

CONTENTS

Preface	xix
Why This Book is for You	1
Chapter 1: Using TCP/IP and the Internet Protocols	3
1.1 The Challenge of the Internet	3
1.2 A Brief History of the Internet	5
1.3 The Protocols of the Internet	7
1.4 The Internet Family	11
1.5 Governing and Documenting the Internet	15
1.6 Applying the Technologies of the Internet	17
1.7 References	18
Chapter 2: Supporting TCP/IP and the Internet Protocols	21
2.1 The Internet Protocols	21
2.2 Internet Support within UNIX Environments	25
2.3 Internet Support within DECnet Environments	26
2.4 Internet Support within IBM Environments	28
2.5 Internet Support within DOS and Windows Environments	31
2.6 Internet Support within Macintosh Workstations	37
2.7 Internet Support within LAN Operating Systems	39
2.7.1 Banyan Systems' VINES	41
2.7.2 IBM's LAN Server and IBM WARP Connect	45
2.7.3 Microsoft's Windows NT	49
2.7.4 Novell's NetWare	53
2.8 Internetwork Analysis Tools	58
2.9 References	60
Chapter 3: Troubleshooting the Network Interface Connection . .	65
3.1 ARCNET	67
3.2 Ethernet	70
3.3 IEEE 802.3	72
3.4 IEEE 802.5	74
3.5 FDDI	76
3.6 Serial Lines	77
3.6.1 Serial Line IP	77
3.6.2 Point-to-Point Protocol	79
3.6.3 PPP Multilink Protocol	82
3.7 Data Link Switching	83
3.8 Public Data Networks Using X.25	85
3.9 Frame Relay	87

Contents

3.10 Switched Multimegabit Data Service	91
3.11 Asynchronous Transfer Mode	94
3.11.1 LAN Emulation	94
3.11.2 IP over ATM	98
3.11.3 Multiprotocol over ATM	101
3.12 Troubleshooting the Network Interface Connection	101
3.13 Case Studies	102
3.13.1 Initializing a Token Ring Workstation	102
3.13.2 Transmitting Banyan VINES Packets Through the Internet	107
3.13.3 Collisions on an Ethernet	112
3.13.4 Incompatibilities Between Ethernet and IEEE 802.3 Frames	115
3.13.5 Encapsulating IP Packets Inside AppleTalk Packets	119
3.13.6 Transmitting IP Datagrams Over a PSPDN	127
3.13.7 File Transfers over Frame Relay Networks	138
3.14 References	154

Chapter 4: Troubleshooting the Internet Connection 159

4.1 Internet Protocol	160
4.2 Internetwork Addressing	165
4.3 Address Translation	168
4.3.1 Address Resolution Protocol	169
4.3.2 Reverse Address Resolution Protocol	170
4.3.3 Inverse ARP	171
4.3.4 ATMARP	171
4.3.5 Proxy ARP	173
4.3.6 Bootstrap Protocol	174
4.3.7 Dynamic Host Configuration Protocol	176
4.4 Datagram Routing	178
4.4.1 Routing Information Protocol	179
4.4.2 Open Shortest Path First Protocol	182
4.4.2.1 Comparing Routing Algorithms	182
4.4.2.2 OSPF Operation and Packet Formats	183
4.5 Intra-Network Communications	193
4.6 Domain Name System (DNS)	199
4.7 Troubleshooting the Internetwork Connection	202
4.8 Case Studies	202
4.8.1 Login to a Remote Host	203
4.8.2 Fragmenting Long Messages	211
4.8.3 Measuring the Aging of ARP Tables	216
4.8.4 Duplicate IP Addresses	219
4.8.5 Incorrect Address Mask	227
4.8.6 Using ICMP Echo Messages	231
4.8.7 Misdirected Datagrams	235
4.8.8 Confused Routers	243
4.8.9 Using OSPF	252
4.9 References	256

Chapter 5: Troubleshooting the Host-to-Host Connection . . 259

5.1 The Host-to-Host Connection 259

5.2 Port Addresses 262

5.3 User Datagram Protocol 265

5.4 Transmission Control Protocol 266

5.5 TCP Functions 270

 5.5.1 Basic Data Transfer 270

 5.5.2 Reliability 270

 5.5.3 Flow Control 272

 5.5.4 Multiplexing 274

 5.5.5 Connections 274

 5.5.6 Precedence/Security 278

 5.5.7 The TCP Connection State Diagram 278

5.7 Case Studies 281

 5.7.1 Using BOOTP with UDP Transport 281

 5.7.2 Clock Synchronization with UDP 286

 5.7.3 Establishing and Terminating TCP Connections 292

 5.7.4 Reset TCP Connection 299

 5.7.5 Repeated Host Acknowledgements 303

 5.7.6 Using the Finger User Information Protocol 307

 5.7.7 Tape Backups via an Internetwork 311

 5.7.8 Optimizing the TCP Window Size 314

5.8 References 328

Chapter 6: Troubleshooting the Process/Application Connection 331

6.1 The Process/Application Connection 331

6.2 Trivial File Transfer Protocol (TFTP) 333

6.3 File Transfer Protocol 337

 6.3.1 Data Representation, Data Structures, and Transmission Modes 338

 6.3.2 FTP Commands 338

 6.3.2.1 Access Control Commands 338

 6.3.2.2 Transfer Parameter Commands 339

 6.3.2.3 Service Commands 339

 6.3.3 FTP Replies 340

 6.3.4 FTP Operation 341

6.4 Sun Microsystems Network File System 341

6.5 TELNET 344

6.6 Simple Mail Transfer Protocol 348

 6.6.1 Message Transfer 348

 6.6.2 Message Format 349

 6.6.3 SMTP Commands 350

 6.6.4 SMTP Replies 350

 6.6.5 Multipurpose Internet Mail Extensions 351

6.7 NetBIOS 355

 6.7.1 NetBIOS Name Service 356

Contents

6.7.2 NetBIOS Session Service	357
6.7.3 NetBIOS Datagram Service	358
6.8 Troubleshooting the Process/Application Connection	361
6.9 Case Studies	362
6.9.1 Using TFTP	362
6.9.2 Collaborative Efforts of FTP, ARP, and TFTP	370
6.9.3 Selecting the Proper Terminal Option for TELNET	381
6.9.4 TELNET over ATM	391
6.9.5 SMTP Interoperability Problems	409
6.9.6 NetBIOS and TCP Interactions	415
6.9.7 Implementing Multiple Protocol Stacks	427
6.10 References	437
Chapter 7: Managing the Internet	441
7.1 Managing Internetworks	442
7.1.1 Fault Management	443
7.1.2 Accounting Management	443
7.1.3 Configuration Management	443
7.1.4 Performance Management	443
7.1.5 Security Management	443
7.1.6 Managing TCP/IP-Based Internetworks	444
7.2 The Agent/Manager Model	445
7.3 The SNMP Network Management Process	446
7.3.1 The Structure of Management Information	447
7.3.2 Management Information Base	449
7.4 Simple Network Management Protocol version 1 (SNMPv1)	451
7.4.1 SNMPv1 Architecture	452
7.4.2 SNMPv1 Messages	453
7.5 Simple Network Management Protocol version 2 (SNMPv2)	457
7.6 Common Management Information Protocol (CMIP/CMOT)	459
7.7 IEEE LAN/MAN Management	462
7.8 Desktop Management Task Force	464
7.9 Network Management Systems	465
7.10 Case Study	466
7.11 References	479
Chapter 8: The Next Generation	485
8.1 IPng Development	485
8.1.1 Common Architecture for the Internet (CATNIP)	487
8.1.2 Simple Internet Protocol Plus (SIPP)	487
8.1.3 TCP/UDP Over CLNP-Addressed Networks (TUBA)	488
8.2 IPv6 Capabilities	488
8.3 IPv6 Documentation	490
8.4 IPv6 Specification	491
8.5 The IPv6 Header	492
8.5.1 Extension Headers	493
8.5.2 Extension Header Order	494

8.5.3 Hop-by-Hop Options Header	496
8.5.4 Destination Options Header	496
8.5.5 Routing Header	497
8.5.6 Fragment Header	498
8.5.7 Authentication Header	499
8.5.8 Encapsulating Security Payload Header	501
8.5.9 No Next Header	502
8.6 IPv6 Addressing	502
8.6.1 IPv6 Address Types	502
8.6.2 IPv6 Address Representation	506
8.6.3 IPv6 Address Prefixes	507
8.7 ICMPv6 for IPv6	509
8.8 The Great Transition: IPv4 to IPv6	511
8.8.1 Dual IP Layers	512
8.8.2 Tunneling	512
8.9 References	515
Appendix A: Addresses of Standards Organizations	519
Appendix B: Broadband Technology Forums	523
Appendix C: Selected Manufacturers of TCP/IP-Related Internetworking Products	525
Appendix D: Sources of Internet Information	553
Internet Directory and Database Services	553
Registration Services	553
Internet Organizations	554
Obtaining RFCs	554
Primary Repositories:	555
Secondary Repositories:	559
The RFC-Info Service	562
Internet Mailing Lists	563
Appendix E: RFC Index	565
Appendix F: Internet Parameters	627
Introduction	628
Data Notations	629
Transmission Order of Bytes	630
Significance of Bits	630
Special Addresses	630
Version Numbers	632
Protocol Numbers	632
Well-Known Port Numbers	636
Registered Port Numbers	668
Internet Multicast Addresses	669
IP Parameters	671

Contents

IP Option Numbers	671
IP Time to Live Parameter	672
IP TOS Parameters	672
ICMP Type Numbers	674
TCP Parameters	678
TCP Option Numbers	678
TCP Alternate Checksum Numbers	679
TELNET Parameters	679
TELNET Options	679
TELNET Authentication Types	681
Domain Name System Parameters	682
Domain System Parameters:	682
BOOTP and DHCP Parameters	683
Address Family Numbers	686
OSPF Authentication Codes	687
Network Management Parameters	687
Private Enterprise Numbers	696
Address Resolution Protocol Parameters	696
Reverse Address Resolution Protocol Operation Codes	696
Dynamic Reverse ARP	696
Inverse Address Resolution Protocol	697
Protocol Type (pro)	698
IEEE 802 Numbers of Interest	698
Ethernet Numbers	699
EtherTypes	699
IANA Ethernet Address Block	705
Ethernet Vendor Address Components	706
Ethernet Multicast Addresses	710
X.25 Type Numbers	713
Public Data Network Numbers	714
XNS Protocol Types	718
Point to Point Protocol Parameters	719
PPP DLL Protocol Numbers	719
PPP LCP and IPCP Codes	722
PPP LCP Configuration Option Types	723
PPP LCP Callback Operation Fields	724
PPP IPCP Configuration Option Types	724
PPP ATCP Configuration Option Types	725
PPP OSINLCP Configuration Option Types	725
PPP Bridging Configuration Option Types	726
PPP Bridging MAC Types	726
PPP Bridging Spanning Tree	726
Protocol and Service Names	727

Appendix G: Acronyms and Abbreviations	733
---	------------

Trademarks	759
-------------------	------------

Index	761
--------------	------------

