CHAPTER 0

READER'S AND INSTRUCTOR'S GUIDE

"In the meanwhile, then," demanded Li-loe, "relate to me the story to which reference has been made, thereby proving the truth of your assertion, and at the same time affording an entertainment of a somewhat exceptional kind."

"The shadows lengthen," replied Kai Lung, "but as the narrative in question is of an inconspicuous span I will raise no barrier against your flattering request, especially as it indicates an awakening taste hitherto unexpected."

—*Kai Lung's Golden Hours*, Earnest Bramah

This book, with its accompanying Web site, covers a lot of material. Here we give the reader some basic background information.

0.1 OUTLINE OF THE BOOK

The book is organized into five parts:

Part One. Overview: Provides an introduction to the range of topics covered in the book. This part includes a general overview of data communications and networking and a discussion of protocols, OSI, and the TCP/IP protocol suite.

Part Two. Data Communications: Concerned primarily with the exchange of data between two directly connected devices. Within this restricted scope, the key aspects of transmission, interfacing, link control, and multiplexing are examined.

Part Three. Wide Area Networks: Examines the internal mechanisms and user-network interfaces that have been developed to support voice, data, and multimedia communications over long-distance networks. The traditional technologies of packet switching and circuit switching are examined, as well as the more recent ATM and wireless WANs. Separate chapters are devoted to routing and congestion control issues that are relevant both to switched data networks and to the Internet.

Part Four. Local Area Networks: Explores the technologies and architectures that have been developed for networking over shorter distances. The transmission media, topologies, and medium access control protocols that are the key ingredients of a LAN design are explored and specific standardized LAN systems examined.

Part Five. Networking Protocols: Explores both the architectural principles and the mechanisms required for the exchange of data among computers, workstations, servers, and other data processing devices. Much of the material in this part relates to the TCP/IP protocol suite.

Part Six. Internet Applications: Looks at a range of applications that operate over the Internet.

A more detailed, chapter-by-chapter summary of each part appears at the beginning of that part.

0.2   ROADMAP

Course Emphasis

The material in this book is organized into four broad categories: data transmission and communication; communications networks; network protocols; and applications and security. The chapters and parts of the book are sufficiently modular to provide a great deal of flexibility in the design of courses. The following are suggestions for three different course designs:

- **Fundamentals of Data Communications**: Parts One (overview) and Two (data communications) and Chapters 10 and 11 (circuit switching, packet switching, and ATM).
- **Communications Networks**: If the student has a basic background in data communications, then this course could cover Parts One (overview), Three (WAN), and Four (LAN).
- **Computer Networks**: If the student has a basic background in data communications, then this course could cover Part One (overview), Chapters 6 and 7 (data communication techniques and data link control), Part Five (protocols), and part or all of Part Six (applications).

In addition, a more streamlined course that covers the entire book is possible by eliminating certain chapters that are not essential on a first reading. Chapters that could be optional are Chapters 3 (data transmission) and 4 (transmission media), if the student has a basic understanding of these topics; Chapter 8 (multiplexing); Chapter 9 (spread spectrum); Chapters 12 through 14 (routing, congestion control, cellular networks); Chapter 18 (internetworking); and Chapter 21 (network security).

Bottom–Up versus Top–Down

The book is organized in a modular fashion. After reading Part One, the other parts can be read in a number of possible sequences. Figure 0.1a shows the bottom-up approach provided by reading the book from front to back. With this approach, each part builds on the material in the previous part, so that it is always clear how a given layer of functionality is supported from below. There is more material than can be comfortably covered in a single semester, but the book's organization makes it easy to eliminate some chapters and maintain the bottom-up sequence. Figure 0.1b suggests one approach to a survey course.

Some readers, and some instructors, are more comfortable with a top-down approach. After the background material (Part One), the reader continues at the application level and works down through the protocol layers. This has the advantage of immediately focusing on the most visible part of the material, the applications, and then seeing, progressively, how each layer is supported by the next layer down. Figure 0.1c is an example of a comprehensive treatment and Figure 0.1d is an example of a survey treatment.
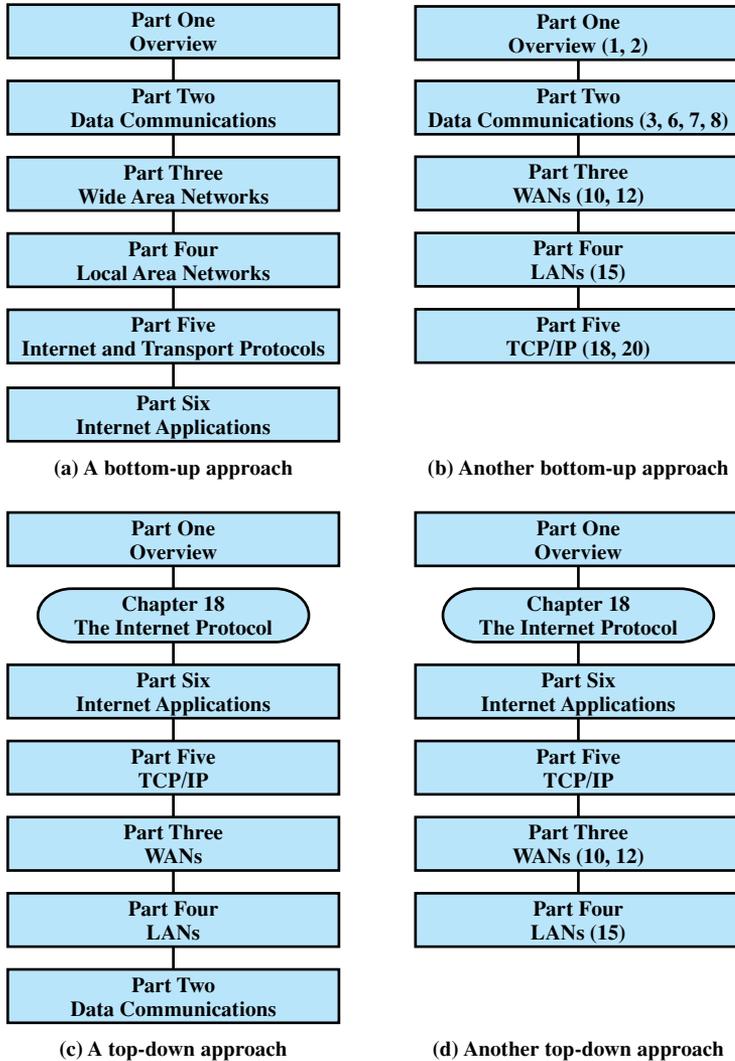
Part One Overview	Part One Overview (1, 2)
Part Two Data Communications	Part Two Data Communications (3, 6, 7, 8)
Part Three Wide Area Networks	Part Three WANs (10, 12)
Part Four Local Area Networks	Part Four LANs (15)
Part Five Internet and Transport Protocols	Part Five TCP/IP (18, 20)
Part Six Internet Applications	
(a) A bottom-up approach	**(b) Another bottom-up approach**

Part One Overview	Part One Overview
Chapter 18 The Internet Protocol	Chapter 18 The Internet Protocol
Part Six Internet Applications	Part Six Internet Applications
Part Five TCP/IP	Part Five TCP/IP
Part Three WANs	Part Three WANs (10, 12)
Part Four LANs	Part Four LANs (15)
Part Two Data Communications	
(c) A top-down approach	**(d) Another top-down approach**

Figure 0.1 Suggested Reading Orders

Finally, it is possible to select chapters to reflect specific teaching objectives by not sticking to a strict chapter ordering. We give two examples used in courses taught with the seventh edition. One course used the sequence Part One (Overview); Chapter 3 (Data Transmission); Chapter 6 (Digital Data Communications Techniques); Chapter 7 (Data Link Control); Chapter 15 (LAN Overview); Chapter 16 (High-Speed LANs); Chapter 10 (Circuit and Packet Switching); Chapter 12 (Routing); Chapter 18 (Internet Protocols); and Chapter 19 (Internet Operation). The other course used the sequence Part One (Overview); Chapter 3 (Data Transmission); Chapter 4 (Guided and Wireless Transmission); Chapter 5 (Signal Encoding Techniques); Chapter 8 (Multiplexing); Chapter 15 (LAN

Overview); Chapter 16 (High-Speed LANs); Chapter 10 (Circuit and Packet Switching); Chapter 20 (Transport Protocols); Chapter 18 (Internet Protocols); and Chapter 19 (Internet Operation).

0.3 INTERNET AND WEB RESOURCES

There are a number of resources available on the Internet and the Web to support this book and to help one keep up with developments in this field.

Web Sites for This Book

A special Web page has been set up for this book at **WilliamStallings.com/DCC/ DCC8e.html**. See the two-page layout at the beginning of this book for a detailed description of that site.

As soon as any typos or other errors are discovered, an errata list for this book will be available at the Web site. Please report any errors that you spot. Errata sheets for my other books are at **WilliamStallings.com**.

I also maintain the Computer Science Student Resource Site, at **WilliamStallings.com/StudentSupport.html**. The purpose of this site is to provide documents, information, and links for computer science students and professionals. Links and documents are organized into four categories:

- **Math**: Includes a basic math refresher, a queuing analysis primer, a number system primer, and links to numerous math sites
- **How-to**: Advice and guidance for solving homework problems, writing technical reports, and preparing technical presentations
- **Research resources**: Links to important collections of papers, technical reports, and bibliographies
- **Miscellaneous**: A variety of useful documents and links

Other Web Sites

There are numerous Web sites that provide information related to the topics of this book. In subsequent chapters, pointers to specific Web sites can be found in the *Recommended Reading and Web Sites* section. Because the addresses for Web sites tend to change frequently, I have not included URLs in the book. For all of the Web sites listed in the book, the appropriate link can be found at this book's Web site. Other links not mentioned in this book will be added to the Web site over time.

The following are Web sites of general interest related to data and computer communications:

- **Network World**: Information and links to resources about data communications and networking.
- **IETF**: Maintains archives that relate to the Internet and IETF activities. Includes keyword-indexed library of RFCs and draft documents as well as many other documents related to the Internet and related protocols.

- **Vendors**: Links to thousands of hardware and software vendors who currently have Web sites, as well as a list of thousands of computer and networking companies in a phone directory.
- **IEEE Communications Society**: Good way to keep up on conferences, publications, and so on.
- **ACM Special Interest Group on Communications (SIGCOMM)**: Good way to keep up on conferences, publications, and so on.
- **International Telecommunications Union**: Contains a listing of ITU-T recommendations, plus information on obtaining ITU-T documents in hard copy or on DVD.
- **International Organization for Standardization**: Contains a listing of ISO standards, plus information on obtaining ISO documents in hard copy or on CD-ROM.
- **CommWeb**: Links to vendors, tutorials, and other useful information.
- **CommsDesign**: Lot of useful articles, tutorials, and product information. A bit hard to navigate, but worthwhile.

USENET Newsgroups

A number of USENET newsgroups are devoted to some aspect of data communications, networks, and protocols. As with virtually all USENET groups, there is a high noise-to-signal ratio, but it is worth experimenting to see if any meet your needs. The most relevant are as follows:

- **comp.dcom.lans, comp.dcom.lans.misc**: General discussions of LANs
- **comp.dcom.lans.ethernet**: Covers Ethernet, Ethernet-like systems, and the IEEE 802.3 CSMA/CD standards
- **comp.std.wireless**: General discussion of wireless networks, including wireless LANs
- **comp.security.misc**: Computer security and encryption
- **comp.dcom.cell-relay**: Covers ATM and ATM LANs
- **comp.dcom.frame-relay**: Covers frame relay networks
- **comp.dcom.net-management**: Discussion of network management applications, protocols, and standards
- **comp.protocols.tcp-ip**: The TCP/IP protocol suite

0.4   STANDARDS

It has long been accepted in the telecommunications industry that standards are required to govern the physical, electrical, and procedural characteristics of communication equipment. In the past, this view has not been embraced by the computer industry. Whereas communication equipment vendors recognize that their

equipment will generally interface to and communicate with other vendors' equipment, computer vendors have traditionally attempted to monopolize their customers. The proliferation of computers and distributed processing has made that an untenable position. Computers from different vendors must communicate with each other and, with the ongoing evolution of protocol standards, customers will no longer accept special-purpose protocol conversion software development. The result is that standards now permeate all of the areas of technology discussed in this book.

There are a number of advantages and disadvantages to the standards-making process. We list here the most striking ones. The principal advantages of standards are as follows:

- A standard assures that there will be a large market for a particular piece of equipment or software. This encourages mass production and, in some cases, the use of large-scale-integration (LSI) or very-large-scale-integration (VLSI) techniques, resulting in lower costs.
- A standard allows products from multiple vendors to communicate, giving the purchaser more flexibility in equipment selection and use.

The principal disadvantages are as follows:

- A standard tends to freeze the technology. By the time a standard is developed, subjected to review and compromise, and promulgated, more efficient techniques are possible.
- There are multiple standards for the same thing. This is not a disadvantage of standards per se, but of the current way things are done. Fortunately, in recent years the various standards-making organizations have begun to cooperate more closely. Nevertheless, there are still areas where multiple conflicting standards exist.

Throughout this book, we describe the most important standards in use or being developed for various aspects of data and computer communications. Various organizations have been involved in the development or promotion of these standards. The following are the most important (in the current context) of these organizations:

- **Internet Society**: The Internet SOCiety (ISOC) is a professional membership society with more than 150 organizational and 6000 individual members in over 100 countries. It provides leadership in addressing issues that confront the future of the Internet and is the organization home for the groups responsible for Internet infrastructure standards, including the Internet Engineering Task Force (IETF) and the Internet Architecture Board (IAB). All of the RFCs and Internet standards are developed through these organizations.
- **IEEE 802**: The IEEE (Institute of Electrical and Electronics Engineers) 802 LAN/MAN Standards Committee develops local area network standards and metropolitan area network standards. The most widely used standards are for the Ethernet family, wireless LAN, bridging, and virtual bridged LANs. An individual working group provides the focus for each area.

- **ITU-T**: The International Telecommunication Union (ITU) is an international organization within the United Nations System where governments and the private sector coordinate global telecom networks and services. The ITU Telecommunication Standardization Sector (ITU-T) is one of the three sectors of the ITU. ITU-T's mission is the production of standards covering all fields of telecommunications.

- **ATM Forum**: The ATM Forum is an international nonprofit organization formed with the objective of accelerating the use of ATM (asynchronous transfer mode) products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

- **ISO**: The International Organization for Standardization (ISO)[1] is a worldwide federation of national standards bodies from more than 140 countries, one from each country. ISO is a nongovernmental organization that promotes the development of standardization and related activities with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological, and economic activity. ISO's work results in international agreements that are published as International Standards.

A more detailed discussion of these organizations is contained in Appendix D.

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[1]ISO is not an acronym (in which case it would be IOS), but a word, derived from the Greek, meaning *equal*.