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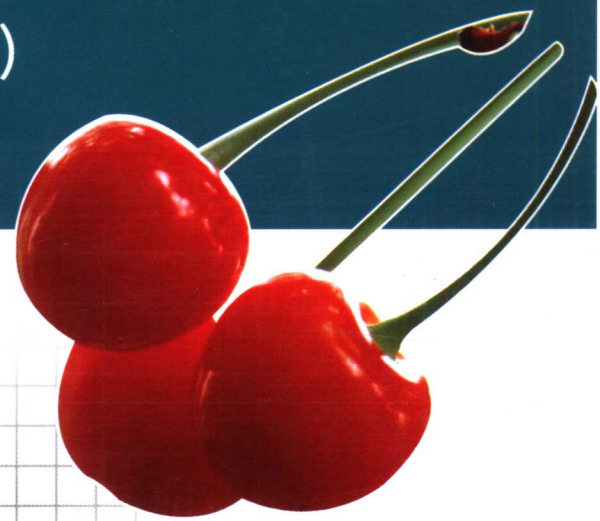
FOURTH EDITION

计算机网络

（第4版）



Andrew S. Tanenbaum 著

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Computer Networks

Fourth Edition

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（第4版）

Andrew S. Tanenbaum

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进入21世纪，世界各国的经济、科技以及综合国力的竞争将更加激烈。竞争的中心无疑是对人才的竞争。谁拥有大量高素质的人才，谁就能在竞争中取得优势。高等教育，作为培养高素质人才的事业，必然受到高度重视。目前我国高等教育的教材更新较慢，为了加快教材的更新频率，教育部正在大力促进我国高校采用国外原版教材。

清华大学出版社从1996年开始，与国外著名出版公司合作，影印出版了“大学计算机教育丛书（影印版）”等一系列引进图书，受到了国内读者的欢迎和支持。跨入21世纪，我们本着为我国高等教育教材建设服务的初衷，在已有的基础上，进一步扩大选题内容，改变图书开本尺寸，一如既往地请有关专家挑选适用于我国高校本科及研究生计算机教育的国外经典教材或著名教材，组成本套“大学计算机教育国外著名教材系列（影印版）”，以飨读者。深切期盼读者及时将使用本系列教材的效果和意见反馈给我们。更希望国内专家、教授积极向我们推荐国外计算机教育的优秀教材，以利我们把“大学计算机教育国外著名教材系列（影印版）”做得更好，更适合高校师生的需要。

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PREFACE

This book is now in its fourth edition. Each edition has corresponded to a different phase in the way computer networks were used. When the first edition appeared in 1980, networks were an academic curiosity. When the second edition appeared in 1988, networks were used by universities and large businesses. When the third edition appeared in 1996, computer networks, especially the Internet, had become a daily reality for millions of people. The new item in the fourth edition is the rapid growth of wireless networking in many forms.

The networking picture has changed radically since the third edition. In the mid-1990s, numerous kinds of LANs and WANs existed, along with multiple protocol stacks. By 2003, the only wired LAN in widespread use was Ethernet, and virtually all WANs were on the Internet. Accordingly, a large amount of material about these older networks has been removed.

However, new developments are also plentiful. The most important is the huge increase in wireless networks, including 802.11, wireless local loops, 2G and 3G cellular networks, Bluetooth, WAP, i-mode, and others. Accordingly, a large amount of material has been added on wireless networks. Another newly-important topic is security, so a whole chapter on it has been added.

Although Chap. 1 has the same introductory function as it did in the third edition, the contents have been revised and brought up to date. For example, introductions to the Internet, Ethernet, and wireless LANs are given there, along with some history and background. Home networking is also discussed briefly.

Chapter 2 has been reorganized somewhat. After a brief introduction to the principles of data communication, there are three major sections on transmission (guided media, wireless, and satellite), followed by three more on important examples (the public switched telephone system, the mobile telephone system, and cable television). Among the new topics covered in this chapter are ADSL, broadband wireless, wireless MANs, and Internet access over cable and DOCSIS.

Chapter 3 has always dealt with the fundamental principles of point-to-point protocols. These ideas are essentially timeless and have not changed for decades.

Accordingly, the series of detailed example protocols presented in this chapter is largely unchanged from the third edition.

In contrast, the MAC sublayer has been an area of great activity in recent years, so many changes are present in Chap. 4. The section on Ethernet has been expanded to include gigabit Ethernet. Completely new are major sections on wireless LANs, broadband wireless, Bluetooth, and data link layer switching, including MPLS.

Chapter 5 has also been updated, with the removal of all the ATM material and the addition of additional material on the Internet. Quality of service is now also a major topic, including discussions of integrated services and differentiated services. Wireless networks are also present here, with a discussion of routing in ad hoc networks. Other new topics include NAT and peer-to-peer networks.

Chap. 6 is still about the transport layer, but here, too, some changes have occurred. Among these is an example of socket programming. A one-page client and a one-page server are given in C and discussed. These programs, available on the book's Web site, can be compiled and run. Together they provide a primitive remote file or Web server available for experimentation. Other new topics include remote procedure call, RTP, and transaction/TCP.

Chap. 7, on the application layer, has been more sharply focused. After a short introduction to DNS, the rest of the chapter deals with just three topics: e-mail, the Web, and multimedia. But each topic is treated in great detail. The discussion of how the Web works is now over 60 pages, covering a vast array of topics, including static and dynamic Web pages, HTTP, CGI scripts, content delivery networks, cookies, and Web caching. Material is also present on how modern Web pages are written, including brief introductions to XML, XSL, XHTML, PHP, and more, all with examples that can be tested. The wireless Web is also discussed, focusing on i-mode and WAP. The multimedia material now includes MP3, streaming audio, Internet radio, and voice over IP.

Security has become so important that it has now been expanded to a complete chapter of over 100 pages. It covers both the principles of security (symmetric- and public-key algorithms, digital signatures, and X.509 certificates) and the applications of these principles (authentication, e-mail security, and Web security). The chapter is both broad (ranging from quantum cryptography to government censorship) and deep (e.g., how SHA-1 works in detail).

Chapter 9 contains an all-new list of suggested readings and a comprehensive bibliography of over 350 citations to the current literature. Over 200 of these are to papers and books written in 2000 or later.

Computer books are full of acronyms. This one is no exception. By the time you are finished reading this one, the following should ring a bell: ADSL, AES, AMPS, AODV, ARP, ATM, BGP, CDMA, CDN, CGI, CIDR, DCF, DES, DHCP, DMCA, FDM, FHSS, GPRS, GSM, HDLC, HFC, HTML, HTTP, ICMP, IMAP, ISP, ITU, LAN, LMDS, MAC, MACA, MIME, MPEG, MPLS, MTU, NAP, NAT, NSA, NTSC, OFDM, OSPF, PCF, PCM, PGP, PHP, PKI, POTS,

PPP, PSTN, QAM, QPSK, RED, RFC, RPC, RSA, RSVP, RTP, SSL, TCP, TDM, UDP, URL, UTP, VLAN, VPN, VSAT, WAN, WAP, WDMA, WEP, WWW, and XML But don't worry. Each will be carefully defined before it is used.

To help instructors using this book as a text for a course, the author has prepared various teaching aids, including

- A problem solutions manual.
- Files containing the figures in multiple formats.
- PowerPoint sheets for a course using the book.
- A simulator (written in C) for the example protocols of Chap. 3.
- A Web page with links to many tutorials, organizations, FAQs, etc.

The solutions manual is available directly from Prentice Hall (but **only** to instructors, not to students). All the other material is on the book's Web site:

http://www.prenhall.com/tanenbaum

From there, click on the book's cover.

Many people helped me during the course of the fourth edition. I would especially like to thank the following people: Ross Anderson, Elizabeth Belding-Royer, Steve Bellovin, Chatschik Bisdikian, Kees Bot, Scott Bradner, Jennifer Bray, Pat Cain, Ed Felten, Warwick Ford, Kevin Fu, Ron Fulle, Jim Geier, Mario Gerla, Natalie Giroux, Steve Hanna, Jeff Hayes, Amir Herzberg, Philip Homburg, Philipp Hoschka, David Green, Bart Jacobs, Frans Kaashoek, Steve Kent, Roger Kermode, Robert Kinicki, Shay Kutten, Rob Lanphier, Marcus Leech, Tom Maufer, Brent Miller, Shivakant Mishra, Thomas Nadeau, Shlomo Ovadia, Kaveh Pahlavan, Radia Perlman, Guillaume Pierre, Wayne Pleasant, Patrick Powell, Thomas Robertazzi, Medy Sanadidi, Christian Schmutzer, Henning Schulzrinne, Paul Sevinc, Mihail Sichitiu, Bernard Sklar, Ed Skoudis, Bob Strader, George Swallow, George Thiruvathukal, Peter Tomsu, Patrick Verkaik, Dave Vittali, Spyros Voulgaris, Jan-Mark Wams, Ruediger Weis, Bert Wijnen, Joseph Wilkes, Leendert van Doorn, and Maarten van Steen.

Special thanks go to Trudy Levine for proving that grandmothers can do a fine job of reviewing technical material. Shivakant Mishra thought of many challenging end-of-chapter problems. Andy Dornan suggested additional readings for Chap. 9. Jan Looyen provided essential hardware at a critical moment. Dr. F. de Nies did an expert cut-and-paste job right when it was needed. My editor at Prentice Hall, Mary Franz, provided me with more reading material than I had consumed in the previous 7 years and was helpful in numerous other ways as well.

Finally, we come to the most important people: Suzanne, Barbara, and Marvin. To Suzanne for her love, patience, and picnic lunches. To Barbara and Marvin for being fun and cheery all the time (except when complaining about awful college textbooks, thus keeping me on my toes). Thank you.

ANDREW S. TANENBAUM

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