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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

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 compatibility, 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 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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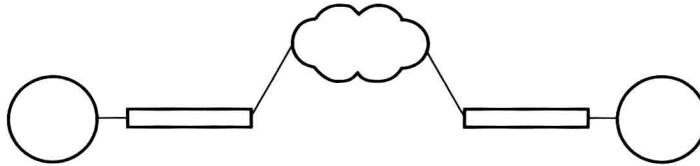
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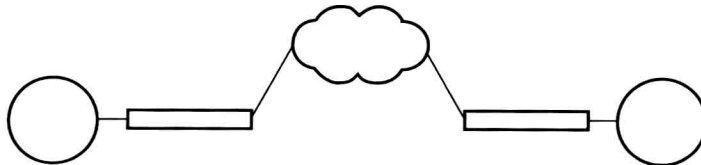
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CHAPTER **1**



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 sub-networks (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*