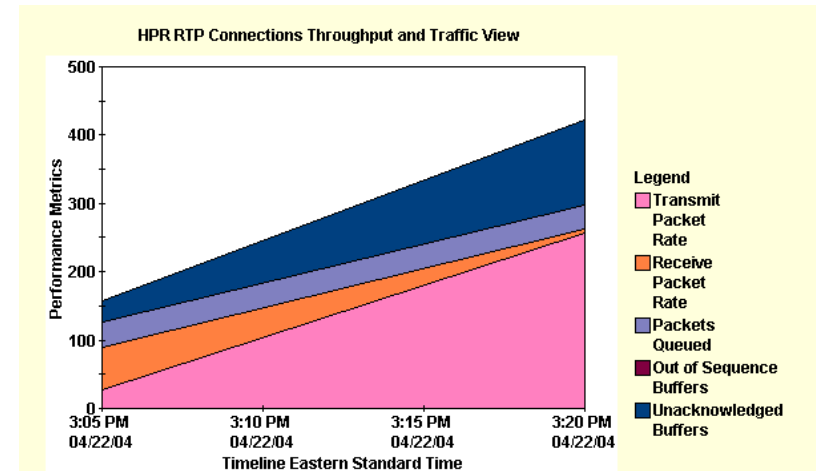
- Adjust sampling based on analysis or timeliness

Key Statistical Measures

- Measure of central tendency (average, mode, median)

- Measures of spread (standard deviation)

- Probability of density function



Sampling Rate and Size

Sample size is the number of samples that have been collected

Sampling rate is the rate at which the data is collected from the network

$$\text{Sampling} = \frac{1}{\text{Polling Interval}}$$

The higher the sampling rate the more detailed the data collection

A data interval of 15 minutes provides 4 times the detail of polling once an hour



Average-Mean-Mode

Average is the center of a distribution

Mode is the most common occurrence of a value in a distribution

Median is the middle value in the distribution

Mode and median help identify skews

Assume you collected the following data
120 119 121 110 120 100 128 2400 2390 2405 120 121 100 119 120

Sort data in ascending order

Mode

100 100 110 110 119 119 120 120 120 120 121 121 128 2390 2400 2405

Average

Median

Standard Deviation

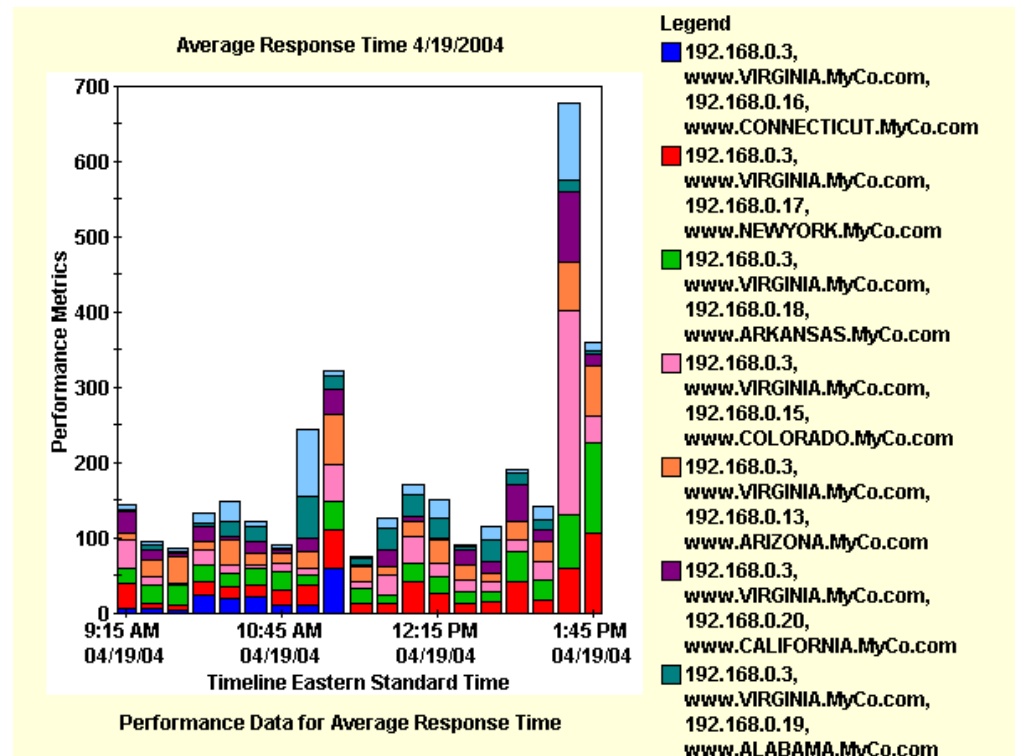
Standard deviation is a measure of spread

Looks at all data values

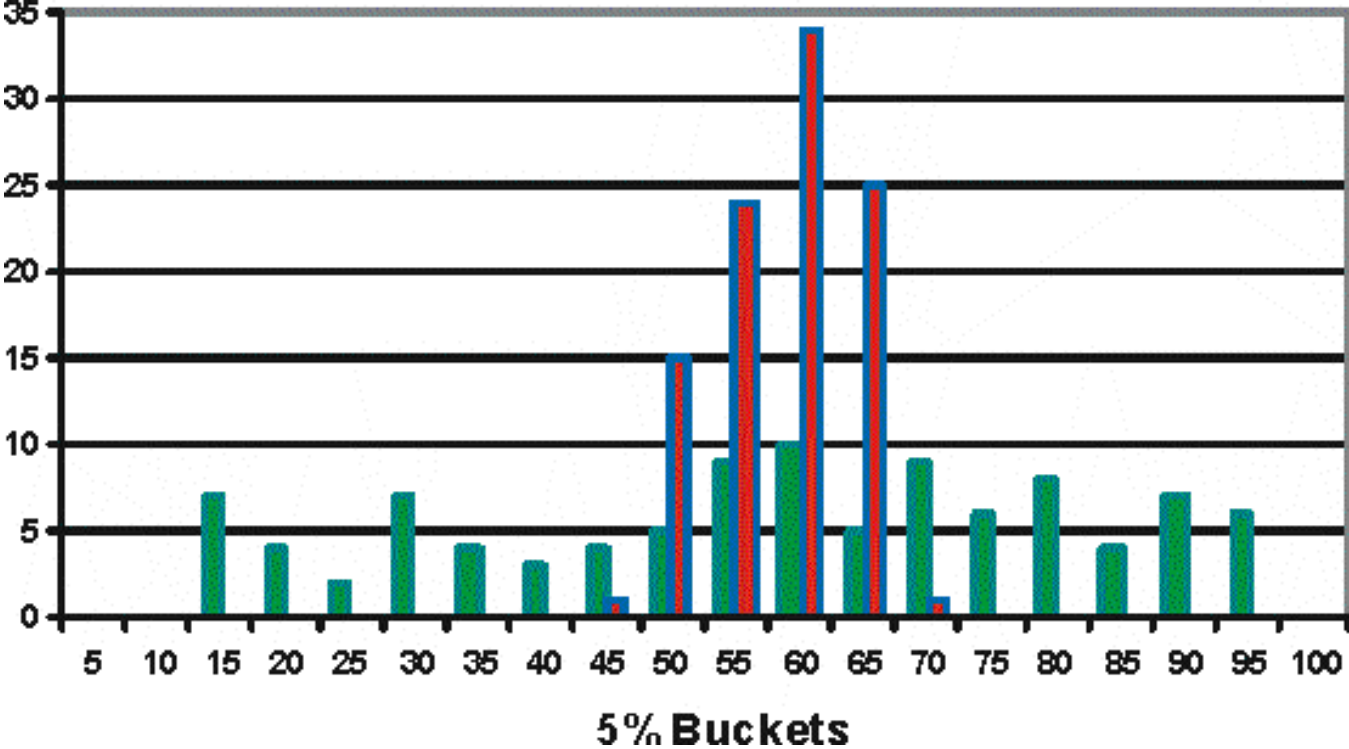
Most well known and used method

Integrated into most management systems

Can be calculated as data arrives



Probability Density Function



Groups data into buckets

Provides visualization of data's statistical properties

Measuring Performance

Polling interval and aggregation

RFC 1857

Rule of thumb on polling interval - 15 minutes

24 hour aggregation - 15 minutes

1 month aggregation - 1 hour

1 year aggregation - 1 day

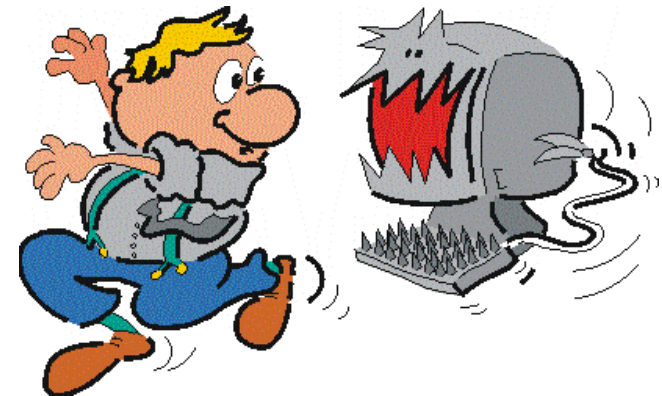
Measuring performance

Availability

Response time

Accuracy

Utilization



Performance Management

You never solve performance problems
....you just keep moving them around
your network

Basic performance issues
remain the same...but QoS and
new information types are
expanding its role

Emerging applications demand high performance

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

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



Vielen
Dank

Questions?

Köszönettel

תודה

Teşekkürler

Obrigado!

THANK YOU

Bedankt

Ευχαριστώ
Gracias

ขอบคุณ

شكراً

धन्यवाद

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Merci
Díky

Hvala

Our other presentations:

Tuesday, 9:30 am – 10:30 am: Performance Management 101

Tuesday, 3:00 pm - 4:00 pm: Performance Management in a Virtualized Environment

Wednesday 3:00 pm – 4:00 pm: Management Changes in IPv6 – Focus on ICMPv6

Thursday 9:30 am – 10:30 am: Hot Topics in Networking and Security

Thursday 1:30 pm – 2:30 pm: Network Problem Diagnosis with OSA Examples

Thursday 3:00 pm – 4:00 pm: TCP/IP Forensics

Friday 8:00 am – 9:00 pm: Keeping Your Network at Peak Performance as you Virtualize the Data Center

Friday 9:30 am – 10:30 am: Virtualization: New Technologies and Methods to Assure the Health of the Infrastructure