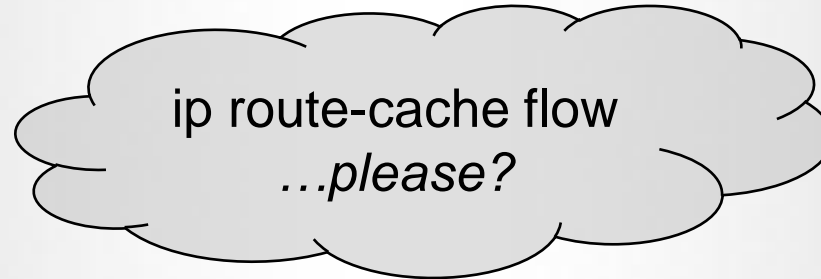


Leveraging Cisco IOS® Technologies For Performance Management



Ward Cobleigh
ward.cobleigh@flukenetworks.com

Because your infrastructure has *so much* it wants to tell you

Today's Agenda

- Fluke Networks overview
- Evolution of network management and Cisco IOS Technologies
- Leveraging Cisco IOS Technologies for performance management:
 - *NetFlow*
 - *IP SLAs*
 - *Performance Routing*
- Open forum discussion

Who Is Fluke Networks?

- Began as an exploratory business unit within Fluke Corporation in 1992
 - *Fluke Corporation has 60 years as world-leader of electronic test tools*
- In 2000, growth and market conditions caused Fluke Networks to become a separate business
 - *Fluke Networks and Fluke Corporation are separate and distinct entities*
 - *Both are part of the Danaher family of companies (NYSE:DHR)*



DSP-100
Fluke Networks'
First Cable Tester



Fluke Networks'
First Handheld
Network Analyzer



Danaher, a diversified technology leader, designs, manufactures, and markets innovative products and services with strong brand names and significant market positions over 6 strategic platforms

Test & Measurement

Environmental



Hand Tools



Motion



Medical



Product ID



Fluke Networks Today



- Part of a \$11B premiere global enterprise
- Continuously profitable company since its inception
- Total annual sales exceed \$340M
- Over 800 associates worldwide
 - Worldwide Headquarters: Everett, WA
 - Major research & development facilities: Colorado Springs, CO; Austin, TX; Dallas, TX; Duluth, GA; Cincinnati, OH; Bridgewater, NJ; Rockville, MD; Dublin, Ireland; Bangalore, India; Shanghai, China
 - Sales Offices & Associates Worldwide: Extensive operations in Europe, Asia, Australia, South America and North America
 - Technical Assistance Centers: Everett, WA; Watford, UK; Rockville, MD

Fluke Networks' Core Customers

Enterprise Managers

Distributed and handheld LAN and WAN test and analysis solutions



Datacom Installers

Copper & fiber cable certification and troubleshooting
Communication networks testing



Communication Service Providers

xDSL qualification
Process improvement
Access management and testing



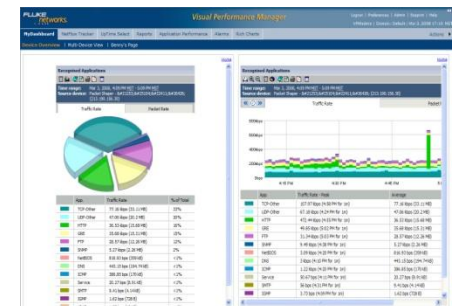
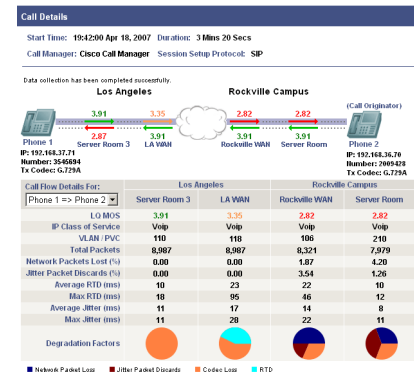
Fluke Networks Performance Management (PfM)

Overview

- Manage application performance and network performance in a converged voice/data network
- Broad enterprise visibility, deep analysis and detailed troubleshooting capability

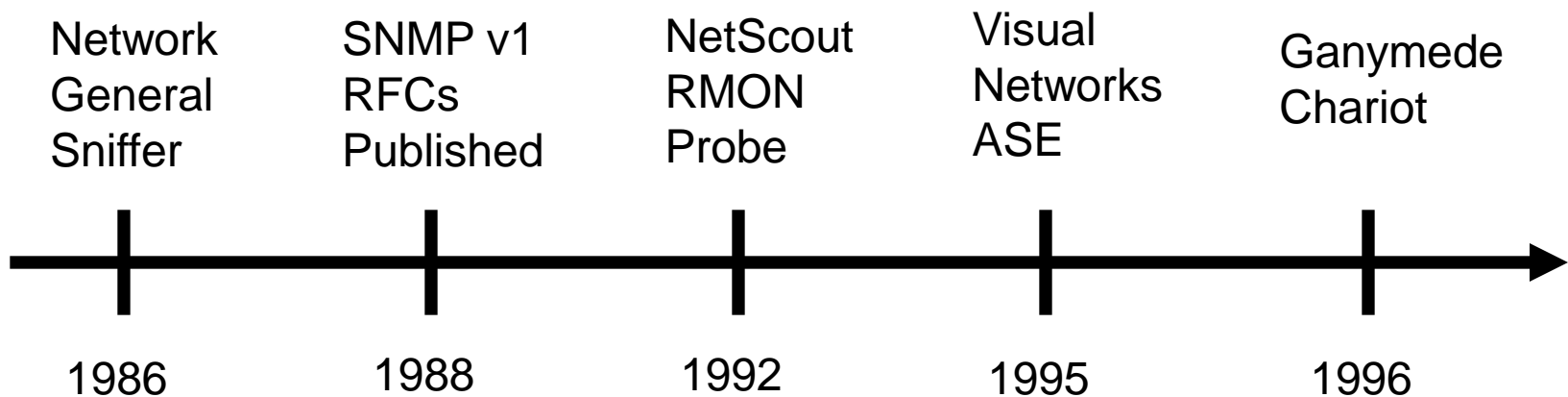
Value to our customers

- Maximize the value of IT by delivering superior IT services
- Provide quality end user experience through:
 - Proactive monitoring and management
 - Reactive troubleshooting and recovery



Network Management & Cisco IOS Technologies Milestones

Early Network Management Milestones



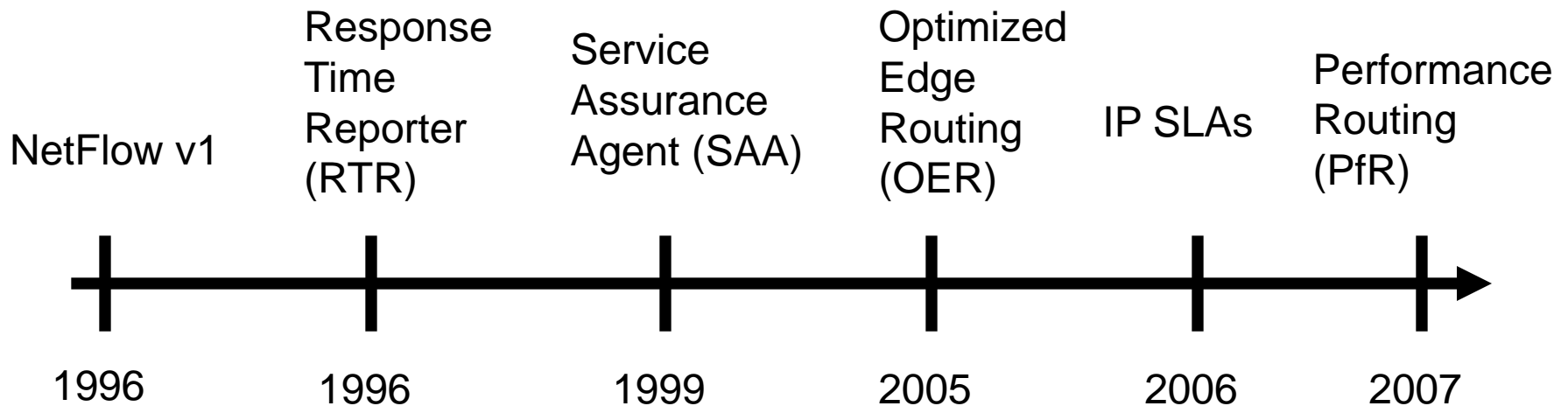
- Hardware probes
- Software agents
- Primarily focused on reactive troubleshooting

Things Were Changing...

- Evolution from shared to switched media (first Ethernet switch introduced in 1989)
- Faster speeds and feeds becoming more commonplace (Gigabit Ethernet standardized in 1998)
- Data volumes and network configurations began to challenge the “capture and analyze everything” philosophy (MPLS standardized in 2001)

- Processing power of infrastructure devices increasing
- Routers and switches could do more than just route and switch

Cisco IOS Technologies Milestones



- Embedded IOS functionality
- No probes or agents required
- Better suited for proactive performance management

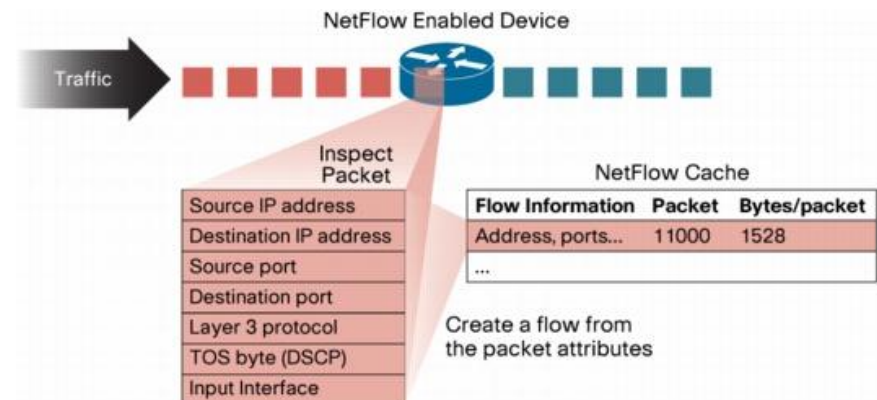
Cisco IOS NetFlow

What Is NetFlow?

“YOU CAN THINK OF NETFLOW AS A FORM OF TELEMETRY PUSHED FROM ROUTERS AND LAYER 3 SWITCHES, EACH ONE ACTING AS A SENSOR.”

JOHN CORNELL, CISCO IT TECHNICAL STAFF

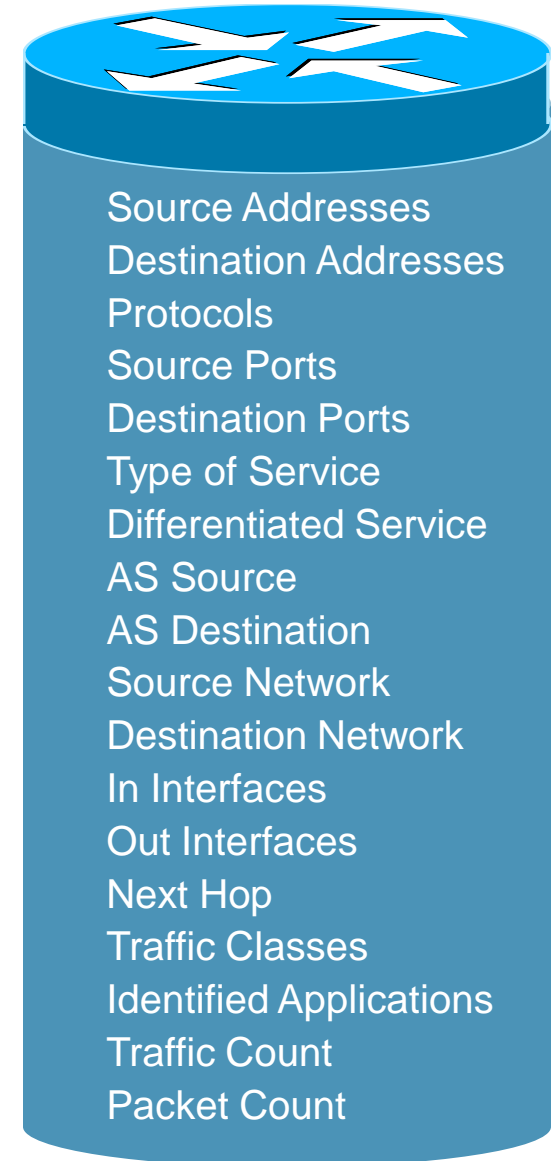
- NetFlow is a protocol for a router or Layer 3 switch to quantify the traffic passing through it
 - *Traffic statistics are locally stored (cached)*
 - *Traffic statistics can be exported to other devices or applications for analysis and reporting*



- Applications for NetFlow: Troubleshooting, forensic traffic analysis, intrusion detection, capacity planning, usage based accounting, etc.

NetFlow As a Data Source

- Great data source, but...
 - *How do you keep the data for a meaningful amount of time at a useful level of granularity?*
 - *How can you easily manipulate this data to quickly get to what you need?*
 - *How do you present the data in a simple, intuitive manner?*



What “Top N” Doesn’t Tell You

Top hosts,
conversations,
protocols



My servers are busy

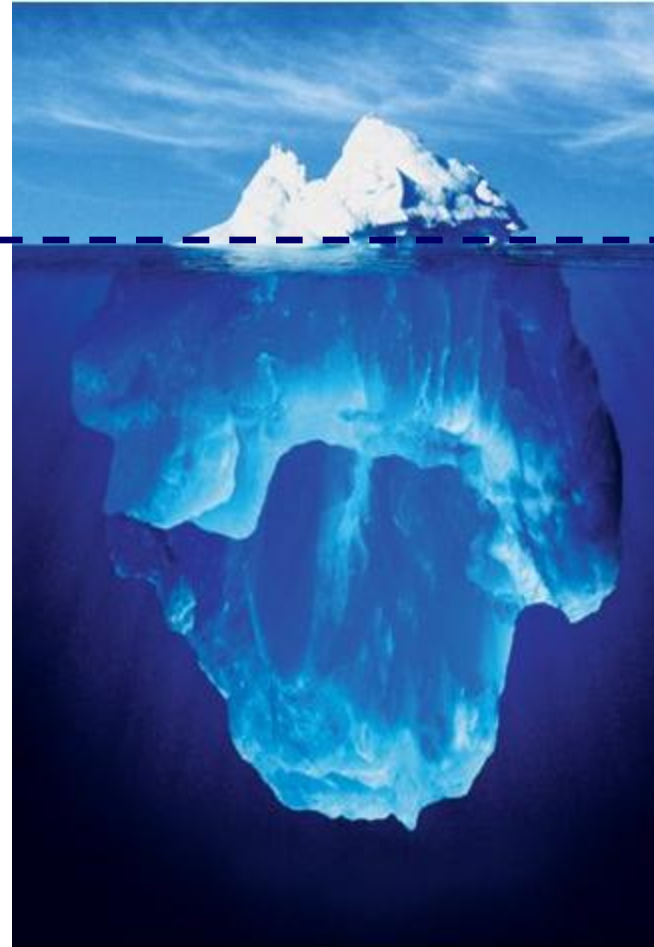
What’s really
happening on
my network

“Other”



What “Top N” Doesn’t Tell You

Top hosts,
conversations,
protocols



What’s really
happening on
my network

My servers are busy

Voice

Virus

Hacking

Multicast

DNS

Peer-to-peer

Worms

How MySpace Is Hurting Your Network

Social networking sites drive up DNS traffic, bandwidth

Increasingly popular social-networking sites such as MySpace, YouTube and Facebook are accounting for such huge volumes of DNS queries and bandwidth consumption that carriers, universities and corporations are scrambling to keep pace.

Social-networking sites create large volumes of DNS traffic because they pull content from all over the Internet. Most of these sites use content-delivery networks to extend the geographical reach of their content so users can access it closer to home.

"A single MySpace page can have anywhere from 200 to 300 DNS lookups, while a normal news site with ads might have 10 to 15 DNS lookups," Tovar says. "It's an exponential increase."

"They're making use of an awful lot of short TTLs [time to live values]," Oborn says. "That increases the load on the DNS servers. The same thing would happen for an enterprise customer as you see happening on a service provider network."

The impact of social-networking sites is primarily on carrier and university networks today, but it is likely to affect more corporations as they add social-networking features to their e-commerce and intranet sites.

By Carolyn Duffy Marsan, Network World, 06/22/07

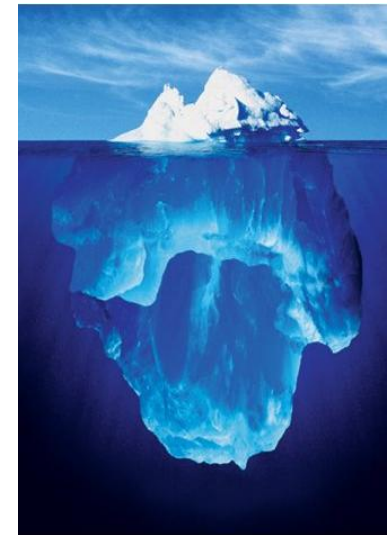
Conversations

Time Range: 14-Aug-2007, 16:56 IST - 16:57 IST
 Source Address: 116.32.207.100
 Dest Application: MS SQL

Results 1 to 233 of 22772

	Source Address	Source App.	Dest. Address	Dest. App.	Traffic	% of Total Traffic	Packets	% of Total Packets
○	116.32.207.100	6000/TCP	149.153.0.0	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.1	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.2	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.3	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.4	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.5	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.6	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.7	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.8	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.9	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.10	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.11	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.12	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.13	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.14	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.15	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.16	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.17	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.18	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.19	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.20	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.21	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.22	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.23	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.24	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.25	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.26	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.27	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.28	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.29	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.30	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.31	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.32	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.33	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.34	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.35	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.36	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.37	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.38	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%
○	116.32.207.100	6000/TCP	149.153.0.39	1433/TCP (MS SQL)	5.33 bps (40 B)	<1%	0.02 /s (1)	<1%

**22,772
Conversations in
ONE MINUTE!**



Less than 900KB

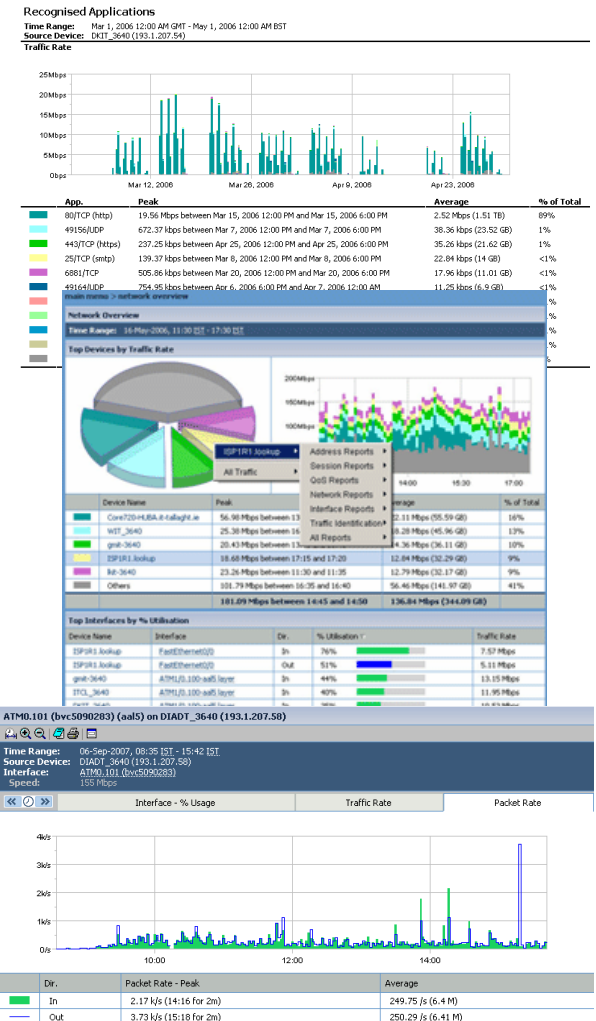
Questions To Consider

- How will we use NetFlow-provided data to:
 - *Solve a current problem?*
 - *Achieve an organizational goal?*
 - *Satisfy an identified need?*
- What depth, breadth, coverage is required?
- Is NetFlow available everywhere we need it?
- How long will we need to retain the data?
- Who will use the information?

There is no one-size-fits-all solution for NetFlow analysis

NetFlow Tracker

- All of the flows, all of the time:
 - Not Top-N limited (Top-N-y)
 - Keep real time data at one minute resolution indefinitely
- User-defined data retention and granularity
- “Sweep and swoop” from high-level summaries right down to individual flows
- 100% web-based, fully URL controllable
- Supports all major flow types
- Available as an appliance or software only



NetFlow Tracker Demo



Reference

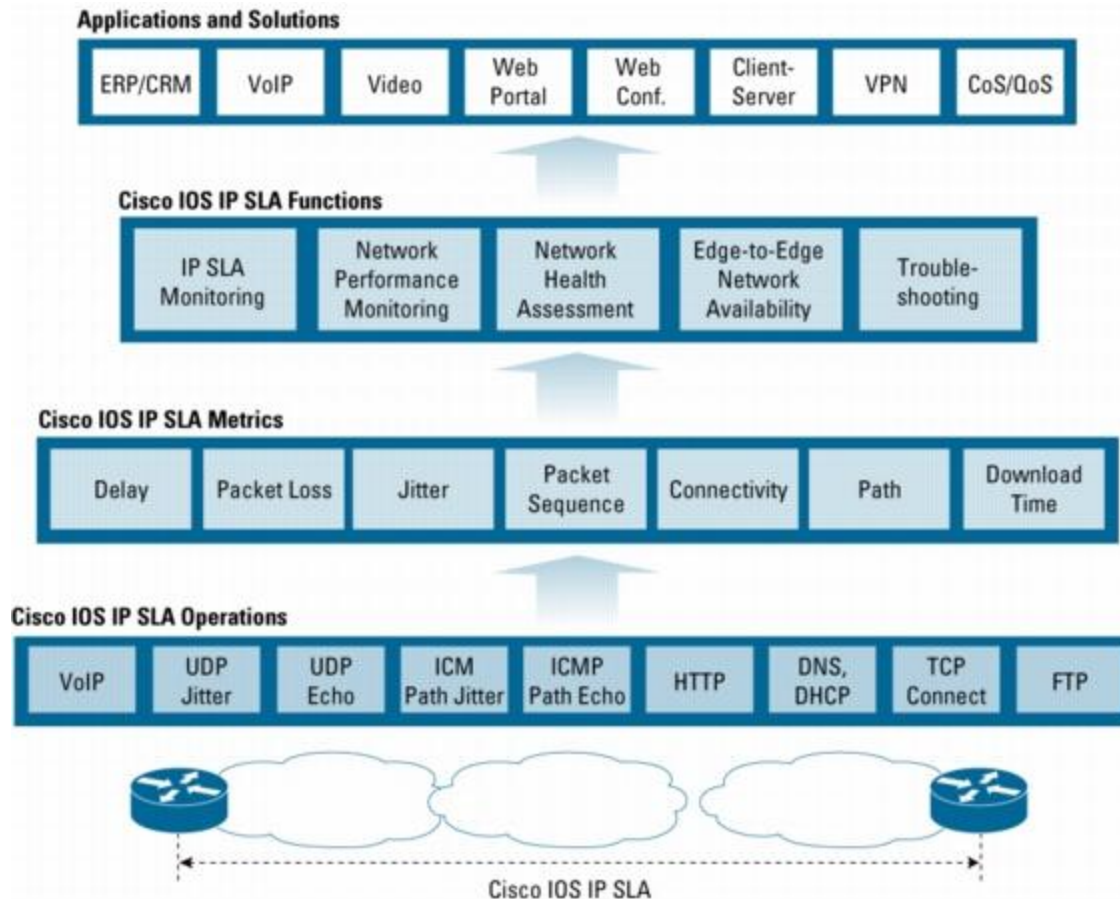
Cisco IOS NetFlow on Cisco.com:
<http://www.cisco.com/go/netflow>

Cisco IOS IP Service Level Agreements (IP SLAs)

What Are IP SLAs?

- Formerly known as the Service Assurance Agent (SAA) or Response Time Reporter (RTR)
- Active traffic generation in a continuous, reliable, predictable manner for measuring network, application, and voice performance
- Generated traffic simulates network applications like VoIP and collects performance information in real-time.
- Routers and switches are configured to be IP SLA agents or IP SLA responders (agents initiate tests)
- Agent test results stored in Cisco RTTMON-MIB

IP SLA Operations, Metrics, Functions



Why use Cisco IP SLAs?

IP SLAs is an Embedded IP Application Service in the Network

- **Service Level Agreement (SLA)** Monitoring and validation.
- **Performance** and **Availability** validation testing of the Networks
- Additional **Trend Monitoring** to NMS
- **Network Baselines** – Prepare for New Services
- Aid **Troubleshooting & Fault** Analysis
- Performance Issue Isolation **@ or between** Any two Network Nodes
- **Change Control Impact** – Verify Performance and Health impacts.
- **Ubiquity** – IP SLAs is on nearly every Cisco platform and OS

UDP Jitter with VoIP MOS Score

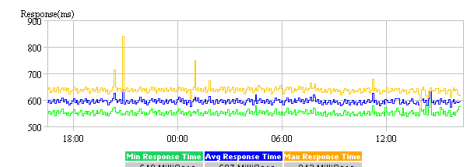
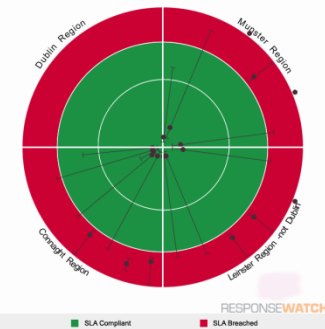
- Introduced in Cisco IOS 12.3(4)T
- This enhanced UDP Jitter operation reports both Mean Opinion Score (**MOS**) and Calculated Planning Impairment Factor (**ICPIF**)
- The results estimate the users VoIP experience through the network and should be used as part of reporting in conjunction and comparison with passive measurement technologies as well.
- Supported Codecs:
 - G.711 A Law (g711alaw: 64 kbps PCM compression method)
 - G.711 mu Law (g711ulaw: 64 kbps PCM compression method)
 - G.729A (g729a: 8 kbps CS-ACELP compression method)

Questions To Consider

- How can we effectively utilize IP SLAs for:
 - *VoIP pre-assessment testing?*
 - *Network/Application/VoIP troubleshooting?*
 - *Monitoring server availability and responsiveness?*
- How do IP SLAs fit with our existing tool set and network management approach?
- Do we have adequate coverage?
- What additional visibility will we need?
- Who will use the information?

Fluke Networks *ResponseWatch*

- Can monitor any Cisco IP SLA test type
- Reporting presentation by response times and SLA compliance
- Internal and External SLA monitoring
- Performance visibility for business-critical applications
- Network performance monitoring
- Network operation troubleshooting
- IP service (e.g., VoIP) network health readiness or assessment
- Edge-to-edge network availability monitoring
- Alerting (Syslog output)
- 100% web enabled (no console)



TCP port connection portion of download session



ResponseWatch Demo



Reference

Cisco IP SLAs on Cisco.com:

<http://www.cisco.com/go/ipsla>

Cisco IOS Performance Routing

Cisco 'Empowered Branch' offerings

(9/26/07 announcement)

- Cisco 1861 Integrated Services Router (ISR)
- Cisco Catalyst® 2960 Series Switches with LAN Lite Cisco IOS® Software
- Cisco Intrusion Prevention System Advanced Integration Module (IPS AIM)
- *Cisco IOS Performance Routing (PfR) and High-End Cisco Wide Area Application Services (WAAS) Network Module. Accelerates business-critical applications and minimizes WAN bandwidth expenses with application-aware routing and WAN traffic optimization*
- Wireless LAN Controller support for IEEE 802.11n
- Cisco Unified Messaging Gateway

Best Path Selection, Two or More Paths



WAN Access Links Are Biggest End-to-End Bottleneck!

Headquarters

SP A

SP B

SP C

Remote Office

By Default BGP Chooses Best Path Based on Fewest AS-Path Hops!

Bottlenecks!

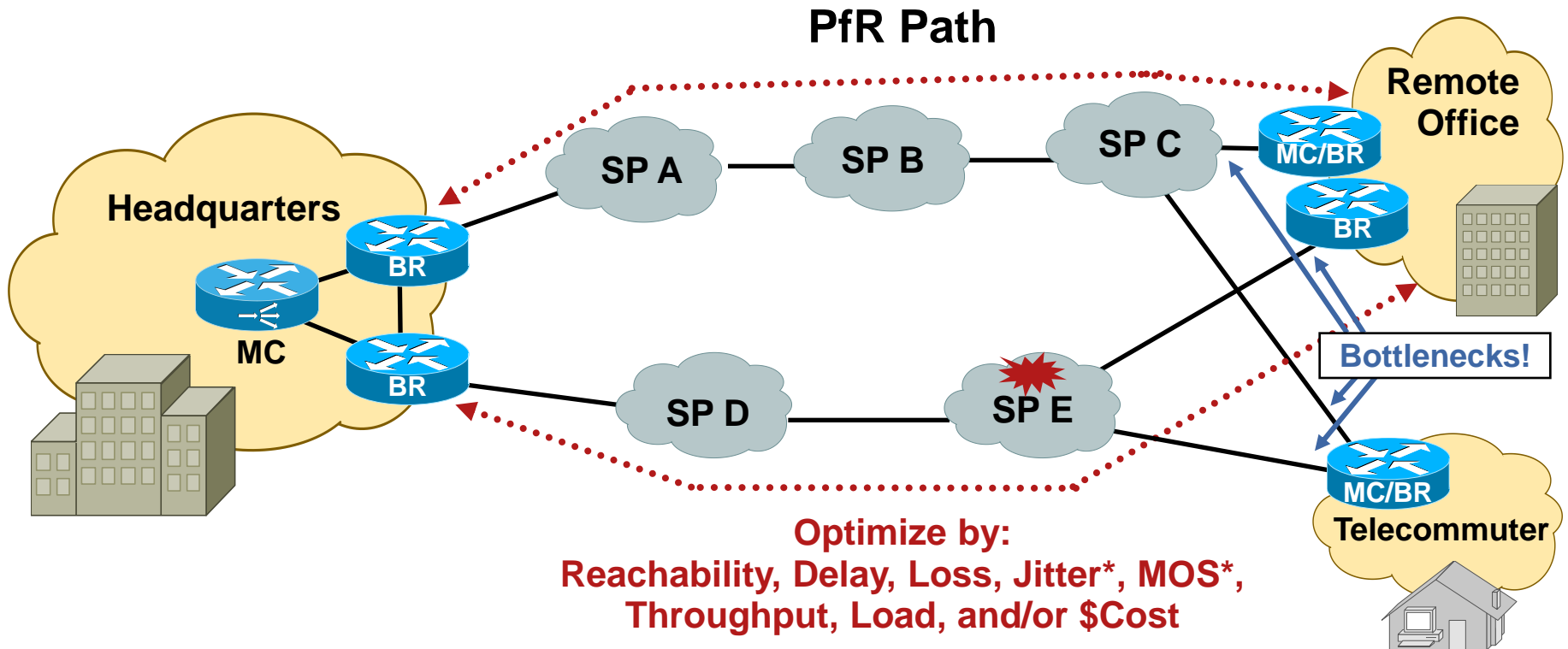
SP D

SP E

Telecommuter

Shortest Path Is Not Always the Best Path in Terms of Performance

PfR Best Path



PfR Components

- BR—Border Router
- MC—Master Controller (decision maker)

Selecting “Best” Traffic-Class Path

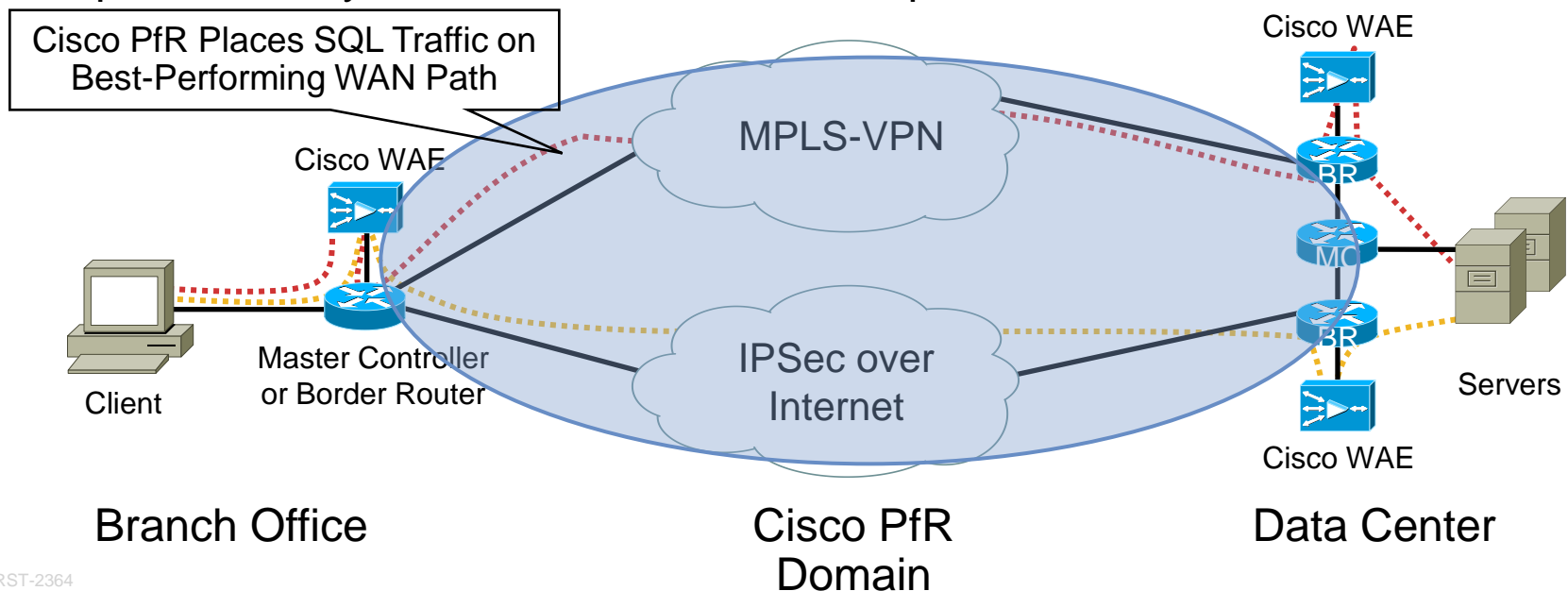
Link	Utilization	Delay (ms) Priority 1	Jitter (ms) Priority 2
Serial1	90%	100	30
Serial2	50%	113	30
Serial3	60%	119	32
Serial4	10%	150	20



Cisco PfR and Cisco WAAS Integration

Adaptive WAN-Optimized Network

- Cisco® Wide Area Application Services (WAAS) optimizes the **TCP session**
 - Reduction in latency and data on the wire
- Cisco PfR monitors and optimizes WAN **path selection**
 - Not all WAN paths are equal: latency, loss, throughput, etc.
- Cisco WAAS network transparency allows individualized session placement by Cisco PfR over best WAN path



Questions To Consider

- Are we making optimal use of all available bandwidth and paths?
- Would it be advantageous to route around network congestion or service provider performance problems?
- Are there business-critical applications that should receive priority treatment?
- Do we know how the network is performing under normal circumstances?
- Will leveraging PfR, NetFlow, and IP SLAs help IT deliver better service to the business and to our customers?

Fluke Networks *PfR Manager*



What is Fluke Networks *PfR Manager*?

- Developed in partnership with Cisco over an 18-month period
- Browser-based Windows application
- Complete, intuitive graphical user interface for:
 - *PfR Traffic Class and Policy configuration*
 - *Real-time analysis, status updates, troubleshooting*
 - *Historical reporting*
- The only PfR management system available today

Fluke Networks *PfR Manager*—Why?

- *PfR Manager* provides a graphical user interface for:
 - *PfR Traffic Class and Policy configuration*
 - *Real-time analysis, status updates, troubleshooting*
 - *Historical reporting*
- *PfR Manager* reduces learning curve, time, and costs associated with PfR testing, configuration, implementation, and administration
- *PfR Manager* helps you understand and demonstrate the impact of change—what value is PfR providing?

How *PfR Manager* Works

- *PfR Manager* communicates directly with the Master Controllers via secure API link
- *PfR Manager* sends Traffic Class and Policy configuration data to the Master Controllers
- PfR Manager receives:
 - *Performance statistics*
 - *Status of classes and exits*
 - *Events*
- Web-based interface, URL-accessible reporting
- Role-based security

Master Controller Configuration

General | Traffic Classes | Threshold Policy | Security Policy

You can add, edit or delete general Master Controller settings, traffic class and policies by navigating the page below. Alternatively the associated tabs can be used to configure individual master controller properties directly.

Name:

IP Address:

Provider Id:

Port:

Authentication Key ID:

Authentication Key String:

Persistence Enabled: True False

Traffic Class	Associated Policy	Policy Description
---------------	-------------------	--------------------

Configuring PfR with *PfR Manager*

- Define Traffic Classes
 - *Addresses, ports, protocols, DSCP values*
- Configure policy thresholds
- Choose modes of operation
 - *Observe or Control*
 - *Good or Best*
 - *Passive or Active*
- Create security policies

back | main menu > administration > master controllers > master controller configuration

Master Controller Configuration

General | Traffic Classes | Threshold Policy | Security Policy

You can add new or edit existing threshold policies from this page. The default Threshold Policy Control Settings should only be changed by advanced users.

Create New or Load Policy

Policies: Create New

General Settings

Policy Name:

Policy Description:

Policy Threshold Settings

	Absolute	Relative
<input type="checkbox"/> Delay	<input type="text" value="1"/> ms	<input type="radio"/> 50 %
<input type="checkbox"/> Packet Loss	<input type="text" value="1"/> ppm	<input type="radio"/> 10 %
<input type="checkbox"/> Unreachability	<input type="text" value="1"/> fpm	<input type="radio"/> Relative Packet Loss (percentage)
<input type="checkbox"/> MOS	<input type="text" value="3"/> <input type="text" value="6"/>	<input type="radio"/> 30 %
<input type="checkbox"/> Jitter	<input type="text" value="20"/> ms	

Policy Control Settings

Operation Mode: HoldDown Timer: secs BackOff Timers (secs): min step max

Decision Mode: Periodic Timer: secs

Collection Mode: Probe Interval: secs

Add metrics you wish to set priorities for

Resolver Priority	Variance
<input type="text"/>	<input type="text"/>

Associate Probe

Type	Target IP	Target Port
<input type="text"/>	<input type="text"/>	<input type="text"/>

Create

PfR Manager—Status Reporting and Navigation

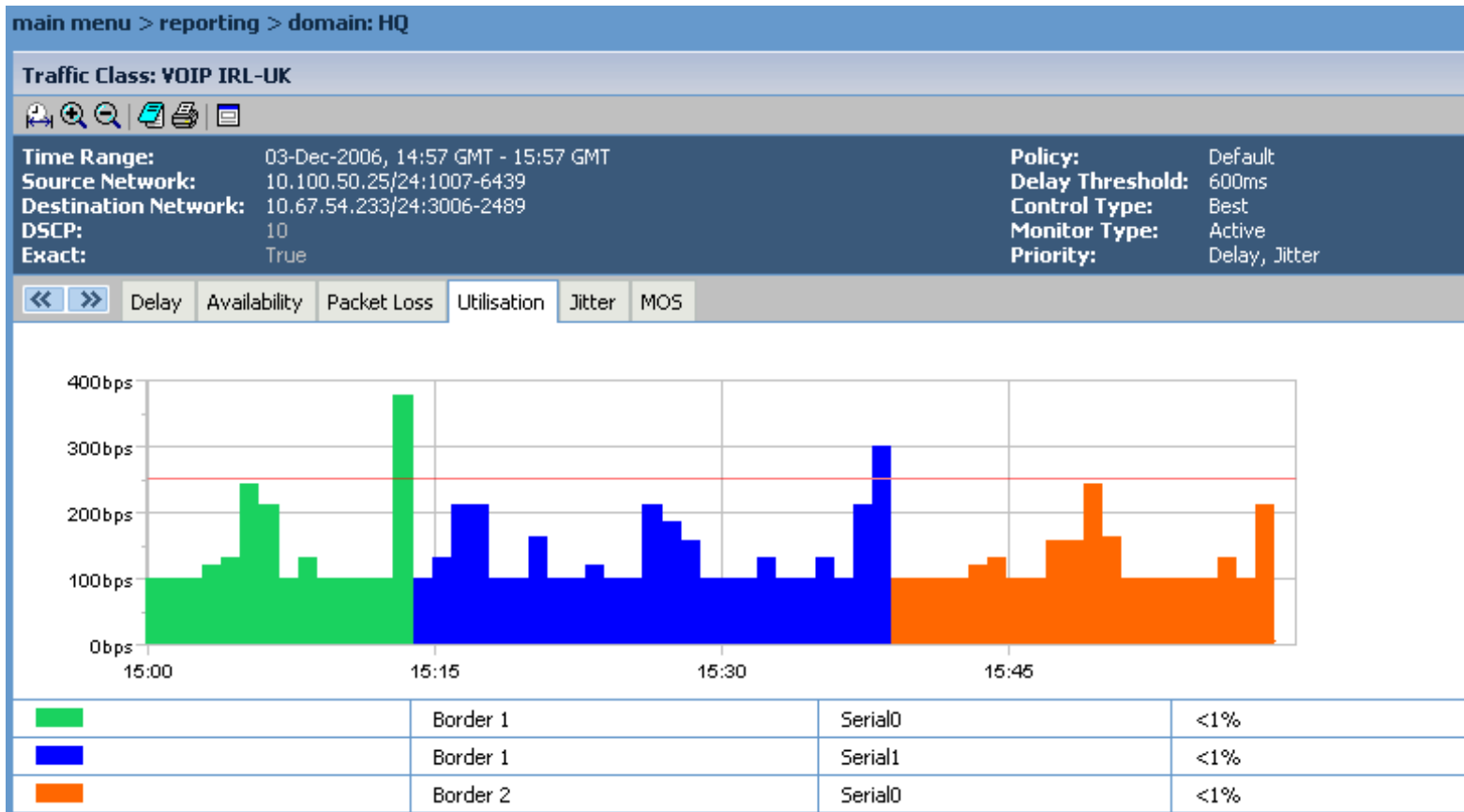
PfR Domains						
Name	Address	Traffic Classes	Currently Out Of Policy	Currently In Policy ^	Currently Uncontrolled	
HQ	10.100.50.252	6	2	4	0	
Backup Site	10.100.100.250	6	1	5	0	
UK	10.100.150.252	6	0	6	0	

main menu > reporting > domain: HQ						
HQ: Exit Links						
Status	Exit Link	Device	Last Change	Threshold Utilisation	Total Utilisation	
	Serial0	Border 1	02 Dec 2006, 09:12 (2 days)	80%	50%	
	Serial1	Border1	02 Dec 2006, 09:12 (2 days)	30%	17%	
	Serial0	Border2	04 Dec 2006, 12:05 (32 minutes)	0%	0%	

HQ: Traffic Classes										
Status	Description	Policy	Current Exit	Last Change	Delay	Util	Avail	Loss	Jitter	MOS
	VOIP IRL-UK	Critical VOIP	Border1/Serial0	02 Dec 2006, 09:12 (2 Days)	10ms	10%	100%	0%	5ms	4.85
	SAP-1	Priority 2 SAP	Border1/Serial1	04 Dec 2006, 11:15 (1:22 Hrs)	180ms	5%	100%	-	-	-
	HTTP	LOW Priority HTML	Border2/Serial0	02 Dec 2006, 09:12 (2 Days)	100 ms	30%	99.99%	-	-	-

- Aggregated view of vital statistics—single view of PfR Domains
- Traffic Class and Exit Link listing with current status
- At-a-glance status and performance data
- Problems on the network are immediately evident

History of Traffic Class Performance



Reference

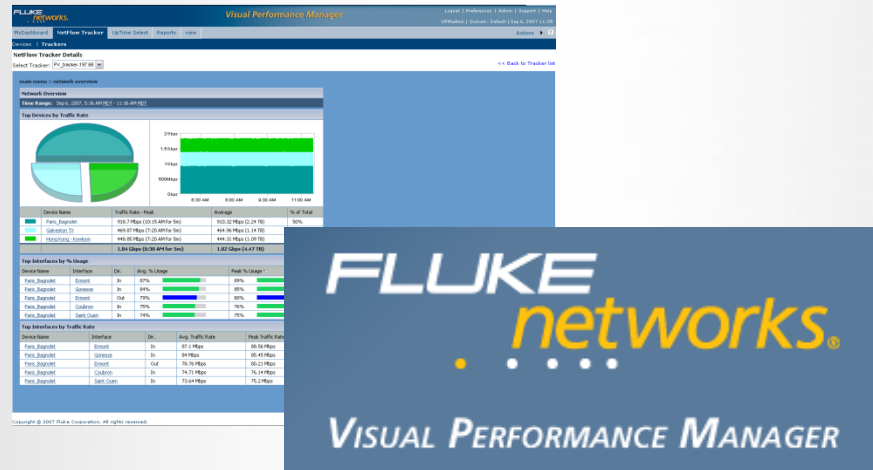
Cisco PfR on Cisco.com:

<http://www.cisco.com/go/pfr/>

Leveraging Cisco IOS Technologies for Performance Management

- Unleash the full power of Cisco IOS by utilizing embedded capabilities and data sources
 - *NetFlow*
 - *IP SLAs*
 - *Performance Routing*
- Numerous applications: Troubleshooting, forensic analysis, capacity planning, VoIP pre-assessment testing, SLA management, proactive performance management
- Not a panacea; complements existing tools and technologies
- What problem are you trying to solve?

Bringing It All Together



Visual Performance Manager provides an integrated view of critical network data to deliver an unrivaled depth and breadth of information so that enterprises can more effectively manage end-to-end quality of experience

Thank You!

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