Cisco Systems

Cisco 职业认证培训系列
CISCO CAREER CERTIFICATIONS

ciscopress.com

CCNA

Cisco 网络设备互连
(英文版)

CCNA Self-Study

Interconnecting Cisco Network Devices

Cisco authorized self-study book for
CCNA foundation learning

[美] Steve McQuerry, CCIE No. 6108 编著

人民邮电出版社
POSTS & TELECOMMUNICATIONS PRESS

Cisco 职业认证培训系列

Cisco 网络设备互连

（英 文 版）

Interconnecting Cisco Network Devices

[美] Steve McQuerry，CCIE No.6108 编著

人 民 邮 电 出 版 社

图书在版编目（CIP）数据

Cisco 网络设备互连 /（美）麦夸尼（McQuerny, S.）编著. —北京：人民邮电出版社，2003.4
ISBN 7-115-11190-1

Ⅰ. C... Ⅱ. 麦... Ⅲ. 计算机网络－工程技术人员－资格考核－自学参考资料－英文
Ⅳ. TP393

中国版本图书馆 CIP 数据核字（2003）第 020028 号

版 权 声 明

Original edition, Interconnecting Cisco Network Devices, 1st Edition, 1578701112 by McQuerry, Steven, published by Pearson Education, Inc., publishing as Cisco Press, Copyright © 2000 Cisco Systems,Inc.

All right reserved. No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage retrieval system, without permission from Pearson Education Inc.

English reprint published by Pearson Education North Asia Limited and Posts and Telecommunications Press, Copyright © 2003.

This edition is manufactured in the People's Republic of China, and is authorized for sale and distribution in the People's Republic of China exclusively (except Taiwan, Hong Kong SAR and Macao SAR).

本书封面贴有 Pearson Education（培生教育出版集团）激光防伪标签，无标签者不得销售。

Cisco 职业认证培训系列

Cisco 网络设备互连（英文版）

◆ 编　著　[美] Steve McQuerry, CCIE No.6108
责任编辑　李　岚

◆ 人民邮电出版社出版发行　北京市崇文区夕照寺街 14 号
邮编　100061　电子函件　315@ptpress.com.cn
网址　http://www.ptpress.com.cn
读者热线　010-67132705
北京汉魂图文设计有限公司制作
北京顺义振华印刷厂印刷
新华书店总店北京发行所经销

◆ 开本：800×1000　1/16
印张：35
字数：778 千字　　2003 年 4 月第 1 版
印数：1-4 000 册　　2003 年 4 月北京第 1 次印刷

著作权合同登记　图字：01－2003－1488 号
ISBN 7-115-11190-1/TP・3397

定价：58.00 元

本书如有印装质量问题，请与本社联系　电话：（010）67129223

内容提要

基于同名的 Cisco 全球培训课程，针对 CCNA 考试，本书内容涵盖了 ICND 课程的所有主题。全书分为五大部分：

- Cisco 网络基础，包括设备的装配、布线、操作、配置和管理；
- Catalyst 交换机互连，主要讲述基本交换操作与 VLAN 配置；
- Cisco 路由器互连，包括 TCP/IP、IP 路由、流量管理以及 IPX 配置；
- 将网络扩展成 WAN，包括序列对等连接、ISDN BRI、帧中继 PVC 连接；
- 附录，包括 AppleTalk、超级终端、Cisco700 系列路由器、口令恢复技术。

另外，每章最后配有复习题，帮助你更好地理解关键概念。

本书可以帮助读者顺利通过 Cisco CCNA 认证考试，也可以作为网络互联领域工作的参考书籍。

About the Editor

Steve McQuerry, CCIE No. 6108, is a certified Cisco Systems instructor who works as a contract instructor and consultant throughout the U.S., teaching networking professionals how to configure and integrate Cisco equipment into their networks. Steve also holds CNE, MCSE, MCT, CCNP, and CCNA certifications. He has worked in the networking industry for over 10 years and has experience with multiple protocols in small and large networks, including TCP/IP and IPX. Steve currently teaches the Cisco courses ICND, ACRC, CIT, and CLSC with Global Knowledge.

About the Technical Reviewers

Elan Beer, CCIE No. 1837. As president and founder of Synaptic Solutions Inc., for the past 14 years, Elan has held several key positions within the telecommunications industry, including senior telecommunications consultant, project manager, and telecommunications instructor, as well as Canadian training manager with GeoTrain Corporation, a multinational training and consulting organization. Through his global consulting and training engagements, Elan is recognized internationally as a telecommunications industry expert. Elan's strong technical skills have enabled him to attain several top-level industry certifications.

As one of the first product-based public certified Cisco instructors in the world, Elan has utilized his expertise in multiprotocol internetworking, LAN, WAN, and MAN technology, network management, and software engineering to provide training and consulting services to many of Canada's top companies. As a senior trainer and course developer, Elan has designed and presented intensive public and implementation-specific technical courses for clients in North America, Europe, Australia, Africa, Asia, and Scandinavia.

Shawn Coville, a double CCIE (CCIE No. 4432) in Routing and Switching and ISP-Dial, is a consultant and instructor for Chesapeake Computer Consultants, where he regularly teaches several Cisco router courses, including ICND, ACRC, BCRAN, and MCNS, as well as Check Point Firewall courses. In his consulting position, Shawn has gained extensive, practical experience in the installation and configuration of Cisco routers, PIX Firewall, and Cisco AS5200 access servers. Before joining Chesapeake, Shawn worked as a senior computer specialist for the U.S. Information Agency, where he was responsible for a worldwide Lotus Notes deployment and local-area network support, as well as Internet access installation.

David Hucaby, CCIE No. 4594, is a senior network consultant for The Information Connection, where he provides consulting and troubleshooting services for a variety of clientele. He has extensive design, implementation, and management experience with switched and routed enterprise networks using Cisco Catalyst switches, routers, firewalls, VPNs, and IP telephony products. He has implemented network operations center services for multiple clients. Prior to his current position, David designed, implemented, and maintained networks for the University of Kentucky Hospital using Cisco routers and switches and IBM devices. David has a B.S. and M.S. in Electrical Engineering from the University of Kentucky.

Stephen Wisniewski has a master's degree in telecommunications management from Stevens Institute of Technology. His numerous network certifications include Microsoft MCSE, Novell CNE, Cisco CCNA, and Cisco CCNP. Stephen teaches telecommunications part-time at Devry Institute in North Brunswick, New Jersey, and he travels the world installing Cisco WAN networking implementations for Net2Phone Inc. Stephen resides in East Brunswick, New Jersey, with his wife, Ellen.

此为试读，需要完整PDF请访问：www.ertongbook.com

Dedications

I would like to dedicate this work to Becky, Katie, Logan, and Cameron, for the love, support, and understanding that only a family could offer.

Acknowledgments

I would like to acknowledge all of those who have been instrumental in making this book possible:

Cisco WWT and the course developers: Keith Serrao, Ilona Serrao, Pat Lao, Joe Bagg, Gary Hauser, and Diane Teare.

Everyone at Cisco Press, especially Amy Lewis, Brett Bartow, and Chris Cleveland, for all the patience they showed and guidance they offered during this process.

The technical editors—Elan Beer, Shawn Coville, Dave Hucaby, and Steve Wisniewski—for all their comments and suggestions. Their expertise and sharp eyes have been critical in providing a "sanity check" for me during the editing of this book.

All the students and instructors I have had the pleasure of teaching and working with over the past few years. Your questions, comments, and challenges offered many of the tips, cautions, and questions for this book.

My family, for their patience and understanding during this project and all of my projects.

God, for giving me the skills, talents, and opportunity to work in such a challenging and exciting profession.

Foreword

Interconnecting Cisco Network Devices is a Cisco authorized, self-paced learning tool that helps you understand foundation concepts covered on the Cisco Certified Network Associate (CCNA) exam. This book was developed in cooperation with the Cisco Internet Learning Solutions group, the team within Cisco responsible for the development of the CCNA exam. As an early-stage exam preparation product, this book presents detailed and comprehensive coverage of the tasks that network engineers need to perform to build and support small- to medium-sized networks. Whether you are studying to become CCNA certified or are simply seeking to gain a better understanding of the products, services, and policies that enable you to build multirouter, multigroup Internetworks, you will benefit from the information presented in this book.

Cisco Systems and Cisco Press present this material in text-based format to provide another learning vehicle for our customers and the broader user community in general. Although a publication does not duplicate the instructor-led or e-learning environment, we acknowledge that not everyone responds in the same way to the same delivery mechanism. It is our intent that presenting this material via a Cisco Press publication will enhance the transfer of knowledge to a broad audience of networking professionals.

Cisco Press will present other books in the Certification Self-Study Series on existing and future exams to help achieve Cisco Internet Learning Solutions Group's principal objectives: to educate the Cisco community of networking professionals and to enable that community to build and maintain reliable, scalable networks. The Cisco Career Certifications and classes that support these certifications are directed at meeting these objectives through a disciplined approach to progressive learning.

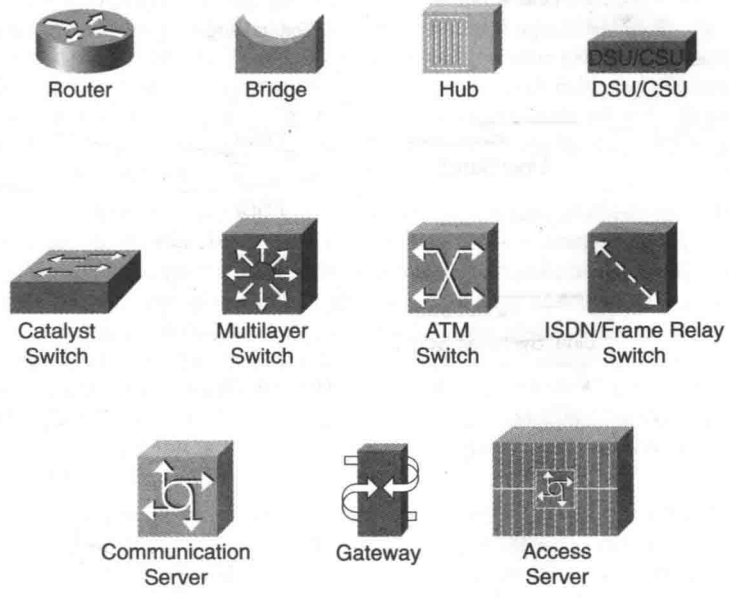
In order to succeed with Cisco Career Certifications and in your daily job as a Cisco certified professional, we recommend a blended learning solution that combines instructor-led training with hands-on experience, e-learning, and self-study training. Cisco Systems has authorized Cisco Learning Partners worldwide, which can provide you with the most highly qualified instruction and invaluable hands-on experience in lab and simulation environments. To learn more about Cisco Learning Partner programs available in your area, please go to www.cisco.com/go/authorizedtraining.

The books Cisco Press creates in partnership with Cisco Systems will meet the same standards for content quality demanded of our courses and certifications. It is our intent that you will find this and subsequent Cisco Press certification self-study publications of value as you build your networking knowledge base.

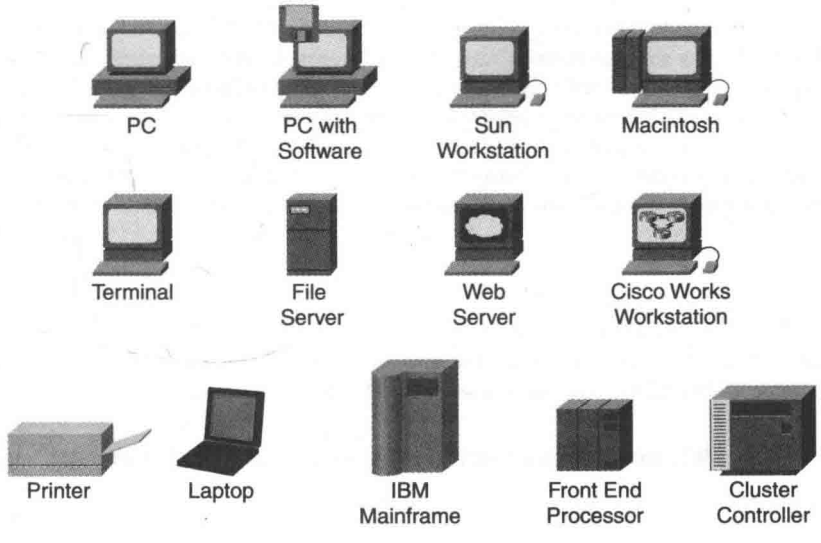
Thomas M. Kelly
Vice-President, Internet Learning Solutions Group
Cisco Systems, Inc.
December 2002

Figure Icons Used in This Book

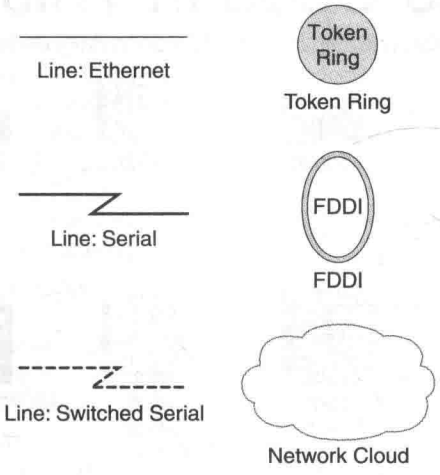
Throughout this book, you will see the following icons used for networking devices:



The following icons are used for peripherals and other devices:



The following icons are used for networks and network connections:



Introduction

Since the introduction of the personal computer in the early 1970s, businesses have found more uses and applications for technology in the workplace. With the introduction of local-area networks, file sharing, and print sharing in the 1980s, it became obvious that distributed computing was no longer a passing fad. By the 1990s, computers became less expensive, and innovations such as the Internet allowed everyone to connect to computer services worldwide. Computing was becoming big and distributed. The days of punch cards and greenbar paper are behind us, and a new generation of computing experts is being asked to keep this distributed technology operational. These experts are destined to have a new set of issues and problems to deal with, the most complex of them being connectivity and compatibility between differing systems and devices.

The primary challenge with data networking today is to link multiple devices' protocols and sites with maximum effectiveness and ease of use for the end users. Of course, this must all be accomplished in a cost-effective way. Cisco Systems offers a variety of products to give network managers and analysts the ability to face and solve the challenges of internetworking. As networking professionals begin working with this equipment to create solutions, they must understand how to use and configure these devices. Cisco Worldwide Training (WWT) develops courses to help networking professionals learn the fundamentals of configuring and installing Cisco products. This book is based on the Cisco WWT course Interconnecting Cisco Network Devices (ICND). ICND is a combination of and replaces two Cisco Courses: CRLS (Cisco Routers and LAN Switches) and ICRC (Introduction to Cisco Router Configuration). It also draws from CLSC (Cisco LAN Switch Configuration). ICND results in a single course that covers Cisco switches and routers in a realistic environment.

This book is based on the course materials. It presents the concepts, commands, and practices required to configure Cisco switches and routers in multiprotocol internetworks. You will find information that will help you identify and recommend the best Cisco solutions for small to medium-sized businesses. You will be introduced to all the basic configuration procedures required to build a multirouter, multigroup internetwork that uses LAN and WAN interfaces for the most commonly used routing and routed protocols. ICND provides the installation and configuration information that technical support people require to install and configure Cisco products.

This is an introductory-level book designed for people who have one to three years of internetworking experience, who are familiar with basic internetworking concepts, and who have some experience with the TCP/IP protocol. This book is useful for those who are pursuing the CCNA (Cisco Certified Networking Associate) certification. Also, network administrators responsible for implementing and managing small and medium-sized business networks might find the information in this book helpful. Network support staff who perform a help desk role in a medium- or enterprise-sized company will find this a valuable resource. Finally, Cisco customers or channel resellers and network technicians entering the internetworking industry who are new to Cisco products can benefit from the contents of this book.

Goals

Readers can expect to gain the knowledge needed to select, connect, and configure Cisco devices. You will learn the structure and terminology of the Cisco IOS (Internetwork Operating System). You will be introduced to the basic concepts of routing and Layer 2 switching, and you will learn how to select and configure Cisco devices to fill these roles in your data networks.

This book also helps you prepare for the CCNA certification, because it covers many of the topics associated with that test.

NOTE Readers interested in the CCNA certification should consult the Cisco web site at http://www.cisco.com/warp/public/10/wwtraining/certprog/lan/programs/ccna.html for more information. To schedule a Cisco certification test, contact Sylvan Prometric at 800 204-EXAM or on the web at www.2test.com.

Chapter Organization

This book is broken up into five parts. This book is designed to be read in order, because many chapters build on content from a previous chapter.

Part I "Getting Started with Cisco Networks," includes chapters that contain an overview of networking and Cisco devices. Chapter 1, "Internetworking Concepts Overview," reviews some basic internetworking concepts. Chapter 2, "Assembling and Cabling Cisco Devices," explores the physical connections needed to assemble network devices. Chapter 3, "Operating and Configuring a Cisco IOS Device," explains the concepts and structure of the Cisco Internetwork Operating System. Chapter 4, "Managing Your Network Environment," discusses topics such as Telnet, configuration file management, and Cisco Discovery Protocol, which help you control and manage network devices.

Part II, "Interconnecting Catalyst Switches," explores the operation and configuration of the Catalyst 1900 switch. Chapter 5, "Catalyst 1900 Switch Operations," discusses basic switch theory, including IEEE 802.1 Spanning-Tree Protocol. This chapter also discusses basic switch configuration. Chapter 6, "Extending Switched Networks with Virtual LANs," explores the theory and operation of virtual LANs and interswitch VLAN configurations. This chapter includes discussions of Inter-Switch Link (ISL) trunking and the Virtual Trunking Protocol (VTP).

Part III, "Interconnecting Cisco Routers," looks at the interconnectivity between networks using Layer 3 protocols such as TCP/IP and IPX. Chapter 7, "Interconnecting Networks with TCP/IP," provides an overview of the TCP/IP protocol suite, including discussions of basic IP subnetting. This chapter also details how to configure IP addresses on your router interfaces. In Chapter 8, "Determining IP Routes," you learn how a router provides connectivity between the different networks in an internetwork. You also learn how routers exchange and maintain routing information using distance vector routing protocols such as the Routing Information Protocol (RIP) and Cisco's Interior Gateway Routing Protocol (IGRP). Chapter 9, "Basic IP Traffic Management with Access Lists," discusses the control of IP traffic. This chapter discusses the need to effectively manage IP traffic in the internetwork and shows you how access lists provide traffic management on Cisco routers. The final chapter in this part, Chapter 10, "Configuring Novell IPX," looks at the operation and configuration of Novell's Internetwork Packet Exchange (IPX) protocol. This chapter discusses IPX addressing, routing, and traffic control.

Part IV, "Extending the Network to WANs," looks beyond the local-area network (LAN) and discusses connecting devices across wide geographic locations. Chapter 11, "Establishing Serial Point-to-Point Connections," provides an overview of wide-area networking (WAN) connectivity. This chapter discusses methods of connecting to remote sites using leased lines with protocols such as PPP (Point-to-Point Protocol) and HDLC (High-Level Data Link Control). This chapter also discusses PPP options such as authentication. In Chapter 12, "Completing an ISDN BRI Call," you learn how to establish a dial-on-demand circuit to a remote site using Integrated Services Digital Network (ISDN) circuits. This chapter shows how this digital technology can be used to provide on-demand access to and from remote sites. Finally, in Chapter 13, "Establishing a Frame Relay PVC Connection," you learn how to connect remote sites through Frame Relay services. This chapter discusses the Frame Relay terminology, concepts, and parameters required to allow connectivity between remote locations.

Part V, "Appendixes," is the final part of this book. It begins with Appendix A, "Configuring AppleTalk," which discusses addressing, routing, and configuring routers connected to an AppleTalk network. Appendix B, "Establishing

此为试读,需要完整PDF请访问: www.ertongbook.com

a HyperTerminal Session," walks you through the process of connecting your router to a PC or laptop for configuration purposes. Appendix C, "Cisco 700 Series Routers," examines the configuration and operation of the Cisco 700 series Small Office/Home Office (SOHO) router. In Appendix D, "Password Recovery," you learn how the configuration register is used to restore administrative control for a router. Finally, Appendix E, "Answers to Review Questions," provides answers to the review questions at the end of each chapter.

Features

This book features actual router and switch output to aid in the discussion of the configuration of these devices. There are also many notes, tips, and cautions spread throughout the text. In addition, you will find many references to standards, documents, books, and web sites that will help you understand networking concepts. At the end of each chapter, your comprehension and knowledge are tested by review questions prepared by a Cisco Certified Systems Instructor.

NOTE The operating systems used in this book are Cisco IOS Version 12.0 for the routers and Cisco Catalyst 1900/2820 Enterprise Edition Software Version V8.01.01 for the switch.

Contents

Part I Getting Started with Cisco Networks 2

Chapter 1 Internetworking Concepts Overview 4

Defining Network Components 5

Mapping Business Needs to a Hierarchical Model 7
- Access Layer 8
- Distribution Layer 9
- Core Layer 9

OSI Reference Model Overview 10
- Upper Layers 10
- Lower Layers 11

Communicating Between OSI Reference Model Layers 12

Physical Layer Functions 14
- Physical Media and Connectors 15
- Collision/Broadcast Domains 16

Data Link Layer Functions 18
- MAC Sublayer Frames 19
- LLC Sublayer Frames 20
- Data Link Layer Devices 21

Network Layer Functions 24
- Network Layer Addresses 24
- Router Operation at the Network Layer 26

Transport Layer Functions 28

OSI Lower Layer Review 30

Selecting Cisco Products 32
- Cisco Hub Products 34
- Catalyst Switch Products 35
- Cisco Router Products 36

Summary 38

Review Questions 38

Chapter 2 Assembling and Cabling Cisco Devices 40

Cabling the LAN 41
- LAN Physical Layer Implementations 43
- Positioning Ethernet in the Campus 44

Comparing Ethernet Media Requirements 45
Differentiating Between Connections 46
UTP Implementation 47
Cabling the Campus 52

Cabling the WAN 53
WAN Physical Layer Implementations 55
Differentiating Between WAN Serial Connections 55
Cabling Routers for Serial Connections 57
Cabling Routers for ISDN BRI Connections 62

Setting Up Console Connections to Cisco Devices 64

Summary 65

Review Questions 65

Chapter 3 Operating and Configuring a Cisco IOS Device 66

Basic Operation of Cisco IOS Software 67
Operations upon Router/Switch Startup 68
Router/Switch Configuration Locations 68
IOS Command Modes 69

What Happens When You Start a Switch 70
Catalyst Switch Status LEDs 71
Logging On to a 1900 Switch After Startup 74

Keyboard Help in Switch Command-Line Interface 75
Context-Sensitive Help for Switches 76
Console Error Messages for Switches 77
Command History Buffer for Switches 77

Commands to Get Basic Switch Information 78
show version Command 78
show running-configuration Command 79
show interfaces Command 80
show ip Command 82

Configuring the Switch from the Command Line 82

What Happens When You Start a Router 83
Initial Router Configuration 84
Modifying Router Configuration 89

Keyboard Help in Router Command-Line Interface 91
Context-Sensitive Help for Routers 92
Console Error Messages for Routers 92
Command History Buffer for Routers 93

Using CLI Help Features Example 94
Enhanced Editing Mode: Editing Key Functions 96

Commands to Get Basic Router Information 98
show version Command 98
show running-configuration and **show startup-configuration** Commands 98

Configuring a Router from the Command Line 99
Additional Useful Console Commands 104
Configuring Router Interfaces 104

Summary 110

Review Questions 110

Chapter 4 Managing Your Network Environment 112

Getting Information About Neighboring Devices 113
Displaying General Information About Neighboring Devices 115
Displaying CDP Information About a Device 115
Displaying CDP Information About Neighboring Devices 116
Displaying Detailed CDP Information About Neighboring Devices 118
Displaying Information About Device Traffic 119
Displaying Configuration Information and Interface Status for a Device 120

Getting Information About Remote Devices 120
Establishing a Telnet Session to a Remote Device 120
Verifying and Displaying Active Telnet Sessions 121
Suspending, Re-Establishing, and Ending Active Telnet Sessions 122

Documenting the Network with the ping and traceroute Commands 123

Router Booting Sequence and Verification Commands 124
Router Booting Sequence 124
Router Components 125
ROM Microcode 126
Loading/Running the Router Configuration 131
Managing Router Configurations with copy Commands 132
IOS File System 135
Moving/Managing Router Configuration Files 136

Managing IOS Images 137
Backing Up Your IOS Image File 138
Loading a New IOS Image File from the Network Server 139

Summary 140

Review Questions 140

Part II Interconnecting Catalyst Switches 142

Chapter 5 Catalyst 1900 Switch Operations 144

Basic Layer 2 Switching (Bridging) Technologies 145
- The Address Learning Function 146
- Forward/Filter Decision 148
- Loop Avoidance 150
- How Spanning Tree Works 155
- How Devices Stay Informed About the Topology 161

Catalyst Switch Technology 162
- How Frames Are Transmitted 162
- How the Switch Talks to Other Devices 163

Configuring the Catalyst 1900 Switch 165
- Default Configuration Settings for the Catalyst 1900 Switch 165
- Default Port Configurations for the Catalyst 1900 Switch 166
- Configuration Modes for the Catalyst 1900 Switch 167
- Configuring the IP Address, Subnet Mask, and Default Gateway on the Catalyst 1900 Switch 167
- Configuring the Duplex Mode for a Catalyst 1900 Switch Interface 168
- MAC Addresses and Catalyst 1900 Switch Port Interfaces 170
- Displaying Switch IOS Information 174
- Managing Switch Configuration Files 175

Catalyst 1900 Switch Command Summary 176

Summary 177

Review Questions 177

Chapter 6 Extending Switched Networks with Virtual LANs 178

VLAN Concepts 182
- How VLANs Operate 183
- VLAN Membership Modes 184

Inter-Switch Links 185
- ISL Tagging 186
- ISL Encapsulation 187

VLAN Trunking Protocol 188
- VTP Modes 189
- How VTP Works 191
- VTP Pruning 192

VLAN Configuration 193
- VLAN Configuration Guidelines 194

VLAN Configuration Steps 194
VTP Configuration Guidelines 195
Configuring VTP 195
Adding a VLAN 197
Verifying a VLAN/Modifying VLAN Parameters 197
Assigning Ports to a VLAN 198
Displaying Spanning-Tree Protocol Configuration Status 199

VLAN Command Summary 200

Summary 200

Review Questions 201

Part III Interconnecting Cisco Routers 202

Chapter 7 Interconnecting Networks with TCP/IP 204

TCP/IP Application Layer Overview 206

TCP/IP Transport Layer Overview 206
TCP/UDP Header Format 207
How TCP and UDP Use Port Numbers 209
Establishing a TCP Connection: The Three-Way Handshake 211
Flow Control for TCP/UDP 213

TCP/IP Internet Layer Overview 215
IP 215
Internet Control Message Protocol 217
Address Resolution Protocol 218
Reverse Address Resolution Protocol 219

TCP/IP Address Overview 220
IP Address Classes 222
Host Addresses 224
Subnet Addresses 226
Subnet Masks 227
Broadcasts 231
Identifying IP Addresses 233
Subnet Planning 235

Configuring IP Addresses 237
Assigning Switch Logical Network Addresses and Default Gateways 237
Assigning Router Interface Logical Network Addresses 237
Specifying the Subnet Mask Format 238
Assigning Host Names to IP Addresses 238
Defining Name Servers 239
Displaying Host Names and Addresses 240

此为试读,需要完整PDF请访问: www.ertongbook.com