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# Guide to Designing and Implementing Local and Wide Area Networks

Second Edition

## 局域网与广域网 设计与实现 (第二版)

Michael Palmer  
Robert Bruce Sinclair

著

(影印版)



清华大学出版社

# 局域网与广域网设计与实现

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北 京

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# 前 言

本书采用方便、实用的方法，循序渐进地向读者讲述了计算机网络方面的各种概念。读者可以使用网络设备和现代操作系统——Windows 2000 Server, Windows 2000 Professional, Windows XP Professional 和 Red Hat Linux——实现这些理论。纵观本书，已被验证的工具组合将帮助您的学习过程，这些工具组合能极大地增强读者对概念的掌握，并提供很好的实际经验。

## 本书主要内容

- 逐步讲述网络设备的用法以及如何为网络配置 Windows 2000 Server, Windows 2000 Professional, Windows XP Professional 以及 Red Hat Linux。
- 每章的最后都有综合性的资料，包括逐点总结、问题回顾、案例研究和可选用的团队案例项目，所有这些材料都有助于增强您的知识，并使您练习和掌握技巧。
- 扩展的图表和屏幕快照将本书内容和各种练习可视化。
- 附录 A 提供了网络设备供应商清单及其网站，以及这些供应商提供的商品样本，从而帮助读者根据自己的兴趣来确定合适的供货商。
- 本书的缩写词清单以及参考书目。

## 本书适用的读者对象

本书适用于希望深入学习网络技术的个人和信息系统专业人员，主要内容包括如何配置现代操作系统和网络设备。本书完整地阐述了各种网络概念，包括协议、LAN 和 WAN 技术、LAN 和 WAN 在实际环境中的应用、远程通信系统、无线网络技术以及将要出现的各种新技术。

## 各章内容简介

本书在每一章中都均衡地安排了内容，每一章都以前一章所介绍的技能 and 知识为基础。下面简要介绍各章内容：

- 第 1 章：LAN/WAN 网络技术概览。本章介绍了不同类型网络的入门性知识，并叙述了 LAN 和 WAN 的发展简史。读者还可以学习网络协议集以及网络设计的预备知识。
- 第 2 章：LAN/WAN 互联。本章介绍构成许多网络和网络设备基础的 Open System Interconnection (开放系统互联, OSI)模型。您还可以学习 LAN 和 WAN 拓扑结构和传输方法。
- 第 3 章：物理传输技术。本章介绍通信介质和布线技术，包括控制这些技术的设计

标准。读者将学习双绞线和光缆通信布线的高速传输技术。另外，本章还介绍 WAN 载波类型。

- 第 4 章：网络传输设备。本章全面介绍 LAN 和 WAN 中使用的网络设备类型。这些设备包括网络接口、转发器、多站访问部件、集线器、网桥、路由器、桥式路由器、交换机、网关、多路器、信道组、调制解调器、存取服务器以及其他设备。介绍了这些设备，您就可以掌握它们在实际环境中的用法。
- 第 5 章：LAN 协议。本章综合介绍常用的 LAN 协议，包括 IPX/SPX、NetBEUI、AppleTalk、TCP/IP、SNA、DLC 和 DNA。每一种协议都与使用它们的操作系统关联介绍，因此读者可以真正理解这些协议在网络中使用的方式和原因。您还将学习如何规划协议的用法，提高网络性能。
- 第 6 章：TCP/IP 的过去、现状和未来。本章内容以第 5 章内容为基础，主要关注最常使用的 TCP/IP 协议。本章深入介绍 TCP、UDP 和 IP，包括 IP 寻址技术。读者将要学习 IPv4 和 IPv6，以及许多与 TCP/IP 组相关的应用程序协议。
- 第 7 章：WAN 传输方法。本章介绍最常使用的远程网络通信方法，包括 X.25、帧中继、ISDN、SDSL、DSL、SONET 和基于以太网的 MAN。您还将要学习 WAN 协议的用法，包括 SLIP、PPP 和 SS7 的用法。
- 第 8 章：ATM 技术。本章介绍 LAN 和 WAN 中使用的 Asynchronous Transfer Mode（异步传输模式，ATM）。您将学习 ATM 信元结构、ATM 分层通信、ATM 设计方法以及如何在 LAN、WAN，或同时在二者之上部署 ATM。
- 第 9 章：无线网络技术。本章介绍几种无线 LAN 和 WAN 技术以及它们的应用。您将学习 802.11 无线标准、Bluetooth 技术、HiperLAN 以及 HomeRF Shared Wireless Access 协议。您在本章还将学习红外、微波和卫星无线网络技术。
- 第 10 章：语音、视频、音频和数据的集成。本章介绍使用语音、视频、音频和数据集成技术的网络技术。您将学习多媒体应用程序以及如何设计使用多媒体应用程序的网络。本章还安排了一节内容介绍 Voice over IP，学习如何开发新的网络，以适应多媒体应用程序的新发展。
- 第 11 章：LAN 和 WAN 设计。本章综合应用前面所介绍的内容，设计和实现 LAN 和 WAN。本章还介绍了结构化的布线技术和结构化的联网设计技巧。
- 附录 A：网络设备供应商。附录 A 给出了提供各种网络设备（包括线缆、CSU/DSU、路由器等）的公司清单。同时也提供了他们的 URL，便于您访问这些公司的网站。
- 附录 B：术语表。提供了较为详细的网络术语列表。

## 本书特色

为了帮助读者学习，本书包括以下特色。

- 本章学习目标：本书每一章的开始都详细列举了该章应该掌握的主要概念。这可以帮助读者快速预览该章内容，是一个重要的学习辅助工具。
- 图例、屏幕快照和表：网络图例、屏幕快照和概念演示图以可视化方式帮助读者学习抽象理论、概念和设计原则。另外，许多表还给出了实际应用信息和理论知识的细节和对比，可以用于快速回顾各种主题。

- 实习项目：巩固所学习的 LAN 和 WAN 知识最好的方法之一是实际使用网络设备和网络操作系统，创建自己的网络图。本书的每一章包含许多实习项目，使读者可以实际练习所学习的知识。实习项目提供了丰富的网络操作经验，您可以随时将之应用于更复杂的工作中。
- 章末材料：每一章末尾包括了以下材料，巩固该章介绍的内容。
  - 本章总结：此列表简要总结了本章内容，用作本章学习指南。
  - 关键术语：列出了本章出现的重要术语，便于参考。
  - 复习题：测试您对本章所介绍知识的掌握程度。
  - 实习项目：便于读者理论联系实际操作能力。
  - 案例项目：在每一个案例项目中，您将作为虚拟的 Network Design Consultants 公司的顾问。每一个案例项目分为多项任务，使您可以将所学习知识应用到实践中。
  - 可选的小组案例项目：每一章都给出了可选的小组案例项目，使您可以与小组的同学一起工作，协同解决实际问题，或广泛研究这个问题。这些项目可以使您习惯作为小组成员协调工作，这种工作模式被许多公司所采用。

## 教师资料

当在课堂讲授本书时，可以使用下面列出的补充材料。本书的补充材料使用 CD-ROM 提供给授课教师，具体信息请访问 <http://www.tupwq.net> 了解。

- 电子版教师指南：本书的教师指南包括以下内容。
  - 备课时使用的附加授课资料，包括课堂活动指南、讨论的主题、小问题和课堂练习。
  - 章末材料的解决方案，包括复习题、案例项目、可选小组案例项目的解决方案。
- ExamView：本书附带有 ExamView，这是一种功能强大的测试软件，使得教师能够编制并监督纸面、计算机（基于 LAN）和 Internet 考试。ExamView 包含了数以百计的问题，对应于本书介绍的主题，向学生提供了详细的学习指南，包括参考页码，便于深入学习。基于计算机的测试和 Internet 测试组件使得学生可以在他们的计算机上参加考试，可以自动评分，节省了教师大量时间。
- PowerPoint 演示幻灯片：本书提供了每一章内容的 Microsoft PowerPoint 幻灯片，包括用于教学的课堂演示片，学生可以通过网络获取这些资料，也可以打印后分发给学生。教师也可以随意使用自己制作的幻灯片用于授课。
- 图表文件：本书所有的图表都已经复制到教师使用的 CD-ROM 上，采用位图格式。同 PowerPoint 幻灯片一样，它们也用作授课辅助工具，学生可以用来复习本书内容，也可以打印分发给学生。

## 学生使用资料

教师 CD-ROM 中还包含以下学生使用的资料。

- **学生案例作业文件：**这些文件就是章末案例项目和可选小组案例项目作业的电子版，学生可以作出答案，通过 E-mail 提交到网络共享文件夹，或者打印结果，提交给教师。
- **网络图剪图：**学生可以使用绘图软件包制作网络设备剪图，绘图软件包本身不提供这些图。

# 学习本书之前的注意事项

由于您的实验室可能配备了各式各样的操作系统，所以本书分别给出了用于 Windows 2000 Professional、Windows 2000 Server、Windows XP Professional 和 Red Hat Linux 7.x 的实习项目。您可以随意使用这些操作系统。这些操作系统的界面应按以下方式配置：

- Windows 2000 Professional 或 Server：使用默认的图形用户界面
- Windows XP Professional：使用新型经验性 GUI Windows XP Display 样式，或者 Windows XP Category View(不要使用 Windows Classical 样式或 Classic View)
- Red Hat Linux 7.x：使用 GNOME X Window Desktop

许多实习项目要求学生参与。作者建议学生记录实验日志，或者在计算机中记录日志，将解决方案或实验结果记录下来。有时教师可能希望对学生的实验过程进行总结，这就需要回顾实验日志或计算机记录中的内容。除了上面提到的操作系统之外，下面的条件对于实习项目而言也非常重要：

- 联网计算机实验室
- 安装了可以访问 Internet 的 Web 浏览器的工作站
- 绘图工具包，比如 Visio、SmartDraw、AutoCAD 或 Microsoft Paint
- 以太网或令牌网，在其中可以验证设备以及设备的用法
- 基于 TCP/IP 的网络
- 网络集线器或交换机，以及网络线缆
- 细电缆、双绞线和光缆
- 连接双绞线和同轴电缆的材料（线缆上的连接器）
- 不同类型的网络设备，供学生观摩，或者供学生通过实验认识
- 可以访问具有 WAN 功能的校园网或商业局域网



# Preface

Taking a hands-on, practical approach, *A Guide to Designing and Implementing Local and Wide Area Networks* guides you through the process of understanding basic and complex concepts related to computer networking. You practice these concepts using network devices and modern operating systems—Windows 2000 Server and Professional, Windows XP Professional, and Red Hat Linux. Throughout the book, your learning is facilitated by a proven combination of tools that powerfully reinforce both concepts and real-world experience.

This book includes:

- Step-by-step hands-on instructions on how to use networking devices and configure Windows 2000 Server and Professional, Windows XP Professional, and Red Hat Linux for networking.
- Comprehensive end-of-chapter materials, including point-by-point summaries, review questions, case studies, and optional team case projects—all of which reinforce your learning and enable you to practice and master skills.
- Extensive diagrams and screen captures to visually reinforce the text and hands-on exercises.
- Appendix A, which includes a list of network equipment vendors, their Web sites, and a sampling of the products they offer, to serve as a starting point for locating the appropriate vendor for your interests.
- Acronym list and bibliography

## The Intended Audience

This book is designed to serve individuals and information systems professionals who are interested in learning more about networking technologies, including how to configure modern operating systems and devices for networking. It provides a solid understanding of all types of networking concepts, including protocols, LAN and WAN technologies, the implementation of LANs and WANs in practical circumstances, telecommunications systems, wireless networking, and emerging technologies.

## Chapter Descriptions

The chapter coverage is balanced, with each chapter building on the skills and knowledge acquired in the preceding chapters. Here is a summary of what you will learn in each chapter:

- **Chapter 1: LAN/WAN Networking: An Overview** gives you a basic introduction to different types of networks and provides a history of LANs and WANs. You also get an introduction into network protocol integration and learn about the preparatory steps of network design.

- **Chapter 2: LAN/WAN Interconnectivity** introduces you to the Open Systems Interconnection (OSI) model that forms the basis of many networks and network devices. You also learn about LAN and WAN topologies and transmission methods.
- **Chapter 3: Physical Transmission Options** enables you to learn communications media and cabling technologies, including the design standards that govern these technologies. You learn about high-speed technologies for twisted-pair and fiberoptic communications cabling. In addition, you discover WAN carrier types.
- **Chapter 4: Network Transmission Equipment** gives you a thorough grounding in the types of network devices used in LANs and WANs. These devices include network interfaces, repeaters, multistation access units, hubs, bridges, routers, brouters, switches, gateways, multiplexers, channel banks, modems, access servers, and other devices. As you learn about these devices, you also learn how they are used in actual situations.
- **Chapter 5: LAN Protocols** gives you a comprehensive picture of popular LAN protocols, including IPX/SPX, NetBEUI, AppleTalk, TCP/IP, SNA, DLC, and DNA. Each protocol is discussed in association with the computer operating systems that use it, so you gain a realistic understanding of how and why it is used on a network. You also learn how to improve network performance through planning the use of protocols.
- **Chapter 6: TCP/IP Past, Present, and Future** builds on what you learned in Chapter 5, but focuses exclusively on the popular TCP/IP protocol. You get an indepth explanation of TCP, UDP, and IP, including IP addressing. You learn about IPv4 and IPv6 and many of the application protocols associated with the TCP/IP suite.
- **Chapter 7: WAN Transport Methods** enables you to learn the most widely used methods for long distance network communications, including X.25, frame relay, ISDN, SMDS, DSL, SONET, and Ethernet-based MANs. You also learn how WAN protocols, such as SLIP, PPP, and SS7, are used.
- **Chapter 8: ATM Technologies** gives you an understanding of Asynchronous Transfer Mode (ATM) as it is used in LANs and WANs. You learn about ATM cell structure, ATM layered communications, design methods for ATM, and how to deploy ATM on a LAN, WAN, or both.
- **Chapter 9: Wireless Technologies** enables you to learn about several types of wireless LAN and WAN technologies and how they are applied. You gain an understanding of the 802.11 wireless standard and you learn about Bluetooth, HiperLAN, and the HomeRF Shared Wireless Access Protocol. You also learn about infrared, microwave, and satellite wireless networking.
- **Chapter 10: Integrating Voice, Video, and Data** enables you to learn networking using a combination of voice, video, and data technologies. You learn about multimedia applications and how to design networks to accommodate them. Included in the chapter is a section about Voice over IP and a look at how to prepare networks for future advances in multimedia applications.
- **Chapter 11: LAN and WAN Design: Putting It All Together** takes everything you have

learned up to this point and applies it to designing and implementing LANs and WANs. Structured wiring and structured networking design techniques are also emphasized.

- **Appendix A: Network Equipment Vendors** provides a listing of companies that make a full range of network devices, including cable, CSU/DSUs, and routers. URLs are provided so that you can instantly find the Web sites of these companies.

## Features

To ensure a successful learning experience, this book includes the following pedagogical features:

- **Chapter Objectives:** Each chapter in this book begins with a detailed list of the concepts to be mastered within that chapter. This list provides you with a quick reference to the contents of that chapter, as well as a useful study aid.
- **Illustrations, Screen Captures, and Tables:** Network diagrams, reproductions of screens, and illustrations of concepts aid you in the visualization of theories, concepts, and design principles. In addition, many tables provide details and comparisons of both practical and theoretical information and can be used for a quick review of topics.
- **Hands-on Projects:** One of the best ways to reinforce learning about LANs and WANs is to practice using network devices and network operating systems, and to create your own network diagrams. Each chapter in this book contains many Hands-on Projects that give you experience implementing what you have learned. The Hands-on Projects give you a rich set of experiences that you can replicate at any time or use as building blocks for more complex activities.
- **End-of-Chapter Material:** The end of each chapter includes the following features to reinforce the material covered in the chapter:
  - **Chapter Summary:** A bulleted list gives a brief but complete summary of the chapter and can be used as a study guide.
  - **Key Terms:** Important terms that are discussed in the chapter are reviewed in one place for easy reference.
  - **Review Questions:** A list of review questions tests your knowledge of the most important concepts covered in the chapter.
  - **Hands-on Projects:** These enable students to connect the theoretical with practical hands-on learning.
  - **Case Projects:** In each case project, you act as a consultant for a fictional company called Network Design Consultants. Each case project is divided into multiple assignments to enable you to apply the knowledge you have gained to a real-world scenario.
  - **Optional Team Case Projects:** Each chapter concludes with optional team case projects that enable you to work in a small group of students to solve a real-world problem or to extensively research a topic. These projects give you experience working as a team member, which is a common format used by many businesses

and corporations.

## Text and Graphic Conventions

Wherever appropriate, additional information and exercises have been added to this book to help you better understand what is being discussed in the chapter. Icons throughout the text alert you to additional materials. The icons used in this textbook are as follows:



The Note icon is used to present additional helpful material related to the subject being described.



Tips are included from the authors' experiences to provide extra information about how to attack problems or what to do in certain real-world situations.



Hands-on Project icons precede each hands-on activity in this book.



Case Projects icons are located at the end of each chapter. They mark more involved, scenario-based projects.



The Optional Team Case Projects icons denote group projects that provide students with an opportunity to work collaboratively to brainstorm real-world issues that might occur on the job.

## Instructor's Materials

The following supplemental materials are available when this book is used in a classroom setting. All of the supplements available with this book are provided to the instructor on a single CD-ROM.

**Electronic Instructor's Manual.** The Instructor's Manual that accompanies this textbook includes:

- Additional instructional material to assist in class preparation, including suggestions for classroom activities, discussion topics, quizzes, and additional exercises.
- Solutions to all end-of-chapter materials, including the Review Questions, Case Projects, and Optional Team Case Projects.

**ExamView®.** This textbook is accompanied by ExamView, a powerful testing software package that allows instructors to create and administer printed, computer (LAN-based), and Internet exams. ExamView includes hundreds of questions that correspond to the topics covered in this text, enabling students to generate detailed study guides that include page references for further review. The computer-based and Internet testing components allow students to take exams at their computers and save the instructor time by grading each exam automatically.

**PowerPoint Presentations.** This book comes with Microsoft PowerPoint slides for each chapter. These are included as a teaching aid for classroom presentation, to make available to

students on the network for chapter review, or to be printed for classroom distribution. Instructors, please feel at liberty to add your own slides for additional topics you introduce to the class.

**Figure Files.** All of the figures and tables in the book are reproduced on the Instructor's Resource CD, in bit-mapped format. Similar to the PowerPoint presentations, these are included as a teaching aid for classroom presentation, to make available to students for review, or to be printed for classroom distribution.

## **Student's Materials**

The instructor's CD-ROM comes with the following materials for students:

**Student Case Assignment Files.** These files contain the end-of-chapter Case and Optional Team Case Projects assignments in electronic format so that students can enter their answers and submit them through e-mail, to a shared network folder, or print them for submission to the instructor.

**Clipart for Network Diagrams.** Clipart of network devices is available for students using drawing packages that do not include these figures.

# Read This Before You Begin

Because your lab may be equipped with different operating systems, the book presents Hands-on Projects for Windows 2000 Professional, Windows 2000 Server, Windows XP Professional, and Red Hat Linux 7.x. You can use any combination of these operating systems. The interfaces for the operating systems should be configured as follows:

- **For Windows 2000 Professional or Server:** Use the default graphical user interface.
- **For Windows XP Professional:** Use the new experiential GUI Windows XP Display style or Category View for Windows XP (*do not use the Windows Classical style or Classic View*).
- **For Red Hat Linux 7.x:** Use the GNOME X Window desktop.

Many of the Hands-on Projects involve responses from students. The authors recommend that students keep a lab journal or a running word-processed document in which to record their responses or findings. In some cases, instructors may want to review the students' progress by examining the entries in their lab journals or word-processed documents.

In addition to the operating systems mentioned, the following elements are important for the Hands-on Projects:

- A lab with networked computers
- Workstations equipped with Web browsers able to access the Internet
- A drawing package, such as VISIO, SmartDraw, AutoCAD, or Microsoft Paint
- An Ethernet or token ring network on which to view devices and how they are used
- A TCP/IP-based network
- A network hub or switch and network cable
- Thinnet, twisted-pair, and fiber-optic cable samples
- Materials from which to build twisted-pair and coaxial cable ( place connectors on the cable)
- Examples of different types of network devices for students to view or the ability to view these via a tour
- Access to a campus network or local business network that has WAN facilities

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## **Dedication**

I dedicate this book to Edward Palmer who is an incredible brother, friend, and human being.

— Michael Palmer

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