

# Cisco Router and Security Device Manager

## Quality of Service

### Introduction

This document explains how to configure and monitor Quality of Service (QoS).

### Quality of Service

A communications network forms the backbone of any successful organization. These networks transport a multitude of applications and data, including high-quality video and delay-sensitive data such as real-time voice. The bandwidth-intensive applications stretch network capabilities and resources and complement, add value, and enhance every business process. Networks must provide secure, predictable, measurable, and sometimes guaranteed services. Achieving the required quality of service (QoS) by managing delay, delay variation (jitter), bandwidth, and packet loss parameters on a network is the answer to a successful end-to-end business solution. QoS is the technique to manage network resources.

### QoS for VPNs

When packets are encapsulated by tunnel or encryption headers, QoS features are unable to examine the original packet headers and correctly classify the packets. Several packets traveling across the same tunnel have the same tunnel headers, and the packets are treated identically if the physical tunnel interface is congested.

The QoS for VPNs feature is designed for tunnel interfaces. When the new feature is enabled, the QoS features on the output interface classify packets before encryption, adjusting traffic flows in congested environments. The end result is more effective packet tunneling. QoS for VPNs is supported for IP Security (IPSec).

### QoS Supported by Cisco Router and Security Device Manager

Cisco® Router and Security Device Manager (SDM) prioritizes traffic and allocates bandwidth. It creates three traffic categories: Real-Time, Business-Critical, and Trivial, which includes Best-Effort traffic to help users configure QoS policies for outgoing traffic on WAN interfaces and IPSec Tunnels.

SDM considers Voice over IP (VoIP) and signaling packets as Real-Time traffic, and considers Transactional, Management and Routing traffic as Business-Critical traffic that is important for a typical corporate environment. The Transactional traffic handles packets meant for enterprise resource planning (ERP)/Database, interactive sessions, and enterprise applications; the Management traffic handles packets meant for network management; and the Routing traffic handles packets meant for routing and signaling. The traffic that does not belong to Real-Time and Business-Critical traffic is in the Trivial traffic category.

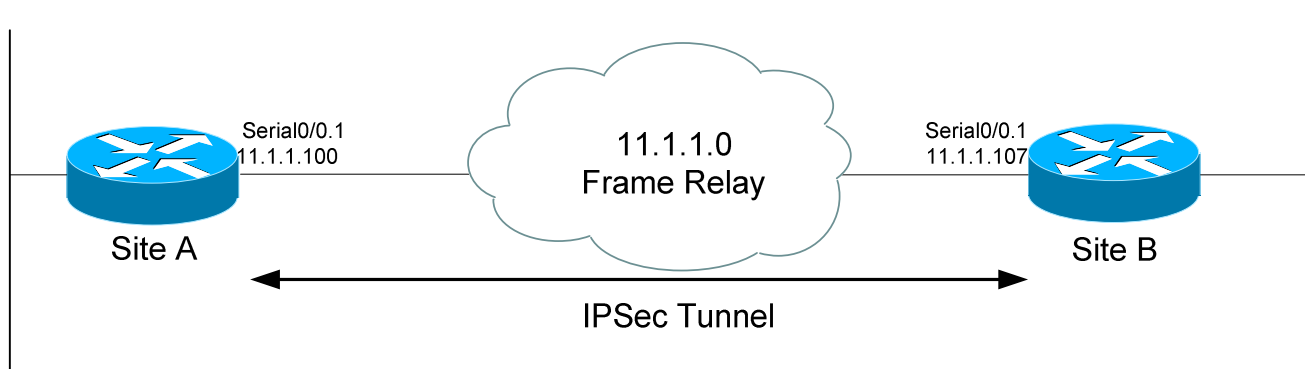
SDM QoS wizard creates and tailors QoS policies with default values based on interface types and functions to facilitate QoS deployment; users can edit the policies to customize the default values.



## Deployment Scenario

This document demonstrates how to configure QoS for data, voice, and video on a Frame-Relay WAN link with IPSec Tunnel (Figure 1).

Figure 1. Network Diagram



## Sample Configuration

### Prerequisites

The site-to-site IPSec Tunnel over Frame Relay link has been established between two sites.

### QoS on Frame Relay Link with IPSec Tunnel

The sample configuration includes the configuration to apply QoS policy to the serial0/0.1 interface of Cisco IOS® Router in Site A; the prerequisite configurations are not covered in this sample configuration.

## Cisco Security Device Manager QoS Management

Cisco Router and SDM facilitates QoS deployment by creating QoS policies with tailored default values and modifying interfaces and router configuration, if necessary, to support QoS. The following steps are used to configure the deployment scenario using Cisco SDM.

### Configuring QoS on a Frame Relay WAN Link with IPSec Tunnel

At **Configure Mode**, select the **Quality of Service**, click **Create QoS Policy** tab (Figure 2), and click **Launch QoS Wizard** to launch the wizard.

Figure 2. Create QoS Policy



File Edit View Tools Help

Home Configure Monitor Refresh Save Help

**Tasks**

- Interfaces and Connections
- Firewall and ACL
- VPN
- Security Audit
- Routing
- NAT
- Intrusion Prevention
- Quality of Service
- Additional Tasks

**Quality of Service**

Create QoS Policy Edit QoS Policy

SDM can guide you in configuring a basic Quality of Service (QoS) policy for outgoing traffic on WAN interfaces and IPSec tunnels.

SDM creates a Low Latency Queuing (LLQ) service policy with its associated classes. The service policy is created by allocating proportional bandwidth on the WAN/IPsec interfaces, and bandwidth you specify for the constituent classes.

The service policy is then associated with the WAN or IPSec interface you select.

**Use Case Scenario**

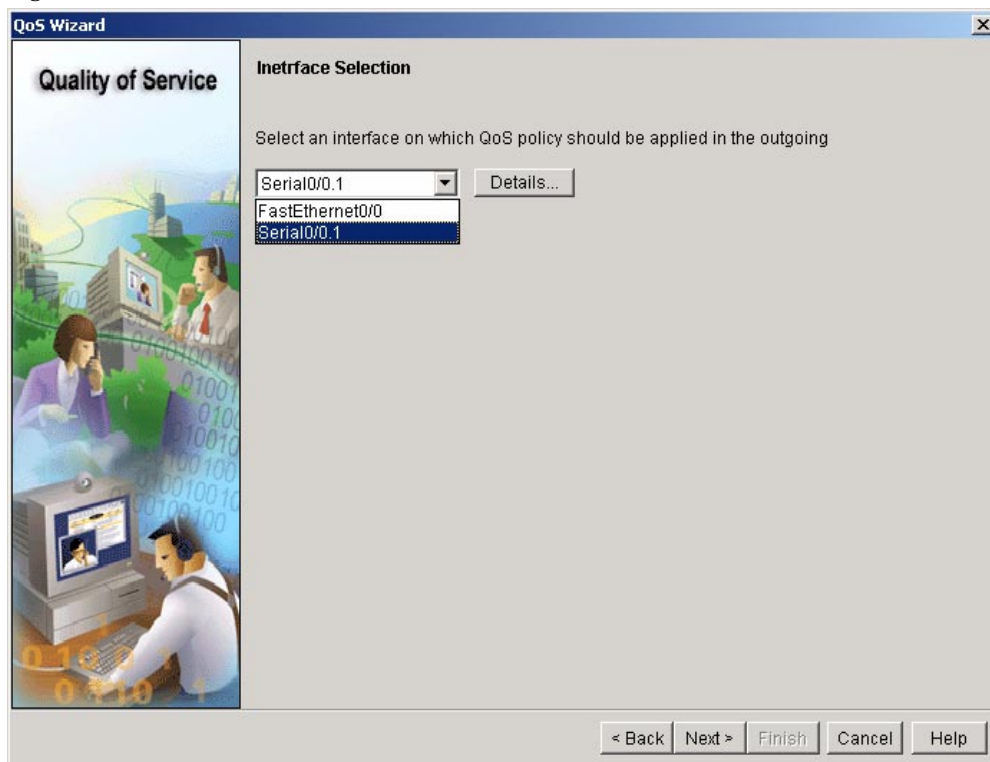
Launch QoS Wizard

Click **Next** to go to **Interface Selection** screen.



- For interface, in this scenario, use **Serial0/0.1** (Figure 3)
- (Optional) Click **Details** to see the current configuration of an interface (Figure 4)
- Click **Next**

**Figure 3. Interface Selection**



**Figure 4. Interface Details of Serial0/0.1**

Details of the Interface : Serial0/0.1	
Item Name	Item Value
IP Address/Subnet Mask	11.1.1.100/255.255.255.0
DLCI	16
Encapsulation	Cisco
NAT	Outside
Access Rule - inbound	<None>
Access Rule - outbound	<None>
IPSec Policy	SDM_CMAP_1
Inspect Rule - inbound	<None>
Inspect Rule - outbound	<None>
QoS Policy - outbound	<None>

Interface Serial0/0.1 is a Frame-Relay link with DLCI = 16 and IPSec Policy configured.



To configure the Bandwidth Allocation (Figure 5), take the following steps:

- Real Time (Voice, Video): **65 percent**
- Business-Critical: **5 percent**

Note: The Total Bandwidth is always 100 percent because SDM automatically recalculates the bandwidth percentage of the Best-Effort category.

- (Optional) Click **View Details** to see the protocols supported classified into Real-Time category and Business-Critical category (Figure 6)
- Click **Next**

**Figure 5. Bandwidth Allocation**

**QoS Wizard**

**Quality of Service**

**QoS Policy Generation**

SDM will create a QoS policy to provide quality of service to 2 types of traffic:

1) Real-Time Traffic :- SDM will create 2 QoS classes to handle VoIP and voice signaling packets.

2) Business-Critical Traffic :- SDM will create 3 QoS classes to handle packets which are important for a typical corporate environment. Some of the protocols included in this traffic category are citrix, sqlnet, notes, ldap, and secure ldap. Routing protocols in this category include bgp, egp, eigrp and rip.

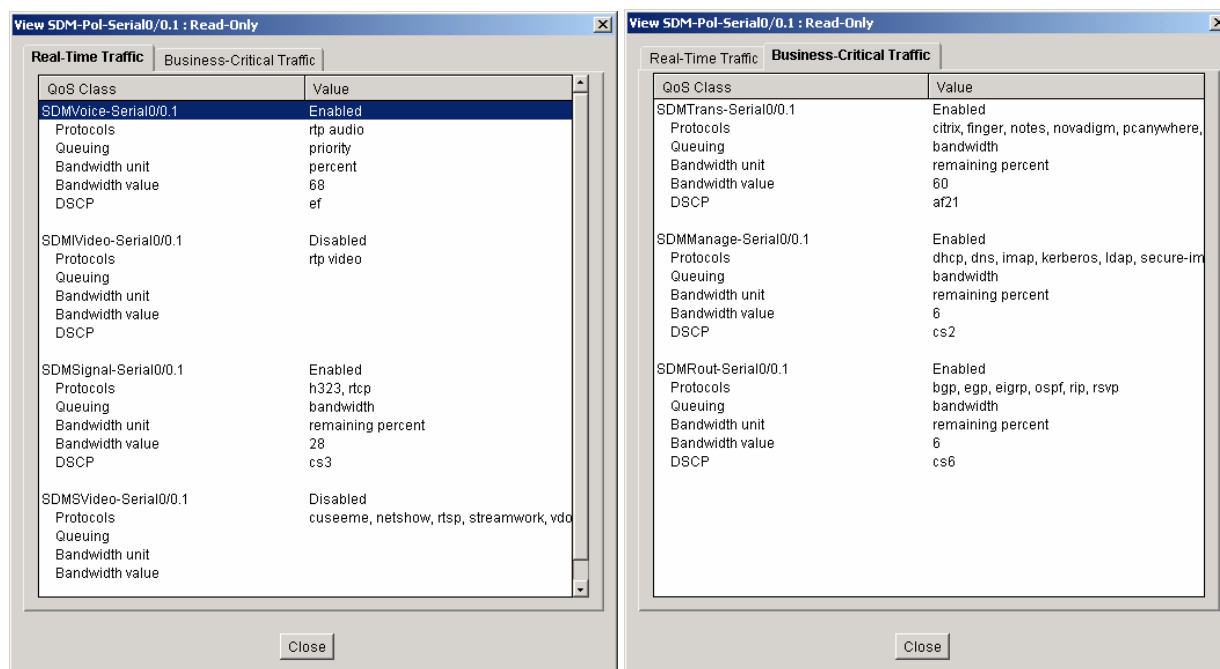
**Bandwidth Allocation**

Type of Traffic	Bandwidth in %	kbps value
Real Time (Voice, Video) :	65	1004
Business-Critical :	5	77
Best-Effort :	30	463
<b>Total Bandwidth :</b>	<b>100</b>	<b>1544</b>

[View Details...](#)

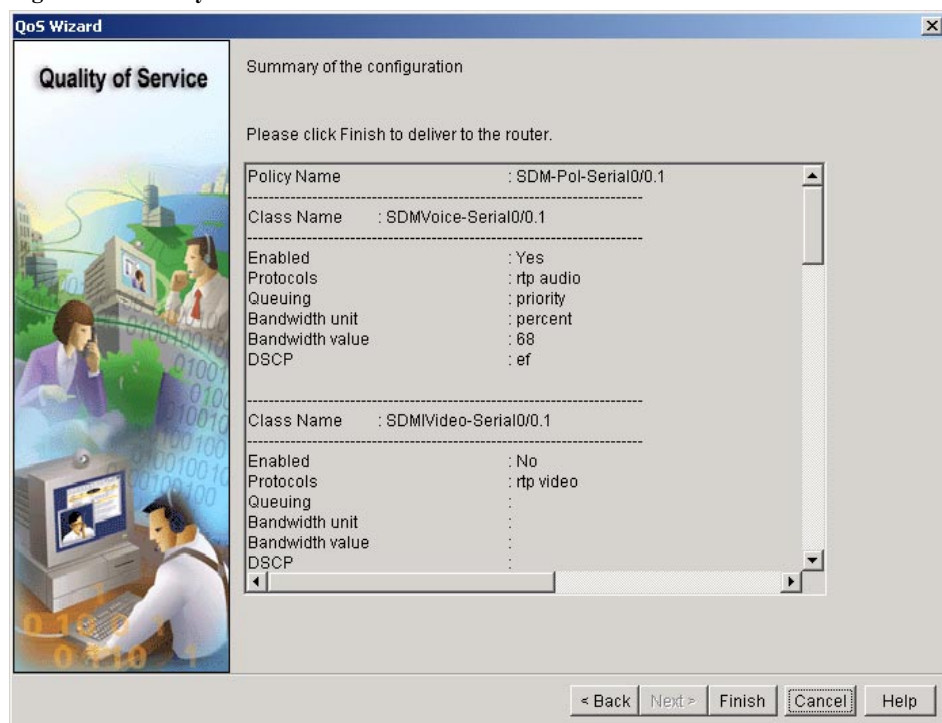
< Back   Next >   Finish   Cancel   Help

**Figure 6. Protocols Classification**



- If you are prompted to enable Network-Based Application Recognition (NBAR) Protocol discovery for this interface, click **Yes**
- Summary screen displays the configuration; click **Finish** to deliver the configuration (Figure 7)

Figure 7. Summary



## Verification



Users can go to **Configure Mode**, select **Quality of Service**, and click **Edit QoS Policy** tab to display QoS Policies. SDM creates a QoS Policy named **SDM-Pol-Serial0/0.1-FR** applied to interface Serial0/0.1 listed in the upper panel. Select the policy and the details of the policy are displayed in the lower panel.

Note: The built-in SDM intelligence automatically reconfigures IPSec Tunnel to support QoS and tailors the QoS policy to meet the Frame Relay interface prerequisites (Figure 8).

Figure 8. Display QoS Policies

File Edit View Tools Help

Home Configure Monitor Refresh Save Help

CISCO SYSTEMS

**Tasks**

Interfaces and Connections

Firewall and ACL

VPN

Security Audit

Routing

NAT

Intrusion Prevention

Quality of Service

Additional Tasks

**Quality of Service**

Create QoS Policy **Edit QoS Policy**

QoS Policies

Clone... Delete

Policy Name	Policy Type	Applied to Interface	IP Address
SDM-Pol-Serial0/0.1-FR	SDM-Default	Serial0/0.1	11.1.1.100

QoS Policy Details

Bandwidth Allocation - Real-Time: 68% Business-Critical: 0% Trivial: 0% Edit...

Traffic Type	Class Name	Enabled	Protocols	Queuing	Percent	Remaining Percent	DSC
Real-Time	SDMSVideo-Serial0/0.1	✗	cuseeme, ne				
Real-Time	SDMVoice-Serial0/0.1	✓	rtp audio	priority	68		ef
Real-Time	SDMSignal-Serial0/0.1	✓	h323, rtcp	bandwidth		28	cs3
Real-Time	SDMIVideo-Serial0/0.1	✗	rtp video				
Business-Critical	SDMManage-Serial0/0.1	✓	dhcp, dns, in	bandwidth		6	cs2
Business-Critical	SDMRout-Serial0/0.1	✓	bgp, egp, eig	bandwidth		6	cs6
Business-Critical	SDMTrans-Serial0/0.1	✓	citrix, finger, i	bandwidth		60	af21
Trivial	SDMBulk-Serial0/0.1	✗	exchange, ftp				

Total Priority Percent = 68 (Max=75)% Bandwidth Remaining Percent = 100 (Max=100)%

Apply Changes Discard Changes



## Edit a QoS Policy

At **Configure Mode**, select the **Quality of Service**; and click **edit QoS Policy** tab to display QoS Policies. In our scenario, select **SDM-Pol-Serial0/0.1-FR** listed in the upper panel. SDM displays QoS Policy Details in the lower panel (shown in Figure 8).

To disable **Business-Critical/SDMManage-Serial0/0.1**, take the following steps:

- Select **Business-Critical/SDMManage-Serial0/0.1**
- Click **Edit**, **Edit QoS Class** window pops up
- Deselect **Add this class to the policy** (Figure 9) and click **OK** to go back to **Edit QoS Policy** screen
- Click **Apply Changes/Discard Changes** button on the bottom of the screen to apply or discard changes

Note: the Apply Changes and Discard Changes buttons are not available if no change is made (shown in Figure 8).

**Figure 9. Edit QoS Class**

**Edit QoS Class : SDMManage-Serial0/0.1**

☐ Add this class to the policy

Protocol/Application : dhcp dns imap http Add... Delete

Queuing

☐ Priority

Percent  (1 to 75)

☒ Bandwidth

Remaining Percent  (1 to 100)

DSCP Marking : 16 (cs2)

OK Cancel Help



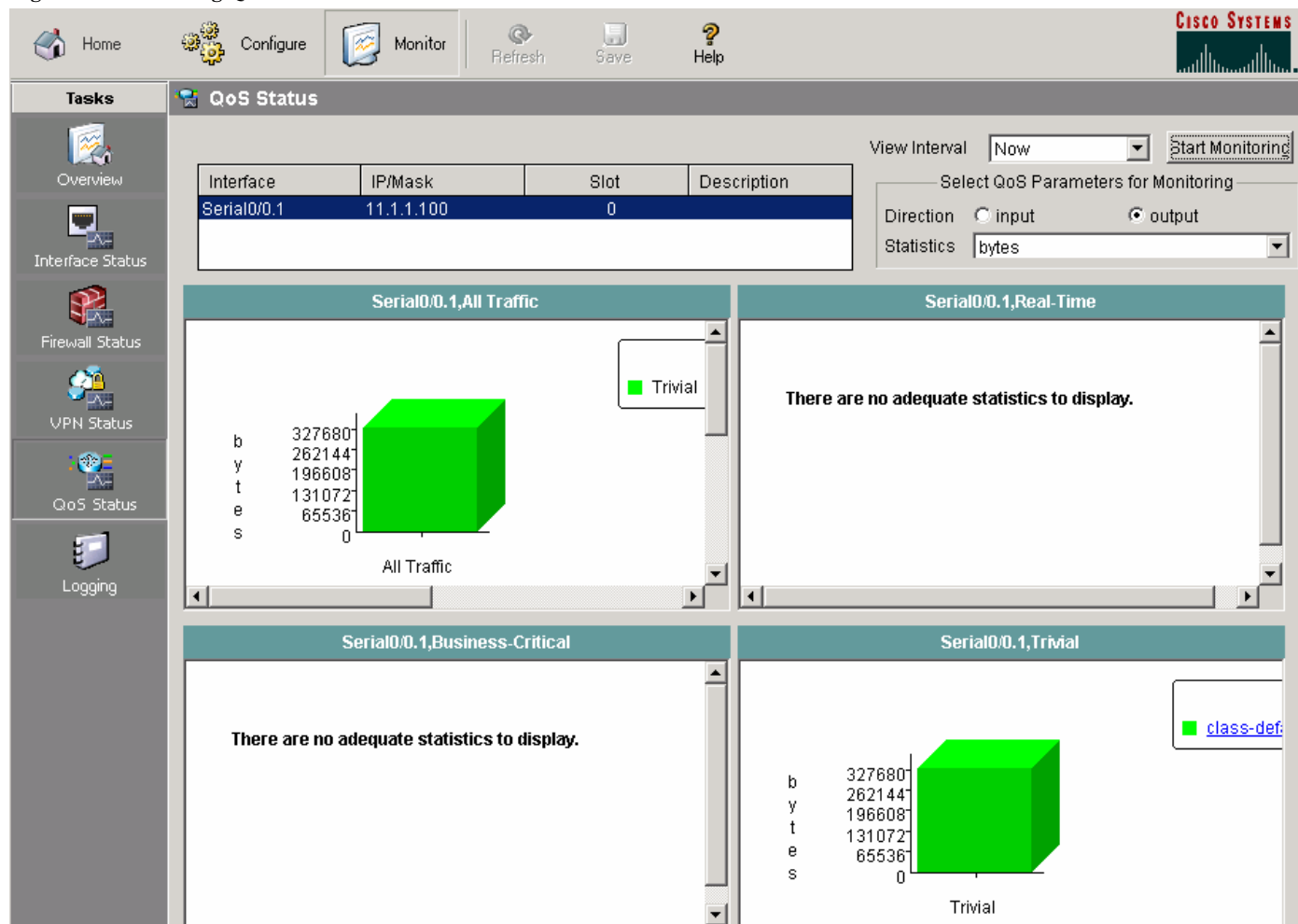


## Monitoring QoS Status

At **Monitor Mode**, select the **QoS Status** (Figure 10). The traffic statistics in bar charts are displayed based on the combination of View Interval (Every 1 minute, every 5 minutes, and every 1 hour) and QoS Parameters for Monitoring (input/output, bandwidth/bytes/packets dropped).

In our scenario, Serial0/0.1 with View Interval = Now, Direction = output, and Statistics = bytes are graphed on the screen.

**Figure 10. Monitoring QoS Status**





## Cisco IOS Software Command-Line Interface

The QoS configuration requires the knowledge of various interfaces (ATM, Frame Relay, low-speed link, and IPSec Tunnel), the characteristics of various protocols, Cisco IOS command-line interface (CLI), and Modular QoS CLIs (MQC). The following CLIs are used to configure the same deployment scenario as above as opposed to the SDM.

```
!  
! Enable the QoS for VPNs  
crypto map SDM_CMAP_1 1 ipsec-isakmp  
  qos pre-classify  
!  
! Configure Traffic Classes  
class-map match-any SDMSVideo-Serial0/0.1  
  match protocol cuseeme  
  match protocol netshow  
  match protocol rtsp  
  match protocol streamwork  
  match protocol vdolive  
class-map match-any SDMBulk-Serial0/0.1  
  match protocol exchange  
  match protocol ftp  
  match protocol irc  
  match protocol nntp  
  match protocol pop3  
  match protocol printer  
  match protocol secure-ftp  
  match protocol secure-irc  
  match protocol secure-nntp  
  match protocol secure-pop3  
  match protocol smtp  
  match protocol tftp  
class-map match-any SDMSave-Serial0/0.1  
  match protocol napster  
  match protocol fasttrack  
  match protocol gnutella  
class-map match-any SDMManage-Serial0/0.1  
  match protocol dhcp  
  match protocol dns  
  match protocol imap  
  match protocol kerberos  
  match protocol ldap  
  match protocol secure-imap  
  match protocol secure-ldap  
  match protocol snmp  
  match protocol socks  
  match protocol syslog  
class-map match-any SDMVoice-Serial0/0.1  
  match protocol rtp audio  
class-map match-any SDMRout-Serial0/0.1  
  match protocol bgp  
  match protocol egp  
  match protocol eigrp  
  match protocol ospf  
  match protocol rip  
  match protocol rsvp  
class-map match-any SDMSignal-Serial0/0.1  
  match protocol h323  
  match protocol rtcp  
class-map match-any SDMIVideo-Serial0/0.1  
  match protocol rtp video  
class-map match-any SDMTrans-Serial0/0.1  
  match protocol citrix
```



```
match protocol finger
match protocol notes
match protocol novadigm
match protocol pcanywhere
match protocol secure-telnet
match protocol sqlnet
match protocol sqlserver
match protocol ssh
match protocol telnet
match protocol xwindows
!
! Configure QoS Policy
policy-map SDM-Pol-Serial0/0.1
  class SDMSignal-Serial0/0.1
    bandwidth remaining percent 28
    set dscp cs3
  class SDMVoice-Serial0/0.1
    priority percent 68
    set dscp ef
  class SDMRout-Serial0/0.1
    bandwidth remaining percent 6
    set dscp cs6
  class SDMManage-Serial0/0.1
    bandwidth remaining percent 6
    set dscp cs2
  class SDMTrans-Serial0/0.1
    bandwidth remaining percent 60
    set dscp af21
!
! For Frame-Relay links, traffic shaping is required
policy-map SDM-Pol-Serial0/0.1-FR
  class class-default
    shape average 128000
    service-policy SDM-Pol-Serial0/0.1
!
! Assign QoS Policy to an interface
interface Serial0/0.1 point-to-point
  service-policy output SDM-Pol-Serial0/0.1-FR
```

In summary, by using the Cisco SDM QoS Wizard, users can conduct the same [SAME AS WHAT?] QoS configuration easily and quickly with minimum knowledge of Cisco IOS CLI, Modular QoS CLIs, and QoS.



## References

Quality of Service:

[http://www.cisco.com/en/US/partner/tech/tk543/tech\\_topology\\_and\\_network\\_serv\\_and\\_protocol\\_suite\\_home.html](http://www.cisco.com/en/US/partner/tech/tk543/tech_topology_and_network_serv_and_protocol_suite_home.html)

Quality of Service for Virtual Private Network:

<http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122t/122t2/ftqosvnp.pdf>



### Corporate Headquarters

Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
[www.cisco.com](http://www.cisco.com)  
Tel: 408 526-4000  
800 553-NETS (6387)  
Fax: 408 526-4100

### European Headquarters

Cisco Systems International  
BV  
Haarlerbergpark  
Haarlerbergweg 13-19  
1101 CH Amsterdam  
The Netherlands  
[www-europe.cisco.com](http://www-europe.cisco.com)  
Tel: 31 0 20 357 1000  
Fax: 31 0 20 357 1100

### Americas Headquarters

Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
[www.cisco.com](http://www.cisco.com)  
Tel: 408 526-7660  
Fax: 408 527-0883

### Asia Pacific Headquarters

Cisco Systems, Inc.  
Capital Tower  
168 Robinson Road  
#22-01 to #29-01  
Singapore 068912  
[www.cisco.com](http://www.cisco.com)  
Tel: +65 317 7777  
Fax: +65 317 7799

Cisco Systems has more than 200 offices in the following countries and regions. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at [www.cisco.com/go/offices](http://www.cisco.com/go/offices).

Argentina • Australia • Austria • Belgium • Brazil • Bulgaria • Canada • Chile • China PRC • Colombia • Costa Rica • Croatia • Czech Republic • Denmark • Dubai, UAE • Finland • France • Germany • Greece • Hong Kong SAR • Hungary • India • Indonesia • Ireland • Israel • Italy • Japan • Korea • Luxembourg • Malaysia • Mexico • The Netherlands • New Zealand • Norway • Peru • Philippines • Poland • Portugal • Puerto Rico • Romania • Russia • Saudi Arabia • Scotland • Singapore • Slovakia • Slovenia • South Africa • Spain • Sweden • Switzerland • Taiwan • Thailand • Turkey • Ukraine • United Kingdom • United States • Venezuela • Vietnam • Zimbabwe

Copyright 2004 Cisco Systems, Inc. All rights reserved. CCSP, the Cisco Square Bridge logo, Cisco Unity, Follow Me Browsing, FormShare, and StackWise are trademarks of Cisco Systems, Inc.; Changing the Way We Work, Live, Play, and Learn, and iQuick Study are service marks of Cisco Systems, Inc.; and Aironet, ASIST, BPX, Catalyst, CCDA, CCDP, CCIE, CCIP, CCNA, CCNP, Cisco, the Cisco Certified Internetwork Expert logo, Cisco IOS, Cisco Press, Cisco Systems, Cisco Systems Capital, the Cisco Systems logo, Empowering the Internet Generation, Enterprise/Solver, EtherChannel, EtherFast, EtherSwitch, Fast Step, GigaDrive, GigaStack, HomeLink, Internet Quotient, IOS, IP/TV, iQ Expertise, the iQ logo, iQ Net Readiness Scorecard, LightStream, Linksys, MeetingPlace, MGX, the Networkers logo, Networking Academy, Network Registrar, Packet, PIX, Post-Routing, Pre-Routing, ProConnect, RateMUX, Registrar, ScriptShare, SlideCast, SMARTnet, StrataView Plus, SwitchProbe, TeleRouter, The Fastest Way to Increase Your Internet Quotient, TransPath, and VCO are registered trademarks of Cisco Systems, Inc. and/or its affiliates in the United States and certain other countries.

All other trademarks mentioned in this document or Website are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (0406R)

Printed in the USA