Contents at a Glance

Introduction

Part I Wireless LANs

Chapter 1 Fundamentals of Wireless Networks

Chapter 2 Analyzing Cisco Wireless Architectures

Chapter 3 Securing Wireless Networks

Chapter 4 Building a Wireless LAN

Part I Review

Part II IP Access Control Lists

Chapter 5 Introduction to TCP/IP Transport and Applications

Chapter 6 Basic IPv4 Access Control Lists

Chapter 7 Named and Extended IP ACLs

Chapter 8 Applied IP ACLs

Part II Review

Part III Security Services

Chapter 9 Security Architectures

Chapter 10 Securing Network Devices

Chapter 11 Implementing Switch Port Security

Chapter 12 DHCP Snooping and ARP Inspection

Part III Review

Part IV IP Services

Chapter 13 Device Management Protocols

Chapter 14 Network Address Translation

Chapter 15 Quality of Service (QoS)

Chapter 16 First Hop Redundancy Protocols

Chapter 17 SNMP, FTP, and TFTP

Part IV Review

Part V Network Architecture

Chapter 18 LAN Architecture

Chapter 19 WAN Architecture

Chapter 20 Cloud Architecture

Part V Review

Part VI Network Automation

Chapter 21 Introduction to Controller-Based Networking

Chapter 22 Cisco Software-Defined Access (Cisco SD-Access)

Chapter 23 Understanding REST and JSON

Chapter 24 Understanding Ansible and Terraform

Part VI Review

Part VII Exam Updates and Final Review

Chapter 25 *CCNA 200-301 Official Cert Guide, Volume 2*, Second Edition, Exam Updates

Chapter 26 Final Review

Part VIII Print Appendixes

Appendix A Numeric Reference Tables

Appendix B Exam Topics Cross-Reference

Appendix C Answers to the “Do I Know This Already?” Quizzes

Glossary

Index

Online Appendixes

Appendix D Topics from Previous Editions

Appendix E Practice for Chapter 6: Basic IPv4 Access Control Lists

Appendix F Study Planner

Glossary

Reader Services

To access additional content for this book, simply register your product. To start the registration process, go to www.ciscopress.com/register and log in or create an account.* Enter the product ISBN 9780138214951 and click **Submit**. After the process is complete, you will find any available bonus content under Registered Products.

*Be sure to check the box that you would like to hear from us to receive exclusive discounts on future editions of this product.

Contents

Introduction

Part I Wireless LANs

Chapter 1 Fundamentals of Wireless Networks

"Do I Know This Already?" Quiz

Foundation Topics

Comparing Wired and Wireless Networks

Wireless LAN Topologies

Basic Service Set

Distribution System

Extended Service Set

Independent Basic Service Set

Other Wireless Topologies

Repeater

Workgroup Bridge

Outdoor Bridge

Mesh Network

Wireless Bands and Channels

Chapter Review

Chapter 2 Analyzing Cisco Wireless Architectures

"Do I Know This Already?" Quiz

Foundation Topics

Autonomous AP Architecture

Cloud-based AP Architecture

Split-MAC Architectures
Comparing Cisco Wireless LAN Controller Deployments
Cisco AP Modes
FlexConnect Mode
Chapter Review

Chapter 3 Securing Wireless Networks

"Do I Know This Already?" Quiz
Foundation Topics
Anatomy of a Secure Connection
Authentication
Message Privacy
Message Integrity
Wireless Client Authentication Methods
Open Authentication
WEP
802.1x/EAP
LEAP
EAP-FAST
PEAP
EAP-TLS
Wireless Privacy and Integrity Methods
TKIP
CCMP
GCMP
WPA, WPA2, and WPA3
Chapter Review

Chapter 4 Building a Wireless LAN

"Do I Know This Already?" Quiz

Foundation Topics
Connecting a Cisco AP
Accessing a Cisco WLC
Connecting a Cisco WLC
WLC Physical Ports
Configuring a WLAN
Configuring a WLAN on an IOS-XE WLC
Step 1: Configure a WLAN Profile
Step 2: Configure a Policy Profile
Step 3: Map the WLAN and Policy Profiles to a Policy Tag
Step 4: Apply the Policy Tag to Some APs
Configuring a WLAN on an AireOS WLC
Step 1: Create a Dynamic Interface
Step 2: Create a New WLAN
Step 3: Configure the WLAN
Configuring WLAN Security
Configuring WLAN QoS
Configuring Advanced WLAN Settings
Finalizing WLAN Configuration
Chapter Review

Part I Review

Part II IP Access Control Lists

Chapter 5 Introduction to TCP/IP Transport and Applications

"Do I Know This Already?" Quiz
Foundation Topics

TCP/IP Layer 4 Protocols: TCP and UDP
Transmission Control Protocol
Multiplexing Using TCP Port Numbers
Popular TCP/IP Applications
Connection Establishment and Termination
Error Recovery and Reliability
Flow Control Using Windowing
User Datagram Protocol
TCP/IP Applications
Uniform Resource Identifiers
Finding the Web Server Using DNS
Transferring Files with HTTP
How the Receiving Host Identifies the Correct Receiving Application
HTTP Versions
HTTP 1.0 and 1.1
HTTP/2 and TLS
HTTP 3.0
Chapter Review

Chapter 6 Basic IPv4 Access Control Lists

"Do I Know This Already?" Quiz
Foundation Topics
IPv4 Access Control List Basics
ACL Location and Direction
Matching Packets
Taking Action When a Match Occurs
Types of IP ACLs
Standard Numbered IPv4 ACLs

List Logic with IP ACLs
Matching Logic and Command Syntax
Matching the Exact IP Address
Matching a Subset of the Address with Wildcard Masks
Binary Wildcard Masks
Finding the Right Wildcard Mask to Match a Subnet
Matching Any/All Addresses
Implementing Standard IP ACLs
Standard Numbered ACL Scenario 1
Standard Numbered ACL Scenario 2
Troubleshooting and Verification Tips
Practice Applying Standard IP ACLs
Practice Building access-list Commands
Reverse Engineering from ACL to Address Range
Chapter Review

Chapter 7 Named and Extended IP ACLs

"Do I Know This Already?" Quiz
Foundation Topics
Named ACLs and ACL Editing
Named IP Access Lists
Editing ACLs
Editing Named ACLs
Editing Numbered ACLs
Extended IP Access Control Lists
Matching the Protocol, Source IP, and Destination IP

Matching TCP and UDP Port Numbers
Extended IP ACL Configuration
Extended IP ACL Example 1: Packets to Web Servers
Extended IP ACL Example 2: Packets from Web Servers
Adjusting ACLs for HTTP/3
Practice Building access-list Commands
ACL Implementation Considerations
Chapter Review

Chapter 8 Applied IP ACLs

"Do I Know This Already?" Quiz
Foundation Topics
ACLs and Network Infrastructure Protocols
Filtering DNS
Filtering ICMP
Filtering OSPF
Filtering DHCP
Filtering SSH and Telnet
Filtering for End User SSH/Telnet
Filtering for Router VTY Access
Comparing ACLs in IOS and IOS XE
Configuration Syntax and Show Commands
Resequencing ACL Sequence Numbers
Using a Second (Common) Interface ACL
Matching Multiple Nonconsecutive Ports with eq
Chapter Review

Part II Review

Part III Security Services

Chapter 9 Security Architectures

"Do I Know This Already?" Quiz

Foundation Topics

Security Terminology

Common Security Threats

Attacks That Spoof Addresses

Denial-of-Service Attacks

Reflection and Amplification Attacks

Man-in-the-Middle Attacks

Address Spoofing Attack Summary

Reconnaissance Attacks

Buffer Overflow Attacks

Malware

Human Vulnerabilities

Password Vulnerabilities

Password Alternatives

Controlling and Monitoring User Access

Developing a Security Program to Educate Users

Chapter Review

Chapter 10 Securing Network Devices

"Do I Know This Already?" Quiz

Foundation Topics

Securing IOS Passwords

Encrypting Older IOS Passwords with service password-encryption

Encoding the Enable Passwords with Hashes

Interactions Between Enable Password and Enable Secret

Making the Enable Secret Truly Secret with a Hash

Improved Hashes for Cisco's Enable Secret

Encoding the Passwords for Local Usernames

Firewalls and Intrusion Prevention Systems

Traditional Firewalls

Security Zones

Intrusion Prevention Systems (IPS)

Cisco Next-Generation Firewalls

Cisco Next-Generation IPS

Chapter Review

Chapter 11 Implementing Switch Port Security

"Do I Know This Already?" Quiz

Foundation Topics

Port Security Concepts and Configuration

Configuring Port Security

Verifying Port Security

Port Security MAC Addresses

Port Security Violation Modes

Port Security Shutdown Mode

Port Security Protect and Restrict Modes

Chapter Review

Chapter 12 DHCP Snooping and ARP Inspection

"Do I Know This Already?" Quiz

Foundation Topics

DHCP Snooping

DHCP Snooping Concepts

A Sample Attack: A Spurious DHCP Server

DHCP Snooping Logic

Filtering DISCOVER Messages Based on MAC Address

Filtering Messages That Release IP Addresses

DHCP Snooping Configuration

Configuring DHCP Snooping on a Layer 2 Switch

Limiting DHCP Message Rates

DHCP Snooping Configuration Summary

Dynamic ARP Inspection

DAI Concepts

Review of Normal IP ARP

Gratuitous ARP as an Attack Vector

Dynamic ARP Inspection Logic

Dynamic ARP Inspection Configuration

Configuring ARP Inspection on a Layer 2 Switch

Limiting DAI Message Rates

Configuring Optional DAI Message Checks

IP ARP Inspection Configuration Summary

Chapter Review

Part III Review

Part IV IP Services

Chapter 13 Device Management Protocols

"Do I Know This Already?" Quiz

Foundation Topics

System Message Logging (Syslog)

Sending Messages in Real Time to Current Users

Storing Log Messages for Later Review

Log Message Format

Log Message Severity Levels

Configuring and Verifying System Logging

The debug Command and Log Messages

Network Time Protocol (NTP)

Setting the Time and Time Zone

Basic NTP Configuration

NTP Reference Clock and Stratum

Analyzing Topology Using CDP and LLDP

Examining Information Learned by CDP

Configuring and Verifying CDP

Examining Information Learned by LLDP

Configuring and Verifying LLDP

LLDP-MED and TLVs

Chapter Review

Chapter 14 Network Address Translation

"Do I Know This Already?" Quiz

Foundation Topics

Network Address Translation Concepts

IPv4 Address Conservation with NAT

Inside Source NAT

Static NAT

Inside Local and Inside Global Addresses
Dynamic NAT
Overloading NAT with Port Address Translation
NAT Configuration and Troubleshooting
Static NAT Configuration
Dynamic NAT Configuration
Dynamic NAT Verification
NAT Overload (PAT) Configuration
NAT Troubleshooting
Chapter Review

Chapter 15 Quality of Service (QoS)
"Do I Know This Already?" Quiz
Foundation Topics
Introduction to QoS
QoS: Managing Bandwidth, Delay, Jitter, and Loss
Types of Traffic
Data Applications
Voice and Video Applications
QoS as Mentioned in This Book
QoS on Switches and Routers
Classification and Marking
Classification Basics
Matching (Classification) Basics
Classification on Routers with ACLs and NBAR
Marking IP DSCP and Ethernet CoS
Marking the IP Header
Marking the Ethernet 802.1Q Header
Other Marking Fields

Defining Trust Boundaries
DiffServ Suggested Marking Values
Expedited Forwarding (EF)
Assured Forwarding (AF)
Class Selector (CS)
Guidelines for DSCP Marking Values
Queuing
Round-Robin Scheduling (Prioritization)
Low Latency Queuing
A Prioritization Strategy for Data, Voice, and Video
Shaping and Policing
Policing
Where to Use Policing
Shaping
Setting a Good Shaping Time Interval for Voice and Video
Congestion Avoidance
TCP Windowing Basics
Congestion Avoidance Tools
Chapter Review

Chapter 16 First Hop Redundancy Protocols

"Do I Know This Already?" Quiz
Foundation Topics
First Hop Redundancy Protocols
The Need for Redundancy in Networks
The Need for a First Hop Redundancy Protocol
The Three Solutions for First-Hop Redundancy
Hot Standby Router Protocol

HSRP Virtual IP and MAC Addresses
HSRP Failover
HSRP Load Balancing
HSRP Interface Tracking
HSRP Recovery and Preemption
HSRP Versions
VRRP and GLBP Concepts
Virtual Router Redundancy Protocol (VRRP)
GLBP Concepts
Similarities of GLBP, HSRP, and VRRP
GLBP Active/Active Load Balancing
Chapter Review

Chapter 17 SNMP, FTP, and TFTP

"Do I Know This Already?" Quiz
Foundation Topics
Simple Network Management Protocol
SNMP Variable Reading and Writing: SNMP Get and Set
SNMP Notifications: Traps and Informs
The Management Information Base
Securing SNMP
FTP and TFTP
Managing Cisco IOS Images with FTP/TFTP
The IOS File System
Upgrading IOS Images
Copying a New IOS Image to a Local IOS File System Using TFTP
Listing the Files in the IOS File System

Verifying IOS Code Integrity with MD5 or SHA512
Copying Images with FTP
The FTP and TFTP Protocols
FTP Protocol Basics
FTP Active and Passive Modes
TFTP Protocol Basics
Chapter Review

Part IV Review

Part V Network Architecture

Chapter 18 LAN Architecture
"Do I Know This Already?" Quiz
Foundation Topics
Analyzing Campus LAN Topologies
Two-Tier Campus Design (Collapsed Core)
Three-Tier Campus Design (Core)
Topology Design Terminology
Ethernet Physical Media and Standards
Ethernet UTP Links at the Access Layer
Multigig Ethernet on CAT 5E Cabling
Fiber Uplinks
Small Office/Home Office
Power over Ethernet (PoE)
PoE Basics
PoE Operation
PoE and LAN Design
Chapter Review

Chapter 19 WAN Architecture

"Do I Know This Already?" Quiz

Foundation Topics

Metro Ethernet

Metro Ethernet Physical Design and Topology

Ethernet WAN Services and Topologies

Ethernet Line Service (Point-to-Point)

Ethernet LAN Service (Full Mesh)

Layer 3 Design Using Metro Ethernet

Layer 3 Design with E-Line Service

Layer 3 Design with E-LAN Service

Multiprotocol Label Switching (MPLS)

MPLS VPN Physical Design and Topology

Layer 3 with MPLS VPN

Internet VPNs

Internet Access

Digital Subscriber Line

Cable Internet

Wireless WAN (4G, 5G)

Fiber (Ethernet) Internet Access

Internet VPN Fundamentals

Site-to-Site VPNs with IPsec

Remote Access VPNs with IPsec

Remote Access VPNs with TLS

Chapter Review

Chapter 20 Cloud Architecture

"Do I Know This Already?" Quiz

Foundation Topics

Server Virtualization

Cisco Server Hardware
Server Virtualization and Virtual Machine Basics
Networking with Virtual Switches on a Virtualized Host
Software Containers
The Physical Data Center Network
Workflow with a Virtualized Data Center
Cloud Computing Services
Private Cloud (On-Premise)
Public Cloud
Cloud and the "As a Service" Model
Infrastructure as a Service
Software as a Service
(Development) Platform as a Service
Virtual Routing and Forwarding (VRF) Instances
WAN Traffic Paths to Reach Cloud Services
Enterprise WAN Connections to Public Cloud
Accessing Public Cloud Services Using the Internet
Pros and Cons with Connecting to Public Cloud with Internet
Private WAN and Internet VPN Access to Public Cloud
Pros and Cons of Connecting to Cloud with Private WANs
Intercloud Exchanges
Summarizing the Pros and Cons of Public Cloud WAN Options
Understanding Cloud Management

Chapter Review

Part V Review

Part VI Network Automation

Chapter 21 Introduction to Controller-Based Networking

"Do I Know This Already?" Quiz

Foundation Topics

SDN and Controller-Based Networks

The Data, Control, and Management Planes

The Data Plane

The Control Plane

The Management Plane

Cisco Switch Data Plane Internals

Controllers and Software Defined Architecture

Controllers and Centralized Control

The Southbound Interface

The Northbound Interface

Software Defined Architecture Summary

Examples of Network Programmability and SDN

OpenDaylight and OpenFlow

The OpenDaylight Controller

The Cisco Open SDN Controller (OSC)

Cisco Application Centric Infrastructure (ACI)

ACI Physical Design: Spine and Leaf

ACI Operating Model with Intent-Based Networking

Summary of the SDN Examples

Comparing Traditional Versus Controller-Based Networks

How Automation Impacts Network Management

Comparing Traditional Networks with Controller-Based Networks

Chapter Review

Chapter 22 Cisco Software-Defined Access (Cisco SD-Access)

"Do I Know This Already?" Quiz

Foundation Topics

Cisco SD-Access Fabric, Underlay, and Overlay

The Cisco SD-Access Underlay

Using Existing Gear for the Cisco SD-Access Underlay

Using New Gear for the Cisco SD-Access Underlay

The Cisco SD-Access Overlay

VXLAN Tunnels in the Overlay (Data Plane)

LISP for Overlay Discovery and Location (Control Plane)

Cisco Catalyst Center and Cisco SD-Access Operation

Cisco Catalyst Center

Cisco Catalyst Center and Scalable Groups

Issues with Traditional IP-Based Security

Cisco SD-Access Security Is Based on User Groups

Cisco Catalyst Center as a Network Management Platform

Cisco Catalyst Center Similarities to Traditional Management
Cisco Catalyst Center and Differences with Traditional Management
Artificial Intelligence (AI), Machine Learning (ML), and Operational Management
Chapter Review

Chapter 23 Understanding REST and JSON

"Do I Know This Already?" Quiz
Foundation Topics
REST-Based APIs
REST-Based (RESTful) APIs
Client/Server Architecture
Stateless Operation
Cacheable (or Not)
Background: Data and Variables
Simple Variables
List and Dictionary Variables
REST APIs and HTTP
Software CRUD Actions and HTTP Verbs
Using URIs with HTTP to Specify the Resource
Example of REST API Call to Cisco Catalyst Center
Data Serialization and JSON
The Need for a Data Model with APIs
Data Serialization Languages
JSON
XML

YAML
Summary of Data Serialization
Recognizing the Components of JSON
Interpreting JSON Key:Value Pairs
Interpreting JSON Objects and Arrays
Minified and Beautified JSON
Chapter Review

Chapter 24 Understanding Ansible and Terraform

"Do I Know This Already?" Quiz
Foundation Topics
Device Configuration Challenges and Solutions
Configuration Drift
Centralized Configuration Files and Version Control
Configuration Monitoring and Enforcement
Configuration Provisioning
Configuration Templates and Variables
Files That Control Configuration Automation
Ansible and Terraform Basics
Ansible
Terraform
Summary of Configuration Management Tools
Chapter Review

Part VI Review

Part VII Exam Updates and Final Review

Chapter 25 *CCNA 200-301 Official Cert Guide, Volume 2,* Second Edition, Exam Updates

The Purpose of This Chapter

Additional Technical Content

Official Blueprint Changes

Impact on You and Your Study Plan

News About the Next CCNA Exam Release

Updated Technical Content

Chapter 26 Final Review

Advice About the Exam Event

Learn About Question Types

Think About Your Time Budget

An Example Time-Check Method

One Week Before Your Exam

24 Hours Before Your Exam

30 Minutes Before Your Exam

The Hour After Your Exam

Exam Review

Using Practice Questions

Hold Practice Exam Events

Exam Scoring on the Real Exam

Self-Assessment Suggestions

Gap Analysis Using Q&A

Advice on How to Answer Exam Questions

Additional Exams with the Premium Edition

Practicing CLI Skills

Adjustments for Your Second Attempt

Other Study Tasks

Final Thoughts

Part VIII Print Appendixes

Appendix A Numeric Reference Tables

Appendix B Exam Topics Cross-Reference

Appendix C Answers to the "Do I Know This Already?" Quizzes

Glossary

Index

Online Appendixes

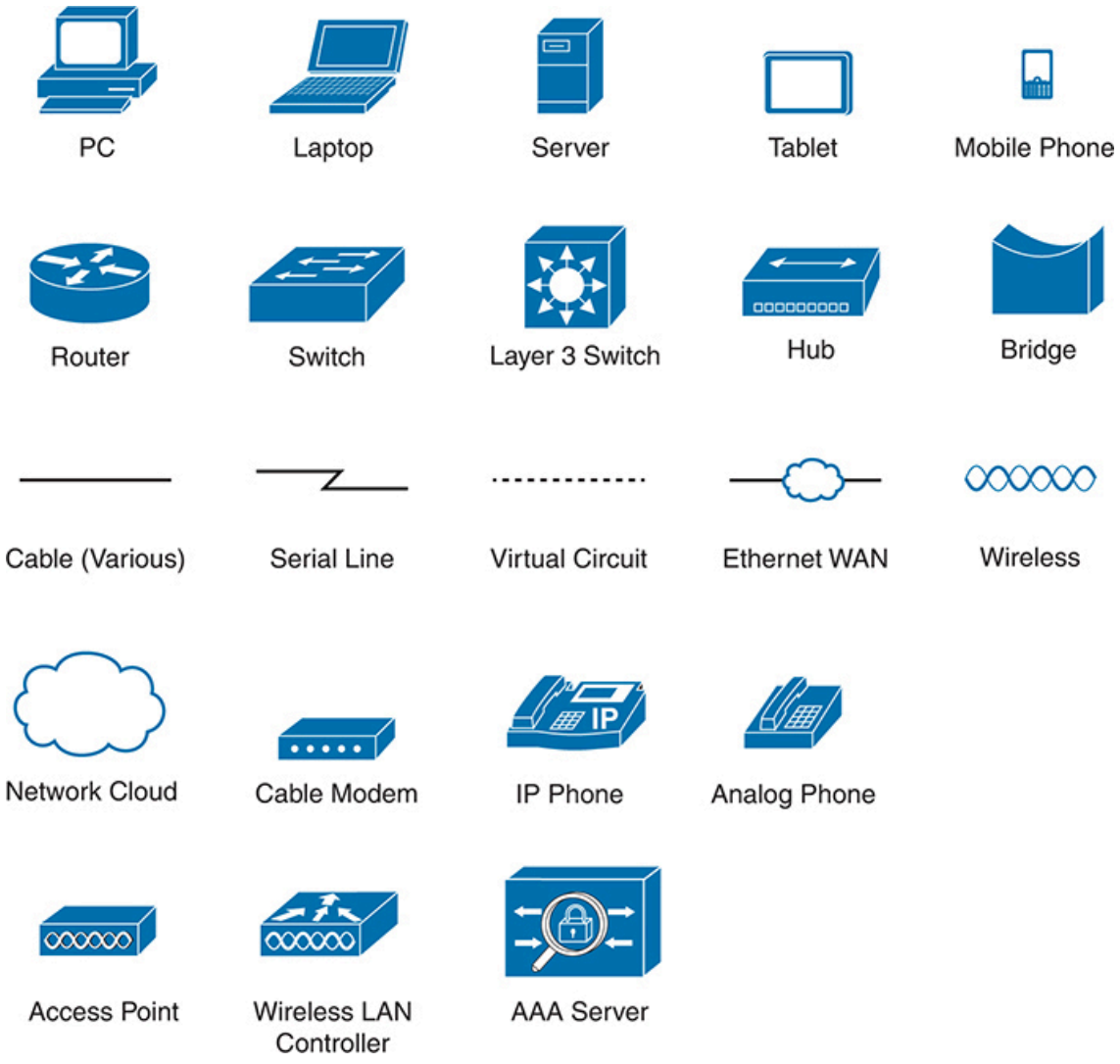
Appendix D Topics from Previous Editions

Appendix E Practice for Chapter 6: Basic IPv4 Access Control Lists

Appendix F Study Planner

Glossary

Icons Used in This Book



Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ([ ]) indicate an optional element.
- Braces ({ }) indicate a required choice.
- Braces within brackets ([{ }]) indicate a required choice within an optional element.