

CISCO SYSTEMS



Monitoring QoS

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Agenda

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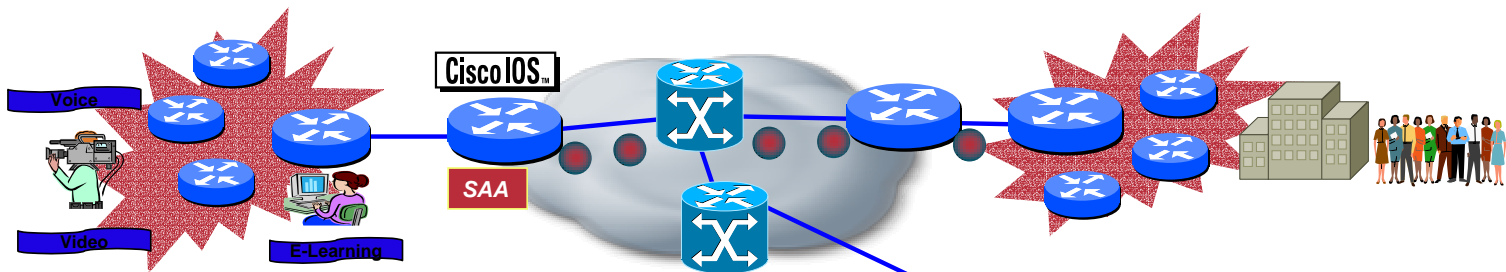
- **Service Assurance Agent**
- **Class-Based QoS MIB**
- **NBAR Protocol Discovery**
- **Summary and References**

Service Assurance Agent (SAA)

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Active Monitoring of Network Infrastructure

- Is the packet loss acceptable?
- What is the network latency?
- Are the network Applications performing well?
- Can you monitor Service Level Agreements?



Service Assurance Agent (SAA)

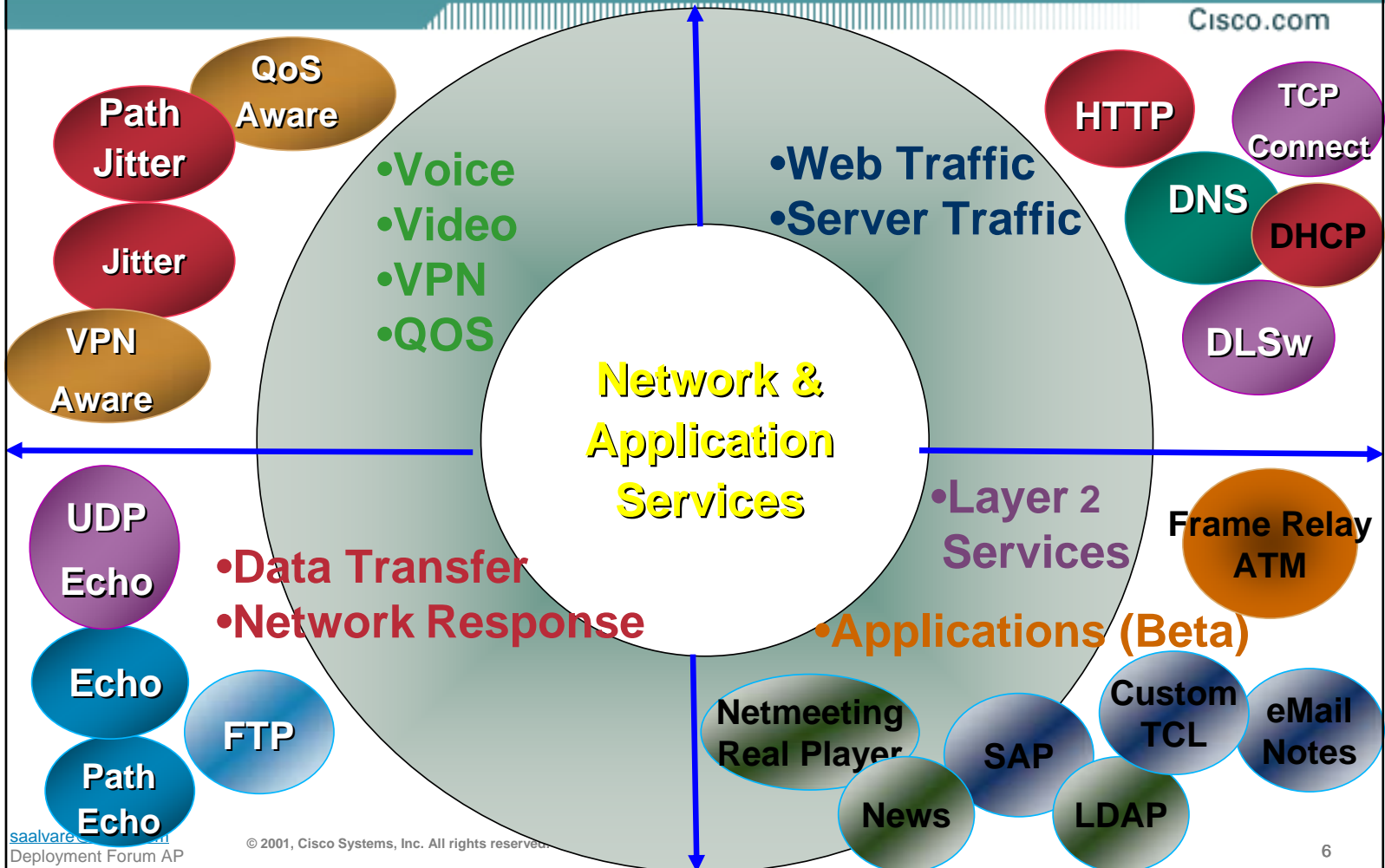
Measuring the Network

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- **Active Traffic Generation within IOS® using SAA Probes**
 - Monitor network performance and health
 - Test and troubleshoot network problems
- **Measurement of key end to end network metrics**
 - Network Delay
 - Packet Loss
 - Network Delay Variation (jitter)
 - Connectivity
 - History and distributions of network statistics
- **Scheduling of packet streams and Threshold Violation Notification**
- **Across the board support for most IOS® Devices**

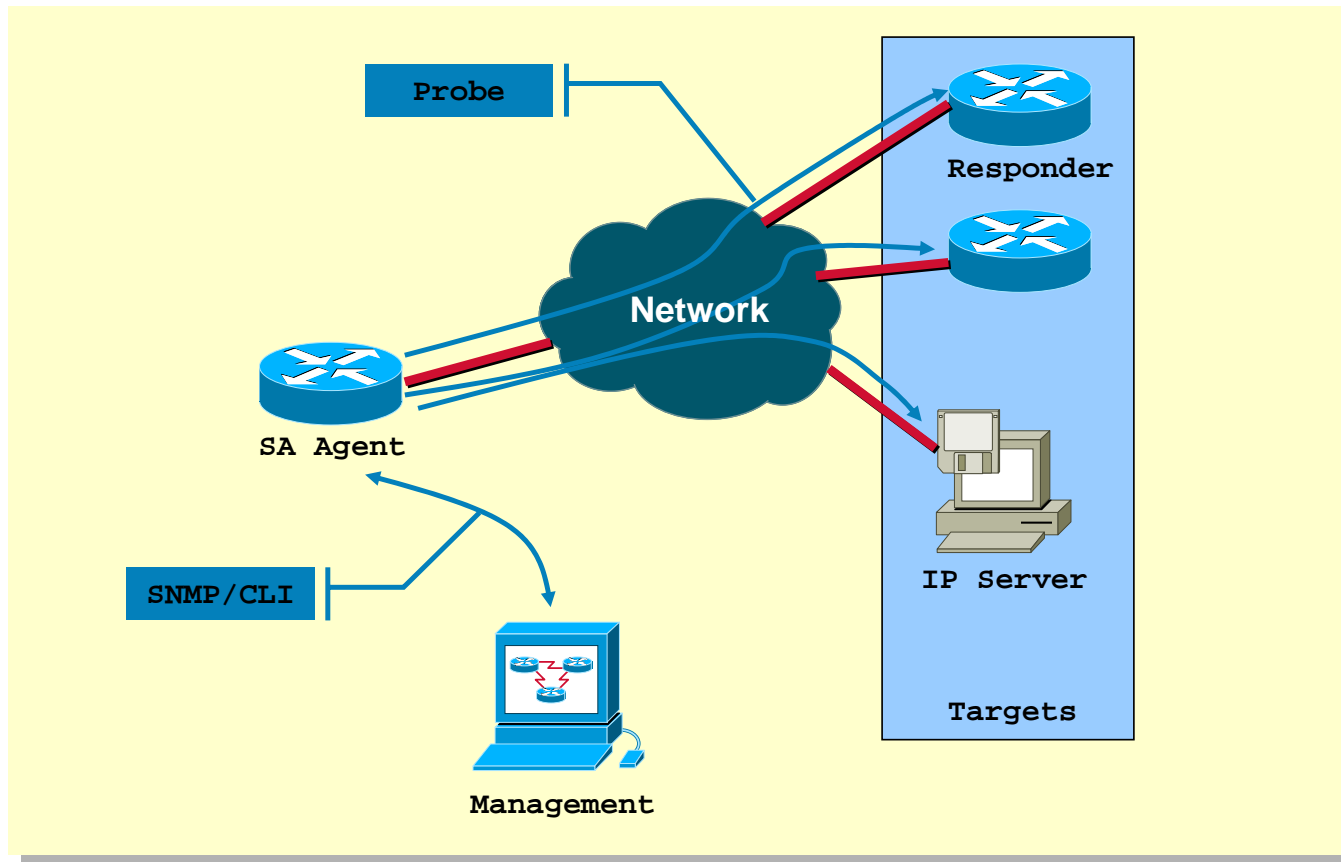
SAA Probe Types

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SAA Architecture Overview

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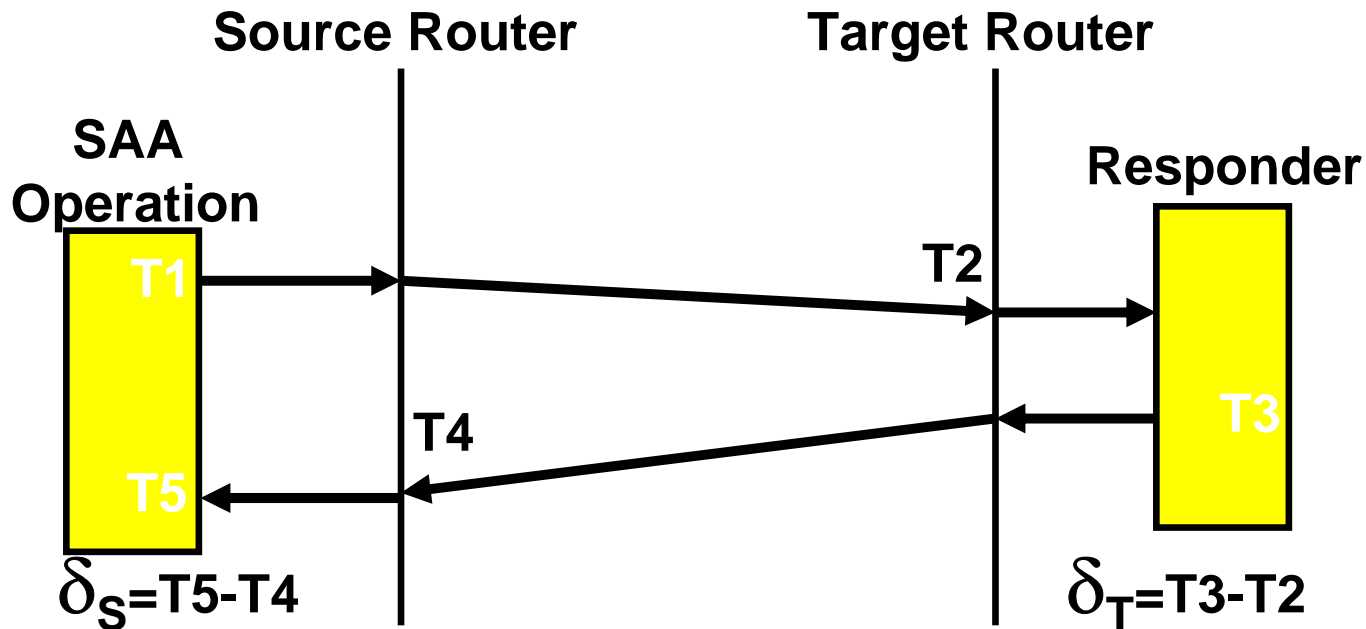
SA Agent Responder

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- **Responds to SA Agent packets**
- **User defined UDP/TCP ports**
- **SA Agent Control Protocol**
- **Authentication**
- **Required for accurate measurements**

SAA Examples Round Trip Time Calculation

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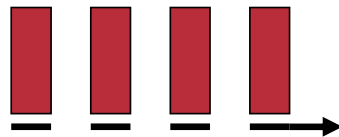
✓ Responder significant Error Reduction vs ICMP
45ms versus 2 ms

$$\text{Round Trip Time RTT} = T5 - (T1 + \delta_S + \delta_T)$$

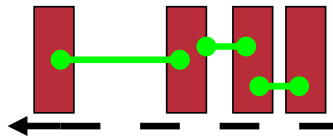
SAA Examples Jitter

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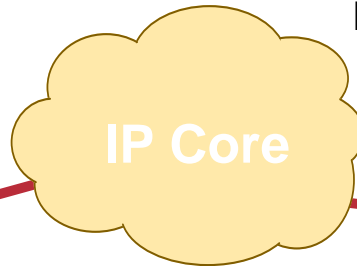
Send train of packets with constant Interval



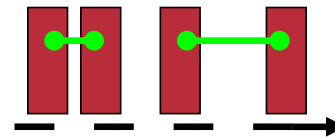
SAA



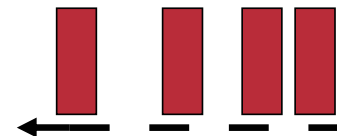
IP Core



Receive train of packets at Interval impacted by Network



Responder



Per-direction inter-packet delay (Jitter)

Per-direction packet loss

Average RTD

Time stamp when Rxd
Increment Rx Count
Delta Time

Set Reaction Conditions

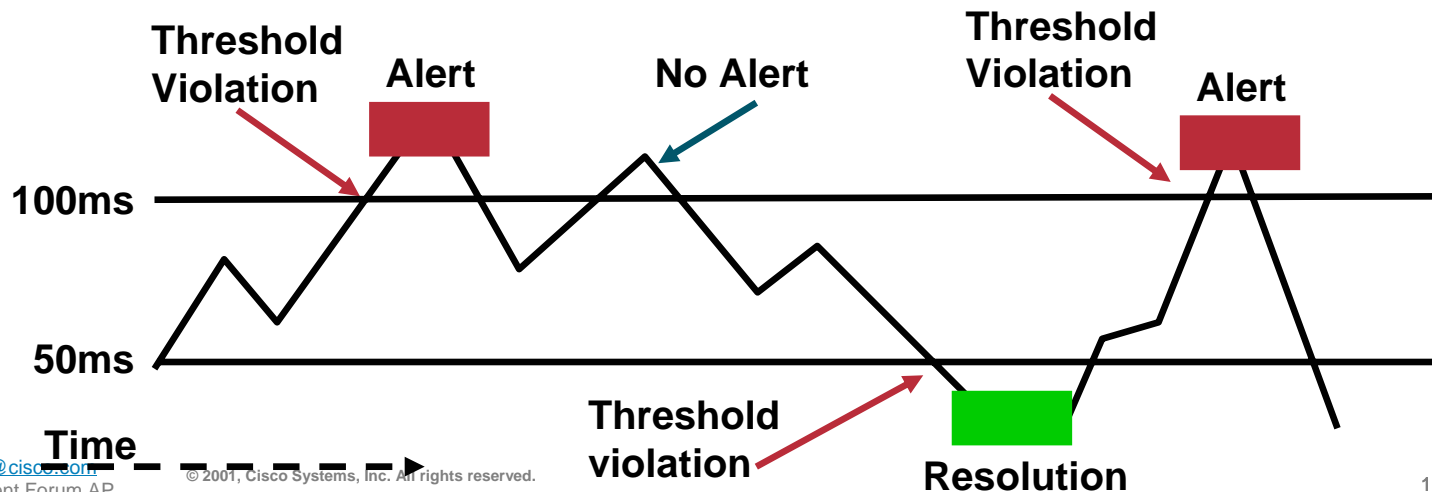
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✓ Reaction Trigger to Events - Take an Action

- Connection Loss
- Timeout
- Round Trip Time Threshold Exceeded
 - Send a trap
 - Execute another Probe

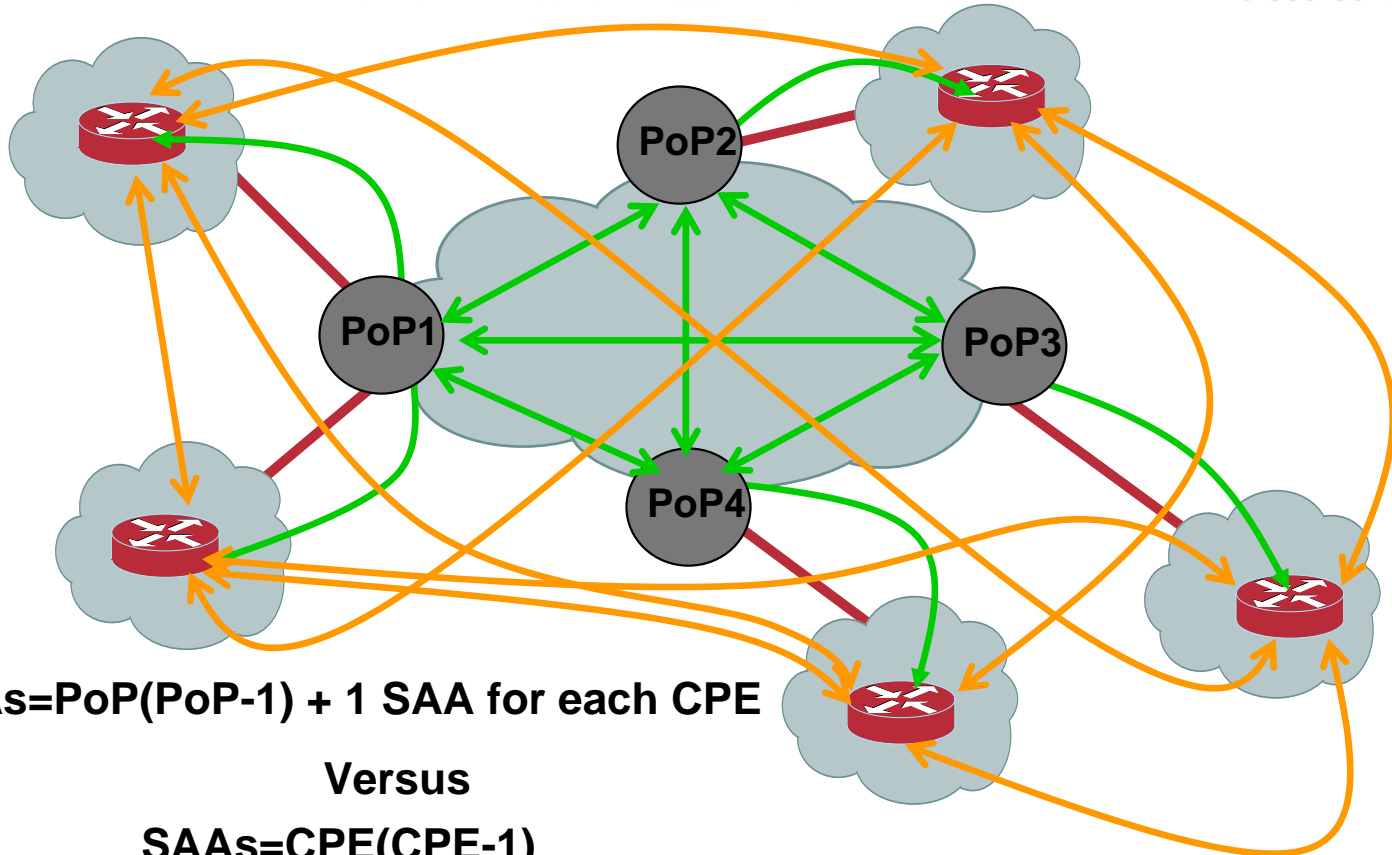
Trigger

- ✓ Immediate
- ✓ Consecutive Occurrences
- ✓ X of Y times
- ✓ Average Exceeded



Scalability at the Expense of Less Accuracy

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$\text{SAAs} = \text{PoP}(\text{PoP}-1) + 1 \text{ SAA for each CPE}$

Versus

$\text{SAAs} = \text{CPE}(\text{CPE}-1)$

SAA Latest Enhancements

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✓ Voice Over IP Active Monitoring

- Voice over IP network assessment and health monitoring
- Generate RTP based traffic including SAA MIB support

✓ MPLS Enhancement

- Port current MPLS/VPN SAA features to IOS 26S
- MPLS network health monitoring

✓ Bulk Scheduling SAA probes

- Increase scalability and accuracy

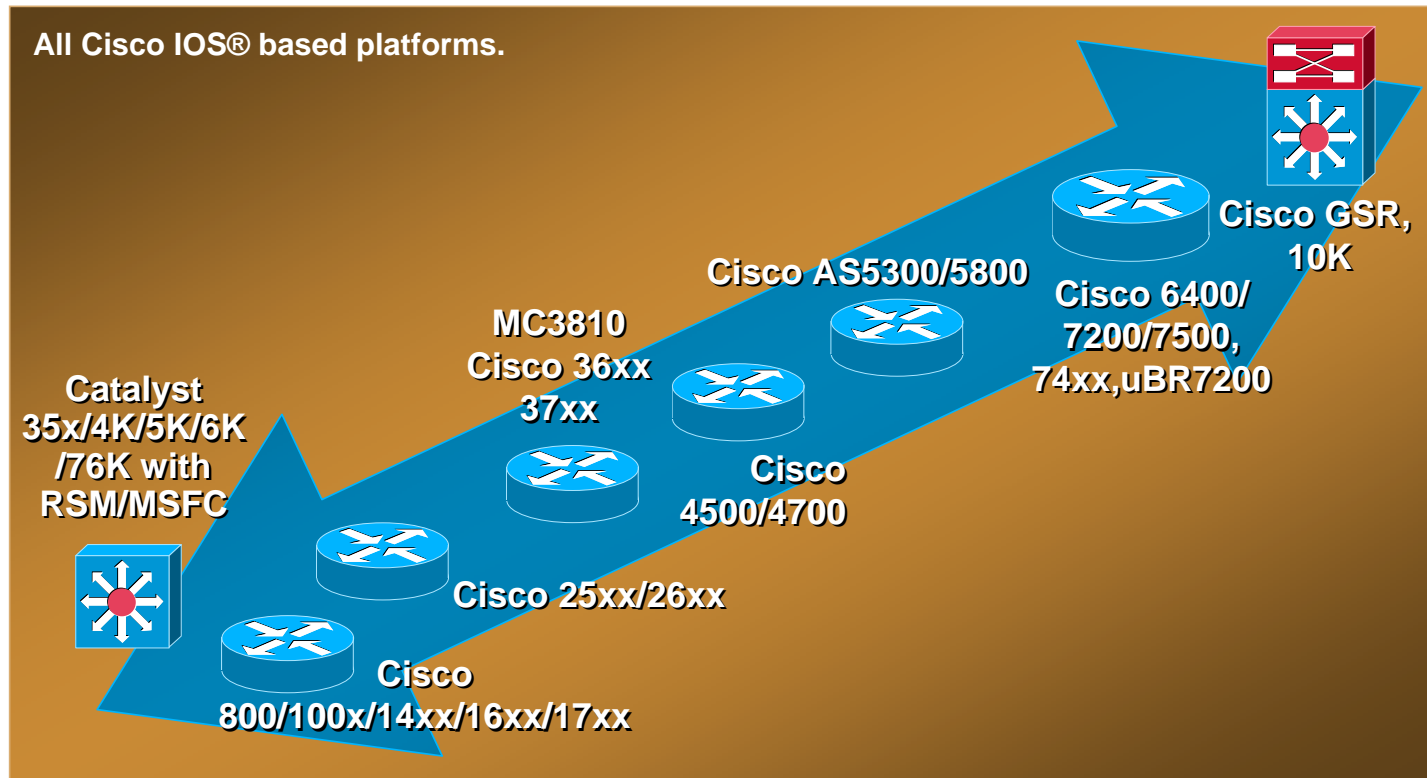
✓ Ease of use Improvements

- Enhanced show commands
- MIB design change

SAA Hardware Support

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All Cisco IOS® based platforms.



Service Assurance Agent Strategic NMS Applications and Partners

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Agilent Technologies



SAA support on Cisco Tools

- CW2000 Internetwork Performance Monitor (IPM)
- VPNSC / ISC - MPLS/VPN and IPSec VPN
- Tunnel Builder-Pro - MPLS Traffic Engineering
- QPM & CW2000 Service Management Solution

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ciscoCBQoSMB: All you need to know

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- Available since IOS 12.1(5)T → IOS 12.2
- Moving forward, the Modular QoS Command Line Interface (MQC) is the de-facto Cisco standard for configuring QoS.

- **ciscoCBQoSMB provides:**

Read access to active MQC configuration.

Statistics for active MQC configuration.

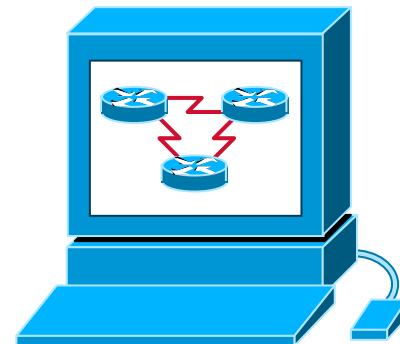
Active means any configured policy that has been attached to one or more interfaces

ciscoCBQoSMB: Key points 1

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- **Primary accounting mechanism for QoS:**
 - ✓ **Policing**
 - ✓ **Classification**
 - ✓ **Shaping**
 - ✓ **Queueing**
 - ✓ **Congestion Avoidance**
- **For example, “How many packets are being dropped or marked?”**

**Management
Application**



ciscoCBQoSMB: Key points 2

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- **ciscoCBQoSMB is read only. QoS is configured through MQC (no SNMP configuration).**
- **No ciscoCBQoSMB statistics if**
 - QoS is not configured.**
 - QoS is configured but not via MQC.**
 - Devices (6xxx) running CATOS. It is available with Native IOS.**

ciscoCBQosMIB Statistics Tables

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- **cbQosClassMapStats**
- **cbQosMatchStmtStats**
- **cbQosPoliceStats**
- **cbQosQueueingStats**
- **cbQosTSStats**
- **cbQosREDClassStats**

Management Platforms

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- **Cisco**
 - **QoS Policy Manager V3**
 - **IP Solution Center ver. 3 (IPSC)**
 - **CNS Performance Engine**
- **Concord eHealth**
- **InfoVista**

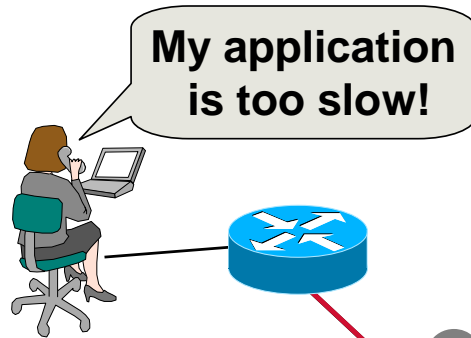
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Network Based Application Recognition

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My application is too slow!

- Intelligent Classification Engine
- Used in conjunction with QoS class-based features
- Protocol Discovery analyzes application traffic patterns in real time

Platforms

1700

2600

3600

7100

7200

7500

Flex Wan

Link Utilization

Citrix	25%
Netshow	15%
Fasttrack	10%
FTP	30%
HTTP	20%



- Discovers which traffic is running on the network
- Attractive for managed service

NBAR Description

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- **Network Based Application Recognition** classifies traffic by **protocol**.
- Accounting functionality is enabled via NBAR feature **Protocol Discovery**
- Protocol Discovery analyzes **application traffic** patterns in real time and Discovers which traffic is running on the network

NBAR Protocol Discovery

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- **IP Packet Classifier Capable of Classifying layers 4-7:**
 - ✓ Statically assigned TCP and UDP port numbers (ACLs can also)
 - ✓ Non-TCP and Non-UDP IP protocols eg. GRE, ICMP, IPSec, EIGRP,...
 - ✓ Client-server applications **dynamically assigned TCP and UDP port numbers** during connection establishment
 - ✓ **Sub-port classification** based on **deep inspection** Ability to look deeper into the packet to identify applications and therefore require stateful inspection
 - ✓ **HTTP traffic (by URL, host name or MIME type)** using regular expressions (*, ?, []), Citrix ICA traffic (server-based portal & application software), FTP, **RTP (Real-Time Transport Protocol) Payload type** classification
- **Real time** statistics on applications
- **SNMP MIB** support
- **per-interface, per-application, bi-directional** (input and output) statistics:
 - bit rate (**bps**)
 - packet** counts
 - byte** counts

NBAR

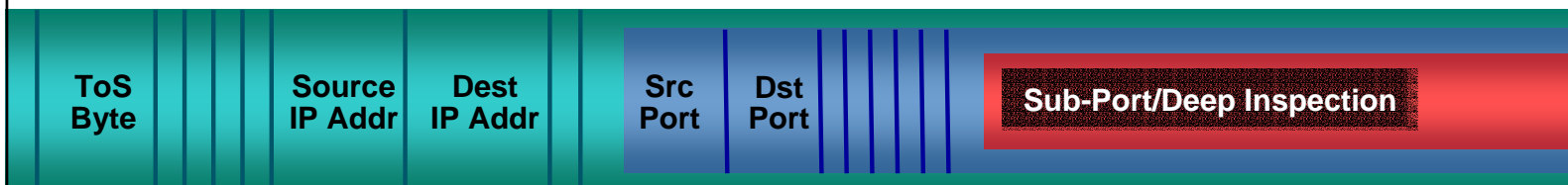
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Stateful/Dynamic Inspection

IP Packet

TCP/UDP Packet

Data Packet



egg	exchange	kerberos	secure-nntp	smtp
gre	finger	l2tp	notes	snmp
icmp	ftp	ldap	novadigm	socks
ipinip	secure-ftp	secure-ldap	ntp	sqlnet
ipsec	gopher	netshow	pcanywhere	ssh
eigrp	http	pptp	pop3	streamwork
bgp	secure-http	sqlserver	secure-pop3	syslog
cuseeme	imap	netbios	printer	telnet
dhcp	irc	nfs	realaudio	secure-telnet
dns	secure-irc	nntp	rcmd	tftp
		citrix	napster	vdolive
				xwindows

NBAR currently supports 85 protocols/applications

NBAR Configuration

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```
router# sh run int fa6/0
!
interface FastEthernet0/0
ip address 10.0.147.3 255.255.255.0
ip nbar protocol-discovery
end
```

```
Router# show ip nbar protocol-discovery interface FastEthernet 6/0
```

Protocol	Input	Output
	Packet Count	Packet Count
	Byte Count	Byte Count
	5 minute bit rate (bps)	5 minute bit rate
(bps)		
-----	-----	-----
http	316773	0
	26340105	0
	3000	0
pop3	4437	7367
	2301891	339213
	3000	0
snmp	279538	14644
	319106191	673624
	0	0
ftp	8979	7714
	906550	694260
	0	0
...		
Total	17203819	151684936
	19161397327	50967034611
	4179000	6620000

CISCO-NBAR-PROTOCOL- DISCOVERY-MIB Tables

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Table	Description
cnpdMIBNotifications	rising/falling trap
cnpdStatus	NBAR enable/Time
cnpdAllStats	All NBAR by interface
cnpdTopNconfig	Top N table config by interface
cnpdTopNstats	Top N table statistics
cnpdThresholdconfig	Protocol threshold configuration
cnpdThresholdhistory	History of falling rising events
cnpdNotificationsconfig	Enable traps
cnpdSupportedProtocols	List of all protocols supported

Tables listed in order they are listed in the MIB
CISCO-NBAR-PROTOCOL-DISCOVERY-MIB (CNPD-MIB)

CNPD Thresholds and Traps

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- **User can set thresholds on individual protocols on an interface, or on a statistic regardless of protocol.**

Thresholds for any combination of supported protocols/and or all protocols.

- **Configurable Statistic types**

**Interface in, out and sum
Bytes, Packets, and Bit rate.**

- **If the threshold is breached, the information is stored for prolonged period of time.**
- **A Notification (trap) is generated and sent to the user with a summary of threshold information.**

NBAR Hardware and Software Support

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- **Platforms: 1700, 2600, 3600, 7100, 7200, 7300, 7500 & 7600 w/ Flex Wan**
- **Runs on CEF and dCEF**
- **No concept of flow**
- **First supported in 12.1(4)T, 12.2(8)T and 12.1(11b)E**
- **Protocol discovery MIB support planned for 12.2(15)T**

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Summary

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- **Cisco IOS SAA key to actively monitor your SLAs**
- **Cisco IOS provides extensive QoS accounting**
- **Monitoring and accounting capabilities are available using SNMP**
- **Cisco applications leverage monitoring capabilities on Cisco IOS**
- **Cisco partners provide additional support**

References

Cisco.com

- **SAA Page on CCO**
<http://www.cisco.com/go/saa>
- **Cisco MIB Page**
<http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>
- **QOS page on CCO**
<http://www.cisco.com/go/qos>

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