

Table of Contents

Preface	1
Chapter 1: Introduction to Network Protocols	5
1.1 ISO OSI	8
1.1.1 Physical Layer	8
1.1.2 Data Link Layer	9
1.1.3 Network Layer	11
1.1.4 Transport Layer	12
1.1.5 Session Layer	13
1.1.6 Presentation Layer	13
1.1.7 Application Layer	13
1.2 TCP/IP	14
1.2.1 Internet Protocol	14
1.2.2 TCP and UDP	14
1.2.3 Application Protocols	15
1.3 Methods of Information Transmission	16
1.3.1 Synchronous Transmission	16
1.3.2 Packet Transmission	17
1.3.3 Asynchronous Transmission	17
1.4 Virtual Circuit	18
Chapter 2: Network Monitoring Tools	21
2.1 Packet Drivers	22
2.2 MS Network Monitor	23
2.2.1 Frame Capturing	23
2.2.2 Viewing Captured Frames	26
2.2.3 Filters for Displaying Captured Frames	28
2.3 Ethereal	28
2.4 Homework	30

Chapter 3: Physical Layer	33
3.1 Serial Line	34
3.1.1 Serial and Parallel Data Transport	34
3.1.2 Symmetrical and Asymmetrical Signals	34
3.1.3 Synchronous and Asynchronous Transport	35
3.1.4 V.24, V.35, and X.21 Protocols	36
3.1.5 Null Modem	40
3.2 Modems	40
3.2.1 Dial-Up Connection	41
3.2.2 Leased Lines	41
3.2.3 Automatic Modem	42
3.2.3.1 AT Commands	42
3.2.4 Synchronous Transmission	44
3.2.5 Baseband, Voice Band, and ADSL	44
3.2.6 Transmission Rate	49
3.2.6.1 The V.90 Recommendation	49
3.2.7 Data Compression	50
3.2.8 Error Detection	51
3.3 Digital Circuits	51
3.3.1 ISDN	51
3.3.1.1 Basic Rate	52
3.3.1.2 Higher Layer Protocols and Signaling	54
3.3.2 E and T Lines	56
3.4 LAN	57
3.4.1 Structured Cables	57
3.4.1.1 Copper Distribution	58
3.4.1.2 Optical Fibers	59
3.4.2 Ethernet (10 Mbps)	62
3.4.2.1 AUI	62
3.4.2.2 BNC	62
3.4.2.3 Twisted-Pair	62
3.4.3 Fast Ethernet (100 Mbps)	63
3.4.4 Gigabyte Ethernet (1 Gbps)	63
Chapter 4: Link Layer	65
4.1 Serial Line Internet Protocol	65
4.2 Compressed SLIP	66

4.3 High-Level Data Link Control Protocol	71
4.3.1 Flag	72
4.3.2 Address Field	73
4.3.3 Control Field	73
4.3.3.1 I-Frame	74
4.3.3.2 S-Frame	75
4.3.3.3 U-Frame	75
4.3.4 Data Field and a Transferred Protocol Type	76
4.3.5 Checksum	77
4.3.6 HDLC Protocol Summary	77
4.4 Point-To-Point Protocol	77
4.4.1 Dialing a Phone Line	80
4.4.2 Link Control Protocol	81
4.4.3 Authentication	87
4.4.3.1 Password Authentication Protocol	88
4.4.3.2 Challenge Handshake Authentication Protocols	89
4.4.3.3 Extensible Authentication Protocol	90
4.4.3.4 Radius Protocol	91
4.4.4 Call-Back Control Protocol	92
4.4.5 Other Protocols	94
4.4.5.1 Multilink Protocol	94
4.4.5.2 Bandwidth Allocation Protocol and Bandwidth Allocation Control Protocol	96
4.4.5.3 Compression Control Protocol	97
4.4.5.4 Encryption Control Protocol	98
4.4.5.5 Setting Encryption Keys	98
4.4.6 Internet Protocol Control Protocol	99
4.5 Frame Relay	101
4.5.1 A Frame Relay Protocol Frame	105
4.5.2 IP Through Frame Relay	108
4.5.3 Local Management Interface	110
4.5.4 Frame Relay Configuration on CISCO Routers	110
4.5.5 Frame Relay Protocol	110
4.6 Local Area Networks	111
4.6.1 Ethernet	112
4.7 Wireless Local Area Network	121
4.7.1 Typical WLAN Configuration	123
4.7.1.1 Peer-To-Peer Networks	123
4.7.1.2 Access Point	123
4.7.1.3 Roaming (Several Access Points)	124
4.7.1.4 Backbone Point-to-Point Connection	124

4.7.2 Antennas	124
4.7.3 Security of WLAN	125
4.7.3.1 Service Set ID	125
4.7.3.2 Wired Equivalent Privacy	125
4.7.3.3 IEEE 802.1X	126
4.8 Fixed Wireless Access	127
4.8.1 The Differences Between FWA and WLAN	127
4.8.2 The Main Benefits of FWA	128
Chapter 5: Internet Protocol	129
5.1 IP Datagram	133
5.2. Internet Control Message Protocol	137
5.2.1 Echo	140
5.2.2 Destination Unreachable	141
5.2.3 Source Quench (Lower Sending Speed)	141
5.2.4 Redirect	141
5.2.5 ICMP Router Discovery	141
5.2.6 Time Exceeded	142
5.2.7 Subnet Address Mask Request	144
5.2.8 Time Synchronization	144
5.3 Fragmentation	145
5.4 Optional Entries in the IP Header	149
5.4.1 Record Route	150
5.4.2 Timestamp	152
5.4.3 Source Routing	153
5.4.4 IP Router Alert Option	155
5.5 ARP and RARP Protocols	156
5.5.1 ARP Filtering	159
5.5.2 Proxy ARP	160
5.5.3 Reverse ARP	160
5.6 Internet Group Management Protocol	161
5.7 Multicast and Link Protocol	164
Chapter 6: IP Address	167
6.1 Network: First Period of History	168
6.1.1 Special-Use IP Addresses	169
6.1.2 Network Mask	170
6.2 Network: Second Period of History	171
6.2.1 Subnetworks	173
6.2.2 Super-Networks and Autonomous Systems	177

6.3 IP Addresses in the Intranet and Special-Use IP Addresses	182
6.4 Unnumbered Interface	183
6.4.1 Dynamic Address Assignment	184
6.5 Address Plan	184
6.6 Over 254 Interfaces in a LAN	186
Chapter 7: Routing	189
7.1 Forwarding and Screening	191
7.2 Routing	192
7.2.1 Processing	194
7.3 Handling Routing Tables	195
7.3.1 List of Contents of a Routing Table in a Command Prompt	195
7.3.1.1 Contents of a Routing Table in UNIX	195
7.3.2 Routing Table Listing in Windows 2000/XP/2003	196
7.3.3 Contents of a Routing Table in Cisco Routers	197
7.3.4 Routing Table Entry Addition and Removal	198
7.4 Routing Protocols	199
7.4.1 Routing Vector Protocols	199
7.4.1.1 RVP Principle	199
7.4.1.2 RIP and RIP2	203
7.4.2 Link State Protocols	204
7.4.2.1 OSPF	209
7.4.3 IPG and EGP	211
7.4.4 Aggregation	211
7.4.5 Redistribution	211
7.5 Neutral Exchange Point	212
Chapter 8: IP Version 6	213
8.1 Next Headers of IP Version 6 Datagram	216
8.1.1 Hop-By-Hop Options	217
8.1.2 Routing Header	219
8.1.3 Fragment Header	222
8.1.4 Authentication Header	222
8.1.5 Encapsulating Security Payload Header	223
8.2 ICMP Version 6 Protocol	224
8.2.1 Address Resolution	225
8.2.2 Router Discovery	229
8.2.3 Redirect	231

8.3. IP Addresses	233
8.3.1 Types of Address Inscription	233
8.3.2 Multicasts	234
8.3.3 Unicasts	235
8.4 Windows 2003	236
Chapter 9: Transmission Control Protocol	239
9.1 TCP Segments	241
9.2 TCP Header Options	246
9.3 Establishing and Terminating a Connection with TCP	247
9.3.1 Establishing a Connection	248
9.3.2 Terminating a Connection	252
9.3.3 Aborting a Connection	255
9.4 Determining the Connection State	256
9.5 Response Delay Techniques	257
9.6 Window Technique	261
9.7 Network Congestion	264
9.7.1 Slow Start	264
9.7.2 Congestion Avoidance	265
9.7.3 Segment Loss	266
9.8 The Window Scale Factor	266
Chapter 10: User Datagram Protocol	269
10.1 Fragmentation	271
10.2 Broadcasts and Multicasts	272
Chapter 11: Domain Name System	273
11.1 Domains and Subdomains	274
11.2 Name Syntax	275
11.3 Reverse Domains	276
11.4 Resource Records	278
11.5 DNS Protocol	279
11.6 DNS Query	280
11.6.1 DNS Query Packet Format	281
11.6.2 DNS Query Packet Header	281
11.6.3 Question Section	283
11.6.4 The Answer Section, Authoritative Servers, and Additional Information	285

Chapter 12: Telnet	287
12.1 The NVT Protocol	288
12.2 Telnet Protocol Commands	290
12.2.1 Signal for Synchronization	294
12.2.2 The Telnet Command Line	294
12.2.3 Communication Modes	297
12.3 Example of Windows NT Client Communication	298
12.4 Example of UNIX Client Communication	300
Chapter 13: File Transfer Protocol	305
13.1 Architecture	306
13.2 Active Mode of FTP Protocol Communication	308
13.3 Passive Mode of FTP Protocol Communication	311
13.4 FTP Commands	313
13.5 Proxy	316
13.6 Return Codes	317
13.7 Abnormal Termination of Data Transfer	318
13.8 Anonymous FTP	319
Chapter 14: Hypertext Transfer Protocol	321
14.1 Client-Server	321
14.2 Proxy	326
14.3 Gateway	329
14.4 Tunnel	331
14.5 More Intermediate Nodes	333
14.6 Uniform Resource Identifier	334
14.6.1 The http Scheme	334
14.6.2 The ftp Scheme	335
14.6.3 The mailto Scheme	336
14.6.4 The nntp Scheme	336
14.6.5 The telnet Scheme	336
14.6.6 The file Scheme	336
14.6.7 The pop Scheme	336
14.7 Relative URI	337
14.8 The HTTP Request	337
14.8.1 The GET Method	338
14.8.2 The POST Method	341

14.8.3 The HEAD Method	342
14.8.4 The TRACE Method	343
14.8.5 The OPTIONS Method	343
14.9 The HTTP Response	344
14.9.1 An Overview of Result Codes	344
14.10 Other Header Fields	346
14.10.1 Accept Header Field	346
14.10.2 Client Authentication	347
14.10.3 Proxy Authentication	348
14.10.4 Content Header Field	348
14.10.5 Redirection and Temporary Unavailability of Objects	349
14.10.6 Cache	350
14.10.7 Software Information	352
14.11 Cookie	352
14.11.1 Set-Cookie and Set-Cookie2 Header Fields	355
14.11.1.1 Cookie Header Field	355
Chapter 15: Email	357
15.1 Email Architecture	357
15.1.1 DNS and Email	365
15.2 Mail Message Format	365
15.2.1 Basic Header Fields	366
15.3 MIME	368
15.3.1 MIME Header Fields	369
15.3.1.1 MIME-Version	369
15.3.1.2 Content-Type	370
15.3.1.3 Content-Transfer-Encoding	371
15.3.1.4 Content-Disposition	371
15.3.2 Standard Encoding Mechanisms	372
15.3.2.1 Quoted-Printable	372
15.3.2.2 Base64	373
15.3.3 Non-ASCII Text in Message Header Fields	375
15.3.4 Discrete Media Types in Content-Type	375
15.3.4.1 text	375
15.3.4.2 application	376
15.3.4.3 image	377
15.3.4.4 audio	377
15.3.4.5 video	378
15.3.4.6 model	378

15.3.5 Composite Media Types in Content-Type	378
15.3.5.1 multipart	378
15.3.5.2 message	382
15.4 SMTP	383
15.5 ESMTP	386
15.5.1 Message Delivery Receipt	388
15.5.1.1 Delivery Status Notification	390
15.5.1.2 The Disposition-Notification-To Header Field	393
15.6 POP3	395
15.7 IMAP4	397
15.7.1 Unauthenticated State	400
15.7.1.1 LOGIN	400
15.7.1.2 AUTHENTICATE	400
15.7.2 Authenticated State	400
15.7.2.1 CREATE, DELETE, RENAME, and LIST Commands	400
15.7.2.2 SUBSCRIBE, LSUB, and UNSUBSCRIBE Commands	403
15.7.2.3 STATUS	403
15.7.2.4 SELECT and EXAMINE Commands	404
15.7.3 Open Mailbox	404
15.7.3.1 COPY	405
15.7.3.2 SEARCH	405
15.7.3.3 FETCH	406
15.7.3.4 STORE	408
15.7.3.5 EXPUNGE	409
15.7.3.6 CLOSE	409
15.8 Mailing Lists	409
Chapter 16: Forums	413
16.1 Message Format	414
16.2 NNTP Protocol	415
16.2.1 End User Communication	416
16.2.2 Communication Among Servers	419
16.2.3 Session Termination	420
Chapter 17: Lightweight Directory Access Protocol	421
17.1 Protocol Principle	421
17.2 Data Model of LDAP Directory	422
17.3 LDAP Protocol Data Units	426
17.3.1 The Search Operation	427
17.3.1.1 Filters	429

17.3.2 Further Operations with Entries	430
17.3.2.1 The Add Operation	430
17.3.2.2 The Modify Operation	431
17.3.2.3 The Delete Operation	431
17.3.2.4 The Modify DN Operation	432
17.3.2.5 The Compare Operation	432
17.4 Server Programs	432
17.5 Client Programs	432
17.5.1 The LDAP Browser	433
17.5.2 The OpenLDAP Client	433
17.5.3 ADSIedit	434
17.5.4 MS Outlook Express and MS Outlook	434
17.6 Lightweight Directory Interchange Format	435
<u>Appendix A: CISCO Routers</u>	<u>437</u>
A.1 Interface Identification	440
A.2 Cables	440
A.3 Memory	441
A.4 Console	442
A.5 Commands	443
A.5.1 Non-Privileged Mode	444
A.5.2 Privileged mode	445
A.6 Configuration	445
A.6.1 Setting a Password for Privileged Mode	447
A.6.2 Web	448
A.6.3 ConfigMaker	448
A.7 Debugging	449
<u>Index</u>	<u>453</u>