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INTRODUCTION

This book differs from most other books on TCP/IP because it focuses on how to implement the TCP/IP protocols using the most prevalent TCP/IP routing device in use today, the Cisco router. The book provides detailed descriptions, examples, and configurations that can be used for building real-world internetworks. The text begins at a level appropriate for the TCP/IP and router novice, but advances to cover topics such as routing protocol optimization, security, implementing multiprotocol networks, and troubleshooting techniques that experienced router engineers will find useful.

The TCP/IP set of networking protocols rapidly is becoming the de facto standard for local and wide area networking. Its prominence is due in part to its openness. It is considered an open standard because no one commercial organization controls the standard. This allows all vendors an equal footing when developing TCP/IP products and gives devices from different vendors a better-than-even chance of working together properly.

In addition to being an open standard, the TCP/IP protocols have proved themselves durable in the largest network in the world, the Internet.

Fueling the current growth of the Internet are World Wide Web services, which make it easy for anyone who can operate a computer mouse to retrieve information from anywhere in the world. This technology is so attractive to organizations that most forward-thinking companies are building much of their information storage and retrieval systems around it on their own internal intranets. Intranets use the same TCP/IP network protocols as the public Internet but are implemented on the company's own private network.

To support this new computing paradigm, a TCP/IP network is required. To implement a TCP/IP network, you need routers. If you are involved in any way with network administration, design, or management, router technology either is or will become important to you.

This book is clearly not a novel, and I don't expect it to be read as one. Of course, you can start at Chapter 1 and read all chapters in sequence, but this is not how I use my technical books. I suspect that

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most people will read the chapters that are of particular interest to them at different times. To support this type of use, there is some duplication of information across chapters when necessary.

In this, the book's third edition, the configurations have been updated to reflect changes in syntax that now appear in versions 11 and 12 of Cisco's IOS. Version 11.3 was used throughout this edition even though some releases of version 12 are available to the public. This was chosen, as I currently use 11.3 in more instances than version 12, due to hardware requirements, performance and bug levels. Although I think Cisco does an extremely good job of moving its software forward and retaining backwards compatability, you should never assume that a newer version of IOS will behave identically to a previous version. The mantra should be to always test any new IOS thoroughly before deploying it on your network.

The configurations given work equally well on versions of IOS 12 as they do on IOS 11.3.

Terminology

Throughout the book, I have used some terms that should be defined. First, let's discuss how we identify, in networking terms, computers that are grouped together. An *internetwork* is a collection of networks connected together. A *network* refers to all devices that belong to one network number. A *subnetwork*, or *subnet*, is a section of a network configured to act as if it were a separate network as far as other computers configured on the same network number are concerned.

Another potentially confusing term is that of *gateway*. In general networking terms, a gateway is an Application layer device, something that converts from one type of communications protocol to another. In TCP/IP language, a gateway is synonymous with a router.

Conventions

Outputs from Cisco router screen displays are presented in many figures and parts of the text. Any text or commands that are to be entered into the terminal attached to the router are in **`boldface`** type; the `nonbold` text represents what is displayed by the router. In these screen displays, I have had to indicate that at times, a shifting key and letter key must be depressed simultaneously to get the desired response. An example is <Ctrl-Z>, which means that you hold down the key labeled "Ctrl" while pressing the "Z" key.

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About the Author

Christopher S. Lewis (Hastings-on-Hudson, New York) is a vice-president at ILX Systems, a chartered engineer, a member of the Institution of Electrical Engineers and frequently publishes articles in leading networking journals.

About the Reviewer

As the leading publisher of technical books for more than 100 years, McGraw-Hill prides itself on bringing you the most authoritative and up-to-date information available. To ensure that our books meet the highest standards of accuracy, we have asked some top professionals and technical experts to review the accuracy of the material you are about to read.

We take great pleasure in thanking the following technical reviewer for his insights:

Tom Owens is the proud father of four wonderful children and devoted husband to a dear, sweet wife. He has worked in the networking industry for 15-plus years. It has been his privilege to build and maintain portions of the corporate LAN and WAN infrastructures at the Equifax Data Center in Atlanta, Georgia, and to maintain the campus network infrastructure at Georgia Institute of Technology, also in Atlanta. He enjoys his family, gardening, old tools, and (of course) trying to keep up with the explosive technical growth of Cisco's product line.

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CONTENTS

	Acknowledgments	xi
	Introduction	xiii
	Trademarks	xv
Chapter 1	Router Basics	1
	Objectives	2
	Router Concepts	2
	Routers Compared to Bridges	5
	Routers Compared to Other Computers	7
	Getting to Know Your Router	9
	Connecting a Terminal to a Cisco Router	9
	The Cisco User Interface	10
	Cisco Hardware	14
	Cisco's Single-User Products	15
	Cisco's Small Business Branch Office Solutions	17
	Cisco's 2600 Range	19
	Cisco's 3600 Range	20
	The Cisco 7x00 Range	22
	Summary	23
Chapter 2	TCP/IP Communications	25
	Objectives	26
	What Is TCP/IP?	26
	The OSI Data Communications Model	27
	Department of Defense Model	31
	TCP/IP Addressing	39
	Application Layer Addressing	40
	Transport Layer Addressing	41
	Internet Layer Addressing	42
	Network Access Layer Addressing	47

此为试读,需要完整PDF请访问: www.ertongbook.com

Putting It All Together 50
Summary 50
Answers to Netmask Questions 51

Chapter 3 Configuring Cisco Routers 53

Objectives 54
Sources for Configuring a Router 54
Configuring a Router Manually 54
Configuring a Router from a Network Server 65
Configuring a Router Using Auto-Install 67
Setting Up a Lab 70
Lab Exercises 90
Overview of Physical Layer Troubleshooting 91
Overview of Data Link Layer Troubleshooting 92
Overview of Network Layer Troubleshooting 92
Summary 92

Chapter 4 Routing Protocols Used in TCP/IP 93

Objectives 94
Routing Protocol Responsibilities 94
Interior Gateway Protocols: Distance Vector 96
Generic Distance Vector 96
RIP: The Routing Information Protocol 97
IGRP: Interior Gateway Routing Protocol 107
EIGRP: The Hybrid Protocol 116
Inside EIGRP 118
Configuring EIGRP 119
Routing Protocols: Link State 121
OSPF: Open Shortest Path First 122
Integrated IS-IS 132
Exterior Gateway Routing Protocols 133
Static Routing 133
Exterior Gateway Protocol 134
BGP: Border Gateway Protocol 135
Redistributing Route Information between Protocols 137
Redistributing between RIP and OSPF 138
Routing between Autonomous Systems 144
IP Version 6 148
RIP Version 2 165
Summary 167

Chapter 5 Adding Support for Legacy LANs 169

Objectives 170
Novell NetWare's IPX/SPX Protocols 170
Overview of IPX and SPX 171
NetWare Client-to-Server Communication 173
Configuring Basic IPX Routing 175
Viewing Potential Problems 177
Optimizing IPX Routing and Service Advertising 179
Optimizing Periodic NetWare Maintenance Traffic 183
Configuring EIGRP for IPX 186
The Basics of NLSP and IPXWAN Operation 189
NetBIOS over IPX 195
Bridging Nonroutable Protocols 197
Transparent Bridges 198
Source Routing Bridges 202
Source Route Transparent Bridging 206
IBM Networking 207
Overview of IBM Technology 208
Cisco's Approach to IBM Technology Integration 210
Networking Windows NT 219
Windows NT Network Protocols 219
Windows NT Network Traffic 221
Transporting Windows NT Traffic over a WAN 223
Implementing Quality of Service Features 228
Summary 233

Chapter 6 Supporting Popular WAN Technologies 235

Objectives 236
Frame Relay 236
Frame Relay Terms 240
Configuring Frame Relay Features 241
Configuring a Test Frame Relay Network 247
SMDS: Switched Multimegabit Data Service 250
SMDS Protocols 251
Configuring SMDS 253
X.25 254
X.25 Basics 255
Configuring an X.25 Network Connection 258

Viewing X.25 Connection Status 265
Customizing X.25 Parameters 266
Point-to-Point Protocols 268
SLIP Communications 268
PPP Communications 269
SDLC 277
ISDN 279
Additional WAN Technologies 291
Cisco Serial Interfaces 291
Line Types 294
Cisco Virtual Private Networks 297
VPN Definition and Components 298
VPN Architectures and Implementation 300
VPN Configuration 306
Summary 312

Chapter 7 Building a TCP/IP Router-Based Network 313

Objectives 314
The Base Internetwork 314
IANA or Not IANA? 315
Internetwork Topology 318
Backbone Topologies 319
Distribution Center Topologies 323
Head Office and Remote Site Topologies 326
Designing Physical Network Layout 328
Reducing Manual Configuration 329
RARP: Reverse Address Resolution Protocol 329
DHCP: Dynamic Host Configuration Protocol 330
Centrally Managing Host Names 331
Integrating the Operation of DNS and DHCP 334
Securing a TCP/IP Internetwork 341
Application Layer Measures 341
Packet-Level Security 345
Cisco's PIX Firewall 363
Physical Layer Security 369
IOS NAT Features 370
IOS Version Information 370
IOS NAT Configuration 371
IP Unnumbered and Data Compression 373
IP Unnumbered 374
Data Compression 377

Overview of Managing an Internetwork 380
SNMP System Components 381
Systems Management Objectives 382
Sample Router Configuration for SNMP Management 383
Overview of Managing an Internetwork with CiscoWorks 386
Remotely Upgrading Router IOS from a TFTP Server 389
Overview of Cisco Router Password Recovery Procedures 394
Putting Together the Sample Internetwork 396
Defining the Problem 397
The Central Site Configuration 402
Distribution Center Configuration 404
Remote Site Configuration 405
ISDN Backup and Asynchronous Dial-Up Service Configuration 406
Miscellaneous Issues 406
Summary 408

Chapter 8 Troubleshooting 409

Objectives 410
A General Troubleshooting Blueprint 410
Troubleshooting the First Three ISO Layers 412
Simple Troubleshooting at the Physical Layer 413
Simple Data Link Layer Troubleshooting 417
Simple Troubleshooting at the Network Layer 418
Summary of a Simple Troubleshooting Process 419
Troubleshooting Interface Problems 421
Troubleshooting Serial Interfaces 422
Troubleshooting Asynchronous Communications 435
Troubleshooting Ethernet 442
Troubleshooting Token-Ring 444
Troubleshooting Protocol Problems 447
Troubleshooting IP Connectivity 447
Troubleshooting Packet-Oriented WAN Protocols 453
Summary 457

Index 459

CHAPTER 1

Router Basics

Objectives

The objectives of this chapter are as follows:

- Explain the role of a router in an internetwork.
- Discuss how a router is both similar to and different from other network computing devices.
- Introduce the Cisco router user interface.

Router Concepts

This section introduces router technology and its responsibility in an *internetwork*, an accepted networking industry term for a set of many interconnected networks. Each individual network will have its own network number that must be unique for that particular internetwork. If some of the terms used here are unfamiliar, don't worry; all the ideas presented in this overview are discussed in more detail and explained fully in later chapters.

Routers direct traffic through an internetwork, based on information learned from network protocols. Let's discuss some of the goals of these computer network protocols.

With an internetwork that has hundreds or even thousands of computers linked together, there has to be some agreed-upon way for those devices to address one another and communicate. As a network grows larger, it is not feasible for each computer to keep track of the individual address of every other computer on the internetwork. There must be some scheme for reducing the amount of information each computer has to hold locally in order to communicate with every other computer.

The scheme used involves splitting an internetwork into many discrete but connected networks, which may themselves be split into subnetworks (Fig. 1-1). The job of keeping track of these discrete networks is then given to specialized computers called *routers*. Using this method, the network computers need only keep track of the networks on the internetwork, rather than keeping track of every network computer.

The best analogy I can think of for describing how computers on an internetwork address each other is the postal service. When you address a letter, you provide an apartment number, street name and number, town, and state. In computer terms, messages are delivered by *application*

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