

# Condensed QoS for MPLS



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## About the Speaker

- **Dr. Pete Welcher**
  - Cisco CCIE #1773, CCSI #94014, CCIP
  - Network design & management consulting
    - Stock quotation firm, 3000 routers, TCP/IP
    - Second stock quotation firm, 2000 routers, UDP broadcasts
    - Hotel chain, 1000 routers, SNA
    - Government agency, 1500 routers
  - Teach many of the Cisco courses
- **Enterprise Networking Magazine articles**
  - <http://www.netcraftsmen.net/welcher/papers>



## Objectives

**Upon completion of this lesson, students will be able to:**

- **Provide an overview of the Cisco approach to QoS**
- **Explain the QoS options for Cisco MPLS**
- **Be able to configure QoS for MPLS using CBWFQ**

## Topics

- **QoS Overview / Review**
- **QoS for MPLS**
- **Implementing QoS for MPLS**

## Components of QoS

- **Classification / Marking**
- **Policing / Shaping**
- **Queuing / Scheduling**
- **Congestion Avoidance (Drop Policy)**

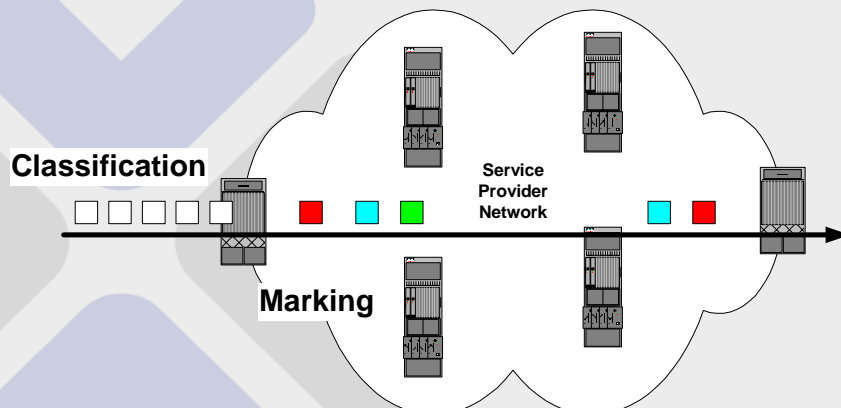
## Classification

- **Recognizing different forms of network traffic**
- **May require L2, L3, L4, or higher layer analysis of packets or frames**
  - This can require significant processing
- **Usually done at network edge, on lower speed interfaces where possible**

## Marking

- **Setting some bits in packet or frame**
  - Saves higher-speed core devices the work of classification
  - Allows downstream devices to focus on delivery of services
- **Purpose:**
  - Allow downstream devices to quickly recognize desired CoS and apply policy

## Classification and Marking

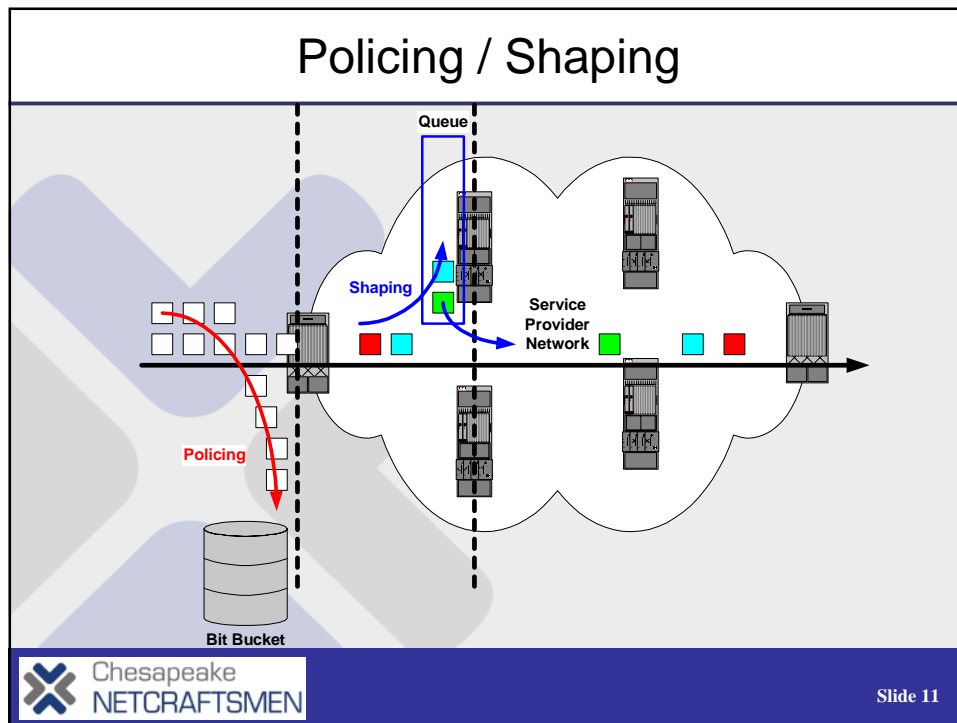


## Marking — Which Bits

- **IP ToS byte in IP header**
  - IP Precedence (most significant 3 bits)
  - Diff Serve Code Point (most significant 6 bits)
  - No code bit to indicate which, but compatible with each other
- **MPLS EXP 3 bits in shim header**
- **Layer 2 CoS 3 bits in 802.1q or ISL trunk header**
- **Other bits (DE in FR, CLP in ATM, etc.)**

## Policing / Shaping

- **Policing reduces the impact of excess traffic**
  - Drop it
  - Or mark it for lower quality of service
- **Shaping queues excess traffic to smooth out bursts**
  - May increase latency for best effort traffic



- ## Special Queuing
- **Older techniques, harder to use well**
    - Priority Queuing
    - Custom Queuing
  - **Weighted Fair Queueing (WFQ)**
    - Favors traffic with higher IP Precedence or DSCP marking. Just setting Precedence to 5 may benefit voice traffic if WFQ is enabled!
  - **Class-Based WFQ**
    - Can also do this, implement policy for several special classes of traffic
- Chesapeake  
NETCRAFTSMEN
- Slide 12

## Scheduling

- **WFQ has scheduling based on weights**
  - $32767/(1+\text{precedence})$
- **Weights can also guarantee bandwidth**
- **PQ-WFQ (RTP priority) adds a policed priority queue to WFQ**
- **PQ-CBWFQ = LLQ (Low Latency Queuing) adds a policed priority queue to CBWFQ**

## Congestion Avoidance

- **Congestion Avoidance Techniques:**
- **Tail drop (congestion has occurred)**
- **WRED (drop selectively, lowest precedence first)**
- **DSCP-aware WRED**
- **Hardware queues**

## Topics

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- QoS for MPLS
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## QoS for MPLS — Techniques

- **E-LSP: use the EXP bits**
  - Cisco does this for frame-based MPLS
  - Re-uses the IP code / algorithms?
- **L-LSP: CoS implicit in the label**
  - One Cisco approach for cell-based MPLS
  - Up to 4 labels for each destination: one for each CoS

## Cell-mode MPLS QoS

- **The MPLS over ATM QoS options:**
  - Legacy ATM: PVC acts like serial link, use the frame-based mechanisms
    - Single PVC mode
  - ATM LSR: two choices:
    - Single LSP mode (one LSP for all classes of service to each destination)
    - Multi-VC mode → (see next slide)

## Multi-VC mode

- **Enable multi-VC mode and the LSR will create 4 LSP's per destination**
  - Configure cos-map to specify IP Precedence (recently: EXP bits) to LSP mapping, also to create fewer LSP's if desired
  - Low order 2 bits of EXP bits determine CoS
  - High order bit may determine ATM CLP bit

## Topics

- QoS Overview/Review
- QoS for MPLS
- **Implementing QoS for MPLS**

## Implementing QoS for MPLS

- **Older Cisco IOS versions, can use:**
  - CAR (Committed Access Rate)
  - WRED (Weighted Random Early Detection)
- **Recent releases, easier to use CBWFQ**
  - Class-Based Weighted Fair Queuing

## Configuring CBWFQ

- 1 Create classes of traffic**  
Specify what traffic is in each class
- 2 Create policy**  
Tell what to do with each class
- 3 Apply to an interface**  
Service-policy, inbound or outbound

## Configuring QoS — Classes of Service

### **CBWFQ: specify classes of service (and what traffic belongs to each class)**

1

```
Router(config)# class-map gold
Router(config-cmap)# match access-group 101
Router(config-cmap)# exit

Router(config)# class-map silver
Router(config-cmap)# match access-group 102
Router(config-cmap)# exit
```

## Configuring QoS — Policy

### CBWFQ: then specify your policy...

2

```
Router(config)# policy-map premium_policy
Router(config-pmap)# class Gold
Router(config-pmap-c)# bandwidth percent 40
Router(config-pmap-c)# queue-limit 64
Router(config-pmap-c)# random-detect
Router(config-pmap)# exit
Router(config-pmap)# class silver
Router(config-pmap-c)# bandwidth percent 20
Router(config-pmap)# exit
Router(config-pmap)# class class-default
Router(config-pmap-c)# fair-queue 10
Router(config-pmap)# exit
```



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## Configuring QoS — Apply the Policy

### CBWFQ: and apply your policy to interface(s)...

3

```
Router(config)# interface s1/1
Router(config-if)# service-policy out premium_policy
Router(config-if)# exit

Router(config)# interface s/0/0
Router(config-if)# service-policy out premium_policy
Router(config-if)# exit
```



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## NBAR —Match Protocols

- GRE
- ICMP
- IPINIP
- IPSec
- EIGRP
- BGP
- CU-SeeMe
- DHCP/Bootp
- DNS
- Finger
- Gopher
- HTTP
- HTTPS
- IMAP
- IRC
- Kerberos
- L2TP
- LDAP
- MS-PPTP
- MS-SQLServer
- NetBIOS
- NFS
- NNTP
- Lotus Notes
- NTP
- PCAnywhere
- POP3
- PPTP
- RIP
- RSVP
- SFTP
- SHTTP
- SIMAP
- SIRC
- SLDAP
- SNNTP
- SMTP
- SNMP
- SOCKS
- SPOP3
- SSH
- STELNET
- Syslog
- Telnet
- X Windows

- **Via Stateful Inspection**

- FTP
- MS Exchange
- HTTP (URL and MIME)
- Netshow
- Realaudio
- UNIX r-commands
- Oracle SQL\*NET
- SunRPC
- TFTP
- StreamWorks
- VDOLive

```
Router(config)# class-map gold
Router(config-cmap)# match
protocol XWindows
```

## NBAR Protocol Discovery

**You can let the router do the work of figuring out what traffic is using a link:**

```
Router(config)# interface ethernet 0/0
Router(config-if)# ip nbar protocol-discovery
Router(config-if)# end
```

```
Router# show ip nbar protocol-discovery [interface
interface-spec] [stats {byte-count | bit-rate |
packet-count}] [{protocol protocol-name | top-n
number}]
```

## CBWFQ for MPLS — Edge

### SAMPLE

Configuration of  
CBWFQ for the  
edge of a Service  
Provider network

Purpose: classify  
and mark, possibly  
police

```
class match-any voice
  match ip precedence 5
class match-any netshow
  match protocol netshow
policy-map mypolicy
class voice
  set mpls exp 5
class netshow
  set mpls exp 2
  police percent 30
interface ...
  service-policy in mypolicy
```



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## CBWFQ for MPLS — Core

### SAMPLE

Configuration of  
CBWFQ for the core  
of a Service Provider  
network

Purpose: use edge  
markings to apply  
policy

```
class match-any voice
  match mpls exp 5
class match-any netshow
  match mpls exp 2
policy-map mypolicy
class voice
  bandwidth percent 30
class netshow
  police percent 30
interface ...
  service-policy out
  mypolicy
```



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## Verifying QoS for MPLS

### **show policy ...**

- Shows what has been configured without requiring enable access

### **show policy interface interface-name**

- Shows hits against the rules (packets, bps, etc.)



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## Summary

**After completing this lesson, you should be able to complete the following tasks:**

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- **Be able to configure QoS for MPLS using CBWFQ**



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## A Word About Us ...

- **We can provide**

- Network design review: how to make what you have work better
- Periodic strategic advice: what's the next step for your network or staff
- Network management tools & procedures advice: what's right for you
- Implementation guidance (your staff does the details) or full implementation



- **We do**

- Small- and Large-Scale Routing and Switching (design, health check, etc.)
- IPsec VPN and V3PN (design and implementation)
- QoS (strategy, design and implementation)
- IP Telephony (preparedness survey, design, and implementation)
- Call Manager deployment
- Security
- Network Management (design, installation, tuning, tech transfer, services, etc.)



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## A Word About Us ...

### Certified by Cisco in:

- IP Telephony
- Network Management
- Wireless
- Security
- (Routing and Switching)



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