Implementing Cisco Quality of Service

Length
5 days

Format
Lecture/lab

Version
2.2

Course Description

This course provides students with in-depth knowledge of IP QoS requirements; conceptual models using Differentiated Services (DiffServ), Integrated Services (IntServ), and Best Effort (over provisioning); and the implementation of IP QoS on Cisco IOS switch and router platforms.

QOS covers the theory of IP QoS, design issues, and configuration of various QoS mechanisms to facilitate the creation of effective administrative policies.

Who Should Attend

This course is designed for Cisco customers and Channel Partners who are working toward CCVP certification or the IPT Support Specialization.

Recommended Prerequisites

- Interconnecting Cisco Networking Devices (ICND)

  or
- Cisco Certified Networking Associate (CCNA)

Related Courses

- Cisco IP Telephony Part 1 (CIPT1)
- Cisco Voice Over IP (CVOICE)
- IP Telephony Troubleshooting (IPTT)
- Implementing Cisco Voice Gateways and Gatekeepers (GWGK)

QOS

Learning Objectives

After completing this course, you will be able to:

- Identify the components of the Cisco Unity system, their standard and optional features, and explain how they integrate into a unified messaging system
- Explain the need to implement quality of dervice (QoS) and explain methods for implementing and managing QoS
- Identify and describe different models used for ensuring QoS in a network and explain key IP QoS mechanisms used to implement the models
- Explain the use of MQC and AutoQoS to implement QoS on the network
- Use Cisco QoS queuing mechanisms to manage network congestion
- Use Cisco QoS congestion avoidance mechanisms to reduce the effects of congestion on the network
- Use Cisco QoS traffic policing and traffic shaping to effectively limit the rate of network traffic
- Use Cisco link efficiency to improve the bandwidth efficiency of the link
- Select the most appropriate QoS mechanisms for providing QoS using Cisco best practices

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Course Outline

Module 1: Introduction to IP QoS

Lesson 1: Understanding the Need for QoS
Converged Networks
Converged Networks Quality Issues
Available Bandwidth
End-to-End Delay
Packet Loss

Lesson 2: Understanding IP QoS
QoS Defined
QoS for Converged Networks
QoS Requirements
QoS Traffic Classes
QoS Policy

Lesson 3: Implementing IP QoS
Methods for Implementing QoS Policy
Legacy CLI
Modular QoS CLI
AutoQoS
QoS Implementation Methods Compared
QoS Policy Manager
Network MIBs for Monitoring QoS
MIBs for Managing QoS

Module 2: The Building Blocks of IP QoS

Lesson 1: Identifying Models for Implementing QoS
QoS Models
Best-Effort Model
IntServ Model
DiffServ Model

Lesson 2: Understanding the Differentiated Services Model
Differentiated Services Model
DSCP Encoding
Per-Hop Behaviors
Backward Compatibility Using the Class Selector

Lesson 3: Identifying IP QoS Mechanisms
QoS Mechanisms
Classification
Marking
Congestion Management
Congestion Avoidance
Policing and Shaping
Compression
Link Fragmentation and Interleaving
Applying QoS to Input and Output Interfaces

Lesson 4: Understanding QoS in the Life of a Packet
QoS and Packets
Life of a High-Priority (VoIP) Packet
Life of a Low-Priority (FTP) Packet

Module 3: Introduction to Modular QoS CLI and AutoQoS

Lesson 1: Introducing Modular QoS CLI
Modular QoS CLI
Modular QoS CLI Components
Class Maps
Configuring and Monitoring Class Maps
Policy Maps
Configuring and Monitoring Policy Maps
Service Policy
Attaching Service Policies to Interfaces

Lesson 2: Introducing AutoQoS
AutoQoS
AutoQoS: Router Platforms
AutoQoS: Switch Platforms
Configuring AutoQoS
Monitoring AutoQoS
Automation with Cisco AutoQoS

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Module 4: Classification and Marking

Lesson 1: Understanding Classification and Marking
Classification
Marking
Classification and Marking at the Link Layer
Classification and Marking at the Network Layer
Mapping CoS to Network Layer QoS
QoS Service Class Defined
Implementing a QoS Policy Using a QoS Service Class
Trust Boundaries

Lesson 2: Using MQC for Classification
MQC Classification Options
Configuring Classification with MQC
Configuring Classification Using Input Interface
Configuring Classification Using CoS
Configuring Classification Using Access Lists
Configuring Classification Using IP Precedence
Configuring Classification Using DSCP
Configuring Classification Using a UDP Port Range
Monitoring Class Maps

Lesson 3: Using MQC for Class-Based Marking
Class-Based Marking Overview
MQC Marking Options
Configuring Class-Based Marking
Configuring CoS Marking
Configuring IP Precedence Marking
Configuring IP DSCP Marking
Monitoring Class-Based Marking

Lesson 4: Using NBAR for Classification
Network-Based Application Recognition
NBAR Application Support
Packet Description Language Module
Protocol Discovery
Configuring and Monitoring Protocol Discovery
Configuring NBAR for Static Protocols
Configuring NBAR for Stateful Protocols

Lesson 5: Configuring QoS Pre-Classify
Implementing QoS with Pre-Classify
QoS Pre-Classify Applications
QoS Pre-Classify Deployment Options
Configuring QoS Pre-Classify
Monitoring QoS Pre-Classify

Lesson 6: Configuring QoS Policy Propagation through BGP
QoS Policy Propagation through BGP
IP QoS and BGP Interaction
Cisco Express Forwarding
QPPB Configuration Tasks
Configuring QPPB

Lesson 7: Configuring LAN Classification and Marking
LAN-Based Classification and Marking
QoS Trust Boundaries
LAN Classification and Marking Platforms
Configuring LAN-Based Classification and Marking
Monitoring LAN-Based Classification and Marking

Module 5: Congestion Management

Lesson 1: Introducing Queuing
Congestion and Queuing
Queuing Algorithms
FIFO
Priority Queuing
Round Robin
Weighted Round Robin
Deficit Round Robin

Lesson 2: Understanding Queuing Implementations
Queuing Components
Hardware Queue (TxQ) Size
Congestion on Software Interfaces
Queuing Implementations in Cisco IOS

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Module 5: Congestion Management (Cont.)

Lesson 3: Configuring FIFO and WFQ
FIFO Queuing
Weighted Fair Queuing
WFQ Classification
WFQ Insertion and Drop Policy
WFQ Scheduling
Benefits and Drawbacks of WFQ
Configuring WFQ
Monitoring WFQ

Lesson 4: Configuring CBWFQ and LLQ
CBWFQ and LLQ
CBWFQ
CBWFQ Architecture
CBWFQ Benefits
Configuring and Monitoring CBWFQ
LLQ
LLQ Architecture
LLQ Benefits
Configuring and Monitoring LLQ

Lesson 5: Configuring LAN Congestion Management
Queuing on Catalyst Switches
Weighted Round Robin
Configuring CoS-to-Queue Mappings for PQ on Catalyst 2950 Switches
Configuring WRR on Catalyst 2950 Switches
Monitoring Queuing on Catalyst 2950 Switches

Module 6: Congestion Avoidance

Lesson 1: Introducing Congestion Avoidance
Behavior of TCP Senders and Receivers
Congestion and TCP
Managing Interface Congestion with Tail Drop
Tail-Drop Limitations

Lesson 2: Introducing RED
Random Early Detection
RED Profiles
RED Modes
TCP Traffic Before and After RED
Applying Congestion Avoidance

Lesson 3: Configuring Class-Based Weighted RED
Weighted Random Early Detection
WRED Profiles
Configuring CB-WRED
Configuring DSCP-Based CB-WRED
Monitoring CB-WRED

Lesson 4: Configuring Explicit Congestion Notification
Explicit Congestion Notification
ECN Field Defined
ECN and WRED
Configuring ECN-Enabled WRED
Monitoring ECN-Enabled WRED

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Course Outline

Module 7: Traffic Policing and Shaping

Lesson 1: Understanding Traffic Policing and Shaping

Traffic Policing and Shaping Overview
Why Use Traffic Conditioners?
Policing vs. Shaping
Measuring Traffic Rates
Single Token Bucket Class-Based Policing
Dual Token Bucket Class-Based Policing
Dual-Rate Token Bucket Class-Based Policing
Class-Based Traffic Shaping
Cisco IOS Traffic Policing and Shaping Mechanisms
Applying Traffic Conditioners

Lesson 2: Configuring Class-Based Policing

Class-Based Policing Overview
Configuring Single-Rate Class-Based Policing
Configuring Dual-Rate Class-Based Policing
Configuring Percentage-Based Class-Based Policing
Monitoring Class-Based Policing

Lesson 3: Configuring Class-Based Shaping

Class-Based Shaping Overview
Traffic Shaping Methods
Configuring Class-Based Shaping
Monitoring Class-Based Shaping

Lesson 4: Configuring Class-Based Shaping on Frame Relay Interfaces

Frame Relay Refresher
Frame Relay Congestion Control
Frame Relay Congestion Adaptation
FECN-to-BECN Propagation
Configuring Frame Relay Adaptive Class-Based Shaping
Monitoring MQC-Based Frame Relay Traffic Shaping
MQC-Based Frame Relay Traffic Shaping Example on Multipoint Main Interface

Module 8: Link Efficiency Mechanisms

Lesson 1: Understanding Link Efficiency Mechanisms

Link Efficiency Mechanisms Overview
L2 Payload Compression
Header Compression
Large Packets "Freeze Out" Voice on Slow WAN Links
Link Fragmentation and Interleaving
Applying Link Efficiency Mechanisms

Lesson 2: Configuring Class-Based Header Compression

Header Compression Overview
Class-Based TCP Header Compression
Class-Based RTP Header Compression
Configuring Class-Based Header Compression
Monitoring Class-Based Header Compression

Lesson 3: Configuring Link Fragmentation and Interleaving

Fragmentation Options
Serialization Delay and Fragment Sizing
Configuring MLP with Interleaving
Monitoring MLP with Interleaving
FRF.12 Frame Relay Fragmentation
Configuring FRF.12 Frame Relay Fragmentation
Monitoring FRF.12 Frame Relay Fragmentation

Module 9: QoS Best Practices

Lesson 1: Understanding Traffic Classification Best Practices

QoS Best Practices
Voice, Video, and Data QoS Requirements
QoS Requirements Summary
Traffic Classification
Example: LLQ Bandwidth Allocation
Example: LLQ Example on the Enterprise WAN Edge Router
Enterprise to Service Provider QoS Class Mapping

Lesson 2: Deploying End-to-End QoS

QoS Service Level Agreements
Deploying End-to-End QoS
Enterprise Campus QoS Implementations
WAN Edge (CE/PE) QoS Implementations
Service Provider Backbone QoS Implementations

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Course Labs

Case Study 2-1: QoS Mechanisms

Lab 2-1: QoS Lab Setup and Initialization

Lab 2-2: Baseline QoS Measurement

Lab 3-1: Configuring QoS with AutoQoS

Case Study 4-1: Classification and Marking

Lab 4-1: Classification and Marking Using MQC

Lab 4-2: Classification Using NBAR

Lab 4-3: Configuring QoS Pre-Classify

Lab 4-4: LAN-Based Packet Classification and Marking

Lab 5-1: Configuring Basic Queuing

Lab 5-2: Configuring LLQ

Lab 5-3: Queuing on Catalyst Switches

Case Study 6-1: WRED Traffic Profiles

Lab 6-1: Configuring DSCP-Based WRED

Lab 7-1: Configuring Class-Based Policing

Lab 7-2: Configuring Class-Based Shaping

Lab 8-1: Configuring Class-Based Header Compression

Lab 8-2: Configuring LFI

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