Network Reading List:
TCP/IP, UNIX, and Ethernet

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Document Version 3.6
May, 1992

Abstract

This annotated list of resources is intended for network managers, developers, and users at the University of Texas at Austin, or anywhere that TCP/IP, UNIX, and Ethernet are used to provide computer communications.* These three networking technologies share the same major attribute: they can be used to build interoperable network systems across a wide range of computer equipment. Because of their ability to provide the glue that holds networks together, TCP/IP, UNIX, and Ethernet are in wide use on campus and at many other sites.

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*UNIX is a registered trademark of AT&T, Ethernet is a trademark of Xerox Inc.

Introduction

This annotated list of resources was created to help you find information about TCP/IP, UNIX, and Ethernet. The list describes a number of items, including both introductory and in-depth information. Many items have material quoted to help indicate their scope and organization.

This list is not comprehensive; instead it tries to describe those items that cover the territory well, and that deal with real-world problems found on growing networks. This list is not current either; the amount of literature in this field is large and growing every day.

Why These Three Technologies?

The three technologies featured in this list are in wide use on campus, at research centers, and at a growing number of companies worldwide. The popularity of TCP/IP, UNIX, and Ethernet is largely due to the non-proprietary nature of these technologies, which helps make interoperable networking possible. By using this set of networking technologies you can interact with a wide range of computers.

All three technologies are ‘‘open’’ in that the software and specifications are readily available. For example, each release of Berkeley UNIX has furthered the goal of replacing AT&T-controlled source with Berkeley-controlled source, making the networking software more widely available. The TCP/IP protocols were developed with public funding and are in the public domain. The specification for Ethernet was published by a multi-vendor consortium and has since become a world-wide standard. Any vendor can develop products based on these three widely available technologies, and many have. This openness is the key to the network interoperability that these technologies provide.

While there is no precise definition of network interoperability, it is often taken to mean a set of computers of widely varying types that are capable of working well together. In an interoperable network system you can get your work done across a large range of computer systems linked by a common set of standard network protocols, network software, and network hardware.

In the network computing environment on campus today you will find equipment in use that comes from a wide variety of computer vendors. In such an environment interoperability isn’t just a desirable feature, it’s essential to the operation of the network system.

Another common feature of today’s networks is their growth and increasing complexity. TCP/IP, UNIX, and Ethernet have proven their ability to adapt as networks evolve and more and more users are added. By using these three technologies, it’s possible to build large networks that are both reliable and fast, and that support thousands of users.

Organization

The list was designed to be as self-contained as possible, and to make it easier for you to decide whether you want to follow up on a given resource.

ISBN book numbers are shown to make it easier to find and order the books listed here. Prices are included when available. The prices should be treated only as a rough guide however, since they may have changed by the time you read this list.

Comments, corrections, etc. are welcome and may be sent to **utnet@utexas.edu.**

Introduction

This is Section 1 of a four-section document entitled ‘‘Network Reading List: TCP/IP, UNIX, and Ethernet.’’ The four sections of this annotated list of resources were created to help you find information about TCP/IP, UNIX, and Ethernet. The complete list describes a wide range of items, including both introductory and in-depth information.

Section 1 covers TCP/IP resources, Section 2 covers UNIX, Section 3 Ethernet, and Section 4, miscellaneous items.

Section 1

1. TCP/IP

A major advantage of the TCP/IP protocol suite is that it is widely implemented in many computer systems. This makes it possible for network managers to use TCP/IP protocols to link computers from many vendors.

The TCP/IP protocol suite is a set of network standards originally developed for the Advanced Research Projects Agency (ARPA), of the US Department of Defense. This development led to the creation of the ARPANET which, in turn, led to today’s system of national networks. The nationwide network system interconnects many regional network systems. The regional networks link university campuses and corporate sites. This growing system of interoperating TCP/IP networks, called the Internet, now spans the globe. This system of IP networks allows you to send electronic mail, transfer files, and log in to computers no matter where they are located, as long as they are attached to the Internet.

The formal network standards for the TCP/IP protocol suite are available as a set of documents known as Request for Comments (RFCs). The RFCs contain a wealth of material, and some recent RFCs are written specifically to provide tutorial information on the TCP/IP protocol suite.

However, most of the RFCs are technical specifications and do not contain introductory material to help the newcomer. Also, the details of managing a TCP/IP network are not covered in the formal network protocol specifications. To help fill in the gaps, this section begins with a look at some books that explain how things work. It also includes several guides to the worldwide network system that has grown up around the TCP/IP protocols.

1.1. Introduction To TCP/IP

- **Internetworking With TCP/IP,**
  Volume I Principles, Protocols, and Architecture
  Douglas E. Comer.
  1991, Second Edition, Prentice Hall, Englewood Cliffs, New Jersey, 547 pps. with index and bibliography.
  ISBN 0-13-468505-9.
  $48.00.

Comer’s writing style is clear and the book is well organized, making this a good starting point for anyone who wants to know how the TCP/IP protocol suite works. The book provides an introduction and guide to the entire TCP/IP protocol suite. The basic concepts behind internetworking are described, as well as LAN technologies such as Ethernet and ProNET. With the basics covered, Comer goes on to explain how the essential elements of the TCP/IP protocols function, including examples of network applications based on the protocols.

A glossary is included to help deal with all the special terms and jargon found in the networking world. Appendix 1 features a guide to the RFCs that includes a listing of the RFCs by category, to help make it easier to find the RFCs you need.

From the Preface:

''Most textbooks and network courses concentrate on the first two stages of network research, presenting the well-known theories of data communications and queueing analysis. Although such information is important to engineers who design network technologies and hardware products, most network architects purchase commercially available network hardware. Instead of detailed knowledge about how bits or packets flow across communication media, they need to know how to interconnect such hardware and how to use the resulting system.''

''This text concentrates on the third stage of networking. It examines the architecture of interconnected networks and explains the principles and protocols that make such interconnected architectures function as a single unified communication system. More important, it shows how an interconnected architecture can be used for distributed computation.''

''Designed as both a college text and as a professional reference, the book is written at an advanced undergraduate or graduate level. For professionals, the book provides a comprehensive introduction to the TCP/IP technology and the architecture of the Internet. Although it is not intended to replace protocol standards, the book is a good starting point for learning about internetworking because it provides a uniform overview that emphasizes principles. Moreover, it gives the reader perspective that can be extremely difficult to obtain from individual protocol documents.''

''The book is organized into four main parts. Chapters 1 and 2 form an introduction that provides an overview and discusses existing technologies. In particular, Chapter 2 reviews physical network hardware. The intention is to provide basic intuition about what is possible, not to spend inordinate time on hardware details. Chapters 3-12 describe the TCP/IP Internet from the viewpoint of a single host, showing the basic services available and the protocols a host uses to access them. They cover the basics of Internet addressing and routing as well as the notion of protocol layering. Chapters 13-17 describe the architecture of the Internet when viewed globally. They explore the core gateway system and the protocols gateways use to exchange routing information. Chapters 18-26 discuss application level services available in the Internet. They present the client-server model of interaction and give several examples of how one can organize client and server software. The last section discusses electronic mail and the domain name system, two topics that are extremely popular.''

- **Internetworking With TCP/IP, Volume II**
  Design, Implementation, and Internals.
  Douglas E. Comer, David L. Stevens
  1991, Prentice Hall, Englewood Cliffs, New Jersey, 524 pps. with index and bibliography.
  ISBN 0-13-472242-6.
  $48.00.

Volume II continues the description of the TCP/IP protocol suite with an example implementation. The implementation is from the Xinu operating system, also developed by Douglas Comer. This makes it possible to easily distribute the software, since Xinu is a research system and none of the software is subject to commercial licensing.

The book features large amounts of C code that are integrated with the text. Comer notes that the work on the Xinu implementation has attempted to follow the RFC specifications closely, with the result that it obeys the TCP/IP standards more strictly than many commercial implementations.

From the Preface:

''Since the publication of Internetworking With TCP/IP in 1988, many readers have asked for a second volume that provides more information on how the TCP/IP protocols operate. This text attempts to satisfy the need for additional information. It examines the details of individual

protocols, discuses their implementation, and focuses on the internals of protocol software.''

''To help explain the interaction among protocols and to insure that our solutions fit together, we designed and built a working system that serves as a central example throughout the text. The system provides most of the protocols in the TCP/IP suite, including: TCP, IP, ICMP, UDP, ARP, RIP, and SNMP. In addition, it has an example client and server for the finger service. Because the text contains code for each protocol, the reader can study the implementation and understand its internal structure. Most important, because the example system integrates the protocol software into a working whole, the reader can clearly understand the interaction among protocols.''

From the Introduction:

''This book explores TCP/IP protocols in great detail. It reviews concepts and explains nuances in each protocol. It discusses abstractions that underlie TCP/IP software, and describes the data structures and procedures that implement the protocols. Finally, it reviews design choices, and discusses the consequence of design alternatives.''

''To provide a concrete example of protocol implementation, and to help the reader understand the relationships among protocols, the text takes an integrated view - it focuses on a complete working system. It shows data structures and source code, and explains the principles underlying each.''

''This text is organized around the TCP/IP protocol stack in approximately the same order as Volume I. It begins with a review of the operating system functions that TCP uses, followed by a brief description of the device interface layer. Remaining chapters describe the TCP/IP protocols, and show example code to illustrate the implementation of each.''

- **Introduction to the Internet Protocols**
  Charles L. Hedrick.
  1987, Rutgers, The State University of New Jersey, 27 pps.
  Available via anonymous FTP from host **cs.rutgers.edu** in the **runet** subdirectory. The file is called **tcp-ip-intro.doc** and a PostScript version is available as **tcp-ip-intro.ps.** Instructions for using anonymous FTP can be found in the section on RFCs, below.

This tutorial was written by Charles Hedrick in July 1987. It serves as a short introduction to some of the basic concepts of the TCP/IP protocol suite. For another approach to the subject see RFC 1180, ''A TCP/IP Tutorial'' in the following section on RFCs.

From the Introduction:

''This document is a brief introduction to TCP/IP, followed by advice on what to read for more information. This is not intended to be a complete description. It can give you a reasonable idea of the capabilities of the protocols. But if you need to know any details of the technology, you will want to read the standards yourself.''

1.2. Guides To The TCP/IP Internet

- **Tour of the Internet**
  HyperCard Stack
  The NSF Network Service Center (NNSC)

This unique guide is based on HyperCard, a program that runs on Apple Macintosh computers. The guide includes a large amount of information on both the structure and the content of the Internet. The set of cards in this HyperCard stack contain information on subjects ranging from the networks that make up the Internet, to how to find a variety of specific services available via the Internet. The HyperCard stack includes a section reserved for local information on your network. This allows you to customize the stack for use at your site.

From the README file:

‘‘The NSF Network Service Center (NNSC), a project of the Laboratories business unit of the Systems and Technologies Division, has developed a Tour of the Internet in HyperCard (TM) format for novice network users. The stack has basic information including history, sample email, ftp, and telnet sessions, and a glossary. The Tour is intended to be a fun and easy way to learn about the Internet.’’

‘‘We have included a ’Local Info’ section as part of the Tour. This section is a place where an organization can add information relevant to its own group of users, for example a listing of resources at that site, or other, specialized information.’’

‘‘In order to run this stack, you need to have HyperCard 2. HyperCard 2 requires Macintosh system 6.0.5 or higher.’’

Access Information for Internet Tour

The Internet Tour HyperCard stack is available via anonymous FTP from host **nnsc.nsf.net** in the **internet-tour** directory. The file **Internet-Tour-README** contains instructions on how to retrieve the HyperCard stack and convert it into a HyperCard file on your Macintosh.

An alternative method of access is to use the CSNET INFO-SERVER as described in the following excerpt from the README file:

(1) Send a message to ’INFO-SERVER@sh.cs.net’. You do not need a subject field. The text of your message must be in a special format (this is very important), but it does not matter whether the letters are uppercase or lowercase.
REQUEST: nsfnet
topic: INTERNET-TOUR
TOPIC: HELP
request: end

‘‘Request: nsfnet’’ tells the Info-Server to look for the topics in the NSFNET section of the Info-Server. ‘‘Topic:internet-tour’’ orders BOTH of the files about the tour, ‘‘Internet-Tour-readme’’ and ‘‘Internet-Tour.sit.hqx’’. ‘‘Topic: help’’ orders a file with information about other NSFNET files in the CSNET Info-Server.

(2) If you want to order ONLY the file ‘‘Internet-Tour.sit.hqx’’, put the following request in the text of your message:
request: NSFNET
topic: internet-tour.sit.hqx
REQUEST: end

- **The Matrix, Computer Networks and Conferencing Systems Worldwide**
  John S. Quarterman.
  Digital Press, 1990. 719 pps. with index.
  ISBN 1-55558-033-5.
  $49.95
  Digital Press part number for ordering is EY-C176E-DP.
  Digital Press phone is 800-343-8321.

In *The Matrix,* John Quarterman has created a guidebook to the internet in which he describes a wide variety of networks in more detail than ever before. There’s a large amount of information included in *The Matrix,* all clearly organized and heavily indexed.

The chapter on the worldwide TCP/IP Internet describes the many regional networks that make up the Internet system. Also covered are the various mail addressing formats in use on these networks. In addition, Quarterman includes maps showing the network topology. The *Matrix* is an indispensable tool for the network manager, and especially valuable for those who must deal with

wide area connections.

From the Preface

‘‘The first half of the book contains background material that introduces some important topics for readers who are not familiar with them. References are provided for those who want more complete treatments. Chapters 1 and 2 introduce basic terminology and services so that Chapter 3 can discuss networked communities and the effects of this technology and its applications on them and on the larger world. The basic underlying networking protocols are outlined in Chapter 4. Management protocols and issues such as naming, addressing, routing, and interconnection of networks are treated in Chapter 5. Chapter 6 considers building actual networks from the technology, including network names, numerical size and speeds, geographical extent, administration, and funding. Chapter 7 sketches the 20 year history of the Matrix, the intrinsic limitations that affect it, its user communities, and constructed and de facto standards for protocols; some speculations on the future are also included. Interoperability requires standards and committees to produce them; these are discussed in Chapter 8.’’

‘‘Descriptions of specific systems occupy the second half of the book. They are organized geographically to facilitate discussions of regional history and approaches, and each is characterized according to the background material developed in the first half of the book. Maps are included when available. Syntaxes and gateways are provided for sending mail from one system to others. Access information is given for those wishing to join or research a system, and the extensive references found at the end of each chapter will be useful for further investigation.’’

- **The User’s Directory of Computer Networks**
  Edited by Tracy L. LaQuey.
  Digital Press, 1990. 630 pps.
  ISBN 1-55558-047-5
  $34.95.
  Digital Press part number for ordering is EY-C200E-DP. Digital Press phone is 800-343-8321.

The User’s Directory concentrates on academic and research networks, with much of the directory consisting of lists of hosts, network numbers, domain names, and organizations. The lists vary in the level of detail they present, going so far as to include individual hosts on some of the networks.

The directory also contains a short description of each of the regional networks listed. The descriptions include maps that show the geographic coverage of most of the networks. The spot formerly occupied by a description of the now-defunct ARPANET contains the poem ‘‘Requiem for the ARPANET’’ by Vint Cerf.

Included in the directory are several introductions to the subjects of the Usenet, the UUCP transport protocol, the Internet Domain Name System, X.500 directory services and electronic mail. The guide to electronic mail includes a handy set of electronic mail addressing tables. These tables help present the complexity of mail addressing conventions in a clear and easily used format.

From the Preface:

‘‘The User’s Directory of Computer Networks was compiled to help people keep up with the increasing number of academic and research networks and the hosts connecting to them.’’

‘‘In the four years since the original directory emerged, the number of networks, hosts, and users has grown rapidly. The evolution of the directory has paralleled this network growth, as this edition is about two and a half times the size of the first one. Because of this growth, it is impossible to keep up with every network, host, and user, and so it was necessary to limit the amount of information included here. Selection criteria were the size and scope of the network and the

responsiveness of its contacts in contributing information. This 1990 User's Directory provides complete host information for networks such as BITNET, CSNET, and SPAN, which maintain information for every connected computer, but it also provides more administration information (domain and site contact information) for some networks, such as those connected to the Internet.''

1.3. Electronic Mail and the Internet

- **!%@:: A Directory of Electronic Mail Addressing and Networks**
  2nd Edition
  Donnalyn Frey and Rick Adams.
  O'Reilly & Associates, Petaluma, CA, 1989. 420 pps. with three-way index.
  ISBN 0-937175-15-3.
  $27.95

This directory describes how to use electronic mail. The first section of the book contains a general description of the format and peculiarities of electronic mail addressing. The next section, the major portion of the book, contains brief descriptions of many of the worldwide networks. Each network description includes an explanation of the electronic mail addressing in use, contact information, and a map of the network. As a quick desk reference for the harried network manager who is trying to unravel tangled electronic mail messages, there's nothing better.

From the preface:

''This book is the second edition of a handbook of electronic mail addressing and networks. If you routinely send electronic mail, this book will provide you with up-to-date, concise information on the major electronic mail networks around the world. If you are an administrator or network manager, your users can use this book to find information on networks themselves, without asking you.''

''This new edition provides readers with a directory and usage guide to approximately 130 of the world's research and educational networks, as well as commercial networks. The network information has been updated for 1990, with many new networks added. Also updated is the three-way index to network name, network type, and country, as well as lists of many of the world's second and third level domains.''

''Assume you need to know how to contact someone in Iceland who you met at a conference. You can use this book by turning to the three-way index and looking up Iceland to find ISNET, the network in Iceland. Next you turn to the section of the book on ISNET and read who participates in the network and how to address mail. Then you can look up an individual university or company in the alphabetical index of second-level domain addresses to help you create a working electronic mail address for your correspondent. You can also send electronic mail to the contact person for ISNET, listed under Contact, and ask how you might find an address for your colleague in Iceland.''

1.4. TCP/IP Network Administration and Management

- **Introduction to Administration of an Internet-based Local Network**
  Charles L. Hedrick.
  1988, Rutgers, The State University of New Jersey. 46 pps. No index.
  Available via anonymous FTP from host **cs.rutgers.edu** in the **runet** subdirectory. The file is called **tcp-ip-admin.doc** and a PostScript version is available as **tcp-ip-admin.ps** Instructions for using anonymous FTP can be found in the section on RFCs, below.

This is a tutorial written by Charles Hedrick in July 1988, and intended for network managers faced with the task of setting up a campus network system based on TCP/IP protocols. The illustrations are limited to ASCII graphics, and there is no index, but nonetheless the information in

this brief guide can be very helpful when it comes to unraveling the issues involved in the complex tangle of network addressing, network routing, network topologies, and network hardware.

Of special interest is the discussion of network repeaters, bridges, and routers, in which Hedrick describes the main features of each, and contrasts their function and utility in the creation of large network systems.

From the Introduction:

‘‘This document is intended to help people who are planning to set up a new network based on the Internet protocols, or to administer an existing one. It assumes a basic familiarity with the TCP/IP protocols, particularly the structure of Internet addresses.’’

‘‘This document does not attempt to replace technical documentation for your specific TCP/IP implementation. Rather, it attempts to give overall background that is not specific to any particular implementation. It is directed specifically at networks of ‘‘medium’’ complexity. That is, it is probably appropriate for a network involving several dozen buildings. Those planning to manage larger networks will need more preparation than you can get by reading this document.’’

- **The Simple Book**
  An Introduction to Management of TCP/IP-based Internets
  Marshall T. Rose
  1991, Prentice Hall, Englewood Cliffs, New Jersey, 347pps with index and bibliography.
  ISBN 0-13-812611-9
  $49.00

As the TCP/IP Internet has grown, the problem of how to manage the network system has grown as well. The approach to network management that has evolved for TCP/IP is based on the Simple Network Management Protocol (SNMP), described in this, *The Simple Book.* Marshall Rose is an expert in the field and has been involved in the standards process that led to the adoption of SNMP. The *Simple Book* explains how the SNMP protocols work, and how they are organized. Marshall Rose candidly discusses the politics of standards development, and includes some pithy observations on this subject between the ‘‘soapbox’’ icons in the book’s margins.

From the Preface:

‘‘This book is intended to serve both as a graduate-level text and also as a professional reference. It is expected that the reader has a modest background in networking.’’

‘‘The first part of the book, Chapters 1 and 2, presents a brief history of networking and the need for network management. Following this, the Internet suite of protocols is examined. Since this is a book about managing TCP/IP-based internets, many of the management details can make sense only in the presence of a discussion of the protocols and systems being managed. The text tries to present a ‘‘detailed introduction.’’ That is, the level of information must be deep enough so that management issues can be explored later on, but not too detailed so as to dwell on the nuances of each protocol.’’

‘‘The second part of the book, Chapters 3 through 5, details the Internet-standard Network Management Framework. In particular, the Structure of Management Information (SMI) and the Management Information Base (MIB) are thoroughly explored, followed by the mechanism used to manage internets, the Simple Network Management Protocol (SNMP).’’

‘‘The third part of the book, Chapter 6, briefly introduces the policies used to manage internets. The actual policies (as opposed to mechanical aspects) of network management are currently poorly understood, so only a basic coverage can be presented at this time.’’

‘‘The fourth part of the book, Chapter 7, gives an overview of an actual implementation, the 4BSD/ISODE SNMP package. Both an agent and manager implementation will be examined, along with a common Applications Programmer’s Interface (API).’’

‘‘Finally, as the book concludes, future trends are identified in Chapter 8. In the appendicies, the book contains a chapter on Internet management ‘‘lore’’ (commonly asked questions and answers), various lists of object assignments and definitions, and so on. In addition, ordering information for ISODE is given.’’

1.5. The Request for Comments (RFCs)

A major advantage of the TCP/IP protocol suite is that the formal protocol standards are made easily available. The standards documents that describe the protocols are freely available over the Internet, or they can be purchased in hard copy form.

These standards are known as Request for Comments, or RFCs. The origin of the name is described in RFC 1000. RFC 1000 describes the evolution of the RFCs, beginning with the original protocol developers who, being graduate students and faced with the need for publishing the evolving technical specifications, chose to call the documents Request for Comments so as not to offend anyone who might be in charge of the newly chartered ARPANET. Most of the RFCs are still available, and the entire set of RFCs provides a rare look at the evolution of a major protocol suite.

The Internet is still evolving, and RFCs are still being written to guide, codify, and explain this evolution. Some of the more recent RFCs have been purely informative in nature, aimed at the newcomer to TCP/IP networking, or intended to help programmers implement the standards correctly.

The RFCs are available electronically by way of the TCP/IP File Transfer Program (FTP), as well as by electronic mail. Both of these methods are described below. For those without a network connection, the RFCs can be ordered by telephone and through the US Postal Service, also as described below.

1.5.1. Some Useful RFCs

The books by Douglas Comer and Marshall Rose contain guides to the RFCs, listed by category. These guides can provide a handy navigational aid through the sea of specifications. As of this writing there are over 1,290 RFCs listed in the RFC index, and it’s impossible to describe even the most important ones here. Instead, listed next are some recent examples of RFCs written as purely informative documents as well as some RFCs describing essential numbers used in TCP/IP.

- **RFC1290, There’s Gold in them thar Networks! or Searching for Treasure in all the Wrong Places.**

An RFC written to help network users navigate among the many sources of information in the Internet. From the RFC:

‘‘This document was presented at the 1991 ACM SIGUCCS User Services Conference. It appears here in its updated form.

There is a wealth of information on the network. In fact, so much information that you could spend your entire life browsing. This paper will present some of the "gold nuggets" of information and file repositories on the network that could be of use to end users.

The ultimate goal is to make the route to these sources of information invisible to the user. At present, this is not easy to do. I will explain some of the techniques that can be used to make these nuggets easier to pick up so that we can all be richer.’’

- **RFC1244, Site Security Handbook**

A comprehensive list of the issues to be considered when developing computer and network security policy at your site. Includes a brief description of each issue, as well as a guide to security

oriented mailing lists and software. Also includes an annotated bibliography of other resources for information on security issues.

- **RFC1208, A Glossary of Networking Terms**

A relatively short (18 pps) glossary produced to help a newcomer to networking find their way around the special jargon and acronyms used in the networking industry.

- **RFC1207, Answers to Commonly Asked 'Experienced Internet User' Questions**

This is one of two RFCs called '' Questions and Answers,'' and produced by the User Services Working Group of the Internet Engineering Task Force. This 15 page set of Questions and Answers focuses on the sort of questions that might be asked by someone with experience using the Internet.

- **RFC1206, Answers to Commonly Asked 'New Internet User' Questions**

The companion RFC to RFC1207. This 32 page set of Questions and Answers focuses on the sort of questions that might be asked by someone new to the Internet.

- **RFC1200, Official Protocol Standards**

This RFC is the most recent version of the Official Protocol Standards. This frequently updated RFC describes the TCP/IP standards creation process, as well as listing the RFCs that are the officially recognized TCP/IP standards.

- **RFC1180, A TCP/IP Tutorial**

A brief (28 pages) description of the basic structure of the TCP/IP protocol suite and how it works. Includes a description of sending TCP/IP datagrams over Ethernet networks, and how the ARP protocol is used to build links between IP and Ethernet addresses.

- **RFC1178, Choosing a Name for Your Computer**

This 8 page RFC provides some guidelines that can help ease the task of choosing a reasonable network name for your computer.

- **RFC1175, Where to Start: A Bibliography of Internetworking Information.**

This 42 page RFC contains an extensive bibliography on TCP/IP and the Internet, including several of the resources listed here. Also included is a list of conferences and workshops of interest to those in the field, as well as a set of newsletters on the subjects of TCP/IP and the regional network systems.

- **RFC1173, Responsibilities of Host and Network Managers: A Summary of the ''Oral Tradition'' of the Internet**

This short (5 page) RFC attempts to fill in some gaps by providing operational guidelines for network managers and host system managers. As noted in the title, the guidelines presented here are of the sort that ''everybody knows'' but that are rarely documented.

- **RFC1147, FYI on a Network Management Tool Catalog: Tools for Monitoring and Debugging TCP/IP Internets and Interconnected Devices**

This RFC is a large collection of tools for network management, including sources for public domain software for network testing and troubleshooting. The RFC includes a network management tutorial that describes some of the basic concepts of networking monitoring and management. A handy guide to a rapidly growing area.

- **RFC1122, Requirements for Internet Hosts - Communication Layers**
  RFC1123, Requirements for Internet Hosts - Application and Support

These two ''Host Requirements'' RFCs provide the latest guidelines and interpretations for the TCP/IP protocols. Together they represent the latest understanding of how the protocol suite functions, as well as providing corrections and expanded information for many of the prior RFCs.

These two documents are essential companions to the RFCs that are listed as standards for the TCP/IP protocol suite.

- **RFC1118, Hitchikers Guide to the Internet**

This 24 page RFC is an informal guide to the basic concepts and the jargon of the TCP/IP Internet, intended for newcomers to TCP/IP.

- **RFC1060, Assigned Numbers**

This is the most recent version of the Assigned Numbers RFC as of this writing. The Assigned Numbers RFC contains a description of the IP addressing fields as well as lists of all the essential numbers used in various parts of the protocol suite. This RFC also contains a list of Ethernet numbers of interest to anyone managing Ethernets. When looking for a copy of the Assigned Numbers RFC make sure to get the most recent version, as this RFC is periodically updated.

- **RFC 1000, The Request For Comments Reference Guide**

This 149 page RFC contains an annotated guide to the first 1000 RFCs, along with a brief history of the origins of the RFCs.

1.5.2. Access To The RFCs

The RFCs listed above, and many more, are available both in hard copy and electronically. One depository for the RFCs is located at SRI Inc., in Menlo Park, California. The address of the network information center at SRI is:

SRI International
Network Information Systems Center - EJ291
333 Ravenswood Avenue
Menlo Park, CA 9402
415-859-6387

1.5.3. TCP/IP CD ROM

The SRI Network Information Center makes available a CD ROM in ISO-9660 (High Sierra) format that contains the RFCs, *Internet Engineering Notes*, a document collection, mailing list archives, and networking source code. To purchase the CD ROM or for more information call the numbers listed above, or send mail to:

TCP-IP-CD@NISC.SRI.COM

1.5.4. The NISC Electronic Mail Server

The RFCs are available via electronic mail from a mail server maintained by the Network Information Systems Center. If your computer does not have a direct connection to the Internet, but does have electronic mail access, then you can send mail to the special address:

MAIL-SERVER@NISC.SRI.COM

and, in the body of your message, indicate the RFC number you want to request, e.g.,

send rfc nnnn

where ‘‘nnnn’’ refers to the number of the RFC. Multiple requests may be included in the same message. There should not be any other information in your message, e.g. do not include a signature line.

1.5.5. Anonymous FTP Access To The RFCS

The RFCs are also available via ‘‘anonymous’’ FTP. If your computer runs the file transfer program known as FTP, and you have access to the Internet, you may make an FTP connection to

host FTP.NISC.SRI.COM, and retrieve files from the ‘‘rfc’’ directory. In the following example the commands you enter are shown in bold face type.

% ftp ftp.nisc.sri.com
Connected to phoebus.NISC.SRI.COM.
220 phoebus FTP server (SRI Version 1.98 Fri Apr 19 11:57:54 PDT 1991) ready.
Name (ftp.nisc.sri.com:spurgeon): **anonymous**
331 Guest login ok, send ident as password.
Password: **your-email-address-here**
230 Guest login ok, access restrictions apply.
ftp> **cd rfc**
250 CWD command successful.
ftp>

Once logged and connected to the correct directory, you can retrieve the RFC you want. A good file to start with is with the Index of RFCs, rfc-index.txt

1.6. The Network Information Center (DDN NIC)

The Defense Data Network (DDN) Network Information Center for the TCP/IP Internet is the source for new IP network number registration, as well as the location of the primary root name server, etc.

These services had been performed by the network information center at SRI until October 1991, when they were moved to a new site located in Virginia. The network address of the NIC.DDN.MIL is 192.112.36.5, and this host currently supports the old WHOIS database, among other services. The primary root name server is: **NS.NIC.DDN.MIL** at IP address **192.112.36.4**

The help desk phone number of the NIC is:
1-800-365-3642 (1-800-365-DNIC)
or
1-703-802-4535

The fax number is:
1-703-802-8376

The electronic mail address is:
NIC@NIC.DDN.MIL

The U.S. Postal Address is:
Government Systems, Inc.
Attn: Network Information Center
14200 Park Meadow Drive
Suite 200
Chantilly, VA 22021

Introduction

This is Section 2 of a four-section document entitled ‘‘Network Reading List: TCP/IP, UNIX, and Ethernet.’’ The four sections of this annotated list of resources were created to help you find information about TCP/IP, UNIX, and Ethernet. The complete list describes a wide range of items, including both introductory and in-depth information.

Section 1 covers TCP/IP resources, Section 2 covers UNIX, Section 3 Ethernet, and Section 4, miscellaneous items.

Section 2

2. UNIX

It may seem odd to include an operating system in a list of network resources. However the Berkeley UNIX system has been the platform for many networking innovations over the last decade. This section of the reading list is designed to help you find information on how UNIX networking functions, and how UNIX fits into the networking equation.

The development of UNIX has been closely tied to both TCP/IP and Ethernet. In the early 1980’s ARPA chose to fund the development of a Berkeley UNIX implementation of the TCP/IP protocols. This led to the inclusion of the TCP/IP protocols in Berkeley UNIX release 4.2.

At the time, Berkeley had begun using the newly standardized Ethernet LAN technology to link their campus computers together, and the model of UNIX systems running TCP/IP and linked with Ethernet was exported to many other sites with the release of 4.2BSD UNIX. The availability of BSD UNIX 4.2, TCP/IP, and Ethernet also helped spur growth of the scientific workstation market. The combination of UNIX workstations with TCP/IP software and Ethernet hardware has become increasingly common.

2.1. UNIX In General

UNIX and how it networks can be a daunting subject to the newcomer. To help try to cut things down to size, these next two items provide some much needed background and context on UNIX in general, and UNIX network administration in particular.

- **Life With UNIX**
  Don Libes, Sandy Ressler
  1989, Prentice Hall, Englewood Cliffs, NJ., 346 pps. with index.
  ISBN 0-13-536657-7.
  $29.95.

UNIX documentation can be exceedingly cryptic and difficult to decipher. While the efforts of the many UNIX vendors have frequently improved the UNIX documentation of their systems (it would be hard to make it worse), it’s still the case that a newcomer can find themselves drowning in details and wishing for some UNIX expert to come by and supply the big picture.

Life With UNIX is that expert. In this book you can discover almost everything you always wanted to know about the UNIX operating system, but couldn’t find out from anyplace else. This book includes much undocumented folklore about how UNIX grew, and why things are the way they are.

Life With UNIX also includes a set of handy reviews of UNIX oriented books and periodicals, UNIX organizations and conferences, and a list of addresses covering every vendor, school or group mentioned in the book. As a result, this book is an essential companion to the standard UNIX documents.

From the Preface:

‘‘No matter what people have told you, you can’t learn UNIX from the manuals, or even the sources. UNIX is so much more than that. To understand UNIX is to understand its users and its applications, as well as its failures and flaws. This is just some of what this book hopes to cover.’’

‘‘Make sure you realize what this book isn’t. It isn’t a textbook on C or UNIX programming. (There are already plenty of good ones.) You won’t learn how to write shell scripts or what is in the kernel. Well, maybe a little. But you will learn plenty of useful things. Things that will fill in gaps between other useful and useless things you already know about UNIX.’’

- **UNIX System Administration Handbook**
  Evi Nemeth, Garth Snyder, and Scott Seebass.
  1989, Prentice Hall, Englewood Cliffs, NJ, 593 pps. with index and bibliography.
  ISBN 0-13-933441-6.
  $32.00

The UNIX System Administration Handbook is an exceptionally comprehensive guide to the nitty gritty details of UNIX system administration. It’s also well written, with solid ‘‘hands-on’’ information. Of special interest is the large section on UNIX network administration.

This section explains how to go about acquiring a registered IP network address for your host, what a domain name is and how to go about registering one, and how to set up printing to remote hosts over the network. The section covers Berkeley UNIX networking based on Ethernet hardware and TCP/IP network protocols.

Included in this section is a brief description of how Ethernet works, featuring a list of typical Ethernet components. There’s a short description of TCP/IP protocols and how to set up the various UNIX files that make TCP/IP software run. There’s also a description of some LAN design issues, followed by the Sun Network File System protocols and operation. The section concludes with a few pages on how to debug and monitor your network. This is all essential information for the UNIX administrator faced with the task of attaching a computer to the network.

From the preface:

‘‘Without guidance, it’s easy for a new administrator to lose sight of ultimate goals in a sea of documentation or to inadvertently skip over one or more critical areas through failure to realize that they are important. That is where this book fits in. While we can’t claim that everything you need to know is included, we can guarantee that after reading it you will know pretty much what UNIX administration involves and how to go about it.’’

‘‘The first six chapters of this book are presented in a sequence you should find useful if you are bringing up a system straight from the packing crate. In this section are contained the bare essentials, things you need to know just to get the system up and running. Chapters 7-14 introduce the various kinds of hardware that are typically used with UNIX and discuss how to install, configure, and operate this equipment. Chapters 15-19 discuss five important UNIX software subsystems: electronic mail, telephone communication, network news, backups, and accounting. The rest of the chapters represent a grab-bag of UNIX topics, some of which may not concern you.’’

2.2. UNIX Networking In Detail

The next several items cover UNIX networking in vast technical detail. These items are for those who want to understand UNIX networking right down to the details of the kernel implementation. Fortunately there are several recent books on the details of UNIX networking implementations. This material assumes that you have a programming background, or at least a reading knowledge of C programming. As it says on old maps of uncharted and dangerous territories, ‘‘Here there be

dragons.''

- **UNIX Networking**
  Stephen G. Kochan and Patrick H. Wood, Consulting Editors.
  1989, Hayden Books, Indianapolis, Indiana. 400 pps. with index.
  ISBN 0-672-48440-4.
  Price $29.95.

UNIX Networking surveys internetworking as it is found in real-world UNIX systems. There are ten chapters, each written by a separate author, and each covering individual UNIX networking topics such as UUCP, TCP/IP, NFS and RPC, Streams, and so on. The book is organized historically, with the earliest UNIX networking packages listed first, which means that the story begins with UUCP, or the UNIX to UNIX Copy Program.

The chapter on TCP/IP is written by Douglas Comer and Thomas Narten. This chapter describes the basics of the TCP/IP protocol suite and the BSD 4.3 library routines and system calls used in application programs based on TCP/IP. The rest of the book introduces several UNIX applications which are based on networking. Several chapters discuss the AT&T approaches to network software on UNIX systems, as exemplified by Streams and the Transport Layer Interface system.

From the Introduction:

''This book provides both a historical and technical look at UNIX networks. The book is organized with the earliest UNIX networks appearing first, and each chapter has an overview of the history of the development of that networking system.''

''Since there are many UNIX networks, and space in this book is limited, only the most popular and widely available networks are described. Also, networking hardware (Ethernet, the telephone system, etc) is only covered where needed to describe the networking software, which is the focus of the book.''

- **The Design and Implementation of the 4.3BSD UNIX Operating System**
  Samuel J. Leffler, Marshall Kirk McKusick, Michael J. Karels, John S. Quarterman.
  1989, Addison-Wesley Publishing Co., Reading, Mass. 471 pps. with index and glossary.
  ISBN 0-201-06196-1
  $40.00

This book provides an in-depth look at the design and implementation of the entire 4.3BSD (Berkeley Software Distribution) UNIX system. Of special interest is Part 4 which describes UNIX Interprocess Communication. This section includes Chapter 10, which describes the kernel data structures and socket mechanisms used for networking, and Chapters 11 and 12, which cover Network Communication and Network Protocols, respectively. These chapters provide an in-depth look into the details of the BSD networking implementation, written by the engineers who had a hand in making the decisions.

From the Preface:

''This book is about the internal structure of 4.3BSD and about the concepts, data structures, and algorithms used in implementing 4.3BSDXs system facilities. Its level of detail is similar to that of Bach's book about System V UNIX however, this text focuses on the facilities, data structures, and algorithms used in the Berkeley variant of the UNIX operating system. The book covers 4.3BSD from the system-call level down -- from the interface to the kernel to the hardware itself. The kernel includes system facilities, such as process management, memory management, the I/O system, the file system, the socket IPC mechanism, and network-protocol implementations. Material above the system-call level such as libraries, shells, commands, programming languages, and other user interfaces is excluded, except for some material related to terminal interface and to system startup. Like Organick's book about Multics, it is an in-depth study of a contemporary operating system.''

- **UNIX Network Programming**
  W. Richard Stevens
  1990, Prentice Hall, Inc., 772 pps. with index and annotated bibliography.
  ISBN 0-13-949876-1.
  $41.00.

Richard Stevens's book features both a comprehensive treatment of UNIX networking concepts and a vast assortment of real world examples. The book contains scores of program examples, and is indispensable reading for the network software developer, or for anyone who wants to see what real networking software looks like in a UNIX system.. The book is an extremely useful resource for anyone who needs an in-depth understanding of the internals of UNIX networking software.

The book contains about 15,000 lines of C source code (including comments), some of which is taken directly from the Berkeley UNIX networking software and modified by the author, and some of which was created by the author for the task at hand. Another major advantage of this text is that all 15,000 lines of source code are available on-line as described below.

From the Preface:

''This book provides both the required basics that are needed to develop networking software along with numerous case studies of existing network applications. The intent of this book, however, is to concentrate on the development of software to use a computer network.''

''This text is divided into four parts. 1. The framework of a UNIX process (Chapter 2), and IPC between processes on a single system (Chapter 3). 2. An overview of networking (Chapter 4), and a description of some networking protocols currently in use (Chapter 5): TCP/IP, Xerox NX (XNS), IBM's SNA, NetBIOS, the OSI protocols, and UUCP. These two chapters provide the networking background for the remainder of the text. 3. Transport layer interfaces: Berkeley sockets and System V TLI (Chapters 6 and 7). These are the interfaces that an application uses to communicate across a network. 4. Networking examples (Chapters 8 through 18). The specific examples covered are: security, time and date servers, file transfer, line printer spoolers, remote command execution, remote login, remote tape drive access, and remote procedure calls.''

2.2.1. Access to Source Code In UNIX Network Programming

The complete source code for the Richard Stevens book is available from the vast collection of UNIX source archives kept by UUNET Technologies in Falls Church, Virginia. UUNET can be reached via the Compuserve network, via dial up modem, and via the Internet at host ftp.uu.net.

For those readers with a connection to the Internet, the source code from the Richard Stevens book may be retrieved using the anonymous FTP service. By opening a connection to host ftp.uu.net and logging in as username ''anonymous,'' you can gain access to the source archives stored at UUNET.

When logging in via FTP with the ''anonymous'' username, it is customary to type your real login name and host address when prompted for a password. This lets the system administrator of the anonymous FTP host keep track of the requests being made for the files on their system.

Once logged into UUNET, the source code is located in the ''/published'' directory as filename stevens.netprog.tar.Z. The capital Z suffix means that the file has been compressed using the UNIX compress program, which turns the file from a text format to a binary format. This, in turn, means that you will have to type ''bin'' to the FTP program, to set the file retrieval to binary mode. The compressed version of the file occupies almost 192 Kilobytes.

Once retrieved, the file will need to be uncompressed, which will leave you with a tape archive or ''tar'' file. Unpacking this file with the UNIX tar program will reveal the 15,000 lines of source code.

UUNET also makes UNIX sources available through a 900 telephone number for modems with speeds of up to 9,600 bps. The number is 1-900-GOT-SRCS, and the login name is ‘‘uucp’’ with no password. For more information, UUNET’s address is listed in Section 4.

Introduction

This is Section 3 of a four-section document entitled ‘‘Network Reading List: TCP/IP, UNIX, and Ethernet.’’ The four sections of this annotated list of resources were created to help you find information about TCP/IP, UNIX, and Ethernet. The complete list describes a wide range of items, including both introductory and in-depth information.

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Section 3

3. Ethernet

Ethernet is a popular LAN technology in wide use at sites around the world. A major reason for its popularity is that Ethernet provides a high level of network interoperability: You can link systems built by many different vendors using the same Ethernet LAN. Like TCP/IP and Unix, Ethernet provides a common basis for supporting heterogeneous networks.

Ethernet has been in existence for over a decade, and is now an international LAN standard. As a result, a large number of vendors sell Ethernet equipment. This helps keep the prices down, and leads to a steady stream of innovations, such as the use of thin coaxial and twisted-pair cabling, that makes it easier to build reliable LANs using standard Ethernet.

The Ethernet system has been so successful that it has grown to include a wide variety of physical media. This evolution has resulted in a number of new versions of the Ethernet standard as well. To accommodate a few introductions to Ethernet technology, as well as to cover the wide range of topics found in building and managing a LAN, this section of the reading list has grown until it is considerably larger than the rest.

3.1. Introduction To LAN Concepts

- **Local Area Networks**
  An introduction to the technology
  John E. McNamara.
  Published by Digital Press, 1985, 165 pps. with index and glossary.
  $29.00
  ISBN 0-932376-79-7.
  Digital Press part number for ordering is EY-00051-DP. Digital Press phone is (800) 343-8321.

This book provides a clear introduction to the essential ideas and basic technologies of LANs. McNamara keeps it simple, while managing to cover many different technologies. The author avoids covering specific products in favor of describing the general territory of LANs and their topologies. The special problems of extending LANs and supporting multiple protocol campus area networks are discussed.

From the Preface:

‘‘This book is intended for students, computer system managers, telecommunications managers, and others who want to become more familiar with local area networks. Since product offerings in this area are constantly changing, a deliberate attempt has been made to emphasize the general principles, operating characteristics, and problem areas of local area network hardware, rather than cite specific product examples.’’

‘‘The book begins with a general introduction, discussing the development of local area networks and emphasizing their possible uses. This is followed by more detailed treatment of physical

factors: topology, media, and installation requirements. Next, the hardware that permits programs to access the local area network and transfer data is discussed. Then, software is covered, starting with an introduction to communications protocols. Finally, the combined base of hardware and software knowledge from the previous parts of the book are used in discussions of network services, network expansion, and the problems associated with creating large networks. The need for standards is implied throughout the book, and a brief final chapter discusses the creation of standards and their current status.''

3.2. Introduction to Three Ethernet Varieties

This short introduction to the three Ethernet technologies most widely used in office connections is provided to help you understand the references to these technologies in the resources that follow. After the IEEE published the basic thick coaxial Ethernet specifications in 1985 it went on to specify new varieties of Ethernet media, including thin coaxial Ethernet and twisted-pair Ethernet. There are currently three media systems designed to provide Ethernet service to an office. They include:

(1) **Thick Ethernet**
The original Ethernet system, consisting of a thick (0.4 inch) yellow coaxial cable. Computers are attached to this cable via an Ethernet transceiver (also called a MAU) clamped to the cable. The transceiver, in turn, is connected to an Ethernet interface in the host computer by way of a transceiver cable (also called an AUI cable). This system is the one developed at Xerox, and could be called ''Ethernet Classic.'' The IEEE has assigned shorthand identifiers for each variety of Ethernet. The identifier for thick Ethernet is 10BASE5, which stands for 10 Mbit/sec speed, baseband signaling, and 500 meter maximum segment length.

(2) **Thin Ethernet**
One variation of classic Ethernet uses a thinner, more flexible coaxial cable, and is known as thin Ethernet or ''Cheapernet.'' In the thin Ethernet system the transceiver connection is inside the host along with the Ethernet interface. This makes it possible to attach the thin Ethernet cable directly to the back of the host computer. That reduces the number of devices and cables needed, and makes the network connection more affordable and convenient for office areas. The IEEE identifier for thin Ethernet is 10BASE2, despite the fact that the maximum segment length in the thin Ethernet standard is actually 185 meters.

(3) **Twisted-Pair Ethernet**
The most recent variation is twisted-pair Ethernet. This new variety of Ethernet is based on the same low cost twisted-pair wiring used for telephone systems. In the new system, individual computers attach to a multiple-connection box called a multiport or hub. Ethernet hubs are frequently designed as modular systems; many hubs can support all three varieties of Ethernet attachment. With its reliance on proven telephone system technology, the new twisted-pair variety provides a reliable yet simple and low-cost method for attaching computers to a 10-Mbit/sec Ethernet system. The IEEE identifier for twisted-pair Ethernet is 10BASE-T.

3.3. Vendor Guides

Some of the best tutorial information on Ethernet may be found in a variety of publications available from vendors. You have to allow for the vendor-specific orientation, but despite the emphasis on a single vendor's products you can find good tutorial information in these guides. Listed next in no particular order are several guides that have proven useful.

Hewlett-Packard Manuals

- **LAN Cable and Accessories Installation Manual**
  Published by Hewlett-Packard Co, January 1986.
  Approx. 204 pps. with index.
  $47.00.
  HP Part No. 5955-7680.
  Order from HP Direct at (800) 538-8787.

This slightly out-of-date manual from HP is still one of the better sources of tutorial information on how to deal with the thick and thin Ethernet varieties. The manual does not mention the twisted-pair Ethernet system.

Despite the specific product orientation, the Ethernet configuration information is useful, and the guidelines for designing networks are clear and well written. Thin Ethernet is covered, using HP's ThinLAN name for the technology. In addition, the manual shows how to tap a thick Ethernet cable for installation of the typical transceiver connection.

One nit to pick is that the advice on running cable between buildings is based on older coax technology and does not take into account the newer IEEE Fiber Optic Inter-Repeater Link (FOIRL) standard. The FOIRL standard makes it possible to link Ethernets between buildings while preserving complete electrical isolation between the LANs. Such isolation is important when it comes to preserving the safety of the LAN system and preventing damage to the system components.

This manual really shines when it comes to descriptions of thick cable and thin cable tooling and details of cable construction. The wire strippers and connector crimpers required for each cable type are described, although only HP part numbers are cited for these tools. There are also diagrams showing how to prepare each kind of cable for connectors, and how to crimp on the N connectors and BNC connectors used with the thick and thin coaxial cables. The manual finishes with a short section on verifying the cables you've built, and a section on how to use a time domain reflectometer to test network cables.

Another useful feature of the manual are the safety warnings that explain the hazards of the crimping tools, and the various electrical dangers that may be present when working on network cable systems. While on the subject of safety warnings, it should be mentioned that the crimping tools shown in this manual use a mechanism that prevents them from opening until they have closed all the way. It can be painful if a finger, rather than a connector, gets into the works. The HP manual thoughtfully includes an appendix on how to get your finger out of a crimp tool, should the need arise.

- **HP SiteWire Twisted-pair Cabling Installation Guide**
  January 1988, Hewlett-Packard Company, Roseville Networks Division, 8000 Foothills Boulevard, Roseville, California 95678.
  Approximately 100 pps, with 11 sections, 2 Appendixes, and an Index.
  $40.00.
  HP Manual Part Number 5959-2208. Order From HP Direct at (800) 538-8787.

Like the HP guide on coaxial cabling, this document is oriented to HP product offerings. Covering twisted-pair wiring for data communications, and including the Ethernet 10BASE-T variety, this guide provides instructions on how to test and install twisted-pair wiring for networks. While limited to HP offerings, it still provides a useful introduction and primer for for twisted-pair Ethernet installations.

The guide begins with a general introduction to twisted-pair connections. The system shown is not based on the widely used AT&T Premises Distribution System (PDS), instead the HP approach to wiring both telephones and data service for an office space is described. PDS

equipment may be used with the HP approach however, and the guide notes that for large installations you may want to base your design entirely on the PDS system.

The guide explains the basics of how to build twisted-pair cables, test them for continuity, and install them in an office. The use of 66-type and 100-type punch-down tools and punch-down blocks is explained, along with the basics of making a host connection to a twisted-pair Ethernet.

The rest of the document describes how to install 10BASE-T hubs. The guide also shows the HP 10BASE-T interface boards for PCs that contain two modular jacks; one for connection to the building wiring system, and one for connection to a telephone. This allows you to support both telephone and data on the same twisted-pair cable, and you are shown how to install wiring for such a system.

DEC Manuals

- **Telecommunications and Networks Buyer's Guide**
  Published twice a year by Digital Press. 1991 January-June issue.
  Approx. 590 pps. with index.
  Free.
  No part number. Ask for it by title from a DEC sales office. Call (800) 332-4636 if you don't have a local DEC sales contact. Or call (800) 343-4040 and ask for assistance on acquiring a free document.

This large guide attempts to list all communication hardware and software products and network services that DEC provides. Of special interest are the configuration guidelines for 802.3/Ethernet products. The guidelines are in section 2 and occupy 159 pages. Here you will find all manner of information about 802.3/Ethernet in general and the DEC product line in particular. Included is a description of DEC's building wiring standard, Open DECconnect.

You will also find media and topology information for fiber optic Ethernet connections, unshielded twisted pair, thin Ethernet and thick Ethernet. The guide includes illustrations and descriptions of many Ethernet components including barrels and terminators for thick Ethernet, DECconnect wiring equipment, and repeaters and bridges.

Appendix A describes Ethernet configuration guidelines for all Ethernet varieties as well as descriptions of extended LAN topologies using LAN bridges and broadband Ethernet.

The guide is completely DEC-centric, of course, but the price is right and the information is quite useful. The guide lists many other products, including DEC's offerings for the 100 Mbit/sec LAN standard known as FDDI.

- **The OPEN DECconnect System Guide**
- **OPEN DECconnect Building Wiring Components and Applications Catalog**
  1990, Digital Equipment Corporation.
  Free.
  No part number. Ask for them by title from DEC sales office. Call (800) 332-4636 if you don't have a local DEC sales contact. Or call (800) 343-4040 and ask for assistance on acquiring a free document.

These two publications describe the Digital structured building wiring system known as OPEN DECconnect. The system guide explains basic LAN topologies and describes the hierarchical physical star network that is specified in the EIA/TIA 568 Commercial Building Wiring Standard. The system guide discusses the various cabling choices for Ethernet wiring, and lists the advantages and disadvantages of each.

Following this section, the system guide describes the design and components of the DECconnect wiring system. Included is a description of Ethernet wiring as well as FDDI wiring, and how to attach stations to the building wiring system. The system guide provides a useful introduction to

the concepts behind structured building wiring systems, as well as providing a look at DECs structured wiring products.

The components and applications catalog lists individual parts of the DECconnect system including a description and order number. Line drawings for each part are shown. The second half of the catalog shows some typical wiring applications and how they are configured to use the DECconnect system.

Taken together these two manuals provide a look at structured wiring concepts in general, as well as providing a detailed tour of one approach to structured wiring called DECconnect.

MOD-TAP

- **MOD-TAP Applications Manual 1991**
- **MOD-TAP Components Catalog**
  MOD-TAP, 285 Ayer Road, PO BOX 706, Harvard, MA 01451-0706, (508) 772-5630.
  Applications Manual $5.00, Components Catalog Free.

MOD-TAP supplies communications cabling products for computer users. Their applications manual covers a wide range of communications cabling applications for several different standards. Of interest here is their support for 10BASE-T Ethernet. The applications manual describes some basic concepts for building cabling design. The manual also goes into detail on the wide variety of twisted pair wiring schemes in use today.

A major benefit of this manual is the information on the various twisted pair wiring schemes currently in use and how they can be made to support standard 10BASE-T unshielded twisted pair Ethernet. The manual also describes some basic wiring installation techniques, including how to develop a cable numbering scheme to help keep it all straight.

The components catalog describes the entire line of MOD-TAP products. Included are a set of charts that show the twisted pair wiring standards for USOC, AT&T 258A, AT&T 356A, ROLM, DEC, EIA, and 10BASE-T. The building you may be trying to wire for 10BASE-T Ethernet may include twisted-pair wires installed according to any one (or more) of these standards. The information shown here can be invaluable for figuring out how to get the signals from the 10BASE-T hub in the wiring closet to show up on the user's desk.

3.4. Troubleshooting Guides

- **Network Troubleshooting Guide**
  August 1990, Digital Equipment Corporation
  Approx. 278 pps. with index and glossary.
  $95.00 (quoted from DEC Direct).
  Digital part number for ordering is EK-339AB-GD-002. Digital Direct phone is (800) 344-4825.

While the price is steep, this is a useful guide to a variety of techniques for testing and troubleshooting networks that support both DECnet and TCP/IP protocols. The guide begins with a brief description of how both DECnet and TCP/IP function, including details of addressing in both protocol suites.

Chapter 2 describes how to develop a basic network troubleshooting methodology for your site. Following this is a chapter on network management and troubleshooting tools, listed alphabetically, and including both VMS and ULTRIX-based tools. The emphasis is on Digital applications, but more general applications such as ‘‘ping’’ and ‘‘traceroute’’ are also shown.

Chapter 4 describes resources for troubleshooting. These include various ULTRIX and VMS log files that contain information on problems that may have occurred with software running the DECnet and TCP/IP protocols.

Chapter 5 is the largest chapter of the guide. It describes network troubleshooting procedures for a wide variety of common network problems in both DECnet and TCP/IP. The problems are categorized as ULTRIX host problems, VMS host problems, LAN problems, WAN problems, and cross-category problems that include two or more of the preceding problems.

This chapter explains how to interpret common error messages seen, and how to go about troubleshooting the source of the error. Each problem is described and troubleshooting procedures explained. An example for TCP/IP includes the the error message ‘‘connection timed out.’’ A variety of errors that could cause this message are explained, and a troubleshooting strategy is listed. You are shown how to use ‘‘ping’’ to check for connectivity, ‘‘netstat’’ to check for errors on the host interface, etc.

While the guide focuses on DEC equipment running VMS and ULTRIX operating systems, there is still much useful information provided for debugging complex network problems in a mixed vendor environment. For example, many of the utilities described for ULTRIX are commonly available on other Unix systems. Although the guide assumes you have a DEC LAN Traffic Monitor (LTM) available, this is not a severe limitation. You can replicate much of the information you can get from the LTM by running commonly available applications such as ‘‘etherfind’’ or ‘‘tcpdump’’ on your system.

This guide has two major advantages; the structured approach to troubleshooting and the unusual mix of both DECnet and TCP/IP troubleshooting procedures in the same manual. While the troubleshooting information appears to list more DECnet-based errors than TCP/IP ones, the guide manages to present quite a lot of technical information about both protocol suites and their possible failure modes in a clear and well organized format.

- **LAN Troubleshooting Handbook**
  Mark A. Miller
  1989, M&T Publishing Co., Redwood City, CA., 309 pps. with index.
  $29.95.
  ISBN 1-55851-054-0

A wide-ranging guide to troubleshooting information for several LAN technologies including Ethernet. The author manages to fit a surprising amount of technical information about three LAN technologies, Ethernet, token ring, and ARCNET, into one volume. Though there isn’t any tutorial information about Ethernet, the troubleshooting information is clear and the book is well illustrated.

The material on Ethernet covers two sections: one on coaxial cable based Ethernets (both thick and thin), and one on twisted-pair Ethernet technology, including Synoptics LattisNet and AT&T StarLAN products. The IEEE 10BASE-T unshielded twisted-pair system is also briefly described. This book provides quick access to some essential troubleshooting information for the three main varieties of Ethernet.

From the Preface:

‘‘This book has a very fundamental thesis: how to keep your local area network alive. There are three parts to that goal. First, you must understand how the LAN should operate if you are to properly define when it is not operating. Secondly, you must have the proper hardware and software tools readily available to troubleshoot problems. Third, you must take preventative measures to keep those failures from recurring in the future.’’

‘‘To accomplish this goal, the book is divided into ‘‘network generic’’ and ‘‘network specific’’ chapters. Chapters 1, 2, 3, and 4 address the generic issues of LAN standards, Documentation, Test Equipment, and Cabling. Chapters 5, 6, 7, and 8 address specific issues associated with popular LAN architectures: ARCNET, Token Ring, Ethernet, and StarLAN, respectively. Also included in the network-specific chapters are examples of protocol analysis of Novell’s NetWare,

IBM's NetBIOS, DEC's DECnet, and TCP/IP. Chapter 9 concludes with a dose of preventative medicine.''

3.5. The Ethernet Standards

Ethernet became the first non-proprietary LAN technology with the publication of the multi-vendor Ethernet specification in 1980.

There are two basic Ethernet standards: one issued by the multi-vendor consortium, and one developed by the Institute of Electrical and Electronics Engineers (IEEE). The multi-vendor standard is known as the DIX standard, so called due to the initials of the three participants: Digital Equipment Corp, Intel, and Xerox. The DIX standard includes versions 1.0 and 2.0.

In 1985 the IEEE 802.3 CSMA/CD version of the standard was released. Based on the DIX Ethernet standard, the IEEE version brought the thick Ethernet system into the world of international standards. While they may appear quite different at first, the DIX version and the IEEE version of the standard are functionally similar. Many vendors rate their Ethernet hardware for use in both IEEE 802.3 and DIX version 2.0 systems. Of course, the prudent networker makes sure that all of the hardware used to attach a computer to the Ethernet is based on one version of the standard.

Most of the changes that the IEEE version of the standard made were at the level of the Ethernet frame, which is the set of bits that carry the data between computers. However, both IEEE and DIX Ethernet frames can coexist on the same Ethernet LAN without any problems.

The next several items list an introduction to IEEE standards and describe the formal Ethernet standards in use today. The formal standards are the technical documents for Ethernet/802.3 LANs, and they can be heavy going for non-engineers. There is no tutorial information in the standards, and the technical jargon they use makes them difficult to read. The newer IEEE standards use a special language developed for open systems standards that can bewilder the unprepared. The book listed next provides a guide to the newcomer to IEEE standards.

- **LANs**
  Applications of IEEE/ANSI 802 Standards
  Thomas W. Madron.
  1989, John Wiley & Sons, New York, NY, 308 pps. with index and glossary
  $34.95.
  ISBN 0-471-62049-1.

An introduction to LANs from the point of view of the evolving network standards. This book presents the world of network standards and how they're organized. The various standards agencies are described and the Open System Interconnection (OSI) model is explained. Following this, the IEEE 802 standards are described, and the way that the IEEE standards fit within the OSI organization is explained.

The bulk of the book describes the individual IEEE LAN standards. The book closes with a explanation of the basics of TCP/IP operation, including the function of LANs in the delivery of TCP/IP services.

From the Preface:

''The object of this book is to provide a reasonably detailed overview of contemporary LAN standards, especially those developed through the auspices of the Institute of Electrical and Electronics Engineers (IEEE). To be meaningful, however, the discussion of the IEEE standards is placed in the context of the development of standards generally, then in the framework of the Open System Interconnection (OSI) Reference Model of the International Organization for Standardization (ISO). After describing the IEEE standards (from 802.1 through 802.6), the way in which the standards can be applied in 'real' networks is illustrated through a discussion of the

Manufacturing Automation Protocol (MAP) and the Transmission Control Protocol/Internet Protocol (TCP/IP), in Chapters 9 and 10 respectively.''

3.5.1. The DIX Standard

- **Version 2.0, DEC-Intel-Xerox (DIX) Ethernet Standard**
  Ethernet Local Area Network Specification Version 2.0. November, 1982
  Digital Equipment Corporation, Intel Corporation, Xerox Corporation, 103 pps.
  $32.00.
  DEC Part Number: AA-K759B-TK.
  Available from DEC-Direct by calling (800) 344-4825.

This is Version 2.0 of the original 10 Mbit/sec thick Ethernet specification. The newer IEEE 802.3 standard supersedes the DIX spec listed here, but many network protocol implementations still use the Ethernet frame from the DIX specification.

This specification is organized according to the OSI model, but uses somewhat less technical jargon than newer standards. That makes it a document that is more approachable by the non-expert than the IEEE standard tends to be. The DIX specification is still a technical standard, however, and contains no tutorial information on the design and operation of Ethernets. Just the facts.

3.5.2. The IEEE 802.3 Standard (ISO 8802.3)

The IEEE 802.3 standard is the current standard for thick Ethernet as well as for the newer varieties. However, nothing stands still very long in the standards world, and the IEEE standard is no exception. Starting as a multi-vendor standard (DIX), the Ethernet system then became a national standard (IEEE/ANSI), and the IEEE specs have now been accepted as an international (ISO/IEC) standard.

This explains why the IEEE specification has been superseded by the International Organization for Standardization (ISO) standard, and why the IEEE organization now sells the ISO volume of specifications, instead of the older IEEE 802.3 volume. The name of the latest international ''Ethernet-like'' standard is (take a deep breath):

- **ISO/IEC 8802-3 : 1990/ADD 2 (E) (ANSI/IEEE Std 802.3-1988 Second Edition)**
  Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications (ANSI)
  ISBN 1-55937-049-1
  IEEE product number: SH13482
  $75.00 (from IEEE publications catalog) ($49.00 to IEEE members)
  Available from, IEEE Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, New Jersey 08854-1331
  or by calling (800) 678-4333 (IEEE). Outside US and Canada call, (908) 981-1393. The FAX number is (908) 981-9667

These are the current specifications for an Ethernet-like CSMA/CD LAN. Despite the major reworking of the original DIX standard by the IEEE, and despite changes made in the way some things work, the IEEE and DIX specs have a strong functional similarity at the hardware level. The changes that have caused hardware problems are the ones that affect the signals and wiring on the transceiver (AUI) cable, primarily used in older thick Ethernet installations.

Old and new hardware can interoperate well on Ethernet/802.3 LANs, despite the differences in the specifications. Many network protocol implementations (TCP/IP among them) continue to use the original DIX Ethernet frame as well. Campus Ethernets used to interconnect computers equipped with hardware built according to both the DIX and 802.3 specs will still interoperate. The standards were written so that mixing things together like this on the same Ethernet media

works.

3.5.3. IEEE Supplements

A few parts of the IEEE 802.3 standard have not yet made it through the ISO standardization process and into the ISO document. Instead, they are found in this document:

- **IEEE Std802.3b, c, d, and e-1989 Edition**
  Supplements to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) (ANSI)
  ISBN 1-55937-013-0
  IEEE Product Number SH12351
  $49.50 (from IEEE publications catalog). Same access as above.

The companion document to ISO 8802-3 above. This supplement contains a set of additions to the basic IEEE standard that have not yet made it to ISO status, including the Fiber Optic Inter-Repeater Link and the broadband Ethernet standard (Type 10BROAD36).

3.5.4. Twisted-Pair Ethernet Specifications

The most recent variety of the three Ethernet varieties described above is twisted-pair Ethernet. The twisted-pair specification is described in another supplement from IEEE. This supplement also contains some newly written guidelines for building large, multi-segment Ethernets using a mix of Ethernet varieties. The title is (take another deep breath):

- **802.3i-1990 IEEE Supplement to Carrier Sense Multiple Access with Collision Detection CSMA/CD Access Method and Physical Layer Specifications: System Considerations for Multisegment 10 Mb/s Baseband Networks (Section 13) and Twisted-Pair Medium Attachment Unit (MAU) and Baseband Medium, Type 10BASE-T (Section 14)**
  ISBN 1-55937-070-X
  IEEE Product Number SH13763
  Price $23.50, from IEEE catalog. Same access for IEEE as above.

3.6. Ethernet Numbers

This section describes two sets of numbers used in the Ethernet system. Both sets are useful in network troubleshooting. The standards agencies that oversee the administration of these numbers are also listed.

3.6.1. Ethernet Type Numbers and Addresses

The Ethernet frame specified by the DIX standard contains a type field. The type field contains a type number that describes the type of high-level network protocol (such as TCP/IP) being carried by the Ethernet frame. This information can be quite handy when you're troubleshooting a LAN problem and trying to figure out which high-level protocol may be involved.

In the new IEEE 802.3 frame specification, the type field was replaced by a more general, but more complex, set of frame specifiers. Nevertheless, many network software implementations still use the DIX frame specification, and its Ethernet type field.

The addresses used in Ethernet frames are also useful to the network troubleshooter. The 48-bit Ethernet address is divided into two 24-bit blocks. The first block corresponds to a specific manufacturer and the second block is a unique interface identifier assigned by the manufacturer. If you know the manufacturer's number, you can frequently identify which computer may be causing network problems.

The IEEE treats Ethernet addresses as confidential information. Nevertheless, a list of type fields and vendors' addresses has been compiled by network administrators who observed and analyzed Ethernet traffic. This means the list is necessarily incomplete. And, of course, the list won't reflect numbers for Ethernet types and addresses assigned after the list was created.

3.6.2. Assigned Numbers RFC

A list of Ethernet numbers for troubleshooting, including both the type field numbers and the Ethernet address numbers, can be found in the latest Assigned Numbers RFC. The Assigned Numbers RFC is a frequently updated RFC for the TCP/IP protocol suite that also contains the Ethernet numbers. The most recent version of this document is RFC1060. This RFC may be retrieved as described in the section on TCP/IP and the RFCs.

3.6.3. MIT Numbers List

Another list of Ethernet numbers may be found via anonymous FTP on host FTP.LCS.MIT.EDU in directory pub/map, filename ''EtherNet-codes''. This set of numbers is updated on a more frequent basis than the Assigned Numbers RFC. If you have discovered a new vendor's address or other Ethernet number that you would like to add to this list, you can send your entry to ''MAP@LCS.MIT.EDU''.

3.6.4. Administration of Ethernet Numbers

Type Field

Since the type field is part of the older DIX specification, Xerox manages the administration of Ethernet type fields. The Ethernet patents are owned by Xerox as well, and licenses to build Ethernet equipment using these patents can be obtained from the same source. Anyone wishing to apply for a new type field should contact Xerox at the following address:

Xerox Corporation
Xerox Systems Institute
3400 Hillview Ave.
P.O. Box 10034
Palo Alto, CA 94303
(415) 813-7164

As stated in a recent Xerox literature catalog: ''Per Appendix B of the Ethernet Specification, a Ethernet type field will be assigned on written request to each licensee of Ethernet patents. The licensing fee is $1000.00. Others wishing to obtain type field assignments may do so by including a $300.00 administrative fee with their written request.''

IEEE 802.3 Addresses

All new Ethernet addresses are assigned by the IEEE, although older ones assigned by Xerox are still valid. The manufacturer assigns an address to each Ethernet interface card.

Anyone attaching a computer to an Ethernet system need not concern themselves with addresses, since a unique Ethernet address is assigned to each Ethernet interface at the factory. On the other hand, for the curious, a block of addresses costs $1000.00. The address for inquiries is:

IEEE Standards Office
820 Second Avenue, 7th Floor
New York, NY 10017-4504
(201) 981-0060

3.7. Ethernet Performance Analysis

Ethernet has been around for a while and provides network communications at many sites, so you'd think that the performance characteristics would be well established. Nonetheless there have been surprising claims made about Ethernet's ability to transmit data.

Some of the claims have been based on papers written about the Ethernet system over the last several years. A number of these papers have based performance analysis on simulations and simplifications of the Ethernet protocols. This has helped establish a mythology about Ethernet performance limits.

Based on these simulations and simplifications, some people will tell you that Ethernet systems saturate at relatively low packet rates. Fortunately there has been some empirical analysis that helps explain how Ethernet has managed to provide robust service and high data rates at so many sites over the years:

- **Measured Capacity of an Ethernet: Myths and Reality**
  David R. Boggs, Jeffrey C. Mogul, Christopher A. Kent.
  Proceedings of the SIGCOMM '88 Symposium on Communications
  Architectures and Protocols, ACM SIGCOMM, Stanford, CA., August 1988,
  31 pps.

This technical report from Digital's Western Research Lab presents empirical evidence showing that the 10 Mbit/sec Ethernet system is capable of transmitting large amounts of data in a reliable fashion. Also useful is the analysis of what makes a good Ethernet implementation. The report includes a brief set of network design guidelines for network managers who want to optimize their Ethernet system.

From the Abstract:

''Ethernet, a 10 Mbit/sec CSMA/CD network, is one of the most successful LAN technologies. Considerable confusion exists as to the actual capacity of an Ethernet, especially since some of the theoretical studies have examined operating regimes that are not characteristic of actual networks. Based on measurements of an actual implementation, we show that for a wide class of applications, Ethernet is capable of carrying its nominal bandwidth of useful traffic, and allocates the bandwidth fairly.''

From the Introduction:

''Ethernet works in practice, but allegedly not in theory: some people have sufficiently misunderstood the existing studies of Ethernet performance so as to create a surprisingly resilient mythology. One myth is that Ethernet is saturated at an offered load of 37%; this is an incorrect reading of the theoretical studies, and is easily disproved in practice. This paper is an attempt to dispel such myths.''

This paper is available over the Internet via electronic mail from the DEC Western Research archive server. Send a message to the automatic mail server with the word ''help'' in the Subject line of the message for detailed instructions. The address of the DEC technical reports mail server is **WRL-Techreports@decwrl.dec.com.**

You may also request a copy of the report through the U.S. postal system by writing to:

Technical Report Distribution
DEC Western Research Laboratory, UCO-4
100 Hamilton Avenue
Palo Alto, California 94301

3.8. Ethernet Hardware and Vendors

Ethernet hardware comes in several forms. At the physical media level, there are basic components: coaxial cable, twisted-pair cable, and connectors. The next level up features components such as transceivers, transceiver cables, Ethernet interfaces, and repeaters. At the higher levels of network concatenation are devices such as Ethernet bridges and routers.

Just to keep things interesting, different varieties of Ethernet require different components. For instance, thick Ethernet media systems use different components than twisted-pair media. Moreover, every vendor seems to have its own special design for equipment such as Ethernet hubs. It's a large market, and impossible to cover in any short list of resources such as this one. Lists of vendors and products may be found in buyer's guides published by some of the LAN magazines shown in the next section.

One representative source of Ethernet equipment is a catalog from the Anixter equipment distributors. The Anixter Wiring Systems Product Catalog is a vast compendium that lists many different vendors, supplying all manner of communications equipment.

For example, the catalog has separate sections for both Ethernet and DEC's special Ethernet wiring system (called DECconnect). The catalog also features a glossary of communications industry terms, and an index. All in all, this catalog is a useful resource for the LAN manager. Catalogs are available from your local Anixter distributor, or try:

- **Anixter Bros., Inc.**
  4711 Golf Road
  Skokie, IL 60076
  Phone (312) 677-2600

Introduction

This is Section 4 of a four-section document entitled ‘‘Network Reading List: TCP/IP, UNIX, and Ethernet.’’ The four sections of this annotated list of resources were created to help you find information about TCP/IP, UNIX, and Ethernet. The complete list describes a wide range of items, including both introductory and in-depth information.

Section 1 covers TCP/IP resources, Section 2 covers UNIX, Section 3 Ethernet, and Section 4, miscellaneous items.

Section 4

4. Interest Groups, Periodicals, and Conferences

This section lists electronic mail interest groups, networking periodicals, networking conferences, and other miscellaneous items.

4.1. Interest Groups

There is a large and ever-increasing set of interest groups that communicate via redistributed electronic mail and the Usenet (User’s Network). Details on how electronic mail functions may be found in ‘‘Life With Unix,’’ ‘‘The User’s Directory of Computer Networks,’’ and other sources listed in previous sections.

Briefly, electronic mail redistribution consists of mailing lists to which you add your email address. Mail sent to the list is redistributed to all members of the list. Some of the lists have moderators who filter the incoming mail before sending it out to the members. Other lists are unmoderated, and all mail sent to the main address of the list is automatically resent to every member of the list.

The Usenet system is a method of distributing electronic mail that has been organized as a set of articles stored as a newsgroup. In practice, each group consists of a disk file that holds a given number of messages sent to the group address. The number of files saved in each group at any given moment is a local administration issue, and depends on the disk space available, etc. As the space is filled up, old messages disappear when new messages arrive. There are hundreds of groups being distributed by the Usenet system, with an uncounted but huge audience worldwide. Usenet is often simply called ‘‘netnews,’’ or even just ‘‘news.’’

4.1.1. SRI List of Lists

Many lists began life on the ARPANET, where they were registered in a master file called the List of Lists. Also known as the Interest Groups file, this master list of electronic mailing lists is kept at SRI. The SRI list that describes all manner of interest groups available via the Internet. There is considerable overlap with the BITNET lists shown below. A sample description from the SRI list follows:

- ‘‘INFO-NETS@THINK.COM
  Mailing list for general discussion of networks, focusing on inter-network connectivity. Questions about connections to particular sites are very common, as are discussions of new networks in the US and abroad.
  New archives are maintained on THINK.COM, and can be accessed via anonymous ftp as mail/info-nets.archives*. Archives cannot be mailed, but they are available on BITNIC for Bitnet users. Old archives are not currently available, but if demand warrants it may be possible to retrieve them.
  All non-BitNet requests to be added to or deleted from this list, problems, questions, etc., should be sent to INFO-NETS-REQUEST@THINK.COM. Multiple users at a given site should create a local distribution list and request that the local alias be added to the list, in

order to reduce the load on the THINK.COM mailer.
There is a BitNet sub-distribution list, INFONETS@BITNIC; BitNet subscribers can join by sending the SUB command with your name. For example, SEND LISTSERV@BITNIC SUB INFONETS Jon Doe
To be removed from the list, SEND LISTSERV@BITNIC SIGNOFF
To make contributions to the list, BitNet subscribers should send mail to the ARPANet list name, NOT to the BITNET list name.
Coordinator: Robert L. Krawitz <rlk@THINK.COM>''

Access to SRI List of Lists

The SRI Interest Groups list is available via anonymous FTP and mail server.
Anonymous FTP:

The anonymous FTP address is:
ftp.nisc.sri.com.
The filename is:
interest-groups
and it may be found in the:
pub/netinfo directory.

Mail Server:

The Interest Groups file may also be retrieved using the electronic mail-based mail server.

The mail server address is:
mail-server@nisc.sri.com.
Send a mail message to the server with the command:
send netinfo/interest-groups
and the server will respond by sending the entire Interest Groups file, split up into several separate mail messages.

4.1.2. BITNET

The BITNET networks support a wide range of interest lists and archives. The best way to find out about these resources is to send a message to the LISTSERV utility maintained at host BITNIC. You can request a help file describing the LISTSERV utility. You can also request a copy of the BITNET list of lists which is called the LISTSERV GROUPS file. Here's an example entry from the BITNET list of lists file:

- ''List: BIG-LAN@SUVM
  Coordinator: John Wobus (JMWOBUS@SUVM)
  BIG-LAN: Discussion of issues in designing and operation Campus-Size Local Area Networks, especially complex ones utilizing multiple technologies and supporting multiple protocols. Topics include repeaters, bridges vs. routers and gateways; how to incorporate smaller Personal-Computer type LANs into the campus-wide LAN; how to unify the mail systems, etc. All requests to be added, deleted from this list, problems or questions should be sent to BIG-REQ@SUVM.'' Requests may also be sent to BIG-LAN-REQUEST@SUVM.ACS.SYR.EDU (INTERNET).

Access to BITNET Lists

To get a copy of the LISTSERV lists file send a mail message to **LISTSERV@BITNIC.BITNET** and include the command:
SENDME LISTSERV GROUPS
The command should be in the body of the message and there should be no other text in the message. To get a copy of a description of the LISTSERV utility send a request to the same address

with the command:
SENDME LISTSERV MEMO

4.1.3. Usenet Groups

There are a large number of interest groups available via the Usenet. Here are just two examples:

- **comp.protocols.tcp-ip**
  This stands for ‘‘computers, protocols, TCP/IP.’’ This list discusses any and all TCP/IP issues.
- **comp.dcom.lans**
  Once heavily oriented to LAN hardware, especially Ethernet equipment, this list also sees message traffic about network operating systems such as Novell.

There are many, many more lists of this sort available via the Usenet. The group **news.announce.newusers** periodically publishes articles that contain lists of groups available on Usenet, as well as mailing lists available on other network systems. The monthly postings in this group also include introductory articles for newcomers to the Usenet system. Consult your local system administrator for information about access to the Usenet system.

4.2. Periodicals

You’ll find networking topics described in many different periodicals and journals. The book ‘‘Life With UNIX’’ lists a number of UNIX periodicals that include articles on networking.

There are also many periodicals and journals that specialize in networking issues or have a heavy emphasis on covering networking stories. Several network periodicals are listed here to provide an idea of what’s available.

Each periodical has a different format, mix of articles, and writing style. It’s up to you to try them out and decide which ones provide the information you need. For more examples consult an engineering library or technical bookstore.

- **Network World**
  The Newsweekly of User Networking Strategies
  Weekly tabloid
  Available free to qualified subscribers
  Network World
  161 Worchester Road
  Framingham, Mass. 01701
  (508) 875-6400

Wide coverage of the network market including frequent buyer’s guides focused on specific equipment such as bridges or routers. A good place to find the latest news on what the major vendors are up to, as well as the latest network technology offerings.

- **Communications Week**
  The Newspaper For Network Decision Makers
  Weekly tabloid
  Available free to qualified subscribers
  Communications Week
  P.O. Box 2070
  Manhasset, NY 11030

A networking weekly that also tracks the networking market as well as the activities of major vendors. Publishes buyer’s guides.

- **Data Communications**
  McGraw-Hill's Networking Technology Magazine
  Monthly magazine
  Available free to qualified subscribers
  Data Communications
  McGraw-Hill Inc.
  McGraw-Hill Building
  1221 Avenue of the Americas
  New York, N.Y. 10020
  (212) 512-2000

Features large network systems along with LAN coverage. Includes articles on wide area networks, T1 and other serial line technologies, equipment tests, the latest networking developments, etc.

- **Connexions**
  The Interoperability Report
  U.S./Canada subscriptions $150 for 12 issues/year
  No advertising
  Connexions
  480 San Antonio Road, Suite 100
  Mountain View, CA 94040
  (415) 941-3399

A publication associated with the Interop conference, Connexions concentrates on technical articles from protocol developers and others working on the latest issues in network interoperability. Status reports on the latest research in various network issues are also featured.

- **Computer Communication Review**
  The SIGCOMM Quarterly Publication
  $37 includes copy of Annual SIGCOMM conference proceedings
  Association for Computing Machinery
  P.O. Box 12115
  Church Street Station
  New York, N.Y. 10249
  (212) 869-7440

The Computer Communication Review is a quarterly report on SIGCOMM, the ACM special interest group on data communication. It includes reports on networking, telephony, and protocol verification. The topics covered include network architecture and design for LANs and large networks, recent network standards activities, etc. You can find news here about the latest thinking in network standards, as well as reports on work to increase the speed of networks and protocols. A subscription also gets you a copy of the annual SIGCOMM conference proceedings.

- **LAN Technology**
  The Technical Resource For Network Integrators
  $25 for 12 issues /year
  For subscriptions:
  LAN Technology
  P.O. Box 52315
  Boulder, CO 80321-2315
  (800) 456-1654

Features personal computer LANs and the network operating software typically found on such LANs. Also covers larger internet issues, such as network management protocols, reports on protocol analyzers, and the like.

- **LAN**
  The Local Area Network Magazine
  $19.97 for 12 issues /year
  For subscriptions:
  LAN
  Miller Freeman Publications
  P.O. Box 41904
  Nashville, TN 37204
  (800) 933-3321 or (615) 377-3322

Covers personal computer LANs, and includes interviews with various networking experts. Also features regular buyer's guides, equipment tests and reviews, and articles on new network technologies.

- **Network Computing**
  Computing in a Network Environment
  Available free to qualified subscribers:
  Network Computing
  P.O. Box 4751
  Manhasset NY 11030-4751
  (516) 562-5071

Emphasizes network operating systems and software. Personal computer issues and the latest in PC network hardware and software are topics.

4.3. Conferences

Just about every computer conference includes networking issues these days. There are also several conferences that focus on networking, each with their own particular slant such as PC networks, mainframe networks, etc.

INTEROP

There is one conference that focuses on interoperability issues and is loaded with information on the three main topics of this reading list. The conference is INTEROP, held each year in October in northern California. The last conference had 20,000 attendees and featured a vendor exhibit with over 200 participants.

The vendor booths are all attached to a large show network in what is the biggest practical demonstration of network interoperability anywhere. The conference features tutorials by TCP/IP experts, and several days of technical sessions on all manner of TCP/IP subjects, UNIX networking, and Ethernet issues, as well as on evolving OSI protocols, etc. For more information contact:

- **Interop Inc.**
  480 San Antonio Road, Suite 100
  Mountain View, CA 94040
  (415) 941-3399
  (800) 468-3767 (1-800-INTEROP)
  FAX (415) 949-1779

USENIX

One UNIX-oriented meeting that is likely to be of use to networkers is the USENIX conference, run by the USENIX Association. USENIX conferences are aimed at the technical UNIX developer and feature technical sessions based on refereed papers.

The latest work in Berkeley UNIX networking is frequently presented here, as well as work in other varieties of UNIX. You can stay fairly current with the latest in UNIX networking and other developments by reading the conference proceedings for the twice a year USENIX conferences.

The USENIX Association also publishes a newsletter, ‘‘;login:,’’ which publishes book reviews, reports on UNIX standardization meetings, and the like. For more information, contact:

- **USENIX Association**
  2560 Ninth Street, Suite 215
  Berkeley, CA 94710
  (415) 528-8649
  Internet Address: office@usenix.org

4.4. Access to the Internet

The UT Austin campus network is connected to the national and worldwide Internet via THEnet, the statewide Texas Higher Education network. Like UT, many universities are connected to the Internet by way of various regional networks. Many companies have gained access to the Internet in the same fashion. If you are looking for an Internet connection, the first thing to do is check with your local network administrator. The following is a list of some network access providers.

- **UUNet Technologies, Inc.**
  3110 Fairview Park Drive, Suite 570
  Falls Church, VA 22042
  (703) 876-5050
  info@uunet.uu.net
- **Performance Systems International (PSI)**
  11800 Sunrise Valley Drive
  Suite 1100
  Reston, VA 22091
  (800) 827-7482
  (703) 620-6651
  FAX: (703) 620-4586
  Email: info@psi.com
- **Advanced Network & Services, Inc. (ANS)**
  100 Clearbrook Road
  Elmsford, NY 10523
  (800) 456-8267
  (914) 789-5300
  Email: info@nis.ans.net
- **California Education & Research Federation Network (CERFnet)**
  c/o San Diego Supercomputer Center
  P.O. Box 85608
  San Diego, CA 92186-9784
  (800) 876-2373
  Email: help@cerf.net

4.5. Access to Books

Many of the resources listed here are books, and can be found in technical bookstores and engineering libraries. If you are having trouble finding a book listed here, the following bookstore can probably help:

- **Computer Literacy Bookshop**
  2590 North First St.
  San Jose, CA 95131
  Phone (408) 435-1118 for mail orders.

Computer Literacy is a good source for computer and electronics books of all kinds. They also carry some of the IEEE and ISO network standards, and can probably supply most of the books listed in this guide.

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