

网络与通信技术 **影印版** 系列

Network Protocols

Signature Edition

网络协议



Matthew Naugle

人民邮电出版社
www.pptph.com.cn

McGraw-Hill
www.mhhe.com

**Mc
Graw
Hill**

网络与通信技术影印版系列

Network Protocols

(Signature Edition)

网络协议

Matthew G.Naagle

 人民邮电出版社 McGraw-Hill 

Matthew G. Naugle: Network Protocols, Signature Edition.
Copyright © 1999, 1994 by The McGraw-Hill Companies, Inc.
Authorized Reprinting by the People's Posts and Telecommunications
Publishing House.
All rights reserved. For sale in the People's Republic of China only.
ISBN 0-07-046603-3
IE ISBN:0-07-118496-1

本书英文影印版由人民邮电出版社和美国麦格劳-希尔国际公司合作出版, 未经出版者书面许可, 不得以任何方式复制或抄袭本书的任何部分。

版权所有, 翻印必究。

网络与通信技术影印版系列

网络协议

-
- ◆ 编 著 Matthew G. Naugle
 - ◆ 人民邮电出版社出版发行 北京市崇文区夕照寺街 14 号
邮编 100061 电子函件 315@pptph.com.cn
网址 <http://www.pptph.com.cn>
北京汉魂图文设计有限公司制作
北京顺义振华印刷厂印刷
新华书店总店北京发行所经销
 - ◆ 开本: 880 × 1230 1/32
印张: 30.5 2000 年 9 月第 1 版
印数: 1 ~ 3 000 册 2000 年 9 月北京第 1 次印刷
著作权合同登记 图字: 01 - 2000 - 2213 号
ISBN 7-115-08786-5/TN·1641
-

定价: 49.00 元

This book is dedicated to my wife, Regina. Her constant reassurance and, most of all, her unrelenting patience made it possible to write this book. Also many thanks to my three children: Bryan, Courtney, and Lauren, who have proven that life is most enjoyable when looking at it through simplistic, innocent, and trusting eyes.

CONTENTS

Chapter 1	The Physical Layer	1
	Introduction	2
	Overview	3
	The Open Systems Interconnect Model	5
	Topologies	8
	Star Topology	8
	Ring Topology	10
	Bus Topology	10
	Wiring Systems for Ethernet, Token Ring, and FDDI	11
	Thick Coaxial Cable	13
	Thin Coaxial Cable	16
	Unshielded Twisted Pair	18
	Repeaters	22
	The Physical Layer for Token Ring	28
	Data Connectors	32
	Multistation Access Unit	33
	FDDI Overview and Physical Layer	35
	FDDI and the OSI	36
	FDDI Cable	37
	Connectors	39
	Port Types	40
	FDDI Station Classes	41
	FDDI Physical Layer Operations	42
	FDDI Station or Ring Breaks	43
	FDDI Concentrators	45
	FDDI Topologies	47
Chapter 2	Ethernet, Token Ring, and FDDI	53
	The DataLink Layer	54
	Ethernet	54
	Fast Ethernet	61
	Gigabit Ethernet Physical Layer	69
	Token Ring	69
	FDDI	78

Addressing the Packet	93
Frame Identification (Ethernet)	94
Physical (MAC) Addressing	96
Bit-Order Transmission	100

Chapter 3	Bridges, Routers, and Basic Network Information	105
	Introduction	106
	Transparent Bridges	106
	Introduction	106
	Redundancy and the Spanning Tree Algorithm	111
	Token Ring Bridges	116
	Differences	124
	Address Conversion	125
	Routers	126
	Theory	126
	Operation	129
	Conclusion	132
	Multiprotocol Routers	134
	Translating Bridges	136
	Gigabit Ethernet—The Need for Speed	137
	Ethernet Technical Review	139
	Starting Up Gigabit Ethernet	141
	Gigabit Ethernet Transmission Methods	145
	Products	149
	Quality of Service	150

Chapter 4	IEEE 802.2	151
	Introduction	152
	LLC Type 2 Operation	154
	Connection-Oriented LLC2—Asynchronous Balance Mode	154
	Frame Formats	156
	Sequencing of Data	160
	Timer Functions	163
	Connection-Oriented Services of the IEEE 802.2 Protocol	164
	Details of LLC Type 2 Operation	165
	LLC2 Frame Reception	168
	A Live Connection	168
	LLC Type 1 Operation	170
	Information Transfer	172
	XID	172

	Test	173
	SNAP	174
Chapter 5	Xerox Network System	179
	Introduction	180
	Network Definition	181
	Terminology and Definitions	186
	Sockets and Routing	189
	XNS at Level 0	189
	Nonbroadcast or Point-to-Point	190
	Host Numbers	194
	Network numbers	194
	Socket numbers	195
	Identifying the IDP Fields	196
	Level 2	199
	Routing Information Protocol	200
	Level 2 Error Protocol	221
	Level 2 Echo Protocol	221
	Level 2 Sequence Packet Protocol	224
	Level 2 Packet Exchange Protocol	236
Chapter 6	Novell Netware	245
	Introduction	246
	Version History	248
	Concepts	250
	Internet Packet Exchange	251
	IPX Routing Architecture: The Data Delivery System	253
	IPX Routing Functions: Novell Routers	261
	IPX Routing Information Protocol	266
	Router Operation	268
	The Service Advertising Protocol	276
	SAP Operation	282
	An Introduction to Workgroup Client-Server Computing	285
	Physical and Virtual Drives	286
	Printing Using a Server	287
	The NetWare Interface	288
	The Workstation	290
	Connection Establishment	292
	File Server Concepts	296
	Server System Calls	303

NetWare Supplementals	306
Multiple NetWare Protocols	306
IntraNetWare	308
Packet Burst Mode Technology	309
NetWare Link Services Protocol	313
The DOS Requester and Associated VLMs	321
NetWare Directory Services	325
Time Services	331
 Chapter 7	
An Introduction to TCP/IP	333
Introduction	334
History	339
The World Wide Web	344
Intranets and Extranets	348
Governing Bodies of the Internet	348
An Overall View of the Internet	350
TCP/IP Technical Documents	350
RFC Details	352
RFC Submission	353
RFC Updates	354
RFC Format	355
RFC Action Words	357
TCP/IP	358
The Internet Protocol	359
The Transport Layer Protocols	363
TCP/IP Applications	363
 Chapter 8	
The Internet Protocol	367
Introduction	368
The Internet Protocol—Connectionless, Best-Effort	
Delivery Service	368
IP Header Fields	370
Version	370
Header Length, Service Type, and Total Length	370
Fragmentation	372
Time to Live	374
Protocol and Checksum	375
IP Options	375
Source and Destination Address (IPv4)	376
Classful Addressing	377
IP Address Format	378

IP Class Identification	380
Subnetting	383
Reasons for Subnetting	384
Subnetting Examples (Class A, B, and C)	385
More Subnet Examples	386
Physical and Logical Addresses	387
Writing a Subnet Mask	388
Multinetting	392
Routers and Subnet Masks	393
Classful IP Address Review	394
Address Allocation (The Internet Registry)	396
Address Resolution Protocol	398
Reverse Address Resolution Protocol	403
Proxy ARP	403
Circuit and Packet Switching	404
Supernatural Acts for IP Addressing	406
Extending the IPv4 Address Space	407
IP Address Assignment (The Old Method)	408
Address Efficiencies: The Terms	409
Classless InterDomain Routing	420
Another Example: ISP Splice	421
Comparison between CIDR and VLSM	424
Zero and Ones Subnet	425
Internet Assigned Numbers Authority	426
Internet Control Message Protocol	427
ICMP Ping	428
More ICMP Functions	429
Chapter 9	
IP Routing	431
Introduction	432
Routing	433
Indirect Routing	434
The Routing Information Protocol (Version 1)	440
RIP Operational Types	441
RIP Field Descriptions	442
Default Routes	444
Disadvantages of the RIPv1 Protocol	445
RIP Version 2	450
Authentication	451
Subnet Mask Field	451
Route Tag and Next Hop Fields	453

Multicast Support	453
Compatibility with RIPv1	454
Static versus Dynamic Routing	455
Remote Networks	456
Open Shortest Path First (RFC 2178)	458
OSPF Features	458
An OSPF Network	459
A Routing Protocol Comparison	460
OSPF Overview	460
OSPF Network Support	461
Router Types and Routing Methods	461
Message Types	462
Metrics (Cost)	464
Generic Packet Format	464
The Hello Protocol	464
Adjacency	466
Maintaining the Database	467
OSPF Areas	468
The Backbone Area	470
The Area Border Router	470
Virtual Link	471
Inter-Area Routing	472
Information from Other Autonomous Systems	473
Stub Areas	474
RFCs Related to OSPF	474
Datagram Routing	475
Chapter 10 IPv6	477
Introduction	478
IPv6 Main Points	480
IPv6 Proposals	480
IPv6 Header Format	482
IPv4 Options Review	483
IPv6 Extension Headers	484
Sizes and Fragments	484
Header Differences	486
Priority and Flow Label	487
IPv6 Addressing	488
Methods of Deploying IPv6	491
Unicast Addresses	492

Local-Use IPv6 Addressing	493
IPv6 Addresses with Embedded IPv4 Addresses	495
Autoconfiguration	496
Neighbor Discovery	496
IPv6 Tunneling	500
Anycast Addressing	503
Multicasting	505
IPv6 Routing	506
RIPv6	507
ICMP for IPv6	508
ICMPv6 and ICMPv4	509
IPv6 Cache Entries	514
IPv6 Algorithm	515
Address Resolution	516
RFCs Related to IPv6	517
Chapter 11 User Datagram Protocol	519
Introduction	520
UDP Multiplexing and Demultiplexing	521
Port Numbers	522
Assigned, Registered, and Dynamic Port Numbers	523
Dynamic Port Numbers	523
Transmission Control Protocol	525
TCP Details	525
TCP Field Definitions	527
TCP Services	528
TCP Connection Establishment	529
The Three-Way Handshake	530
TCP Segment	531
Sequence Numbers and Acknowledgments	533
TCP Flow and Window Management	535
TCP Retransmission	537
Slow Start and Congestion Avoidance	537
Differentiating Connections through Port Numbers	539
Termination	541
Real-Time Protocol and the Real-Time Control Protocol	542
Translators	544
Mixers	544
Support for Time-Sensitive Applications	545
Payload Type	546

	The RTP Header Fields	547
	Providing Control for RTP	549
	Sender and Receiver Reports	550
	Receiver Reports	551
	Source Description Packet	551
	Bye Packet	552
	Application-Specific Messages	553
	Caveats	553
	RFCs and Web Sources	553
Chapter 12	Selected TCP/IP Applications	555
	Introduction	556
	Telnet	557
	Telnet Options	558
	File Transfer Protocol	559
	FTP Commands	560
	FTP Data Transfer	560
	Trivial File Transfer Program	562
	Domain Name Service	563
	DNS Structure	564
	DNS Components	565
	DNS Structure	566
	Name Servers	568
	Query Function Types	570
	Example DNS Database	571
	Playing with the Database	574
	whois Command	575
	More DNS Information	576
	Simple Mail Transfer Protocol	576
	SMTP Functions	577
	SMTP Flow	578
	DNS Interaction for Mail	580
	Post Office Protocol	580
	POP Operation	582
Chapter 13	IP Multicast	585
	Introduction	586
	Multicast Components	587
	Multicast Caveats	588
	Unicast (versus Multicast)	589

Multicasting Types	590
Addressing Type Review	591
Introduction to IP Multicast	591
Extensions to the IP Service Interface	592
Receiving Multicast Datagrams	593
Address Format	594
Mapping to an Ethernet or IEEE 802 MAC Address	595
Protocols	596
IGMP Header	597
Router Functions of IGMP	599
Host Join	600
Multicast Algorithms	601
Leaves, Branches, and the Root	602
Spanning Tree and Flooding	603
Reverse Path Broadcasting	604
Truncated RPB and Reverse Path Multicasting	606
Core-Based Trees	608
Distance Vector Multicast Routing Protocol	609
DVMRP and IGMP	610
Neighbor Discovery	610
Route Reports	611
DVMRP Tables	612
Pruning and Grafting	615
Tunneling	616
Protocol-Independent Multicast	617
PIM Dense Mode	618
Protocol Operation	619
Adding Interfaces	620
PIM Sparse Mode	620
Types of Multicast Trees	621
Joining a Group	622
Sending Data Using PIM Sparse Mode	623
Rendezvous Points	624
Comparison of Sparse-Mode and Dense-Mode Protocols	625
Multicast Open Shortest Path First	625
MOSPF Differences	627
OSPF Caveats	627
Local Group Database and the Group-Membership LSA	627
Role of the DR and the BDR	628
Local Group Database	629
Operation	630

Forwarding Cache	631
Inter-Area MOSPF Routing	632
Inter-Autonomous System Multicast	635
Multicast Conclusion	636
RFCs to Be Reviewed	636
WEB Sites	637
Chapter 14 Other TCP/IP Protocols	639
Boot Protocol	640
BOOTP Operation	640
Client Side (BOOTREQUEST)	641
Server Side	644
Chicken or the Egg?	646
BOOTP Relay Agents (or BOOTP Gateway)	646
Dynamic Host Configuration Protocol	647
IP Address Allocation	648
DHCP Messages	649
DHCP Responses	651
DHCP Shortcuts	652
Lease Duration	653
Efficiencies	654
Resources Reservation Protocol	657
Alternatives	658
RSVP Operation	659
RSVP Control	663
Disabling Reservations and Handling Errors	664
Merging Flow Specs	664
A Simple Example	665
RSVP Issues	666
RSVP Summary	667
Conclusion	668
Simple Network Management Protocol	669
SNMP Manager	670
Agents	671
Management Information Base	671
The Protocol of SNMP	672
Chapter 15 AppleTalk	675
The Physical Layer—AppleTalk Hardware	679
LocalTalk	679
Media Considerations for AppleTalk	683

Data-Link Functions	683
The Control Panel	684
Link Access Protocol Manager for LocalTalk	684
The AppleTalk Address Resolution Protocol	693
LAP Manager for EtherTalk and TokenTalk	696
The AppleTalk Network Layer: End-to-End Data Flow	701
Datagram Delivery Protocol	701
Routers, Routing, Tables and Maintenance	707
AppleTalk Echo Protocol	722
Names on AppleTalk	722
Transport Layer Services	729
Reliable Delivery of Data	729
AppleTalk Transaction Protocol	731
Printer Access Protocol	733
AppleTalk Session Protocol	733
AppleShare and the AppleTalk Filing Protocol	740
Chapter 16 Digital Network Architecture	749
Introduction	750
History	750
The Routing Layer	756
Definitions	756
Functions of DECnet Routing	757
Addressing	758
Areas	760
The Routing Database	763
Declarations	763
Forwarding of Packets	765
Routing the Data	768
Forwarding of Data in a DECnet Environment	776
Endnode Packet Delivery	780
End Communication Layer: The DNA Transport Layer	781
Flow Control	788
The Session Control Layer	789
Network Application Layer	793
Data Access Protocol	795
Network Virtual Terminal	796
Other Layers	801
Chapter 17 Local Area Transport	805
Introduction	806

Node Types on LAT LANs	807
LAT Topology	811
Service Class Layer	812
Slot Layer	814
Virtual Circuit Layer	815
LAT Components	817
Services	817
The Service-Announcement Process	818
Groups	819
Session Establishment	820
Data Transfer	822
Session Flow Control	825
Slot Flow Control	825
Session Termination	827
Other LAT Services	827
Host-Initiated Requests	827
Session Management	828
Virtual Circuit Maintenance	829
Connection Queue Maintenance	830
Chapter 18 Point-to-Point Protocol	833
Introduction	834
Details of PPP	836
PPP Encapsulation	836
PPP Operation	837
Link Control Protocol	838
Authentication	842
Multilink PPP	844
Chapter 19 Frame Relay	847
Introduction	848
Definitions	850
Address Resolution	855
Circuits	857
Committed Information Rate	858
Congestion Control	859
Multicast Data	862
Frame Relay Management	864
LMI Protocols	864

Frame Relay Topologies	868
Frame Relay and IP	872
Frame Relay and IPX	873
Other Tuning Suggestions for Frame Relay Installations	874
RFC 1490: Multiprotocol Interconnect over Frame Relay	874
Configuration Challenges	876
Alternative Frame Relay Implementations	878
Chapter 20 ISDN <i>by Gary C. Kessler and Peter V. Southwick</i>	883
Communications Basics	884
Analog and Digital Signals	884
Amplifiers and Repeaters	886
Structure of the Telephone Network	886
Passband and Bandwidth	890
The Telephone Local Loop	890
Multiplexing	892
Digital Telephony	893
The Move to a Digital Telephone Network	893
Digitizing Voice and Pulse Code Modulation	894
The Digital-TDM Hierarchy	896
Digital Signals on the Local Loop	899
Full-Duplex Communication on the Local Loop	900
Types of Switched Networks	901
Circuit Switching	902
Packet Switching	904
Fast Packet Technologies	906
Open Systems Interconnection Reference Model	906
OSI Layers	907
Packet Switching and X.25	909
Protocol Architectures	910
ISDN Channels	911
The D-Channel	912
The B-Channel	913
H-Channels	914
Access Interfaces	914
Basic Rate Interface	916
Primary Rate Interface	916
Functional Devices and Reference Points	917
ISDN Functional Devices	918
ISDN Reference Points	920