

The background of the cover is a complex digital graphic. It features a dark blue and black background with a grid of glowing blue lines. A prominent feature is a large, stylized orange and red shape that resembles a signal or a data stream, extending from the bottom right towards the center. There are also various other geometric shapes and patterns in shades of blue, green, and yellow, creating a sense of depth and movement.

Broadband Communications

Robert C. Newman

CONTENTS

PART ONE 1

CHAPTER 1 The Enterprise Network Basics 3

- Introduction 3
- 1.1 The Industry 4
- 1.2 Telephone Network Structure 5
- 1.3 Telecommunications Network Functions 7
- 1.4 Telecommunications Network Components 8
- 1.5 Elements of a Data Communications System 9
- 1.6 Local, Metropolitan, and Wide Area Networks 11
- 1.7 Internetworking 15
- 1.8 Basic Data Communication Configurations 16
- 1.9 Standards 19
- 1.10 Data Communications Technology Awareness 20
- Summary 44
- Key Terms 45
- Review Questions 46
- Activities 47

CHAPTER 2 The WAN Infrastructure 49

- Introduction 49
- 2.1 Migration to Broadband Systems 50
- 2.2 *Network Configurations and Design* 51
- 2.3 Access Circuit Types 52
- 2.4 Circuit Switching 54
- 2.5 Packet Switching 57
- 2.6 Analog versus Digital Overview 61
- 2.7 Interfaces 65
- 2.8 Multiplexing 67
- 2.9 Transmission Methods 70
- 2.10 Communications Entities 72
- 2.11 Broadband Access Applications 80
- 2.12 Standards 81
- 2.13 Issues and Considerations 81
- Summary 82
- Key Terms 83

Review Questions	84
Activities	85
Case Study/Project	86

PART TWO 89

CHAPTER 3 Frame Relay/X.25 91

Introduction	91
3.1 Frame Relay Technology	92
3.2 Frame Relay versus X.25	93
3.3 Frame Relay Protocol Architecture	95
3.4 Frame Relay Networks	96
3.5 Frame Relay Frame	98
3.6 Throughput and Capacity	99
3.7 Frame Relay Components	102
3.8 Addressing	104
3.9 Network Interfaces	106
3.10 Frame Relay Standards	108
3.11 Frame Relay Advantages and Disadvantages	110
3.12 Frame Relay Applications	112
3.13 Technology Alternatives	113
3.14 Issues and Considerations	114
Summary	116
Key Terms	116
Review Questions	117
Activities	118
Case Study/Project	119

CHAPTER 4 Asynchronous Transfer Mode 121

Introduction	121
4.1 What is ATM?	122
4.2 ATM Characteristics	123
4.3 ATM Cell Functions	126
4.4 NNI, UNI, PNNI	127
4.5 Switching in Hardware	129
4.6 Access Connectivity	129
4.7 Components of ATM	130
4.8 ATM Logical Connections	134
4.9 AAL Services	135
4.10 ATM Service Classes	136
4.11 Capacity and Throughput	140
4.12 ATM Backbone Networks	141
4.13 ATM Devices	142
4.14 ATM Standards	144
4.15 ATM Network Management	145

- 4.16 ATM Applications 146
- 4.17 Advantages and Disadvantages 148
- 4.18 ATM Technology Alternatives 149
- 4.19 ATM Product and Service Providers 149
- 4.20 Issues and Considerations 150
 - Summary 151
 - Key Terms 152
 - Review Questions 153
 - Activities 154
 - Case Study/Project 155

CHAPTER 5 Synchronous Optical Network 157

- Introduction 157
- 5.1 SONET Infrastructure 158
- 5.2 SONET Frame 160
- 5.3 SONET Multiplexing 161
- 5.4 SONET Components 162
- 5.5 Synchronous Payload Envelope 165
- 5.6 SONET Pointers 167
- 5.7 SONET/SDH End-user Topology 169
- 5.8 SONET Equipment 170
- 5.9 SONET Standards 177
- 5.10 Quality of Service 179
- 5.11 SONET Advantages and Disadvantages 179
- 5.12 SONET Applications 180
- 5.13 SONET Issues and Considerations 181
- 5.14 SONET Technology Alternatives 181
 - Summary 181
 - Key Terms 182
 - Review Questions 182
 - Activities 184
 - Case Study/Project 184

CHAPTER 6 Virtual Private Network (VPN) 185

- Introduction 185
- 6.1 VPN Environment 186
- 6.2 Virtual Networks Overview 188
- 6.3 VPN Types 188
- 6.4 Virtual Networks Connectivity 189
- 6.5 VPN Connectivity and Design 194
- 6.6 VPN Hardware and Software 196
- 6.7 VPN Implementation 205
- 6.8 VPN Standards 208
- 6.9 VPN Applications 208
- 6.10 VPN Issues and Considerations 209

- 6.11 VPN Advantages and Disadvantages 210
- 6.12 VPN Technology Alternatives 212
 - Summary 213
 - Key Terms 214
 - Review Questions 215
 - Activities 216
 - Case Study/Project 216

CHAPTER 7 Fiber Distributed Data Interface 219

- Introduction 219
- 7.1 FDDI Technology 220
- 7.2 FDDI Topology 221
- 7.3 FDDI Physical Specifications 225
- 7.4 FDDI Port Types 229
- 7.5 Ring Connectivity 230
- 7.6 FDDI Architecture 232
- 7.7 FDDI Frame and Token Format 238
- 7.8 FDDI Standards 239
- 7.9 FDDI-I versus FDDI-II 240
- 7.10 FDDI Applications 241
- 7.11 FDDI Advantages and Disadvantages 241
- 7.12 FDDI Technology Alternatives 242
 - Summary 243
 - Key Terms 244
 - Review Questions 245
 - Activities 246
 - Case Study/Project 246

PART THREE 249

CHAPTER 8 Digital Subscriber Line 251

- Introduction 251
- 8.1 POTS and Digital Subscriber Line 252
- 8.2 DSL Technology 253
- 8.3 Digital Subscriber Line Access Multiplexer and Splitter Technology 254
- 8.4 Asymmetrical Digital Subscriber Line 257
- 8.5 High-Bit-Rate DSL 263
- 8.6 Symmetrical DSL 264
- 8.7 Very High-Data-Rate DSL 264
- 8.8 Rate Adaptive DSL 265
- 8.9 DSL Service Alternatives 266
- 8.10 Another Technology Option 267
- 8.11 Cable Modem 268
- 8.12 Cable Modem Technology 270

8.13	Standards	271
8.14	DSL Issues and Considerations	272
8.15	Cable Modem Issues and Considerations	273
8.16	Technology Alternatives	274
8.17	DSL Advantages and Disadvantages	275
8.18	DSL and Cable Modem Applications	276
	Summary	277
	Key Terms	278
	Review Questions	279
	Activities	280
	Case Study/Project	280

CHAPTER 9 Integrated Services Digital Network/Broadband ISDN 283

	Introduction	283
9.1	<i>ISDN Basics</i>	284
9.2	ISDN Architecture	286
9.3	ISDN Connectivity	288
9.4	ISDN Features	290
9.5	Primary Rate and Basic Rate	293
9.6	Functional Groups	298
9.7	Reference Points	299
9.8	Wiring Configurations	300
9.9	ISDN Frame	303
9.10	Broadband ISDN Overview	304
9.11	ISDN Standards	306
9.12	ISDN Advantages, Benefits, and Disadvantages	307
9.13	ISDN Applications	308
9.14	ISDN Technology Alternatives	309
9.15	Issues and Considerations	310
	Summary	311
	Key Terms	312
	<i>Review Questions</i>	313
	Activities	314
	Case Study/Project	314

CHAPTER 10 Switched Multimegabit Digital Service/Metropolitan Area Network 317

	Introduction	317
10.1	Metropolitan Area Networks	318
10.2	SMDS Overview	319
10.3	Service Characteristics	321
10.4	SMDS Connectivity	324
10.5	Distributed Queue Dual Bus (DQDB) Overview	325
10.6	Sustained Information Rate and Access Classes	333
10.7	SMDS Addressing	334

10.8	SMDS WAN	335
10.9	SMDS Interface Protocol	335
10.10	Cell Structure	336
10.11	Quality of Service Operations	337
10.12	Standards	337
10.13	MAN/SMDS Applications	339
10.14	Issues and Considerations	341
10.15	SMDS Advantages and Disadvantages	341
10.16	SMDS Technology Alternatives	342
	Summary	343
	Key Terms	344
	Review Questions	345
	Activities	346
	Case Study/Project	346

CHAPTER 11	Wireless/Personal Communications Service	349
	Introduction	349
11.1	Mobile Services History	350
11.2	Wireless Transmission	351
11.3	Wireless Network Configurations	352
11.4	Local Area Networks	353
11.5	Extended LANs	354
11.6	Wireless LAN Technologies	355
11.7	Radio Technologies	357
11.8	Mobile Telephony	358
11.9	Microwave Technologies	359
11.10	Satellite Transmission	360
11.11	Cellular Telephony	363
11.12	Security and Privacy in Wireless Systems	367
11.13	Personal Communication Services	368
11.14	Two-way Messaging	374
11.15	Wireless Data Technologies	376
11.16	Satellite Services	381
11.17	Wireless Standards	381
11.18	Wireless Issues and Considerations	383
11.19	Advantages and Disadvantages	383
11.20	Wireless Technology Alternatives	386
11.21	Wireless Applications	387
11.22	Product and Service Providers	388
	Summary	390
	Key Terms	391
	Review Questions	392
	Activities	393
	Case Study/Project	394

CHAPTER 12 Fibre Channel 395

- Introduction 395
- 12.1 Fibre Channel Overview 396
- 12.2 Fibre Channel Technology 397
- 12.3 Fibre Channel Physical Medium 398
- 12.4 Fibre Channel Features 399
- 12.5 Fibre Channel Ports 401
- 12.6 Fabrics 402
- 12.7 Fibre Channel Topology 403
- 12.8 Fibre Channel Protocol 405
- 12.9 Fibre Channel Classes of Service 407
- 12.10 Frames, Sequences, and Exchanges 408
- 12.11 Fibre Channel Systems 408
- 12.12 High Availability Architectures 409
- 12.13 Fibre Channel Components 411
- 12.14 Fibre Channel Management Systems 415
- 12.15 Fibre Channel Standards 417
- 12.16 Fibre Channel Applications 418
- 12.17 Technology Comparisons 420
- 12.18 Fibre Channel Advantages 421
- 12.19 Product and Service Providers 422
- Summary 423
- Key Terms 423
- Review Questions 424
- Activities 425
- Case Study/Project 425

CHAPTER 13 Internet/Intranet/Extranet 427

- Introduction 427
- 13.1 Internet History 428
- 13.2 Using the Web 429
- 13.3 Internet Search Tools 430
- 13.4 Internet Components 433
- 13.5 Access and Transport 435
- 13.6 Internet Standards 438
- 13.7 IP Addressing 439
- 13.8 Internet Applications 440
- 13.9 World Wide Web 442
- 13.10 Intranet Overview 443
- 13.11 Intranet Technologies 444
- 13.12 Firewalls 444
- 13.13 Intranet Applications 445
- 13.14 Extranet Environment 446
- 13.15 Extranet Technologies 446
- 13.16 Virtual Private Networks 446

- 13.17 Intranet and Extranet Applications 448
- 13.18 Issues and Considerations 451
- 13.19 Technology Alternatives and Competition 452
 - Summary 453
 - Key Terms 454
 - Review Questions 454
 - Activities 455
 - Case Study/Project 456

PART FOUR 459

CHAPTER 14 Network Management 461

- Introduction 461
- 14.1 Network Management 462
- 14.2 Network Management Systems 462
- 14.3 Network Management Activities 463
- 14.4 Network Management Architecture 464
- 14.5 Common Management Information Protocol 465
- 14.6 Simple Network Management Protocol 468
- 14.7 Trap Protocol Data Unit 478
- 14.8 Network Management Standards 479
- 14.9 Network Management Support Systems 481
- 14.10 Network Management Products and Services 483
- 14.11 Remote Monitoring 484
 - Summary 486
 - Key Terms 487
 - Review Questions 488
 - Activities 489
 - Case Study/Project 489

CHAPTER 15 Problem Solving and Troubleshooting 491

- Introduction 491
- 15.1 Maintaining Network Integrity 492
- 15.2 Network Management Elements 498
- 15.3 Network Troubleshooting 502
- 15.4 Test Equipment and Resources 504
- 15.5 Common Problem Areas 509
- 15.6 Typical Network Problems 511
- 15.7 Technology-Specific Troubleshooting and Problem Solving 513
- 15.8 Asynchronous Transfer Mode 515
- 15.9 Digital Subscriber Line 517
- 15.10 Fiber Distributed Data Interface 520
- 15.11 Fibre Channel 521
- 15.12 Frame Relay 522

15.13	Internet/Intranet/Extranet	524
15.14	Integrated Services Digital Network	526
15.15	Private Line/POTS	528
15.16	Synchronous Optical Network	531
15.17	Switched Multimegabit Data Service	531
15.18	Virtual Private Network	532
15.19	Wireless/Personal Communications Service	532
	Summary	535
	Key Terms	536
	Review Questions	536
	Activities	538
	Case Study/Project	538

Appendix A:	OSI Model	541
Appendix B:	Voice over Internet Protocol	545
Appendix C:	Standards References	549
Appendix D:	Number Systems	552
Appendix E:	Broadband Case Study/Project	555
Appendix F:	Acronyms	559

Glossary	565
-----------------	-----

References and Other Resources	577
---------------------------------------	-----

Index	581
--------------	-----