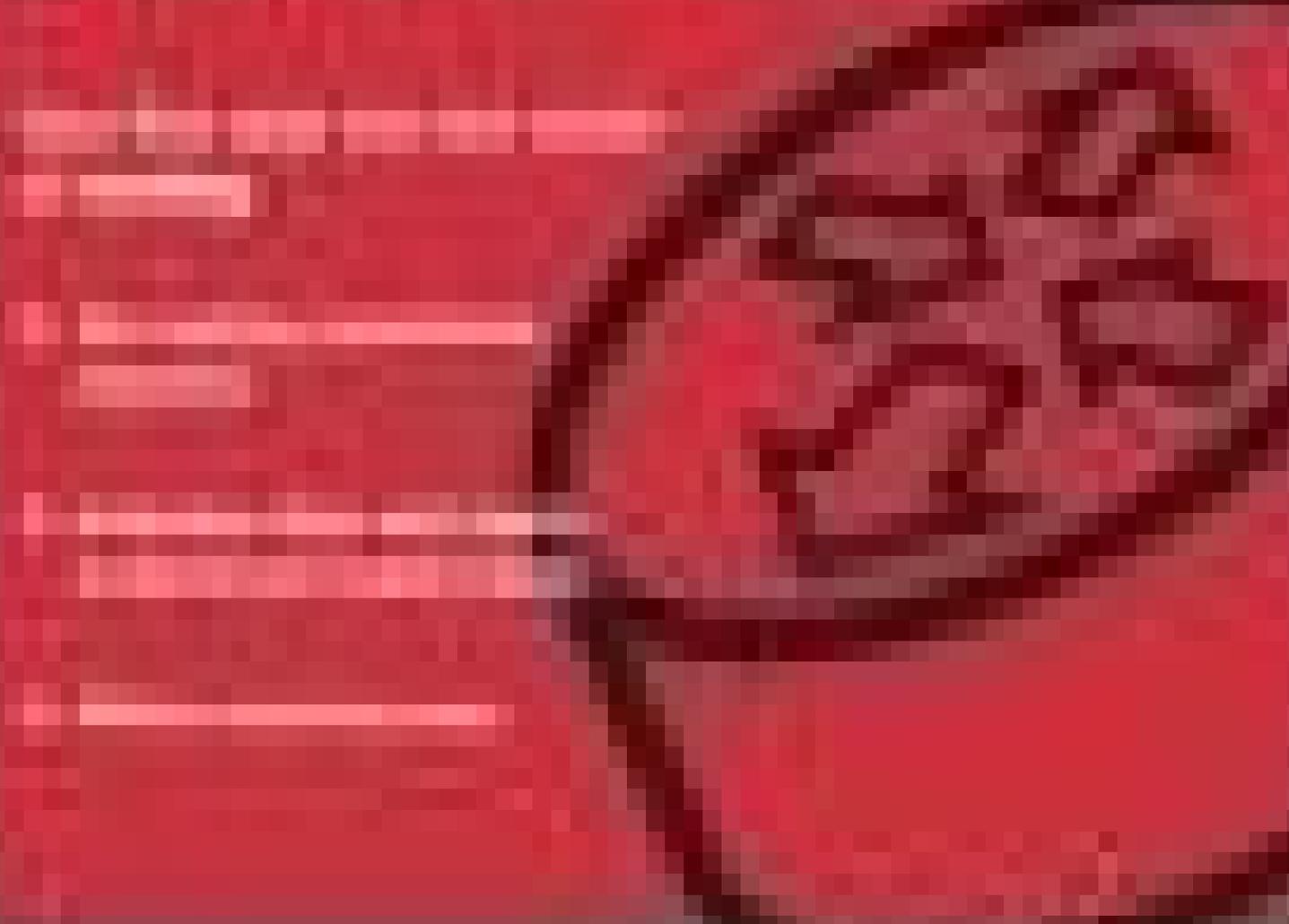




THE NEW YORK TIMES



Routing first-step

By Bill Parkhurst

Publisher : Cisco Press

Pub Date : September 08, 2004

ISBN : 1-58720-122-4

Pages : 432



Your first step into the world of routing

- No routing experience required
- Includes clear and easily understood explanations
- Makes learning easy

Your first step to understanding routing begins here!

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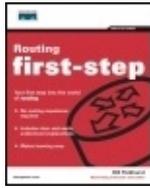
- Learn routing basics simply and easily
- Explore how network traffic gets from here to there
- Understand routing tools and technologies
- Reinforce your understanding with chapter review questions

Welcome to the world of routing!

Routing is the technology that enables worldwide Internet communication. Many people involved with networking technologies or companies need to know how routing works. But learning about routing tends to involve a complex web of terms and acronyms—a language that can be difficult and unfamiliar.

No routing experience needed!

Routing First-Step explains the basics of Internet routing in language all of us can understand. This book takes you on a guided tour of routing, starting with systems you are familiar with: the postal system, the telephone system, and the interstate highway system. From there, you'll learn routing simply and easily. Whether you are looking to take your first step into a career in networking or are interested only in gaining knowledge of the technology, this book is for you!



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Corporate Headquarters

Cisco Systems, Inc.

170 West Tasman Drive
San Jose, CA 95134-1706
USA

www.cisco.com

Tel: 408 526-4000

800 553-NETS (6387)

Fax: 408 526-4100

European Headquarters

Cisco Systems International BV

Haarlerbergpark

Haarlerbergweg 13-19

1101 CH Amsterdam

The Netherlands

www-europe.cisco.com

Tel: 31 0 20 357 1000

Fax: 31 0 20 357 1100

Americas Headquarters

Cisco Systems, Inc.

170 West Tasman Drive

San Jose, CA 95134-1706

USA

www.cisco.com

Tel: 408 526-7660

Fax: 408 527-0883

Asia Pacific Headquarters

Cisco Systems, Inc.

Capital Tower

168 Robinson Road

#22-01 to #29-01

Singapore 068912

www.cisco.com

Tel: +65 6317 7777

Fax: +65 6317 7799

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Dedications

This book is dedicated to my daughter, Laura. I want to congratulate her on graduating from Kansas State University and taking her own first step. Now, if I can only get her to read this book.

About the Author

Bill Parkhurst, Ph.D., CCIE No. 2969, is an advisory engineer at Cisco Systems and a technical advisor for Cisco certifications. Bill has taught networking to students on five continents at all levels, from beginner to advanced. Before joining Cisco, Bill taught networking at Wichita State University and now has the pleasure of working with many of his former students.

About the Technical Reviewers

Mark Gallo is a technical manager with America Online where he leads a group of engineers responsible for the design and deployment of the domestic corporate intranet. His network certifications include CCNP and CCDP. He has led several engineering groups responsible for designing and implementing enterprise LANs and international IP networks. He has a bachelor of science degree in electrical engineering from the University of Pittsburgh. Mark resides in northern Virginia with his wife, Betsy, and son, Paul.

Kevin Turek, CCIE No. 7284, joined Cisco in 2000 and is currently working as a network consulting engineer in the Cisco Federal Support Program in Research Triangle Park. He has been involved with several Cisco Press projects, including co-authoring the Cisco Press title *Cisco Catalyst QoS: Quality of Service in Campus Networks*. Kevin earned his bachelor of science degree in business administration at the State University of New York, Stony Brook.

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Introduction

Over the last decade, the Internet has grown from an interesting research project to a ubiquitous form of communication that has forever changed our world. E-mail, instant messaging, IP telephony, music and video on-demand, online banking, gaming, and travel planning are but a few of the many applications that have made many of our lives more convenient. In time, the Internet will eventually be available to everyone and we can only guess what applications are to come. But whatever form the Internet takes, and whatever applications become available, there is an ever-increasing need for people to design, deploy, support, manage, teach, and sell these technologies.

The Cisco Press First-Step series is the starting point for understanding the basics of computer networking, and this book covers the concepts and protocols that enable the transfer of information from anywhere to anywhere using computer networks. No prior knowledge is assumed and each new concept is explained in understandable terms, allowing you to grasp the concepts without getting lost in the lingo. Of course, you will learn some of the lingo of the trade, but I assure you that it will be painless (mostly). The following description of the chapters in this book will give you an idea of what is in store for you:

- [Chapter 1](#), "Routing and Switching in Everyday Life" Examines familiar systems, such as postal, highway, and phone, that route information similar to the Internet. These systems are used to present an understanding of the concepts and terminology of routing and switching.
- [Chapter 2](#), "A16 B16 C16, As Easy As 012, 102, 112" Covers number systems used by networking professionals. If you like numbers, this chapter should be fun. If you don't like numbers, hopefully this chapter will change your mind.
- [Chapter 3](#), "Internet Addressing and Routing" Uses the concepts learned in the first two chapters to discuss the addressing scheme used in computer networks in detail.
- [Chapter 4](#), "Routing IP" Introduces network routing, basic configuration of Cisco routers, and RIP, one of the first network routing protocols.
- [Chapter 5](#), "Cisco Interior Gateway Protocols" Describes the basic concepts and configuration of the Cisco routing protocols: IGRP and EIGRP.
- [Chapter 6](#), "Open Shortest Path First Better, Stronger, Faster" Introduces OSPF, a popular standards-based routing protocol used in many networks. After reading

this chapter, you will understand the concepts, operation, and configuration of OSPF.

- [Chapter 7](#), "Intermediate System-to-Intermediate System Better, Stronger, Faster, and Scarier" Describes IS-IS, which is similar to OSPF but has a few differences that tend to scare people away from using it. This chapter will remove the mystery and darkness that surrounds IS-IS.
- [Chapter 8](#), "Border Gateway Protocol The Glue That Holds the Internet Together" The routing protocols covered in [Chapters 4](#) through [7](#) are used in the networks of companies, universities, government agencies, and so on. The Internet is what ties all these networks together, and BGP is the protocol that holds it all together.
- [Chapter 9](#), "Multicast What the Post Office Can't Do" Presents the concepts and routing protocols used to simultaneously send information to more than one recipient, something the post office can't do.
- [Appendix A](#), "Answers to Chapter Review Questions" Each chapter ends with a "Chapter Review Questions" section that helps reinforce your understanding of the topics discussed. This appendix repeats the questions and provides the answers.
- Glossary Throughout this book many new terms will be introduced and defined. These new terms are all listed in the glossary for easy reference.

Who Should Read This Book

This book, and this series, is for anyone interested in starting down the road of learning about the many facets of computer networking. The First-Step series can give you a solid foundation to forge ahead into any area of networking you find interesting. If you are in high school and are exploring possible career goals, if you are a college student and want to see if this field is something you might be interested in pursuing, if you are already working in another hi-tech field and are considering a career change, or if your company depends on computer networks but you only need to understand the basics for making the right business decisions, this book is for you.

If you are interested in checking out other books in the First-Step series, visit <http://www.ciscopress.com/firststep> for more information.

What You Will Find in This Book

This book includes several features to help ease the process of learning about routing:

- **Chapter objectives** Every chapter begins with a list of objectives that are addressed in the chapter. The objectives are revisited in the chapter summary.
- **Highlighted key terms and Glossary** Throughout this book, you will see terms formatted with bold and italic. These terms are particularly significant in routing. If you find that you aren't familiar with the term or that you need a refresher, look up the term in the Glossary toward the end of the book to find a full definition.
- **Chapter summaries** Every chapter concludes with a comprehensive summary that reviews chapter objectives, ensuring complete coverage.
- **Chapter review questions** Every chapter concludes with review questions. These questions test the basic ideas and concepts covered in each chapter. You can find the answers to the questions in [Appendix A](#).
- **Examples** In networking, you will encounter router configurations and output. To help prepare you, this book provides basic configuration and output examples that are thoroughly explained in the text and, when necessary, annotated.

The illustrations in this book use the following icons for networking devices:



PC



Router



Switch



Network Cloud

Chapter 1. Routing and Switching in Everyday Life

What You Will Learn

After reading this chapter, you should be able to

- Understand the concepts of routing and switching using familiar systems (postal, road, and telephone)
- Understand the properties of a routable address and how various parts of the address are used to route something from point A to point B
- Understand the concept of route summarization, or aggregation, at the core and distribution level for reducing the amount of information required in the routing tables at these levels

The Internet is nothing new. Think about that statement. Certainly the technologies are new and applications such as e-mail, instant messaging, web sites, and video on demand are new, but the concepts are not. How the Internet operates is conceptually no different than how the postal, highway, and telephone systems operate. They all perform the same function getting things from one place to another. The postal system does this with mail, the highway system does this with families on vacation and produce from California, and the phone system does this with phone calls. This book is about getting things from here to there. If you understand the concepts behind the postal, highway, and phone systems, you can understand the concepts of computer networks. After the concepts are mastered, learning the details of how it all works is easy. So before we jump off into the amazing world of the Internet, let's take the time to look at systems you are already familiar with.

Postal System

First, let's take an imaginary trip back in time and pretend it's your job to develop a system for delivering letters and packages, and whatever else people can think of sending, to anyone anywhere in the country. So, where do you start? I think the best place to start is to establish rules. If your system has any chance of working, you need everyone to follow a clear set of rules. You also want to give your set of rules a fancy name so when you present your plan you sound somewhat authoritative.

Consulting your pocket dictionary, you find that a set of rules is also a set of conventions that is referred to as a **protocol**. That sounds fancy enough, so let's call your set of rules a protocol.

How many protocols do you need? That depends on how you structure the mail delivery system, so you need to think about how the system operates. Ultimately, you need to deliver something from point A to point B. These points can be located anywhere in the country.

After some serious thought, you decide you need to develop the following protocols:

- **Package Protocol (PP)** The type and parameters (size, weight, contents, and so on) of the mail that can be delivered.
- **Addressing Protocol (AP)** Where is the item coming from and where is it going to.
- **Delivery Protocol (DP)** What is the most efficient way to deliver an item from point A to point B.
- **Transportation Protocol (TP)** How to physically deliver the mail to the proper recipient.

These are not protocols used by the post office, of course, but are used for the purpose of the discussion regarding the routing of mail.

In addition, the protocols should be as independent as possible and scalable. Independence means that the operation of one protocol should not depend on other protocols. For example, the type of mail sent should not affect the addressing protocol. You don't want to use one addressing protocol for letters and another for packages. If you send a letter to your mother and a birthday present to your sister, you would have to use the same format for the address on both. For example, you might change the protocol specifying the location of the address on a letter, or package, or include additional information in the address (a ZIP code, for example). You should be able to

do this without affecting which route the mail takes to its final destination.

The delivery protocol will make a delivery, or routing, decision based on the address. In that sense, the delivery protocol is dependent on the addressing protocol. You, however, want the freedom to change the addressing protocol without having to change the delivery protocol. Finally, the means that you use for the physical delivery of the mail (horse and wagon, truck, and so on) should not be dependent on what is actually being sent. With these constraints in mind, you can create a layered model called the Mail System Layered Protocol Model shown in [Figure 1-1](#).

Figure 1-1. Mail System Layered Protocol Model

| | |
|----------------|--|
| Package | What is being sent? |
| Address | Where is it going? Where is it from? |
| Delivery | What is the best route to use for delivery? |
| Transportation | How will the mail physically be delivered? |

A [*scalable protocol*](#) means that the protocols still work well as the size of the system grows. For example, assume that mail will be delivered only between Chicago and Kansas City, and you will allow only one piece of mail every week. Because this is a small volume of mail, you hire someone with a horse to make the delivery. Assume this system works well, and you increase the volume to two pieces of mail per week. You could hire another person with a horse, but now you have two people to pay and two horses to feed. If you follow this method, you cannot scale your system to deliver thousands of pieces of mail because this would require thousands of people and thousands of horses! This system does not scale. You should require each rider to carry as much mail as possible so the system can scale to accommodate higher volumes of mail.

Now that you have decided which protocols are required, you need to determine the details of each protocol.

Package Protocol

The Package Protocol, or PP, is a relatively straightforward protocol. You have to