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VOLUME 2

Edited by
Jacob Slonim
Geac Computers International, Inc.
Markham, Ontario
Canada

E. A. Unger
Kansas State University
Manhattan

P. S. Fisher
Kansas State University
Manhattan

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Advances in Data Communications Management

VOLUME 2

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LIST OF CONTRIBUTORS

TONY ALLSOP, Product Manager, Network Marketing, CNCP Telecommunications, 480 University Avenue, Toronto, Ontario, Canada M5G 1V2. (p. 235).

WILLIAM G. BULGREN, Ph.D., Department of Computer Science, University of Kansas, Lawrence, Kansas, 66045, U.S.A. (p. 251).

EULOUS S. BUTLER, Jr., Col., U.S. Army, Office of the Secretary of Defense, The Pentagon, Arlington, Virginia, U.S.A. (p. 41 & p. 223).

WHITFIELD DIFFIE, Ph.D., BNR, Inc., Mountain View, California 94043, U.S.A. (p. 55).

JOHN R. HAASE, President, Lawrence Data Services, Inc., Lawrence, Kansas 66044, U.S.A. (p. 251).

GILBERT HELD, Chief of Data Communications, 4-Degree Consulting, 4736 Oxford Road, Macon, Georgia 31210, U.S.A. (p. 181 & p. 191).

MARTIN E. HELLMAN, Ph.D., Department of Electrical Engineering, Stanford University, Stanford, California 94305, U.S.A. (p. 55).

MALCOLM G. LANE, Ph.D., Department of Statistics and Computer Science, West Virginia University, Morgantown, West Virginia 26506, U.S.A. (p. 1 & p. 25).

RAYMOND R. PANKO, Ph.D., Department of Marketing, College of Business Administration, University of Hawaii at Manoa, 2404 Maile Way, Honolulu, Hawaii 98222, U.S.A. (p. 205).

UDO POOCH, Ph.D., Department of Computer Science, Texas A & M University, College Station, Texas 77840, U.S.A. (p. 135).

PREFACE TO THE WILEY–HEYDEN ADVANCES LIBRARY IN EDP MANAGEMENT

Information, to be of value, must be timely, accurate, and accessible. By addressing each of these criteria, the *Wiley–Heyden Advances Library in EDP Management* has proved to be a unique and valuable source of information for managers.

The timeliness of the material is maintained by issuing additional volumes within each series. These volumes build upon the base of previous ones to provide new insights and add topics of current interest. Because we continue to generate new ideas our readers receive the most up-to-date information.

The second attribute of useful information is accuracy. To create the *Wiley–Heyden Advances Library in EDP Management*, we assign a separate editor to each volume as an expert in the field, that editor being responsible for the overall content of the volume. Each chapter is in turn developed by an expert in a specific area and then submitted to the volume editor for review. Wherever necessary, additional technical review support is obtained. Because of this detailed editorial and review process, a high degree of accuracy can be assured.

The third attribute that makes information of value is accessibility. This feature is the least commonly discussed and the most difficult of the three to accomplish. In fact, the lack of easy accessibility to information was the main reason for developing the *Wiley–Heyden Advances Library in EDP Management*. Our primary role as developers and managers of this base of material is to provide our users with the information they want in a form in which they can readily use it. This task is accomplished through the selection of relevant topic areas, maintenance of a consistent level of content, and organization of material in line with its intended use.

Although we have tried to achieve our timeliness, accuracy, and accessibility objectives, we strive to improve the library through the added dimension of communication with our end users. Thus we welcome any suggestions for improvement of our current series or expansion into new areas.

Thomas A. Rullo
Executive Editor

PREFACE

Data communications and its impact on the management of offices, businesses, and computer service centers is perhaps the most rapidly changing aspect of computer technology. This volume was designed to provide a firm foundation in the important concepts and associated terminology of data communications and to discuss information utility efforts in the United States and other countries. The authors invited to produce chapters were selected primarily for their knowledge and experience, but a close secondary reason was their ability to communicate this important information clearly, especially to managerial personnel. Most tutorial and survey articles provide bibliographies to assist those readers who wish to pursue the topic in further detail.

The first four chapters provide fundamental information about communications hardware, software (especially protocols), standards, and cryptography. With this basic information as background, the next three chapters address managerial and technical issues to assist in decision making and improvement of systems. The topics include a comparison of networks and protocols, data compression techniques, and lease versus purchase decisions regarding communications. The final four chapters provide an excellent survey of electronic information systems/ computer utilities/office information systems.

Malcolm Lane, a professor at West Virginia University, was asked to write the initial two chapters as tutorials on communications hardware and software (especially protocols). The first chapter is devoted to a discussion of fundamental communication hardware and software, including monitors and handlers. In the second chapter, protocols are discussed, including the basic functions, basic types of protocols and protocol definitions, message types, and standardization.

In the third chapter, data communication standards are discussed by Col. E. S. Butler in order to help managers deal with the challenges of integrating systems which were not designed to be integrated and, as a result, are not very compatible. The ISO standards for layered protocols are given as a foundation for compatibility of distributed intelligence systems.

The authors of the fourth chapter, Diffie of BNR, Inc. and Hellman of Stanford University's Electrical Engineering Department, were selected because of their in-depth knowledge of cryptography. Their chapter is an extensive presentation

of contemporary cryptography. The basic properties of theoretic and computational systems are given for both the classic systems still in use and the modern cryptographic techniques to the security problems of time-sharing systems. An extensive guide to available literature is provided.

It is useful for the technician and technical manager to be able to compare networks and their associated protocol schemes in order to select the best approach in a given new situation. Professor Udo Pooch of Texas A & M University was asked to write a chapter addressing this topic. After providing a framework for comparison (architectures, structures, designs), he provides an extensive comparison of IBM's system network architecture, DEC's digital network architecture, and the ARPA network with IMPs.

Chapters 6 and 7 were written by Gilbert Held of 4-Degree Consulting. He presents very practical information for managers and technicians involved in data communications on data compression techniques (including statistical compression and the Huffman code) and decision criteria for purchase or lease decisions. Held includes an extensive example showing investment tax credit calculations and depreciation.

A tutorial introduction to an electronic mail system is provided by Chapter 8. Specifically, typewriter networks, electronic message systems, voice message systems, and integration schemes are covered by the author.

Col. E. S. Butler, Jr., who is assigned to the Office of the Secretary of Defense, was requested to create a tutorial on the Videotex (Viewdata/Teletex) consumer information utility systems. He reviews current systems world wide, including Prestel (United Kingdom), Telematique (France), Beldschirmtext (West Germany), Telidon (Canada), CAPTAIN (Japan), MicroNet (H & R Block), Viewtron (Knight–Ridder), Green Thumb (U.S. Department of Agriculture), and Dow Jones News/Retrieval.

Tony Allsop, Manager of Electronic Mail and Office Communications of CNCP Telecommunication in Toronto, was selected to write an in-depth study of Infotex Service of CNCP and describes the competition between CNCP and the Canadian National Railroad to create an information utility for Canada. Allsop provides a glossary of terminology for this emerging area.

The final chapter integrates much of the information in previous chapters through discussion of the application of communication technology to the business environment. The coauthors, John Haase and Bill Bulgren, have both been involved in private computer business enterprises for several years. In addition, Bulgren is a professor of Computer Science at the University of Kansas. The topics of data and word processing, electronic message systems, communications, and the electronic office are defined and discussed.

The editors wish to express their appreciation to the various contributors for the quality of their insight and their willingness to impart concise, comprehensive information. Special thanks are also extended to Russell William Hultgren for his indefatigable efforts in compiling and combing the manuscript.

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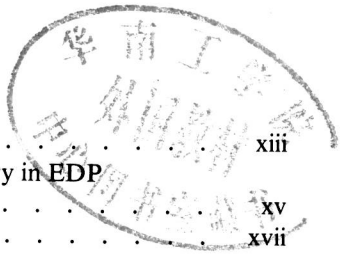

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Chapter 1

DATA COMMUNICATIONS HARDWARE AND SOFTWARE

Malcolm G. Lane
West Virginia University, Morgantown, West Virginia

For a given computer system to be able to communicate with another computer system two things are required: (1) a communications hardware interface and (2) software to implement a specific communications protocol via the hardware interface. While asynchronous (START/STOP) interfaces can be and are used to implement line control protocols, the majority of implementations utilize synchronous interfaces. This chapter focuses on a 'typical' synchronous data communications hardware interface, the requirements for programming such an interface, and the software design, implementation, and debugging techniques for implementing line control protocols.

Much information has been published about data communications protocols, interface standards, packet switching, and hardware interfaces. Yet, without good software, data communications and computer networks cannot exist. More is needed in the area of communications software methodology and implementation techniques. This chapter provides basic concepts for designing 'typical' communications software for implementing line control protocols. Even though networks involve a hierarchy of protocols,[1] a presentation of communications design concepts at the line control level should provide a good basis for understanding software design in general.

Figure 1-1 illustrates the data flow from one computer system to another using data communications over telephone lines. The hardware interface provides data to a modem (modulator/demodulator) which sends and receives data over a line in analog format. The modem presents data to and accepts data from the computer system in digital form. Since modulation of a carrier signal is used to send and receive data in this analog format, the name modulator/demodulator (abbreviated modem) is given to these devices, which are also referred to as data sets in a communications environment. For further information on modems, see McNamara's text.[2]

The medium of data transmission can be a typical phone line, four wires 'strung' locally, satellite, microwave, or light link—to name a few. The programmer usually will not have to be concerned with the means of data transmission

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