BUSINESS DATA COMMUNICATIONS

THIRD EDITION

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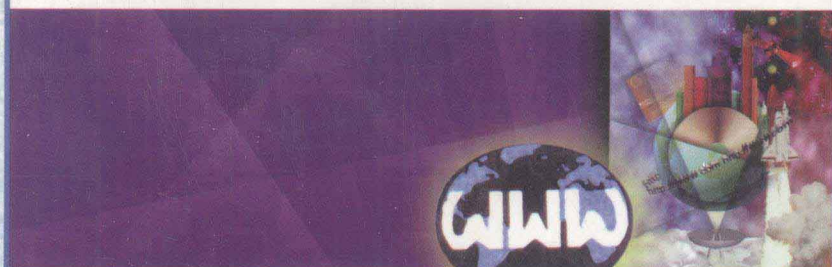
WILLIAM STALLINGS ● RICHARD VAN SLYKE

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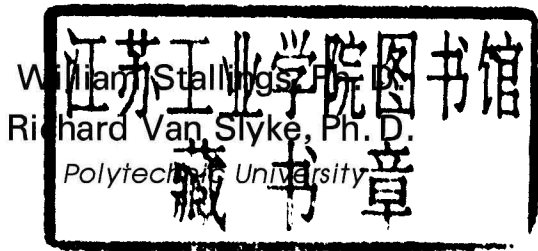
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Prentice-Hall International, Inc.

（京）新登字 158 号

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出 版 前 言

我们的大学生、研究生毕业后,面临的将是一个国际化的信息时代。他们将需要随时查阅大量的外文资料;会有更多的机会参加国际性学术交流活动;接待外国学者;走上国际会议的讲坛。作为科技工作者,他们不仅应有与国外同行进行口头和书面交流的能力,更为重要的是,他们必须具备极强的查阅外文资料获取信息的能力。有鉴于此,在国家教委所颁布的"大学英语教学大纲"中有一条规定:专业阅读应作为必修课程开设。同时,在大纲中还规定了这门课程的学时和教学要求。有些高校除开设"专业阅读"课之外,还在某些专业课拟进行英语授课。但教、学双方都苦于没有一定数量的合适的英文原版教材作为教学参考书。为满足这方面的需要,我们挑选了 7 本计算机科学方面最新版本的教材,进行影印出版。首批影印出版的 6 本书受到广大读者的热情欢迎,我们深受鼓舞,今后还将陆续推出新书。希望读者继续给予大力支持。Prentice Hall 公司和清华大学出版社这次合作将国际先进水平的教材引入我国高等学校,为师生们提供了教学用书,相信会对高校教材改革产生积极的影响。

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Background

Four trends have made a solid understanding of the fundamentals of **data communications** essential to business and information management students·

- *The increasing use of data processing equipment.* As the cost of computer hardware has dropped, data processing equipment has become an increasingly important and pervasive part of the office, factory, and engineering environments.

- *The increasing use of distributed systems.* The dropping hardware costs have resulted in the increasing use of small systems, including minicomputers, microcomputer workstations, and personal computers. These systems are distributed throughout a business and must be interconnected to exchange messages, share files, and share resources, such as printers.

- *The increasing diversity of networking options.* The emergence of a broad range of local area network (LAN) standards plus the evolution of LAN technology have led to a broad, overlapping range of products for local-area communications. Similarly, the planning for the next generation of telephone equipment and networks, and the evolution of new transmission and networking technologies have led to a broad, overlapping range of options for long-distance communications.

- *The sudden emergence of the Internet and the World Wide Web.* In a very short time, the Internet and especially the World Wide Web, have attracted millions of business and personal users. No business can ignore the potential of this enormous facility.

As a result of these factors, business data communications courses have become common in business and information management sequences, and this book intends to address the needs for such a course. However, a focus on data communications is no longer enough.

Over the past twenty years, as data processing capability has been introduced into the office, data communications products and services have gradually

assumed increasing importance. Now, technological developments and the widespread acceptance of standards are transforming the ways in which information is used to support the business function. In addition to the traditional communications requirements for voice and data (meaning text and numerical data), there is now the need to deal with pictorial images and video information. These four types of information (voice, data, image, and video) are essential to the survival of any business in today's competitive international environment. What is needed is a treatment not just of data communications but of **information communications** for the business environment.

Information communications and computer networking have become essential to the functioning of today's businesses, large and small. Furthermore, they have become a major and growing cost to organizations. Management and staff need a thorough understanding of information communications in order to assess needs; plan for the introduction of products, services, and systems; and manage the systems and technical personnel that operate them. This understanding must comprise:

- *Technology:* the underlying technology of information communications facilities, networking systems, and communications software.
- *Architecture:* the way in which hardware, software, and services can be organized to provide computer and terminal interconnection.
- *Applications:* How information communications and networking systems can meet the requirements of today's businesses.

Approach

The purpose of this text is to present the concepts of information communications in a way that relates specifically to the business environment and to the concerns of business management and staff. To this end, the book takes an approach based on requirements, ingredients, and applications:

- *Requirements:* The need to provide services which enable businesses to utilize information is the driving force behind data and information communications technology. The text outlines the specific requirements that this technology is intended to address. This linkage between requirements and technology is essential to motivate a text of this nature.
- *Ingredients:* The technology of information communications includes the hardware, software, and communications services available to support distributed systems. An understanding of this technology is essential for a manager to make intelligent choices among the many alternatives.
- *Applications:* Management and staff must understand not only the technology but also the way in which that technology can be applied to satisfy business requirements.

These three concepts structure the presentation. They provide a way for the student to understand the context of what is being discussed at any point in the text, and they motivate the material. Thus, the student will gain a *practical* understanding of business information communications.

An important theme throughout the book is the essential role of standards. The proliferation of personal computers and other computer systems inevitably means that the manager will be faced with the need to integrate equipment from a variety of vendors. The only way to manage this requirement effectively is through standards. And, indeed, increasingly vendors are offering products and services that conform to international standards. This text addresses some of the key groupings of standards that are shaping the marketplace and that define the choices available to the decision-maker.

Intended Audience

This book is addressed to students and professionals who now have or expect to have some information communications responsibility. As a full-time job, some readers may have or plan to have responsibility for management of the company's telecommunications function. But virtually all managers and many staff personnel will need to have a basic understanding of business information communications to effectively perform their tasks.

For students, this text is intended as an introductory course in information communications for business and information management students. It does not assume any background in data communications, but does assume a basic knowledge of data processing.

The book is also intended for self-study, and is designed for use both as a tutorial and a reference book for those already involved in business information communications.

Plan of the Text

This text is a survey of the broad and fast-changing field of information communications. It is organized in such a way that new material is seen to fit into the context of the material already presented. By emphasizing requirements and applications as well as technology, the student is provided with motivation and a means of assessing the importance of a particular topic with respect to the whole. The book is divided into five parts:

1. *Requirements:* This part defines the needs for information communications in the business environment. It discusses the way in which various forms of information are used and the need for interconnection and networking facilities. An examination of the nature and role of distributed data processing is the highlight of this first part.

2. *Fundamentals:* This part deals with the basic technology of the communication of information. The emphasis is on digital communications techniques, since these are rapidly displacing analog techniques for all products and services related to information communications. Key topics include transmission media, data link control protocols, multiplexing, and compression.

3. *Networking:* This part examines the way in which communications facilities are organized into a network. There is a wide variety of options available to the manager and planner; this part intends to present the range of

options and compare their strengths and weaknesses, so that the reader can make informed choices based on specific requirements. Both wide-area networks (WANs) and local area networks (LANs) are covered.

4. *Applications:* This part deals with the specific business applications that require information communications facilities and networks. Following a look at the underlying TCP/IP protocol suite, this part presents key applications such as electronic mail, electronic document interchange, and the World Wide Web. The part closes with a discussion of client/server computing and intranets.

5. *Management Issues:* This part examines some of the most important issues that confront the manager with respect to the in-house implementation or the purchase of networking and communications services. It begins with the increasingly important issue of doing business on the Internet. This is followed by a discussion of network management and network security.

In addition, the book includes an extensive glossary, a list of frequently-used acronyms, and a bibliography. Each chapter includes problems and suggestions for further reading. Finally, a number of real-world cases studies are sprinkled throughout the book.

Note to the Instructor

The major goal of this text is to make it as effective a teaching tool for this exciting and fast-moving subject as possible. This goal is reflected both in the structure of the book and in the supporting material.

The text itself contains a number of features that provide strong pedagogical support for the instructor. Each chapter begins with a list of chapter objectives, which provides, in effect, an outline of the chapter and alerts the student to look for certain key concepts as the chapter is read. Key terms are introduced in bold face in the chapter, and all of the new key terms for that chapter are listed at the end of the chapter. In addition, all new acronyms are highlighted and listed at the end of the chapter; this is important because the field of information communications, unfortunately, is loaded with acronyms. A glossary and list of acronyms at the end of the book provide a handy summary of all key terms and acronyms. At the end of each chapter, there is a summary which highlights the key concepts and places them in the context of the entire book. In addition, there are questions and homework problems to reinforce and extend what has been learned. The book is also liberally supplied with figures, tables, and charts to enhance the points made in the text.

Throughout the book a number of case studies are presented. These are not "made-up" or "toy" cases, but actual cases reported in the literature. Each case is chosen to reinforce or extend the concepts introduced prior to the case study.

The text is also accompanied by supplementary material which will aid the instructor. A solutions manual provides answers to most of the problems at the end of each chapter. A test bank of additional problems is also available. A set of transparencies are available that reproduce all of the figures in the book.

Internet Services for Instructors and Students

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. 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 in the book in PDF (Adobe Acrobat) format, and sign-up information for the book's internet mailing list. The web page is at http://www.shore.net/~ws/BDC3e.html.

As soon as any typos or other errors are discovered, an errata list for this book will be available at http://www.shore.net/~ws.

Note to the Reader

In a book on this topic, for this sort of audience, it is tempting to launch immediately into a description of communications and networking technology, and to examine and compare the various approaches. Certainly, this is an essential element of a book that deals with business information communications. However, we believe that this approach is inappropriate. The business reader wants, and rightly so, to see the technical material in the context of the needs of the business and the ways in which communications and networking technology support desired business functions. Thus this book begins by defining the requirements for information communications in business. The types of information and their utility are examined first. This sets the stage for an examination of communications and networking alternatives. And, as these alternatives are presented and compared, the applications for which they are suited, as well as the underlying technology, are explored. It is hoped that this strategy will make the material more comprehensible and provides a structure that is more natural to a reader with a business orientation.

What's New in the Third Edition

This third edition is seeing the light of day less than eight years after the publication of the first edition. Much has happened during those years. Indeed, the pace of change, if anything, is increasing. The result is that this revision is more comprehensive and thorough than any of the previous ones. As an indication of this, about one-half of the figures and one-half of the tables in this edition are new. Every chapter has been revised and new chapters have been added.

To begin this process of revision, the second edition of this book was extensively reviewed by a number of professors who taught from that edition. 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, there have been major substantive changes throughout the book. Highlights include:

- **The Internet, the Web, and Intranets:** The Internet was barely on the business radar screen when the second edition came out. What a differ-

ence it has made! Virtually all companies have or are planning some kind of Web presence and virtually all companies provide Internet access for their employees for electronic mail and information gathering. Most companies also have or are planning an internal Internet-style facility, known as an intranet. An entire new chapter of the book is devoted to doing business on the Internet. In addition, a section on the World Wide Web has been added to the chapter on distributed applications and a section on intranets has been added to the chapter on client/server computing. Finally, as mentioned above, this book itself takes advantage of the Internet and Web to provide services to the instructors and students.

- **Wireless Networks:** Wireless networking, both for local area networks (LANs), and wide-area networks (WANs), have become a significant component of many networking configurations. A new chapter explores this important technology.

- **High-speed LANs:** Coverage of this important area is introduced, and includes detailed treatment of leading-edge approaches, including Fast Ethernet (100BASE-T), Gigabit Ethernet, ATM LANs, and Fibre Channel.

- **TCP/IP:** TCP/IP has won the "protocol wars" with OSI, and is now the focus of the protocol coverage in this book.

- **Network Management:** SNMP and SNMPv2 have become essential tools in network management, and the book now contains an extensive discussion of these important protocols.

- **Network Security:** The chapter on network security has been completely rewritten and reorganized to provide a clearer presentation that emphasizes the important tools and strategies that management needs to implement. The chapter now also includes an extensive discussion of Web security.

In addition, throughout the book, virtually every topic has been updated to reflect the developments in standards and technology that have occurred since the publication of the second edition.

Acknowledgments

ACRONYMS

AAL	ATM Adaptation Layer
AM	Amplitude Modulation
AMI	Alternate Mark Inversion
ANS	American National Standard
ANSI	American National Standard Institute
ARQ	Automatic Repeat Request
ASCII	American Standard Code for Information Interchange
ASK	Amplitude-Shift Keying
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband ISDN
BOC	Bell Operating Company
CBR	Constant Bit Rate
CCITT	International Consultative Committee on Telegraphy and Telephony
CIR	Committed Information Rate
CRC	Cyclic Redundancy Check
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
DDP	Distributed Data Processing
DES	Data Encryption Standard
DCE	Data Circuit-Terminating Equipment
DES	Data Encryption Standard
DTE	Data Terminal Equipment
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FDDI	Fiber Distributed Data Interface
FDM	Frequency-Division Multiplexing
FSK	Frequency-Shift Keying
FTP	File Transfer Protocol
FM	Frequency Modulation
HDLC	High-Level Data Link Control
HTTP	Hypertext Transfer Protocol
HTML	Hypertext Markup Language
ICMP	Internet Control Message Protocol
IDN	Integrated Digital Network
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPng	Internet Protocol - Next Generation
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITU	International Telecommunication Union

ITU-T	ITU Telecommunication Standardization Sector
LAN	Local Area Network
LAPB	Link Access Procedure - Balanced
LAPD	Link Access Procedure on the D Channel
LAPF	Link Access Procedure for Frame Mode Bearer Services
LLC	Logical Link Control
MAC	Medium Access Control
MAN	Metropolitan Area Network
MIME	Multi-Purpose Internet Mail Extension
NRZI	Nonreturn to Zero, Inverted
NRZL	Nonreturn to Zero, Level
NT	Network Termination
OSI	Open Systems Interconnection
PBX	Private Branch Exchange
PCM	Pulse-Code Modulation
PDU	Protocol Data Unit
PSK	Phase-Shift Keying
PTT	Postal, Telegraph, and Telephone
PM	Phase Modulation
QOS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RBOC	Regional Bell Operating Company
RF	Radio Frequency
RSA	Rivest, Shamir, Adleman Algorithm
SAP	Service Access Point
SDH	Synchronous Digital Hierarchy
SDU	Service Data Unit
SMDS	Switched Multimegabit Data Service
SMTP	Simple Mail Transfer Protocol
SONET	Synchronous Optical Network
TCP	Transmission Control Protocol
TDM	Time-Division Multiplexing
TE	Terminal Equipment
UDP	User Datagram Protocol
UNI	User-Network Interface
URI	Universal Resource Identifier
URL	Uniform Resource Locator
VAN	Value-Added Network
VBR	Variable Bit Rate
VCC	Virtual Channel Connection
VPC	Virtual Path Connection
WWW	World Wide Web

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1997 年 1 月——1998 年 7 月

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BRIEF CONTENTS