Implementing Cisco Quality of Service 2.5 (QOS)

COURSE OVERVIEW:

Implementing Cisco Quality of Service (QOS) v2.5 provides learners with in-depth knowledge of QoS requirements, conceptual models such as best effort, IntServ, and DiffServ, and the implementation of QoS on Cisco platforms. The curriculum covers the theory of QoS, design issues, and configuration of various QoS mechanisms to facilitate the creation of effective administrative policies providing QoS.

Case studies and lab exercises included in the course help learners to apply the concepts from the individual modules to real-life scenarios. The course also gives learners design and usage rule for advanced QoS features. This gives the learners the opportunity to design and implement efficient, optimal, and trouble-free multiservice networks.

WHO WILL BENEFIT FROM THIS COURSE?

The primary target audiences for the course are:

- Pre-and post-sales technical engineers responsible for designing, implementing, or troubleshooting networks
- Network architects responsible for designing multiservice networks to carry voice, video, and data traffic in enterprise or service provider environments
- Advanced Unified Communications Specialization
- Master UC Specialization
- Master Telepresence ATP

Secondary target audiences are:

- CCIE R&S Candidates

PREREQUISITES:

To fully benefit from this course, students should have the following prerequisite skills and knowledge:

- Interconnecting Cisco Networking Devices, Part 1 and 2 (ICND1 and ICND2)

COURSE OBJECTIVES:

After completion of this course, students will be able to...

- Explain the need for QoS, describe the fundamentals of QoS policy, and identify and describe the different models that are used for ensuring QoS in a network
- Explain the use of MQC and AutoQoS to implement QoS on the network and describe some of the mechanisms used to monitor QoS implementations
- Given a converged network and a policy defining QoS requirements, classify and mark network traffic to implement the policy
- 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 mechanisms to effectively limit the rate of network traffic
- Given a low speed WAN link, use Cisco link efficiency mechanisms to improve the bandwidth efficiency of the link
- Describe the recommended best practices and methods used for end-to-end QoS deployment in the enterprise

COURSE OUTLINE:

Module 1: Introduction to QoS
Lesson 1: Review Converged Networks
- Converged Networks
- Quality Issues in Converged Networks
- Available Bandwidth
- Components of Network Delay
- Calculating End-to-End Delay
- Jitter
- Packet Loss

Lesson 2: Understand QoS
- QoS Defined
- QoS Policy Defined
- Implement a QoS Policy
- Identify Network Traffic
- Voice Traffic Profile
- Videoconferencing Traffic Profile
- Cisco TelePresence Traffic Profile
- Data Traffic Profile
- Divide Network Traffic into Classes
- Define Policies for Traffic Classes
- QoS Mechanisms
- QoS Implementation Methods
- QoS Monitoring Methods
- Cisco Medianet QoS Design

Lesson 3: Describe Best-Effort and Integrated Services Models
- QoS Models
- Best-Effort QoS Model
- IntServ Model
- Resource Reservation Protocol
- RSVP Components
- RSVP Interface Bandwidth Queuing

Lesson 4: Describe the Differentiated Services Model
- DiffServ Model
- DiffServ Terminology
- DSCP Encoding
- Per-Hop Behaviors
- Expedited Forwarding
- Assured Forwarding
- AF Drop Probability
- Class Selector
- Integration of IntServ and DiffServ

Module 2: Implement and Monitor QoS
Lesson 1: MQC Introduction
- Modular QoS CLI
- MQC Components
- Example: MQC Policy Configuration
- Class Maps Overview
- Match Operation in Class Maps
- Policy Maps Overview
- Service Policy Overview
- Hierarchical Policy

Lesson 2: Monitor QoS
- SNMP Management of QoS
- Describe Class-Based QoS MIB
- Cisco NBAR
- Cisco NBAR Protocol Discovery
- Cisco NBAR Protocol Discovery MIB
- NetFlow
- Cisco Flexible NetFlow
- Cisco Flexible NetFlow Integration with NBAR
- Class-Based Flexible NetFlow
- Cisco Performance Monitor
- Cisco Mediatrace
- Cisco IP SLA
- IP SLA: UDP Jitter

Lesson 3: Define Campus AutoQoSAutoQoS
- AutoQoS Macros
- Trust Boundaries
- Campus AutoQoS Trust
- Campus AutoQoS Conditional Trust
- Campus AutoQoS Video
- Campus AutoQoS VoIP
- Campus AutoQoS Classify
- Monitoring AutoQoS in the Campus

Lesson 4: Define WAN AutoQoS
- Cisco AutoQoS for Routers
- WAN AutoQoS VoIP
- AutoQoS for the Enterprise Overview
- Configuring AutoQoS for the Enterprise
- Monitoring AutoQoS in the WAN

Module 3: Classification and Marking
Lesson 1: Classification and Marking Overview
- Classification
- Marking
- Classification and Marking at the Data Link Layer
- Classification and Marking at the Network Layer
- Mapping QoS Marking Between OSI Layers
- QoS Service Class Defined
- Service Class Templates
- RFC 4594 Marking Recommendations

Lesson 2: MQC for Classification and Marking
- MQC Classification Options
- Configuring Class Maps
- Monitoring Classification
- MQC Marking Options
- Configuring Class-Based Marking
- Monitoring Class-Based Marking
- Configuring IPV6 Classification and Marking

Lesson 3: NBAR for Classification
- Cisco NBAR
- NBAR Application Support
- Configuring NBAR With MQC
- Classifying HTTP Traffic
- NBAR2 Application Grouping
- NBAR Port Map
- NBAR Custom Protocols
- Configuring Custom Protocols
- NBAR Worm Policing
- NBAR versus Future Worms

Lesson 4: Use of QoS Preclassify
- Issues with QoS on VPNs
- ToS Byte Preservation
- QoS Preclassify Operation
- Configuring QoS Preclassify
- Monitoring QoS Preclassify

Lesson 5: Campus Classification and Marking
- Campus Classification and Marking
- Overview of QoS Trust Boundaries
- Campus Ingress QoS Models
- QoS Map Tables: Marking
- Internal DSCP
- Applying Campus Switch Classification and Marking
- Monitoring Campus Classification and Marking

Module 4: Congestion Management
Lesson 1: Queuing Introduction
- Congestion and Queuing
- Queuing Components
- Hardware Queue Size
- Congestion on Logical Interfaces
- Queuing Algorithms
- FIFO Queuing
- Priority Queuing
- Round-Robin Queuing
- WRR Queuing
- DRR Queuing

Lesson 2: Configure WFQ
- Weighted Fair Queuing
- WFQ Classification
- WFQ Scheduling
- WFQ Drop Operation
- Benefits and Drawbacks of WFQ
- Configuring WFQ
- Monitoring WFQ

Lesson 3: Configure CBWFQ and LLQ
- Class-Based Weighted Fair Queuing
- CBWFQ Architecture
- Benefits and Drawbacks of CBWFQ
- Configuring CBWFQ
- Low Latency Queuing
- LLQ Architecture
- Configuring LLQ
- Monitoring LLQ-CBWFQ

Lesson 4: Configure Campus Congestion Management
- Campus Queuing
- Catalyst Switch Hardware Queue Nomenclature
- Queue Mapping
- WRR on Campus Switches
- WRR Bandwidth and Buffer Settings
- SRR on Campus Switches
- SRR Common and Reserved Buffers
- Configuring Ingress Queuing on Cisco Catalyst 3750 Series Switches
- Configuring Egress Queuing on Cisco Catalyst 3750 Series Switches
- Monitoring Congestion Management On Cisco Catalyst 3750 Series Switches

Module 5: Congestion Avoidance
Lesson 1: Congestion Avoidance Introduction
- TCP Behavior
- Congestion and TCP
- Example: TCP Congestion Control Algorithms
- Managing Congestion with Tail Drop
- Impact of Tail Drop
- Random Early Detection
- RED Profiles and Modes
- TCP Behavior Before and After RED

Lesson 2: Configure Class-Based WRED
- Weighted Random Early Detection
- Class-Based WRED
- WRED Building Blocks
- WRED Profiles
- IP Precedence-Based WRED
- DSCP-Based WRED
- Configure CBWRED
- Changing WRED Sensitivity to Bursts
- Example: DSCP-Based WRED
- Monitoring CBWRED

Lesson 3: Configure ECN
- Explicit Congestion Notification
- ECN Field
- ECN and WRED
- ECN Operation
- Configuring ECN
- Monitoring ECN

Lesson 4: Describe Campus-Based Congestion Avoidance
- Congestion Avoidance in the Campus
- Weighted Tail Drop
- Configuring WTD Thresholds on the Cisco Catalyst 3750 Series Switch
- WRED on Campus Switches
- Dynamic Buffer Limiting

Module 6: Traffic Policing and Shaping

Lesson 1: Traffic Policing and Shaping Overview
- Traffic Policing and Traffic Shaping
- Policing and Shaping Use Cases
- Policing vs. Shaping
- Single Token Bucket Model
- Single Token Bucket Class-Based Policing
- Dual Token Bucket Class-Based Policing
- Dual-Rate Token Bucket Class-Based Policing
- Class-Based Traffic Shaping

Lesson 2: Configure Class-Based Policing
- Class-Based Policing
- Configuring Class-Based Policing
- Example: Single-Rate Single Token Policer
- Example: Single-Rate Dual Token Policer
- Example: Dual-Rate Policer
- Monitoring Class-Based Policing

Lesson 3: Campus Policing
- Campus Policing Overview
- QoS Map Tables: Policing
- Applying Campus Switch Policing
- Campus Aggregate Policing
- Campus Microflow Policing

Lesson 4: Configure Class-Based Shaping
- Class-Based Shaping
- Shaping Methods
- Configuring Class-Based Shaping
- Example: Shaping Configuration
- Example: Hierarchical Shaping
- Monitoring Class-Based Shaping

Lesson 5: Configure Class-Based Shaping on Frame Relay Interfaces
- Frame Relay Refresher
- Frame Relay Congestion Control
- Frame Relay Congestion Adaptation
- FECN-to-BECN Propagation
- Configuring Adaptive Class-Based Shaping
- Monitoring FRTS

Lesson 6: Configure Frame Relay Voice-Adaptive Traffic Shaping and Fragmentation
- Frame Relay Voice-Adaptive Traffic Shaping and Fragmentation
- Benefits of Frame Relay Voice-Adaptive Traffic Shaping and Fragmentation
- Frame Relay Voice-Adaptive Traffic Shaping and Fragmentation Operation
- Configuring Frame Relay Voice-Adaptive Traffic Shaping and Fragmentation
- Monitoring Frame Relay Voice-Adaptive Traffic Shaping and Fragmentation

Module 7: Link Efficiency Mechanisms
Lesson 1: Link Efficiency Mechanisms Overview
- Link Efficiency Mechanisms
- Layer 2 Payload Compression
- Header Compression
- Large Packet "Freeze Out"
- Serialization Delay
- Link Fragmentation and Interleaving
- Fragment Size Recommendations for Voice

Lesson 2: Configure Class-Based Header Compression
- Header Compression
- Class-Based TCP Header Compression
- Example: Class-Based TCP Header Compression Configuration
- Class-Based RTP Header Compression
- Example: Class-Based RTP Header Compression
- Configuring Class-Based Header Compression
- Monitoring Class-Based Header Compression

Lesson 3: Configure LFI
- LFI Options
- Configuring MLP with Interleaving
- Monitoring MLP Interleaving
- FRF.12 Frame Relay Fragmentation
- Configuring FRF.12 Frame Relay Fragmentation
- Monitoring FRF.12 Frame Relay Fragmentation

Module 8: Deploying End-to-End QoS

Lesson 1: Apply Best Practices for QoS Policy Design
- Optimally Deploying QoS Within the Enterprise
- Strategically Defining QoS Objectives
- Cisco Modified RFC 4594 Marking Recommendations and Class Expansion
- Understanding Application Service-Level Requirements
- QoS Requirements for Control Plane Traffic
- Control Plane Policing
- Data Plane Policing
- Classification and Marking Best Practices
- Policing and Markdown Best Practices
- Queuing and Dropping Best Practices
- Link Efficiency Mechanisms Best Practices

Lesson 2: End-to-End QoS Deployments
- Deploying End-to-End QoS
- Enterprise Campus QoS Guidelines
- Campus QoS Deployment Steps and Options
- Branch Router QoS Guidelines
- WAN Edge QoS Design Considerations
- Enterprise Network with Layer 2 Service
- Enterprise Network with Layer 3 Service
- QoS Service Level Agreements
- QoS Implications of Layer 3 Service Offerings
- Enterprise-to-Service Provider QoS Class Mapping
- Re-Marking DSCP at SP MPLS Edge

Labs:

Lab 2-1: IP SLA Setup and QoS Baseline Measurement
Lab 2-2: Configuring QoS with Cisco AutoQoS
Lab 3-2: Classification and Marking Using MQC
Lab 3-3: Using NBAR for Classification
Lab 3-4: Configuring QoS Preclassify
Lab 3-5: Campus Classification and Marking Using MQC
Lab 4-1: Configuring Fair Queuing
Lab 4-2: Configuring LLQ-CBWFQ
Lab 4-3: Configuring Campus-Based Queuing Mechanisms
Lab 5-2: Configuring DSCP-Based WRED
Lab 5-3: Configuring WTD Thresholds
Lab 6-1: Configuring Class-Based Policing
Lab 6-2: Configuring Class-Based Shaping
Lab 7-1: Configuring Class-Based Header Compression
Lab 7-2: Configuring LFI
Lab 8-1: Mapping Enterprise QoS Policy to the Service Provider Policy

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