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# Cisco 互连网络故障诊断与排除
## (英文版)

CCNP Self-Study
# Cisco Internetwork Troubleshooting

Cisco authorized self-study book for
CCNP Support foundation learning

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Dan Farkas, CCIE No.3800

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# 内容提要

本书是在使用 Cisco 网络设备进行网络互连的过程中，解决疑难问题和排除网络故障的技术专著。本书共由 5 大部分和 4 个附录组成，全面介绍了 Cisco 网络设备各种故障诊断工具的使用方法和各种网络互联故障的排除方法。主要内容包括：故障诊断方法学、多种流行网络协议介绍、常用的故障排除仪器介绍、Cisco 网络设备的寻径和交换过程、Cisco 网络管理和故障诊断工具、TCP / IP 连通性故障排除。Novell 连通性故障排除、AppleTalk 连通性故障排除、园区交换机和 VLAN 故障排除、帧中继故障排除以及 ISDN BRI 故障排除等。

本书不仅适合从事互连网络建设与管理的工程技术人员阅读和参考，也适合为获得 CCNP 证书而参加“Cisco Internetwork Troubleshooting”（CIT）考试的读者学习。

## About the Authors

**Laura Chappell**, Senior Protocol Analyst for the Protocol Analysis Institute, LLC (www.packet-level.com), is a highly-energetic speaker and author who has trained thousands of LAN/WAN administrators, engineers, technicians, and developers. She admittedly "lives, eats, and breathes" packets and packet-level communications.

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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 on Cisco's 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.

*Cisco Internetwork Troubleshooting* is a Cisco authorized, self-paced learning tool that helps you understand the foundation concepts covered on the CCNP Support exam. This book was developed in cooperation with the Cisco Internet Learning Solutions Group, the team within Cisco responsible for the development of the CCNP exams. As an early-stage exam preparation product, this book teaches you how to isolate and resolve common network problems in a variety of environments. Whether you are studying to become CCNP certified or you just need a better understanding of error detection and troubleshooting methodologies, you will benefit from the insights this book offers.

Cisco 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 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.

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 http://www.cisco.com/go/authorizedtraining.

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 self-study publications of value as you build your networking knowledge base.

Thomas M. Kelly
Vice-President, Internet Learning Solutions Group
Cisco Systems, Inc.
May 1999

# Introduction

The networking world is becoming more complex every day as we attempt to add bandwidth and capability to our LANs and WANs overnight. The alarming rate of growth requires a solid understanding of how to quickly and efficiently spot communication and configuration problems. 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 Cisco Internetwork Troubleshooting course. The book provides a comprehensive guide for troubleshooting LANs and WANs that use TCP/IP, IPX/SPX, and AppleTalk protocols. In addition, the book details switched and VLAN network troubleshooting.

Configuration examples demonstrate management and troubleshooting techniques for numerous LAN and WAN designs. 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 exercises useful. The exercises 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, notes, and cautions to help emphasize critical details.

The previously published titles in this series, *Introduction to Cisco Router Configuration* and *Advanced Cisco Router Configuration*, also offer basic through advanced technical details on internetworking devices.

## Who Should Read This Book

This book provides basic through advanced information on networking technology, practices, and troubleshooting for TCP/IP, IPX/SPX, and AppleTalk LANs and WANs. If you are pursuing CCNP certification and anticipate taking the CIT exam, this book is a logical starting point.

Even if you are not using Cisco routers, this book can increase your understanding and efficiency in isolating and troubleshooting internetworking problems.

## Part I: Troubleshooting Tools and Methodology

Part I lays the foundation for the book. It provides the guidelines for troubleshooting, including a problem-solving model that can be used regardless of what the network trouble may be. This section focuses heavily on the protocol characteristics (primarily the various Layer 2 protocols, TCP/IP, NetWare IPX/SPX, and AppleTalk). You'll learn about the basic packet structures and be able to identify frames based on their unique characteristics. This section also details Cisco's router functionality, including the route processor mechanism, the switch processor mechanism, and the various levels of cache that reside within router. You are also presented with an arsenal of tools you can use for solving your network's problems. Some of these are third-party devices, but many of them exist within the Cisco IOS itself. You'll learn about the appropriate tools for solving specific problems.

We recommend that you spend some time becoming familiar with the technology defined in Part I of this book. Parts II, III, and IV assume that you have completed Part I successfully.

## Part II: Routing and Routed Protocol Troubleshooting

In Part II, you'll learn which tools can be used to troubleshoot the most common networking environments today, including TCP/IP, Novell, and AppleTalk networks. In each of the chapters in Part II, you'll find diagnostic commands and tools that can be used to troubleshoot each of these environments, as well as problem resolution and isolation suggestions for each of these environments.

Upon completion of Part II, you should have the knowledge to attack any network problem, regardless of the protocol type or location of devices in the internetwork.

## Part III: Campus Switch and VLAN Troubleshooting

Part III focuses on switch and VLAN communications, with an emphasis on spotting common problems and helpful tools.

Chapter 10 provides the necessary foundations by detailing Catalyst 5000 functionality and general Catalyst switching technology. This chapter also provides definitions of the spanning-tree process, which is a must-read for anyone working in looped networks.

Chapter 11 focuses specifically on VLAN technology and troubleshooting. In this chapter, you learn how VLANs work and the format of frames that are tagged for interswitch communications.

Upon completion of this part, you should be comfortable with the troubleshooting methods and tools for switched networks that use VLAN technology.

## Part IV: WAN Troubleshooting

Part IV focuses on Frame Relay and ISDN BRI WAN technologies specifically and the primary steps required to troubleshoot WAN activity. In each of the chapters in Part IV, you'll find diagnostic commands and tools that can be used to troubleshoot each of these environments, as well as problems, resolutions, and isolation suggestions for each of these environments.

Upon completion of Part IV of this book, you should have the knowledge to identify problems due to line faults, protocol incompatibilities, and configuration errors. You should also be familiar with the most useful troubleshooting tools and utilities.

## Part V: Appendixes

The appendixes contain the answers to each of the chapter tests as well as details on how to work with Cisco Support. The appendixes also contain numerous references and recommended reading that will help you keep up with and further your studies of internetwork technology and troubleshooting. Finally, Appendix D contains a problem-solving checklist and worksheet that can help you organize and document your troubleshooting steps.

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