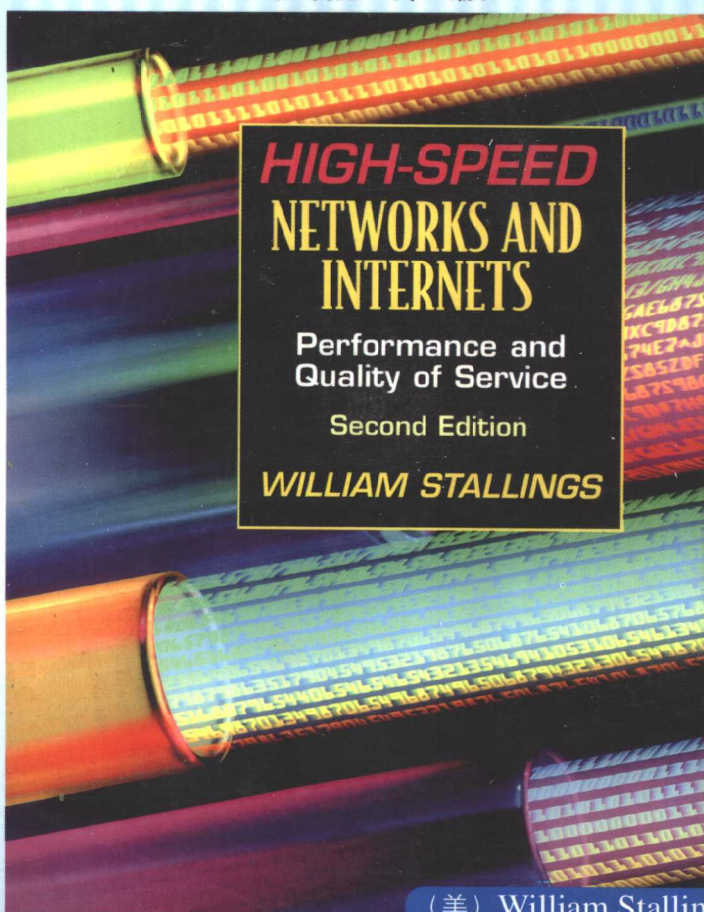


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高速网络与因特网

性能与服务质量

(英文版·第2版)



(美) William Stallings 著

机械工业出版社
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High-Speed Networks and Internets
Performance and Quality of Service

(Second Edition)

江苏工业学院图书馆
藏书章

(美) William Stallings 著

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出版者的话

文艺复兴以降，源远流长的科学精神和逐步形成的学术规范，使西方国家在自然科学的各个领域中取得了垄断性的优势；也正是这样的传统，使美国在信息技术发展的六十多年间名家辈出、独领风骚。在商业化的进程中，美国的产业界与教育界越来越紧密地结合，计算机学科中的许多泰山北斗同时身处科研和教学的最前线，由此而产生的经典科学著作，不仅擘划了研究的范畴，还揭橥了学术的源变，既遵循学术规范，又自有学者个性，其价值并不会因年月的流逝而减退。

近年，在全球信息化大潮的推动下，我国的计算机产业发展迅猛，对专业人才的需求日益迫切。这对计算机教育界和出版界都既是机遇，也是挑战；而专业教材的建设在教育战略上显得举足轻重。在我国信息技术发展时间较短、从业人员较少的现状下，美国等发达国家在其计算机科学发展的几十年间积淀的经典教材仍有许多值得借鉴之处。因此，引进一批国外优秀计算机教材将对我国计算机教育事业的发展起积极的推动作用，也是与世界接轨、建设真正的世界一流大学的必由之路。

机械工业出版社华章图文信息有限公司较早意识到“出版要为教育服务”。自1998年始，华章公司就将工作重点放在了遴选、移译国外优秀教材上。经过几年的不懈努力，我们与Prentice Hall, Addison-Wesley, McGraw-Hill, Morgan Kaufmann等世界著名出版公司建立了良好的合作关系，从它们现有的数百种教材中甄选出Tanenbaum, Stroustrup, Kernighan, Jim Gray等大师名家的一批经典作品，以“计算机科学丛书”为总称出版，供读者学习、研究及度藏。大理石纹理的封面，也正体现了这套丛书的品位和格调。

“计算机科学丛书”的出版工作得到了国内外学者的鼎力襄助，国内专家不仅提供了中肯的选题指导，还不辞劳苦地担任了翻译和审校的工作；而原书的作者也相当关注其作品在中国的传播，有的还专诚为其书的中译本作序。迄今，“计算机科学丛书”已经出版了近百个品种，这些书籍在读者中树立了良好的口碑，并被许多高校采用为正式教材和参考书籍，为进一步推广与发展打下了坚实的基础。

随着学科建设的初步完善和教材改革的逐渐深化，教育界对国外计算机教材的需求和应用都步入一个新的阶段。为此，华章公司将加大引进教材的力度，在“华章教育”的总规划之下出版三个系列的计算机教材：针对本科生的核心课程，剔除外版菁华而成“国外经典教材”系列；对影印版的教材，则单独开辟出“经典原版书库”；定位在高级教程和专业参考的“计算机科学丛书”还将保持原来的风格，继续出版新的品种。为了保证这三套丛书的权威性，同时也为了更好地为学校和老师服务，华章公司聘请了中国科学院、北京大学、清华大学、国防科技大学、复旦大学、上海交通大学、南京大学、浙江大学、中国科技大学、哈尔滨工业大学、西安交通大学、中国人民大学、北京航空航天大学、北京邮电大学、中山大学、解放军理工大学、郑州大学、湖北工学院、中国国家信息安全测评认证中心等国内重点大学和科研机构在计算机的各个领域的著名学者组成“专家指导委员会”，为我们提供选题意见和出版监督。

“经典原版书库”是响应教育部提出的使用原版国外教材的号召，为国内高校的计算机教学度身订造的。在广泛地征求并听取丛书的“专家指导委员会”的意见后，我们最终选定了这30多种篇幅内容适度、讲解鞭辟入里的教材，其中的大部分已经被M.I.T.、Stanford、U.C. Berkley、C.M.U.等世界名牌大学采用。丛书不仅涵盖了程序设计、数据结构、操作系统、计算机体系结构、数据库、编译原理、软件工程、图形学、通信与网络、离散数学等国内大学计算机专业普遍开设的核心课程，而且各具特色——有的出自语言设计者之手、有的历三十年而不衰、有的已被全世界的几百所高校采用。在这些圆熟通博的名师大作的指引之下，读者必将在计算机科学的宫殿中由登堂而入室。

权威的作者、经典的教材、一流的译者、严格的审校、精细的编辑，这些因素使我们的图书有了质量的保证，但我们的目标是尽善尽美，而反馈的意见正是我们达到这一终极目标的重要帮助。教材的出版只是我们的后续服务的起点。华章公司欢迎老师和读者对我们的工作提出建议或给予指正，我们的联系方式如下：

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PREFACE

This book aims at helping to disentangle from an immense mass of material the crucial issues and cardinal decisions. Throughout I have set myself to explain faithfully and to the best of my ability what happened and why.

—The World Crisis, Winston Churchill

BACKGROUND

High-speed networks now dominate both the wide-area network (WAN) and local area network (LAN) markets. In the WAN market, two related trends have appeared. Public and private data networks have evolved from packet-switching networks in the 10s and 100s of kbps, to frame relay networks operating at up to 2 Mbps, and now to asynchronous transfer mode (ATM) networks operating at 155 Mbps or more. For the Internet and private corporate internets, data rates have also soared, with one noteworthy milestone being the construction of a 155-Mbps backbone in 1996.

For many years, the most common LAN was the 10-Mbps shared Ethernet. Then came the switched Ethernet, which offers a dedicated 10 Mbps to each end system. This was followed by Fast Ethernet at 100 Mbps and now Gigabit Ethernet and 10-Gbps Ethernet. Recent years have also seen the introduction of Fibre Channel LANs with speeds up to 3.2 Gbps and wireless LANs with speeds up to 54 Mbps.

This rapid introduction of high-speed networks has spurred the development of new applications and has in turn been driven by the popularity of those applications. Key driving forces have been the increasing use of still image and video data in applications and the popularity of the World Wide Web.

OBJECTIVES

High-speed networks, including gigabit networks, form the focus of the book. Design issues related to two types of networks occupy our attention: internets based on the Internet Protocol (IP) and the entire TCP/IP protocol suite, and ATM (asynchronous transfer mode) networks. These two net-

working technologies dominate the high-speed scene and share many common design approaches.

The objective of this book is to provide an up-to-date survey of developments in this area. Central problems that confront the network designer are the need to support multimedia and real-time traffic, the need to control congestion, and the need to provide different levels of quality of service (QoS) to different applications.

INTENDED AUDIENCE

This book is intended for both a professional and an academic audience. For the professional interested in this field, the book serves as a basic reference volume and is suitable for self-study.

As a textbook, it is suitable for an advanced undergraduate or graduate course. The book treats a number of advanced topics and provides a brief survey of the required elementary topics. After Parts One and Two, the parts are relatively independent. Fewer parts could be covered for a shorter course, and the parts can be covered in any order.

PLAN OF THE BOOK

The book is divided into seven parts:

Part One. Background: Provides a brief survey of fundamental principles, with coverage of TCP/IP and internetworking.

Part Two. High-Speed Networks: Provides an overview of frame relay networks, ATM networks, and high-speed LANs.

Part Three. Performance Modeling and Estimation: The modeling of traffic flow is important both for network design and configuration and for the request of network services. This part provides a tutorial on the use of queuing analysis to model throughput, delay, and buffer requirements. There is increasing evidence that much of the traffic on high-speed networks is self-similar, for which the traditional queuing analysis does not apply. The nature of self-similar traffic, and modeling approaches, are examined.

Part Four. Congestion and Traffic Management: Begins with a discussion of congestion control issues and design approaches for networks and internets. The relatively simple case of link level flow control is used to introduce issues of end-to-end flow control. This part then discusses end-to-end performance parameters and techniques used by TCP to achieve high throughput and to manage congestion. Finally, the part deals with traffic management and congestion control in ATM networks.

Part Five. Internet Routing: Covers the major approaches to routing, including distance-vector, link-state, and path-vector routing, and examines multicast routing.

Part Six. Quality of Service in IP Networks: Within an IP-based network, techniques are needed to control congestion and to provide the desired QoS to active applications. This part surveys those techniques, beginning with a discussion of integrated and differentiated services. Then, important protocols that relate to QoS are examined, including RSVP, MLPS, and RTP.

Part Seven. Compression: Covers both lossless and lossy compression techniques.

In addition, the book includes an extensive glossary, a list of frequently used acronyms, and a bibliography. Each chapter includes problems, suggestions for further reading, and pointers to relevant Web sites.

INTERNET SERVICES FOR INSTRUCTORS AND STUDENTS

There is a Web page for this book that provides support for students and instructors. The page includes links to relevant sites, transparency masters of figures and tables in the book in PDF (Adobe Acrobat) format, PowerPoint slides, and sign-up information for the book's internet mailing list. The Web page is at WilliamStallings.com/HsNet2e.html; see Chapter 1 for more details. An Internet mailing list has been set up so that instructors using this book can exchange information, suggestions, and questions with each other and with the author. As soon as typos or other errors are discovered, an errata list for this book will be available at WilliamStallings.com. Finally, I maintain the Computer Science Student Resource Site at WilliamStallings.com/StudentSupport.html.

SOCKETS PROGRAMMING

The book includes a description of Sockets (Appendix B), and the instructor's manual includes a set of programming projects. The appendix includes a concise overview of Sockets, a discussion of the importance of this facility and a short primer on how to use Sockets, as well as pointers for getting more information on the Web. Sockets programming is an "easy" topic and one that can result in very satisfying hands-on projects for students.

WHAT'S NEW IN THE SECOND EDITION

In the four years since the first edition of this book was published, the field has seen continued innovations and improvements. In this edition, I try to capture these changes while maintaining a broad and comprehensive coverage of the entire field. To begin the process of revision, the first edition of this book was extensively reviewed by a number of professors who teach the subject and by professionals

working in the field. The result is that, in many places, the narrative has been clarified and tightened, and illustrations have been improved. Also, a number of new “field-tested” problems have been added.

Beyond these refinements to improve pedagogy and user friendliness, the technical content of the book has been updated throughout, to reflect the ongoing changes in this exciting field. In addition, the book has been reorganized to provide a better grouping of topics. Some of the most noteworthy changes are the following:

- **Congestion control:** A separate chapter is now devoted to this topic. This unified presentation clarifies the issues involved.
- **Differentiated services:** There have been substantial developments since the publication of the first edition in enhancements to the Internet to support a variety of multimedia and time-sensitive traffic. The most important development, and perhaps the most important vehicle for providing QoS in IP-based networks is differentiated services (DS). This edition provides thorough coverage of DS.
- **Guaranteed frame rate (GFR):** Since the first edition, a new ATM service has been standardized: GFR. GFR is designed specifically to support IP backbone subnetworks. This edition provides an explanation of GFR and examines the mechanisms underlying the GFR service.
- **Multiprotocol label switching (MPLS):** MPLS has emerged as a fundamentally important technology in the Internet and is covered in this edition.
- **TCP/IP details:** A new background chapter on TCP and IP has been added, pulling together material scattered throughout the first edition. This material is vital to an understanding of QoS and performance issues in IP-based networks.
- **High-speed LANs:** The chapter on high-speed LANs has been extensively updated and revised. The material on Ethernet now includes 10-Gbps Ethernet. The chapter now covers Fibre Channel and high-speed wireless LANs.
- **Frame relay:** Despite the importance and growing acceptance of ATM, frame relay remains the most widely used high-speed WAN technology. Accordingly, the coverage of the frame relay protocol and frame relay congestion control is expanded in this edition.
- **Wavelet compression:** Wavelet compression has become increasingly popular and is covered in this edition.

ACKNOWLEDGMENTS

This new edition has benefited from review by a number of people, who gave generously of their time and expertise. The following people reviewed all or a large part of the manuscript: Chunming Qiao (SUNY–Buffalo), Ken Christensen (U. of South Florida), George Polyzoa (UC–San Diego), Ying Sun (U. of Rhode Island), and George Scheets (Oklahoma State).

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Finally, I would like to thank the many people responsible for the publication of the book, all of whom did their usual excellent job. This includes the staff at Prentice Hall, particularly my editors Toni Holm and Alan Apt and production manager Rose Kernan. Also, Jake Warde of Warde Publishers managed the supplements and reviews; Joanna V. Pomeranz, at V&M managed the book's printing; and Patricia M. Daly did the copy editing.

With all this assistance, little remains for which I can take full credit. However, I am proud to say that, with no help whatsoever, I selected all of the quotations.

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