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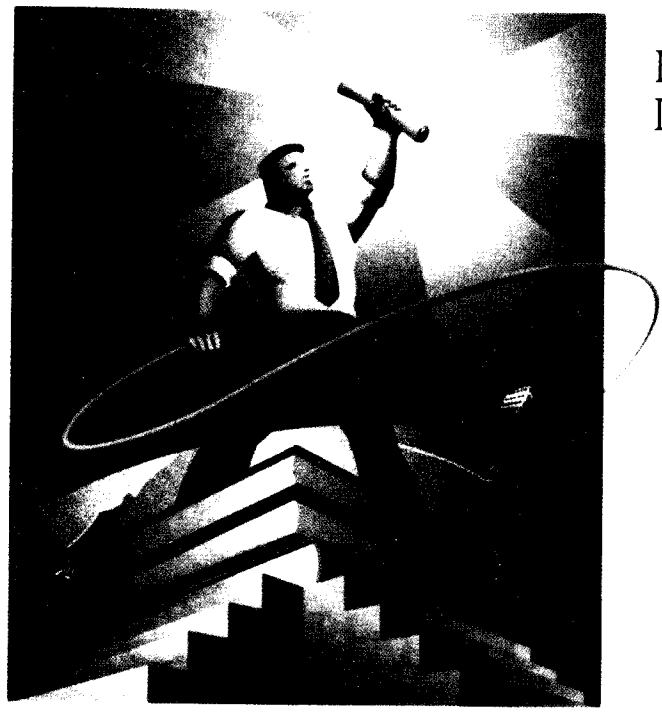

Edited by
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INTRODUCTION TO CISCO ROUTER CONFIGURATION

CISCO路由器配置导论

CISCO SYSTEMS
CISCO PRESS

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Introduction to Cisco Router Configuration

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Laura Chappell, Editor

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出 版 前 言

21 世纪将会是一个信息高速公路四通八达的时代，信息产业发展的水平亦将是评估一个国家综合国力的重要依据。世界各国将会在信息技术的研究开发和信息产业的发展方面展开激烈的竞争。这既是一种挑战也是一种机遇。有鉴于此，我国已经开始全面快速地发展网络技术和因特网。

Cisco Systems 公司是世界领先的全球 Internet，Intranet 以及电信网络设备及解决方案的供应商，1996 年名列世界十大电信公司之一。Cisco Systems 的联网操作系统(IOS)是支持网络服务和网络应用的坚实基础。该公司与麦克米伦计算机出版公司合作创立了 Cisco Press，出版了一系列关于最新的网络技术的权威著作。这些著作不仅兼顾建网与网际互联的基础理论和实际应用，为网络专业人员和用户提供必要的技术支持，还有一部分是为 Cisco CCIE 考试和 CCNA，CCNP，CCDA 及 CCDP 职业考试认证准备的自学和培训教材。Cisco 公司早于 1994 年就进入中国，已为国内信息产业界所熟悉。我们引进其中部分著作组成“CISCO 系列丛书(影印版)”影印出版，以祈对我国信息产业的发展稍尽绵薄之力，并衷心希望这套丛书对从事建网，网际互联的专业人员；有志于我国信息产业发展的读者，以及参加 Cisco 培训和准备 Cisco 考试认证的人员有所裨益。

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Foreword

In April 1998, Cisco Systems, Inc. announced a new professional development initiative called the Cisco Career Certifications. These certifications address the growing worldwide demand for more (and better) trained computer networking experts. Building upon our highly successful Cisco Certified Internetwork Expert (CCIE) program—the industry's most respected networking certification vehicle—Cisco Career Certifications enable you to be certified at various technical proficiency levels.

With *Introduction to Cisco Router Configuration*, Cisco Press presents Cisco's most popular instructor-led certification preparation course as a single-volume book. *Introduction to Cisco Router Configuration* is not intended to replace the instructor-led course of the same name. Instead, it supplements and reinforces topics presented in the course.

Cisco and Cisco Press together present this material in a text-based format in order to provide another learning vehicle for our customers and the broader user community in general. Although a publication cannot replace the instructor-led environment, we must 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 our audience of networking professionals.

This is the first of many course supplements planned for Cisco Press. Cisco will present existing and future courses through these coursebooks to help achieve Cisco Worldwide Training's principal objectives: to educate Cisco's community of networking professionals and to enable that community to build and maintain reliable, scalable networks. The Cisco Career Certifications and classes that define these certifications are directed at

meeting these objectives through a disciplined approach to progressive certification. The books Cisco creates in partnership with Cisco Press 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 and training publications of value as you build your networking knowledge base.

Thomas M. Kelly

Director, Worldwide Training
Cisco Systems, Inc.
August 1998

Introduction

As today's internetworks grow and expand to support multiple sites, protocols, and operating systems, the interconnecting devices are the critical elements along the data path. Understanding these devices and how to configure them and integrate them into efficient, reliable network designs is essential to anyone supporting network communications. Cisco Systems, the premier designer and provider of internetworking devices, is committed to supporting network administrators, designers, and builders in the use of its products.

The content, organization, and goals of this book are based on Cisco's highly successful "Introduction to Cisco Router Configuration" course. As such, the book provides a comprehensive introduction to internetworking LANs and WANs using Cisco routers. Technical background and functionality specifications for the most popular internetworking protocols today, including TCP/IP, Novell IPX, and AppleTalk networks, are covered. In addition, the book surveys wide-area networking (WAN) techniques. Throughout, important general principles are balanced with configuration specifics for Cisco routers.

Many configuration examples are included to demonstrate management and troubleshooting techniques for internetworking communications. If you are using this book as a study aid in preparing for one of Cisco's certification exams, you will find the end-of-chapter tests useful. The tests are designed to help you evaluate your understanding of the concepts contained in the chapter and your ability to apply the configuration techniques available for Cisco routers. Chapters also contain sidebars in the form of Tips, Cautions, and Key Concepts to help emphasize critical details.

A follow-up title, *Advanced Cisco Router Configurations* (Cisco Press), provides more advanced details on traffic management and router configurations.

WHO SHOULD READ THIS BOOK

This book contains a broad range of technical details on routing models, processes, and design; it can be used as a general reference for anyone designing, implementing, or supporting an internetwork with TCP/IP, IPX/SPX, AppleTalk, SNA, DECnet and Banyan VINES protocols. If you anticipate taking one or more of the Cisco certification exams, particularly the Cisco Certified Network Associate (CCNA) exam, this book is a logical starting point.

Even if you're not using Cisco routers, this book can increase your understanding of the underlying technologies affecting network communications and security.

PART 1: INTRODUCTION TO INTERNETWORKING

Part 1 provides the foundation of knowledge required to build and configure a multiprotocol network. It examines the various layers of functionality and introduces the startup sequences and configuration options for Cisco router products.

Chapter 1, "The Internetworking Model," introduces concepts that enable us to move from local to global internetworks. The chapter provides an introduction to the communication processes seen in local, national, and international/global LANs and WANs. You'll learn how the data is built, packaged for end-to-end transport, addressed for internetwork routing, and addressed for local transit.

Chapter 2, "Applications and Upper Layers," focuses on the connection-oriented and connectionless communications defined by the transport layer of the OSI model. It also examines higher layer functions such as text and data formatting and conversion; image conversion; and sound and video conversion. Flow control and congestion avoidance mechanisms and are also covered.

Chapter 3, "Physical and Data Link Layers" focuses on the functionality supported by internetworking routers. You'll learn the difference between the Media Access Control (MAC) and Logical Link Control (LLC) sublayers of the data link layer. You'll learn the basic functionality and specifications defined for Ethernet/802.3, Token Ring/802.5, and FDDI networks. This chapter also introduces various WAN technologies including SDLC, HDLC, LAPB, Frame Relay, PPP, X.25, and ISDN communications.

Chapter 4, "Network Layer and Path Determination," focuses on the layer that defines router functionality and compares routing technologies available for TCP/IP, IPX/SPX, and AppleTalk networks. The chapter describes routing problems such as routing loops and the count-to-infinity problem, as well as the available solutions, such as split horizon,

poison reverse, hold-down timers, and triggered updates. Link state, distance vector, and hybrid routing protocols are introduced and compared.

Chapter 5, "Basic Router Operations," delves into the Cisco-specific procedures required to start up and configure a router using a console port, auxiliary port, virtual terminals, or TFTP server. This chapter surveys the methods a Cisco router uses to obtain its routing configurations, including RAM/DRAM, NVRAM, Flash, and ROM memory. The process of changing router modes from user EXEC to privileged EXEC mode is also described. The chapter concludes with coverage of how to view the router startup, interface, and protocol status.

Chapter 6, "Configuring a Router," examines the process of loading configuration files and changing router modes. This chapter examines password configurations as well as the steps used to configure an interface, shut down an interface, and verify configuration changes. Finally, you'll look at how to manage the configuration environment through backup images and setup modes.

Chapter 7, "Discovering and Accessing Other Cisco Routers," focuses on Cisco Discovery Protocol (CDP) and its ability to discover other Cisco routers. You'll look at how to use CDP on a local or neighboring router.

PART 2: NETWORKING PROTOCOL SUITES

Part 2 details the most popular internetworking protocols: TCP/IP, Novell IPX, and AppleTalk. In this section, you'll examine the addressing system, service discovery, and routing techniques used by each of these protocol suites.

Chapter 8, "TCP/IP Overview," defines the elements in the TCP/IP stack with particular emphasis on the network and transport layer protocols, Internet Protocol (IP), User Datagram Protocol (UDP), and Transmission Control Protocol (TCP). Related elements of the TCP/IP suites, such as Address Resolution Protocol (ARP) and Internet Control Message Protocol (ICMP), are also discussed since routers typically support these elements.

Chapter 9, "IP Addressing," lays the groundwork for IP addresses that use standard class-based default masks and various subnet masking techniques. Examples deal with how to plan a Class B or Class C internetwork considering future network expansion and the current limitations of a class-based addressing scheme. This chapter also focuses on general and directed broadcasts as defined by the IP address format used. Finally, the chapter illustrates how to use simple and extended ping techniques to test communications between TCP/IP devices.

Chapter 10, "IP Routing Configuration," explains how IP routers learn of network destinations and assign a distance to each network. The chapter introduces and compares the RIP and IGRP routing protocols, and provides configuration examples of each. General elements of interior and exterior routing protocols are also compared in this chapter.

Chapter 11, "Configuring Novell IPX," introduces the IPX network routing techniques and the 10-byte addressing system used on NetWare networks. Service Advertising Protocol (SAP), Get Nearest Server (GNS), and encapsulation methods are examined as they relate to a router's functionality in this environment. Finally, you'll look at how to configure path splitting and path costs and validate router configurations for NetWare networks.

Chapter 12, "Configuring AppleTalk," examines the AppleTalk protocol stack and features, including nonextended and extended networks. The AppleTalk addressing process, service discovery, and network printing are covered.

Chapter 13, "Basic Traffic Management with Access Lists," defines the purpose of traffic filtering and management on LANs and WANs. The chapter explains both standard and extended access lists and provides examples of TCP/IP, Novell IPX, and AppleTalk access lists to control network traffic.

PART 3: WIDE-AREA NETWORKING

Part 3 deals with WAN communications, including serial connections, X.25, and Frame Relay networking. You'll examine the addressing system, link establishment, and routing techniques used by each of these protocol suites.

Chapter 14, "Introduction to WAN Connections," surveys the types of serial communications used today and the elements used for call establishment, maintenance, and authentication. This chapter provides substantial detail on Point-to-Point Protocol (PPP) link establishment, authentication, and configuration verification.

Chapter 15, "Configuring X.25," covers the protocol stack, logical elements, addressing, encapsulation, and circuit types of X.25. Complete configuration details, including X.25 packet sizes and window parameters, are also covered in this chapter.

Chapter 16, "Configuring Frame Relay," focuses on the terminology and operation of point-to-point and multipoint frame relay configurations. The chapter looks at star, full-mesh, and partial-mesh topologies and discusses reachability issues for frame relay communications.

VERSION INFORMATION

This book is based on the Cisco "Introduction to Cisco Router Configuration" course which covers IOS v11.3. Although some references are made to earlier versions of IOS, the examples shown throughout this course are based on IOS v11.3. For more information on Cisco router configuration options and commands, refer to the Cisco documentation maintained online at www.cisco.com.

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