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Scope and Sequence

CCNP: Optimizing Converged Networks

Cisco Networking Academy Program

Version 5.0

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Target Audience

Those desiring to continue their post-CCNA preparation for a career as a network administrator, Level 2 support engineer, Level 2 systems engineer, network technician, or deployment engineer. CCNA certified individuals pursuing CCNP, CCIP, CCSP, CCDP, or CCIE certifications.

Prerequisites

Students should have completed CCNA 1 – 4 or equivalent.

CCNA Certification desired but not required.

Work experience beneficial.

Course Description

CCNP: Optimizing Converged Networks is one of four courses leading to the Cisco Certified Network Professional (CCNP) designation. CCNP: Optimizing Converged networks introduces Cisco Networking Academy Program students to optimizing and providing effective QOS techniques in converged networks operating voice, wireless and security applications.

Topics include implementing a VOIP network, implementing QoS on converged networks, specific IP QoS mechanisms for implementing the DiffServ QoS model, AutoQoS, wireless security and basic wireless management.

Course Objectives

The CCNP certification indicates knowledge of networking for the small-office, home-office (SOHO) market and enterprise markets. Following is a list of claims relevant to the ONT certification that a CCNP certified individual will be able to do:

- Describe Cisco VoIP implementations.
- Describe QoS considerations.
- Describe DiffServ QoS implementations.
- Implement AutoQoS.
- Implement WLAN security and management.

CCNP: Optimizing Converged Networks is an integral step towards achieving CCNP Certification.

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Upon completion of this course, students will have performed tasks related to:

- Explaining the Cisco hierarchical network model as it pertains to an end-to-end enterprise network
- Describing specific requirements for implementing a VOIP network
- Describing the need to implement QoS and the methods for implementing QoS on a converged network using Cisco's routers and Catalyst Switches
- Explaining the key IP QoS mechanisms used to implement the DiffServ QoS model
- Configuring Auto QoS for Enterprise
- Describing and configuring wireless security and basic wireless management

Lab Requirements

Please refer to the CCNP Equipment Bundle Spreadsheets on Cisco Academy Connection.

Certification Alignment

The curriculum is aligned with Cisco’s Career Certifications ONT course and the 642-845 exam.

Course Overview

The course is designed to be delivered in a 70 contact hour time frame. Approximately 45 hours will be designated to lab activities and 25 hours on curriculum content. A case study on network QoS is required, but format and timing are determined by the Local Academy.

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Course Outline

Module 1: Converged Network Connectivity Requirements

Module Overview
1.1 The Evolution of Telephony in the Enterprise
- 1.1.1 A Basic Telephone System
- 1.1.2 Traditional Telephone Company Services
- 1.1.3 Digital Telephone Technologies
- 1.1.4 Digital Telephone Services
- 1.1.5 PBXs and Centrex Services
- 1.1.6 Long-Distance Services
- 1.1.7 The Concept of Convergence

1.2 Describing Converged Network Requirements
- 1.2.1 Hierarchical Network Model
- 1.2.2 Cisco Enterprise Architecture
- 1.2.3 Traffic Conditions in a Converged Network
- 1.2.4 Intelligent Information Network
- 1.2.5 Cisco SONA Framework

Module Summary
Module Quiz

Module 2: Cisco VoIP Implementations

Module Overview
2.1 Introducing VoIP Networks
- 2.1.1 Benefits of VoIP Networks
- 2.1.2 Components of a VoIP Network
- 2.1.3 Legacy Analog Interfaces in VoIP Networks
- 2.1.4 Digital Interfaces
- 2.1.5 Stages for Completing a VoIP Telephone Call
- 2.1.6 Distributed Call Control
- 2.1.7 Centralized Call Control

2.2 Digitizing and Packetizing Voice
- 2.2.1 Basic Voice Encoding: Converting Analog Signals to Digital Signals
- 2.2.2 Basic Voice Encoding: Converting Digital Signals to Analog Signals
- 2.2.3 Sampling
- 2.2.4 Quantization
- 2.2.5 Digital Voice Encoding
- 2.2.6 Companding
- 2.2.7 Common Voice Codec Characteristics

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2.2.8 Selecting a Codec Using the Mean Opinion Score
2.2.9 A Closer Look at a DSP

2.3 Encapsulating Voice Packets for Transport
2.3.1 Voice Transport in Circuit-Switched Networks
2.3.2 Voice Transport in IP Networks
2.3.3 Protocols Used in Voice Encapsulation
2.3.4 Voice Encapsulation Codecs
2.3.5 Reducing Header Overhead with cRTP
2.3.6 When to Use RTP Header Compression

2.4 Calculating Bandwidth Requirements for VoIP
2.4.1 Impact of Voice Samples and Packet Size on Bandwidth
2.4.2 Impact of Codecs on Bandwidth
2.4.3 How the Packetization Period Affects VoIP Packet Size and Rate
2.4.4 Data-Link Overhead
2.4.5 Security and Tunneling Overhead
2.4.6 Extra Headers in Security and Tunneling Protocols
2.4.7 Calculating the Total Bandwidth for a VoIP Call
2.4.8 Quick Bandwidth Calculation
2.4.9 Effects of VAD on Bandwidth

2.5 Implementing VoIP in an Enterprise Network
2.5.1 Enterprise Voice Implementations
2.5.2 Deploying CAC
2.5.3 Voice Gateway Functions on a Cisco Router
2.5.4 Cisco Unified CallManager Functions
2.5.5 Enterprise IP Telephony Deployment Models
2.5.6 Cisco IOS Configurations for VoIP

2.6 VoIP Lab Exercises
2.6.1 Lab 2.1 Configure CME using the CLI and Cisco IP Communicator

Module Summary
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Module 3: Introduction to IP QoS

Module Overview
3.1 Introducing QoS 3.1.1 Converged Network Quality Issues
3.1.2 Quality Issues in Converged Networks
3.1.3 Measuring Available Bandwidth
3.1.4 Increasing Available Bandwidth
3.1.5 Effects of End-to-end Delay and Jitter

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3.1.6 Reducing the Impact of Delay on Quality
3.1.7 Packet Loss
3.1.8 Congestion Management: Ways to Prevent Packet Loss

3.2 Implementing Cisco IOS QoS
3.2.1 What is QoS?
3.2.2 Congestion-Management Tools
3.2.3 Queue Management (Congestion-Avoidance Tools)
3.2.4 Preparing to Implement QoS
3.2.5 Step 1: Identify Types of Traffic and Their Requirements
3.2.6 Step 2: Define Traffic Classes
3.2.7 Step 3: Define QoS Policy

3.3 Selecting an Appropriate QoS Policy Model
3.3.1 Three QoS Models
3.3.2 Best-Effort Model
3.3.3 IntServ Model
3.3.4 RSVP and the IntServ QoS Model
3.3.5 RSVP Operation
3.3.6 The DiffServ Model

3.4 Using MQC for Implementing QoS
3.4.1 Methods for Implementing QoS Policy
3.4.2 Configuring QoS at the CLI
3.4.3 Modular QoS CLI
3.4.4 Modular QoS CLI Step 1: Configuring Class Maps
3.4.5 Step 2: Configuring Policy Maps
3.4.6 Step 3: Attaching a Service Policy to Interfaces
3.4.7 Nested Class Maps
3.4.8 MQC Example
3.4.9 Basic MQC Verification Commands

3.5 Implementing QoS with Cisco SDM QoS Wizard
3.5.1 Configuring QoS with Cisco SDM QoS Wizard
3.5.2 Creating a QoS Policy
3.5.3 Reviewing the QoS Configuration
3.5.4 Monitoring QoS Status

3.6 Introduction QoS Lab Exercises
3.6.1 Lab 3.1 Preparing for QoS
3.6.2 Lab 3.2 Installing SDM
3.6.3 Lab 3.3 Configuring QoS with SDM

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Module 4: Implement the DiffServ QoS Model

Module Overview

4.1 Introducing Classification and Marking 4.1.1 Classification
- 4.1.2 Marking
- 4.1.3 Classification and Marking at the Link Layer
- 4.1.4 DiffServ Model
- 4.1.5 IP Precedence and DSCP Compatibility
- 4.1.6 Per-Hop Behaviors
- 4.1.7 Standard PHB Groups
- 4.1.8 Mapping CoS to Network Layer QoS
- 4.1.9 QoS Service Class Defined
- 4.1.10 Implementing QoS Policy Using a QoS Service Class
- 4.1.11 Trust Boundaries

4.2 Using NBAR for Classification
- 4.2.1 Network-Based Application Recognition
- 4.2.2 NBAR Application Support
- 4.2.3 Packet Description Language Module
- 4.2.4 Protocol Discovery
- 4.2.5 Configuring and Monitoring NBAR Protocol Discovery
- 4.2.6 Configuring NBAR for Static Protocols
- 4.2.7 Configuring Stateful NBAR for Dynamic Protocols

4.3 Introducing Queuing Implementations
- 4.3.1 Congestion and Queuing
- 4.3.2 Congestion Management - Queuing Algorithms
- 4.3.3 FIFO
- 4.3.4 Priority Queuing
- 4.3.5 Round Robin
- 4.3.6 Router Queuing Components

4.4 Configuring WFQ
- 4.4.1 Weighted Fair Queuing
- 4.4.2 WFQ Architecture and Benefits
- 4.4.3 WFQ Classification
- 4.4.4 WFQ Insertion and Drop Policy
- 4.4.5 Benefits and Drawbacks of WFQ
- 4.4.6 Configuring WFQ
- 4.4.7 Monitoring WFQ

4.5 Configuring CBWFQ and LLQ
- 4.5.1 Combining Queuing Methods
- 4.5.2 Class-Based Weighted Fair Queuing
- 4.5.3 CBWFQ Architecture, Classification and Scheduling
- 4.5.4 Configuring and Monitoring CBWFQ

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4.5.5 Low Latency Queuing
4.5.6 LLQ Architecture and Benefits
4.5.7 Configuring and Monitoring LLQ

4.6 Congestion Avoidance
4.6.1 Managing Interface Congestion with Tail Drop
4.6.2 Tail Drop Limitations
4.6.3 Using Random Early Detection
4.6.4 Weighted Random Early Detection
4.6.5 WRED Drop Profiles
4.6.6 Configuring CBWRED
4.6.7 WRED Profiles: DSCP-Based WRED (AF)
4.6.8 Monitoring CBWRED

4.7 Introducing Traffic Policing and Shaping
4.7.1 Traffic Policing and Shaping Overview
4.7.2 Why Use Traffic Conditioners?
4.7.3 Policing vs. Shaping
4.7.4 Measuring Traffic Rates with Tokens
4.7.5 Single Token Bucket Class-Based Policing
4.7.6 Cisco IOS Traffic Policing and Shaping Mechanisms
4.7.7 Applying Traffic Policing

4.8 Understanding WAN Link Efficiency Mechanisms
4.8.1 Link Efficiency Mechanisms
4.8.2 Compression Overview
4.8.3 Layer 2 Payload Compression
4.8.4 Header Compression
4.8.5 Large Packets “Freeze Out” Voice on Slow WAN Links
4.8.6 Link Fragmentation and Interleaving
4.8.7 Applying Link Efficiency Mechanisms

4.9 Implementing QoS Preclassify
4.9.1 Virtual Private Networks
4.9.2 Implementing QoS with Preclassification
4.9.3 QoS Preclassify Applications
4.9.4 QoS Preclassification Deployment Options

4.10 Deploying End-to-End QoS
4.10.1 QoS SLAs
4.10.2 Typical SLA Requirements for Voice
4.10.3 Deploying End-to-End QoS
4.10.4 Enterprise Campus QoS Implementations
4.10.5 WAN Edge QoS Implementations
4.10.6 WAN Edge Design

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4.10.7 Control Plane Policing?

4.11 DiffServ QoS Lab Exercises
4.11.1 Lab 4.1 Default Queuing Tools
4.11.2 Lab 4.2 Intermediate Queuing Tools
4.11.3 Lab 4.3 TCP Header Compression
4.11.4 Lab 4.4 Comparing Queuing Strategies
4.11.5 Lab 4.5 Class-based Queuing and NBAR
4.11.6 Lab 4.6 Class-based Marking, Shaping, and Policing
4.11.7 Lab 4.7 WAN QoS Tools
4.11.8 Lab 4.8 Shaping and Policing
4.11.9 Lab 4.9 QoS Pre-classify

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Module 5: Implement Cisco AutoQoS

Module Overview
5.1 Introducing Cisco AutoQoS
5.1.1 Cisco AutoQoS
5.1.2 Cisco AutoQoS Evolution
5.1.3 Deploying Cisco AutoQoS on Switches
5.1.4 Cisco AutoQoS for the Enterprise: Router Deployment Restrictions
5.1.5 Router Design Considerations
5.1.6 Router Prerequisites
5.1.7 Deploying Cisco AutoQoS for the Enterprise on Routers: A Two-Step Approach
5.1.8 Verifying Cisco AutoQoS

5.2 Mitigating Common Cisco AutoQoS Issues
5.2.1 Automation with Cisco AutoQoS
5.2.2 DiffServ QoS Mechanisms Enabled by Cisco AutoQoS
5.2.3 Automated Cisco AutoQoS DiffServ Class Provisioning
5.2.4 Common Issues with Cisco AutoQoS
5.2.5 Interpreting Cisco AutoQoS Configurations
5.2.6 Modifying the Active Cisco AutoQoS Configuration with MQC
5.2.7 Modifying AutoQoS Generated Policy with MQC

5.3 AutoQoS Lab Exercises
5.3.1 Lab 5.1 AutoQoS

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Module 6: Implement Wireless Scalability

Module Overview

6.1 Implementing WLAN QoS
- 6.1.1 A Standard for WLAN QoS
- 6.1.2 WLAN QoS Description
- 6.1.3 WLAN QoS RF Backoff Timing
- 6.1.4 Lightweight Access Point—Split MAC Architecture
- 6.1.5 WLAN QoS Challenges
- 6.1.6 WLAN QoS Implementation
- 6.1.7 Packet Tagging
- 6.1.8 WLAN QoS Configuration

6.2 Introducing Wireless Security
- 6.2.1 The Need for WLAN Security
- 6.2.2 802.11 WEP
- 6.2.3 WLAN Authentication
- 6.2.4 Cisco Enhanced 802.11 WEP Security
- 6.2.5 802.1x Overview
- 6.2.6 LEAP
- 6.2.7 EAP-FAST
- 6.2.8 EAP-TLS
- 6.2.9 PEAP
- 6.2.10 Wi-Fi Protected Access
- 6.2.11 WPA Issues

6.3 Managing WLANs
- 6.3.1 Cisco Unified Wireless Network
- 6.3.2 Cisco WLAN Implementation and Components
- 6.3.3 CiscoWorks WLSE for the Autonomous WLAN Solution
- 6.3.4 Simplified CiscoWorks WLSE Express Setup
- 6.3.5 CiscoWorks WLSE Benefits
- 6.3.6 Cisco WCS for the LWLAN Solution
- 6.3.7 Cisco WCS Software Features
- 6.3.8 Cisco WCS User Interface
- 6.3.9 Cisco Wireless Location Appliance

6.4 Deploying Cisco WCS
- 6.4.1 Cisco WCS Configuration Example
- 6.4.2 Adding a Cisco Wireless LAN Controller to Cisco WCS
- 6.4.3 Configuring a Cisco Access Point
- 6.4.4 Adding a Campus Map to the Cisco WCS Database
- 6.4.5 Adding New Building to the Cisco WCS Database
- 6.4.6 Rogue Access Point Detection
- 6.4.7 Rogue Access Point Location

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6.5 Configuring Encryption and Authentication on Lightweight Access Points
- 6.5.1 Configuring Open Authentication
- 6.5.2 Configuring Static WEP Key Authentication
- 6.5.3 Configuring WPA Preshared Key
- 6.5.4 Configuring Web Authentication
- 6.5.5 Customizing the Web Login Page
- 6.5.6 Configuring 802.1x Authentication
- 6.5.7 Configuring WPA with 802.1x
- 6.5.8 WPA2

6.6 WLAN Lab Exercises
- 6.6.1 Lab 6.1 Configuring a WLAN Controller
- 6.6.2 Lab 6.2 Configuring a WLAN Controller via the Web Interface
- 6.6.3 Lab 6.3 Configuring a Wireless Client
- 6.6.4 Lab 6.4 Configuring WPA Security with Preshared Keys
- 6.6.5 Lab 6.5 Configuring LEAP

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Case Studies

Case Study 1: QoS and MLPPP

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