

INDEX

- Access charges, 176
- Access control:
 - centralized management, 236–237
 - challenge-response systems, 237
 - commercial systems, 237
 - denial of service, 237–239, 267
 - importance of, 11, 213, 215
 - line interruption, 236
 - mechanisms of, 235–236
 - network layer, 236
 - packet filtering, 236
 - role-based (RBAC), 235, 263
- Access ISPs, 199–200
- Access Service Requests (ASR), 37
- Accounting, 147, 155–156, 159, 165–167
- Accounting rate systems (ARS), 166
- Accounting record, defined, 159
- Accredited Standards Committee (ASC) T1, 30
- AC.1, 42
- Active attacks, 213
- Active probing, 147
- Adaptability, eCommerce standards, 16
- Administrative services, 34
- Admission control, 102, 124, 163
- ADSpec (advertising specification), 104–106
- Advanced Communications Technologies and Services (ACTS), 167, 302
- Advanced Encryption Standard (AES), 218, 273
- Aggregate flows, 112
- Agreement, REA ontology, 47, 49
- All-optical network architectures:
 - characteristics of, generally, 294–295
 - dynamic lightpath networks, 297–300
 - optical burst switching (OBS) networks, 303, 323
 - optical packet-switching networks, 300–302
 - overview, 294–295
 - static and semistatic lightpath networks, 295–297
- α -stable random processes, 324, 326
- Alternate routing (AR), 299
- American National Standards Institute (ANSI), 234, 251, 273, 279
- America Online (AOL), 183
- Application and Middleware Layer (AML), 197–198
- Application, generally:
 - gateways, 236
 - layer, 215
 - security, 220
- Application service provider (ASP), 198–200
- Application-specific integrated circuits (ASIC), 72
- Architecture, historical perspective, 8–9. *See also specific IP networks*
- ARPANET, 287
- Arrival process, 319
- ASN, Basic Encoding Rules (BER), 277
- Association for Biometrics, 234
- Assured forwarding (AF) per-hop behavior (PHB), 121–122
- Assured forwarding (AF) services, 110, 114–115, 121–123
- Asymmetrical digital subscriber line (ADSL), 148–149

346 INDEX

- Asymmetric cryptography, *see* Public key
- Asynchronous transfer mode (ATM):
 - cell-based, 293
 - characteristics of, generally, 60, 69, 79, 288, 295
 - charges:
 - accounting process, 156, 167
 - billing process, 166–167
 - calculation, 154–155
 - metering, 156
 - standard data formats, 174
 - DiffServ applications, 124–125
 - flow switching, 310
 - MPLS applications, 134, 140–141
 - optical networks, 305, 308, 328
- ATM Forum, 74
- Attacks:
 - denial-of-service:
 - examples of, 238
 - types of, 213, 264–265
 - encryption cracks:
 - types of, 264–265
 - vulnerability for, 265
 - motivation for, 266
- Attribute certificates, 262–263
- Audio-on-demand, 199
- Auditing, charging support systems (CSS), 192
- Authentication:
 - components of, 215–217
 - certificate management, 253–255
- Authentication header (AH) protocol, 218
- Authentication server (AS), 243–246
- AUTH service, 321
- Avalanche photodiodes (APDs), 289
- Avici, 308

- Back-up files, 201
- Backbone networking, 9, 124
- Backward compatibility, 33
- Bandwidth:
 - bottlenecks, 193
 - functions of, 9
 - Internet growth and, 287
 - IntServ requirements, 97–98, 170
 - quality of service, 67–69
 - pricing models and, 184
- Bank clearing system, 18
- Best-effort model, 61
- Best-effort philosophy, 9
- Best effort service, 119, 187
- Billing:
 - defined, 159–160
 - process, 11–12, 40, 147, 159
 - record, 160
 - systems, types of, 162
 - traditional, 166–167
- BioAPI Consortium, 233–234
- Biometric Consortium (BC), 233
- Biometric identification, 231–234, 266

- Bit error rate (BER), 290, 303
- Blocking probability, 298, 300
- Border gateway protocol (BGP), 97, 101, 125–126
- Boundary nodes, 113, 170
- Breathe Freely, 183
- Bridging standards, 20
- Broadband ISDN (B-ISDN), 96, 166
- Brute-force attacks, 264
- BSI-Federal Information Security Agency, 234
- BT-EC:
 - eCommerce issues:
 - cross-sectorial/cultural adaptability, 19–21
 - IT enablement, 18–19
 - localization/multilingualism, 18–20
 - reports, generally, 14
- Buffers, optical packet-switching networks, 301
- Buffer space, 161
- Bulk protection, 216
- Burst switching, 315
- Burst transmission, 303
- Business Agreement Service, 22–23
- Business domain expert, functions of, 45
- Business Domain View (BDV), UN/CEFACT UMM, 45, 49
- Business entity type (BET), 48
- Business model, charging:
 - application service provider (ASP), 198–200
 - charging content, 200–202
 - Internet service provider segmentation, 197–198
 - market-managed three-tiered model, 196–197
- Business process and information modeling (BPIM):
 - defined, 42
 - ebXML Initiative, 43
 - new-generation operation support systems (NGOSS), TM Forum, 51–52
- Business process definition (BPDS), 44
- Business process modeling, in ebXML, 43–49
- Business Process Project Team, 44
- Business Requirements View (BRV), UN/CEFACT UMM, 45–46, 49
- Business Service View (BSV), UN/CEFACT UMM, 45–46
- Business-to-business solutions, 32
- Business Transaction View (BTV), UN/CEFACT UMM, 45, 49

- Cable TV networks, 143
- Call detail records (CDRs), 147, 159–160, 173–174
- Call-blocking rate, 189
- Capillarity, 95
- Care packet first, don't care packet last (CFDL), 302
- Carrier Access Billing Systems (CABS), 38
- Case diagrams, 32
- Centralized certification, 251
- Certificate management:
 - attribute certificates, 262–263
 - basic operation, 253
 - certification path:

- evolution perspectives, 258–259
 - hierarchical, 255–258
 - overview, 255
- certificate revocation, 261–262
- importance of, 250–253
- replacement certificates, 261
- strong authentication:
 - one-way authentication, 259–260
 - three-way authentication, 259–261
 - two-way authentication, 259–260
- X.509 certificate, 251, 253–254, 261–262
- Certificate revocation list (CRL), 253, 261–262
- Certification authorities:
 - functions of, 235
 - key revocation, 242
- Challenge-response systems, 237
- Charge calculation, 153–155, 160
- Charging and Accounting Schemes in Multi-Service ATM Networks (Ca\$HMAN), 167
- Charging and Information Protocol, 165
- Charging support system:
 - accuracy in, 149–150
 - architecture, ICCAS:
 - external components, 193–194
 - internal components, 193–195
 - open interfaces, 195–196
 - overview, 192–193
 - components of, 146, 189–190, 202–203
 - defined, 145–146, 160, 188
 - dimensions of, 190–191
 - flexibility, importance of, 150–151, 163
 - functions of:
 - accounting, 147, 155–156, 159, 165–166
 - billing, 147, 159–160, 166–167
 - case illustration, 148
 - charge calculation, 147, 153–155, 160
 - costs, 157–158, 160
 - mediation, 147, 156, 160, 165–166
 - metering, 147–148, 156, 160, 165–166, 175
 - overview, 146–148
 - payment, 158–160
 - pricing, 147, 156–157, 160, 175–187
 - quality of service (QoS), 144, 153, 160–161
 - service level agreements (SLAs), 158–159, 161, 163, 171–172
 - settlement, 158, 161
 - tariffing, 147, 157, 161, 164–165, 167, 183, 203
 - tasks, 146–147, 191–192
- Checksum computation, 63
- Childproof systems, eCommerce, 17
- Cipher block chaining (CBC), 263
- Cipher feedback (CFB) encryption, 267–271
- Ciphertext, 242
- Circuit switching, 8
- Circuit-switched communication, 161
- Circuit-switched networks, 175
- Cisco Systems:
 - NetFlow product, 159, 165
 - Tag System, 311
 - Terminal Access Controller Access System (TACACS), 236–237
- Class-based packet processing, 76
- Class-based queuing (CBQ), 89
- Class of service (CoS), 311
- CMIP, 30, 32
- Coarse WDM (CWDM), 289
- Code points, DiffServ architecture, 119
- Code Red worm, 238
- Code tables, 33
- Coding, 9
- Collisions:
 - data integrity verification, 224–225
 - encryption cracks, 265
- CommerceOne, Common Business Library (CBL), 53
- Commercial operating systems, 265–266
- Commercial Transaction, business application
 - contracts, 51
- Commodity Codes, 19
- Common Biometric Exchange File Format (CBEFF), 234
- Common channel signaling (CCS), 238
- Common Object Request Broker Architecture (CORBA), 31–32
- Communication services latency, 72
- Compatibility:
 - business process definition (BPDS), 44
 - eCommerce standards, 17
- Competitive local telephone company (CLEC), 7–8
- Computational integrity, 33
- Conferencing, 149
- Confidentiality, *see* Privacy; Security systems
 - approaches to, 215, 220–221, 266
 - public key cryptography, 222–223
 - symmetric cryptography, 221–222
- Congestion avoidance, 90
- Congestion control, quality of service:
 - explicit congestion notification (ECN), 90, 93–95
 - random early detection (RED), 90–92, 172
 - significance of, 89
 - tail drop, 90–91
- Congestion experienced bit (CE), 93–94
- Congestion management, defined, 90
- Congestion pricing, 164
- Congestion window reduced (CWR) flag, 94–95
- Connection holding time, 319
- Connection interarrival, 319–320
- Connectionless model, 9
- Connectionless networks, 175
- Connectionless protocol, 238
- Connection-oriented networks, 175, 188–189
- Constraint-based label distribution protocol (CR-LDP):
 - defined, 138
 - explicit route, 139

348 INDEX

- Constraint-based label distribution protocol (CR-LDP) (*continued*)
 - negotiation flags, 140
 - path preemption, 139–140
 - pinning mechanism, 140
 - traffic engineering, 140
- Constraint-based routing label distribution protocol (CR-LDP), 131, 136, 138–140, 328
- Consumers, eCommerce:
 - empowerment strategies, 20
 - system development process, 18
- Content addressable memories (CAMs), 312
- Content charging, 192, 200–202
- Contention resolution by delay line (CORD), 301
- Content-level providers, security issues, *see* Security systems
- Contract Negotiation and Charging in ATM Networks (CANCAN), 167
- Controlled-load service, 99–110, 170
- Conventional wavelength band, 290
- Convergence, PSTN, 12
- Convergence time, 299
- Cookies, 248, 265
- Core ISPs, 199–200
- Core routers, 113, 116–117, 171
- Corporate networks, 95
- Cost(s), *see* Charging support system
 - calculation of, 157–158, 160
 - eCommerce, 18
- Country Codes, 19
- Couplers, passive optical, 294
- Cross-sectorial issues, eCommerce, 19–21
- Crosstalk, 290
- Cryptographic keys, secure management of:
 - archiving, 242
 - backup, 242
 - deletion, 242
 - distribution, 241
 - key revocation, 242
 - overview, 240–241
 - production, 241
 - replacement, 242
 - storage, 241
 - symmetric vs. public, 242–243
 - utilization, 242
 - withdrawal, 242
- Cryptography:
 - asymmetric, 266
 - public key, 222–223, 240–243, 266
 - symmetric, 221–223, 228–230, 240–243
- Cryptosystems, 278
- Cultural adaptability, eCommerce issues, 19–21
- Cumulus pricing scheme (CPS), 164
- Currency Codes, 19
- Customer account record exchange (CARE), 34
- Customer care, 11
- Customer Premises Network (CPN), 199–200
- Customer-provided equipment (CPE), 12
- C wavelength band, 290
- Cylink Corporation, 249
- Danielson, Johan, 247
- Data definition standards, examples:
 - ITU Carrier Code (ICC), 39–40
 - ITU-T Recommendation M.1400, 38–39
 - T1 standards:
 - company code, 36–38
 - location entity identification code, 35–36
 - overview, 34–35
- Data encryption algorithm, 273
- Data encryption standard (DES):
 - characteristics of, 273–274
 - triple, 274
- Data flows, IntServ, 97. *See also* Flow level analysis
- Data integrity:
 - approaches to, 223–224, 266
 - importance of, 215, 223
 - verification with:
 - one-way hash function, 224–228, 266
 - symmetric cryptography, 228–230
- Data-link layer switched paths, 136
- Data networking technology, 9–10
- Data protocol, 12, 30
- Data rate, 68
- Decentralized certification, 250
- Decentralized networks, 17
- Decision-making, eCommerce standards, 22–23
- Decryption, 221, 268–271
- Defense Advanced Research Projects Agency (ARPA/DARPA), 301
- Deficit round-robin (DRR) queuing, 89
- Delay, congestion control approaches, 90. *See also* *specific types of delays*
- Delegation path, 263
- Delivery systems, eCommerce, 15
- Demultiplexers, 326
- Denial of service, 213, 237–239, 267
- Design for all, eCommerce, 16–17
- Dense-wavelength division multiplexing (DWDM) technology, 9–10, 69, 79, 124, 141, 289
- Destination address, 101, 131, 311
- Destination port, 101
- Destination port number, 116
- Dialog, eCommerce standards, 16
- DIAMETER, 174
- Differentiated services (DiffServ) architecture:
 - assured forwarding (AF) services, 114–115, 121–123
 - domain concept, 113
 - expedited forwarding (EF) behavior, 114–115, 119–121
 - functionalities:
 - packet classification, 115–116
 - packet dropping, 118
 - packet marking, 117–118
 - packet scheduling, 118

- traffic conditioning, 117
 - traffic monitoring, 116–117
 - traffic shaping, 118
- goals and basics, 110–111
- IPv4/IPv6, 117, 171
- overview, 111–113, 123
- per-hop behavior (PHB), 113, 115, 117–124, 170
- pricing, 187
- quality of service (QoS), 114–124
- service-level agreements (SLA), 113–115, 124, 172
- summary of, 124
- traffic conditioning agreements (TCA), 113–115
- Diffie-Hellman key exchange method, 241, 247–250, 266, 276, 278
- Digital Equipment Corporation (DEC), 243
- Digital signature algorithm (DSA), 230, 267, 279–280
- Digital wrapper, 293
- Directory Access Protocol (DAP), 251
- Directory Information Sharing Protocol (DISP), 251
- Directory system agent (DSA), 251, 278–279
- Directory System Protocol (DSP), 251
- Directory user agent (DUA), 251
- Disconnecting, eCommerce, 18
- Discrimination, 18
- Distributed denial of service (DDOS), 238
- Distributed Management Task Force (DMTF), 52
- Distributed restoration algorithms (DRA), 299–300
- Distributed weighted-fair queuing (DWFQ), 89
- Domain name system (DNS), 174
- Domain responsibility, 33–34
- Domination rule, 263
- Doped fiber amplifiers, 290
- Downstream-assigned, defined, 130
- Downstream-on-demand, 132
- Downstream unsolicited, 132
- DS byte (differentiated service byte), 111
- DSCP encoding, 111, 117, 119, 165
- Dynamic-host configuration protocol (DHCP), 174
- Dynamic lightpath networks, 288, 297–300
- Dynamic pricing models, 182–185
- Dynamic restoration, 326
- Dynamic routing, 326

- EBONE, 287
- eBusiness, 8, 11
- e-Business Process Metamodel, 45
- e-cash, 175
- ECB, 267–268
- Echo cancellation, 12
- ECN-echo flag, 94
- Ecological aspects, eCommerce standards, 18
- eCommerce:
 - global, 34
 - healthcare, 26
 - open-edi:
 - conceptual model, 21–23, 53
 - defined, 21
 - MoU management group, 27–28
 - reference model, 23–33
 - principles and characteristics of, 13–14
 - requirements:
 - consumer, 15–18
 - horizontal aspects, 18–21
 - standardization, consumer interest in, 14–15
 - semantics:
 - data definition standards examples, 34–40
 - harvest existing business information, 40–41
 - IT-enablement, 33–34
 - shared semantics for interoperability:
 - applications, generally, 42–43
 - business application contracts in TM Forum, 51–53
 - business process modeling in ebXML, 43–49
 - Global Telecommunications Data Dictionary (GTDD), 53
 - tML Framework, 49–51
- Economic Claim, REA ontology, 48
- Economic Commitments, REA ontology, 47–49
- Economic Contract, REA ontology, 47–48
- Economic Events, REA ontology, 46, 48
- Economic Resources, REA ontology, 46, 48–49
- Edge pricing, 163
- Edge router, 171
- Edifecs Commerce, 45
- edi Support Service, 22–23
- Efficient networks, 288
- Egress LERs, 127–128
- Egress routers, 115, 170, 127–128
- Electromagnetic radiation, 216
- Electronic bottleneck, 289, 295, 315
- Electronic commerce, *see* eCommerce
- Electronic data interchange (EDI), 13
- Electronic payment systems, 175
- Elliptic curve cryptography (ECC), 278–279
- Elliptic Curve Diffie-Hellman algorithm (ECDH), 278–279
- Elliptic Curve Digital Signal Algorithm (ECDSA), 278–279
- E-mail services, 176, 185, 287
- Enabling technologies, 298
- Encapsulating security payload (ESP) protocol, 218
- Encryption, 158. *See also* Cryptography
- End-system networks, 169, 216
- End-to-end flows, 170
- End-to-end network management, 10, 12, 293
- End-to-end path restoration, 314
- End-to-end QoS, 64, 67
- Engineering and Physical Sciences Research Council (EPSRC), 302
- Enterprise Policy Layer (EPL), 196
- Environmentally friendly products, 18
- Equipment latency, 71–72
- Erbium-doped fiber amplifier (EDFA), 290
- Erlang models, 326

350 INDEX

- Error tolerance, eCommerce, 16
- eSociety, 8
- Ethernet, 60, 78, 141. *See also* Gigabit Ethernet
- Ethics, eCommerce standards, 18
- Euler's theorem, 275
- EuropaNET, 287
- European Asynchronous Transfer Mode Optical Switching (ATMOS), 302
- European Standardization Institute (ETSI), 154–155, 167
- Exchange Access bills, 37–38
- Exchange-access services, 34
- Exchange Message Record (EMR), 38
- Existing business information, 40–41
- Expedited forwarding (EF) behavior:
 - implications of, 110, 114–115, 119–121
 - per-hop behavior (PHB), 120–121
- Explicit Congestion Notification (ECN), 90, 93–95, 164, 185
- Explicit routing, 130, 139
- Explicit-routed LSP (ER LSP), 130–131
- Explorability, eCommerce, 16
- eXtensible Markup Language (eXML):
 - business process modeling:
 - methodology, 45–46
 - requirements, 44–45
 - resource-event-agent (REA) ontology, 46–49
 - technical architecture, 43
 - Initiative, 40–41, 43
 - Registry/Repository, 41
 - semantics, 28–29
- Extensible Markup Language (XML):
 - applications, generally, 29, 31–32, 39, 263
 - Document Type Descriptions (DTDs), 41
- Facial scans, 232
- Fairness:
 - charging support systems (CSS), 151–152, 179
 - dynamic lightpath networks, 298–299
- Fault detection systems, 328
- Fax-over-IP (FoIP), 73
- Fax services, 149, 176
- FDDI, 289
- FEC-to-label binding distribution, 132
- Federal Communication Commission (FCC), 157
- Feedback, 16, 301
- Feedforward, 16, 301
- Fiber delay lines (FDLs), 301
- Fiber optical cross connects (F-OXC), 291, 294
- Fiber optics, 289
- File-switching, 325
- File Transfer Protocol (FTP), 86, 258, 321
- Filters/filtering, 103–104, 106–108, 131, 236
- Fingerprints:
 - data integrity, 224
 - imaging techniques, 232
 - participant identification, 230
- Firewalls, 72, 218
- First-come first-served algorithm (FCFS), 84
- First-generation optical network (FGON):
 - characteristics of, generally, 294, 305
 - defined, 288
 - IP over, 305–309
 - lightpath networks, 295–296
- First-in first-out (FIFO) queuing, 84–85, 91, 168
- First window, 289
- Fixed-filter (FF) reservations, 106–107
- Flat-fee pricing, 182–183, 185, 202–203
- Flat-rate billing, 11
- Flow-based packet processing, 75–76
- Flow-label byte, 63–64
- Flow-level analysis, 315, 321–323
- Flow switching, 288, 309–311, 326
- Formal description techniques (FDTs), 19, 30
- Fortune 1000, 26
- Fragmentation, 62
- Frame relay, 60, 134, 155, 295
- Frame Relay Forum, 74
- Fraud protection, 151
- FreeS/WAN, 218
- Frequency hopping, 216
- Gain, optical amplifiers, 290–291
- Galois field, 278
- Gaming systems, 149
- Gaming theory, 164
- Gaussian marginal distributions, 324
- Generalized processor sharing (GPS), 87
- Gigabit Ethernet:
 - characteristics of, 288
 - optical networks, IP over, 308–309
- Gigabit Ethernet Alliance, 308–309
- Gigabit packet processing, 62
- Gigabit routers, 309–315
- Gigachannel, Lucent, 308
- Global eCommerce, 34
- Global synchronization, 91
- Global Telecommunications Data Dictionary (GTDD), 38–39, 53
- Government of Canada Public Key Infrastructure (GOCPKI), 259
- Grading systems, eCommerce, 18
- Granularity, 110, 169–170, 328
- Guaranteed service, 98–99, 170, 179
- Hand geometry, 232–233
- Hand-held authentication, 237
- Handwritten recognition systems, 232, 267
- Hashed Message Authentication Code (HMAC), 230
- Hash function, 224–228, 235, 265
- Header detection, 301
- Healthcare EDI Coalition (HEDIC), 26
- Heidmal, 247
- HELLO, 328
- Hewlett Packard:
 - Smart Internet Usage (SIU), 165–166

- SpectraLAN, 308
 - High-level traffic multiplex, 315
 - High-speed flows, 124
 - High-speed routers, 109
 - HL7, 44
 - Hop-by-hop, generally:
 - forwarding, 126
 - routing, 130
 - HTTPS, 321
 - Hubs, equipment latency, 71
 - Human-Authentication-Application Program
 - Interface (HA-API) (U.S. Department of Defense), 233
 - Hypertext transfer protocol (HTTP), 66, 86, 238, 258, 311
- IBM, 243, 273
 - ICMP, 238, 328
 - ICOMO, 188
 - Identity-based access control, 235
 - Implementation conventions (ICs), 25–26
 - Incoming Label Map (ILM), 135
 - Incumbent local telephone company (ILEC), 7–8
 - Information and communication technologies (ICT), 15, 18
 - Information Bundles (IBs), 29, 33
 - Information Distribution, business application
 - contracts, 52
 - Information management domain (IMD), 22–23
 - Infrastructure, eCommerce standards, 22–23
 - Ingress LERs, 127–129, 131
 - Ingress router, 113, 127–129, 131, 170
 - In-profile:
 - packets, 117
 - traffic, 122
 - Integrated Service Model (IntServ):
 - accounting services, 170
 - pricing, 187
 - quality of service:
 - architecture, 96–97
 - basics of, 95–96
 - flow definition and requirements, 97
 - goals, 95
 - overview, 95
 - resource reservation protocol (RSVP), 96–110
 - Integrated services digital networks (ISDN), 12, 96, 188
 - Integrated services network, 143
 - Integrated-services packet-switched network, 162
 - Integration, significance of, 11–12, 31–32
 - Intelligence scheduling and information services (ISIS), 125
 - Inter-Bandwidth Broker communication, 192
 - Interception, 213
 - Interconnections, 12, 192–193
 - Interenterprise, 34
 - Interexchange carriers (IECs), 7–8, 38
 - Interface, eCommerce standards, 15–16, 20
 - Interior nodes, 113
 - International Biometric Industry Association (IBIA), 234
 - InterNational Committee for Information Technology Standards (INCITS), 234
 - International data encryption algorithm (IDEA), 275, 278
 - International Electrotechnical Commission (IEC), 27, 33, 234
 - International Organization for Standardization (ISO), 27, 33, 40, 215, 234
 - International standards, eCommerce, 19
 - International Telecommunication Union (ITU), 27, 33
 - Internet, *see* World Wide Web (WWW)
 - access considerations, 149
 - benefits of, 20, 30
 - charges for, *see* Internet charges
 - historical perspective, 287–288
 - hourglass model, 145
 - low speed, 288
 - mobile users, 145
 - next generation, *see* Next-generation Internet (NGI)
 - optical, *see* Optical Internet (OI)
 - Internet Charge Calculation and Accounting System (ICCAS):
 - defined, 193
 - external components, 193–194
 - internal components, 194–195
 - open interfaces, 195–196
 - Internet charges:
 - charging and accounting technologies, 162
 - Internet Demand Experiment (INDEX), 163
 - Market-Managed Multi-service Internet (M3I), 157, 162–164
 - technologies:
 - best effort, 169–171
 - differentiated services, 170–171
 - electronic payment systems, 175
 - integrated services, 170–171
 - interprovider agreements, 171–173
 - quality of service (QoS) methods, 168
 - service differentiation methods, 168–169
 - standardized data formats, 173–175
 - Internet Engineering Task Force (IETF):
 - Authentication, Authorization, and Accounting (AAA), 156, 174
 - certificate management, 251
 - management information base (MIB), 156
 - Network Working Group, on accounting, 155–156
 - optical network standards, 305
 - Pretty Good Privacy (PGP), 278
 - quality of service strategies and initiatives, *see* DiffServ; IntServ; multiple protocol label switching (MPLS)
 - Internet key exchange (IKE), 218, 249

352 INDEX

- Internet protocol detail records (IPDR), 147, 159–160, 174
- Internet Security Association and Key Management Protocol (ISAKMP), 248–249, 266
- Internet service providers (ISPs):
 - capital costs, 185
 - charges, *see* Charging support systems
 - cost models, 187–188
 - functions of, generally, 10–11, 144
 - segmentation, 197–198
- Interoperability, 40–41
- Interprovider charging, 163
- Interworking, 12, 18, 20
- Intranets, 167
- IntServ, *see* Integrated Service Model (IntServ)
- Inverse multiplexing, 308
- IP address, 116, 129, 131
- IP data record (IPDR), 11
- IP management, challenges of, 10–11
- IP/MPLS, 293
- IP over WDM, 288
- IP Precedence, 129
- IP/PSTN integration, 11–12
- IPSec, 218–220, 249, 263, 269
- IPv4, 61–62, 93, 101, 103, 117, 169, 171, 218
- IPv6, 63, 93, 101, 103–104, 165, 169, 171, 218
- Iris recognition, 232
- ISDN, *see* Integrated services digital networks (ISDN)
- ISO Guidelines, eCommerce, 17
- ISO/IEC:
 - JTC 1 Business Team on Electronic Commerce (BT-EC), 14–15, 40
 - public key infrastructure (PKI), 251
- ISO-OSI optical network model, 287, 292
- ISP cost models, 187–188
- IT-enablement, 33–34
- ITU-Sector Telecommunication (ITU-T):
 - alternate approval process (AAP), 49–50
 - authentication Recommendations, 234–235
 - Carrier Code (ICC), 39–40
 - D Recommendations, 166
 - flat-rate charging, 183
 - functions of characteristics of, 30
 - optical network standards, 293, 305
 - quality of service (QoS), 160–161
 - Recommendation M.1400, 38–39
 - security Recommendations, 212–213, 215, 239, 251, 266
- ITU Telecommunications Service Bureau (TSB), 40
- Jitter:
 - buffer, 73
 - congestion control approaches, 90
 - implications of, generally, 67, 73
 - overdimensioning and, 79
 - quality of service and, 73, 79, 81
- KEEPALIVE, 328
- Kerberos:
 - applications, generally, 243, 266
 - defined, 243
 - development of, 243
 - key exchanges, 243–246
 - public key, 246–247
- Key Exchange Algorithms (KEA), 2250
- Key encryption key, 242
- Keys to optical packet switching (KEOPS), 302
- Keystroke recognition techniques, 233
- Label bindings, 132
- Label distribution, MPLS:
 - control, 132–133
 - label stack, 134
 - label stack processing, 134–135
- Label distribution protocol (LDP), 125, 130
- Label edge routers (LERs), 127–129
- Labeled packed, defined, 131
- Label information base (LIB), 129
- Label retention mode, 133
- Label switched paths (LSPs):
 - characteristics of, 126, 28–130, 313–314
 - constraint-based routing, 139–140
 - defined, 128
 - FEC-to-LSP assignment, 130–131
 - to-label assignment, 130
- Label switched routers (LSRs), 128–129, 132, 313–314
- LAN technology:
 - characteristics of, 68, 289
 - equipment latency, 71–72
 - MPLS label stack, 134
 - physical layer (PHY), 309
 - propagation delay, 71
- Language Codes, 19
- Laser diode, 2389
- Latency, quality of service:
 - application processing delays (AD), 70
 - defined, 67, 69
 - end-to-end (EE) delay, 70
 - network (NL), 69–73
 - response time (RT), 70–71
- Layer 2 Tunneling Protocol (L2TP), 217–220
- Leased-line services, 119, 143
- Level 2 switching, 61
- Level 3 switching, 60–61, 79
- Light-emitting diode (LED), 289
- Lightpath-based networks, 288. *See also specific types of lightpath networks*
- LightRing, 299, 303–304
- Lightweight directory-access protocol (LDAP), 174, 236, 251–252
- Linear optical amplifiers (LOAs), 290
- Link layer:
 - defined, 214
 - development of, 287

- flow switching, 310–311
 - security services, 217
 - Link traffic, 324–325
 - Local calling, basic components of, 7
 - Local exchange services, 34
 - Localization, 18–20
 - Location, REA ontology, 48–49
 - LOGIN service, 321
 - Log-log scales, 316, 319
 - Long-distance calls, 8
 - Long-distance router links, 71
 - Long-distance switches, 8
 - Long-range dependence:
 - causes for, 316–321, 323
 - defined, 316
 - modeling, 325–326
 - Loss of frame (LoF), 307
 - Loss of signal (LoS), 307
 - Low connection request blocking, 299
 - LSAPv3, 252

 - Maintenance, 39
 - Mapping:
 - label distribution protocol, 136–137
 - per-hop behavior (PHB), 119
 - Marginal probability density function, 324
 - Market-Managed Multiservice Internet (M3I), 157, 162–164
 - Market-managed three-tiered business model, 196–197
 - Masquerade, 214
 - Massachusetts Institute of Technology (MIT), 243, 249
 - Mediation, 147, 156, 160, 165–166
 - Memorandum of Understanding (MoU) management group, 27–28
 - Menus, eCommerce, 16
 - Mesh, hierarchical-based, 8
 - Message authentication code (MAC), 228–229
 - Metallic loop, 7
 - Metaphors, eCommerce standards, 16
 - Metering, 147–148, 156, 160, 165–166, 175
 - Metropolitan area network (MAN) technology, 60, 68, 80, 290
 - Microelectromechanical switch (MEMS), 291
 - Microflows, 112, 123
 - Micropayments, 175
 - Microprocessor cards, 241
 - Migration, 33, 44
 - Minimum Interoperability Specifications for PKI Components (MISPC), 259
 - Misrouting, 213
 - MOSPF, 101
 - Moving Picture Experts Group (MPEG), 67
 - Multicasting, 163, 179
 - Multicommodity maximum flow (MCMF), 300
 - Multicultural aspects, eCommerce, 17
 - Multihop optical networks, 296
 - Multihop router paths, 71
 - Multilingualism, 17–20
 - Multimedia applications, 287
 - Multimode fiber optics, 289
 - Multiple Exchange Carrier Access Billing (MECAB), 37
 - Multiple packet drops, 91
 - Multiplexers, 326
 - Multiplexing:
 - buffer, 9
 - characteristics of, 184
 - optical networks, 296
 - Multiprotocol label switching (MPLS):
 - ATM technology and, 125–126, 140–141
 - constraint-based routing label distribution protocol (CR-LDP), 131, 136, 138–140
 - domain, 127–128
 - flow switching, 311, 326
 - forward equivalence class (FEC), 126, 128–129, 131
 - generalized (GMPLS), 141
 - goals and basics, 126
 - label distribution, 132–140
 - label switched path, 129–131
 - operation, 126–127
 - overview, 124–125
 - packet-to-FEC assignment, 131
 - protection switching, 326
 - routing and switching basics, 125–126
 - Multiprotocol lambda switching (MP?S), 288, 309, 312–315, 327–328
 - Multiservice accounting, 191
 - Multiservice network charges, *see* Charging support system
 - business model aspects:
 - application service provider (ASP), 198–200
 - charging content, 200–202
 - Internet service provider segmentation, 197–198
 - market-managed three-tiered model, 196–197
 - congestion pricing, 164
 - cumulus pricing scheme, 164
 - customer point of view, 149–150, 179
 - edge pricing, 163
 - fairness and utility, 151–153, 179
 - Internet:
 - Internet Demand Experiment (INDEX), 163
 - ISP cost models, 187–188
 - Market-Managed Multiservice Internet (M3I), 157, 162–164
 - technologies, 162, 167–175
 - motivation and terminology, 146–149
 - networking terms, 161
 - policing, 163
 - premium IP services, 165
 - provider point of view, 150, 179
- Multiwavelength, 294

354 INDEX

- Naming authority, 235
- Narrowband integrated services digital network (NISDN), 155
- National Exchange Carrier Association (NECA), 40
- Nested Message Authentication Code (NMAC), 229–230
- NeTraMet, 156, 165
- Network access server (NAS), 217
- Networking:
 - basic components of, 7–8
 - network architecture, evolution of, 8–9
 - technology breakthrough, 9–10
- Network latency (NL):
 - characteristics of, 69
 - communication services latency, 72
 - equipment latency, 71–72
 - propagation delay, 71
 - transmission speed, 71
- Network layer:
 - access control systems, 236
 - defined, 214
 - routing information, 136
 - security services, 217–220
- Network nodes:
 - DiffServ, 110–111, 113
 - IntServ, 96–98
- Network Operations Center (NOC), 213
- Network operators:
 - functions of:
 - generally, 35
 - ITU-T Recommendation M.1400, 38
 - ITU Carrier Codes (ICCs), 39–40
- New-generation operation support systems (NGOSS):
 - characteristics of, 51–52
 - Shared Information/Data Model (SID), 53
 - Technology Neutral Architecture, 52–53
- Next-generation Internet (NGI), 288, 299
- Next hop label forwarding entry (NHLFE), 135
- NGOSSTM Architecture, 51–52
- Nonlinear amplifiers, 290
- Nonrepudiation:
 - avoidance strategies, generally, 215–216
 - public key security, 242, 266
 - sequence numbering, 240, 267
 - time-stamping, 240, 267
 - types of, 239–240
- North American ICCs, 40
- Notification, business application contracts, 52
- NSFNET, 287
- NULL algorithm, 218

- OAG, 44
- Oakley Key Determination Protocol, 249
- Object Constraint Language (OCL), 45
- O-E-O conversion, 289, 294, 296, 298, 300
- One pass with advertising (OPWA), 106
- One-stop billing, 190

- One-way authentication, certificate management, 259–260
- One-way hash function, 224–228, 250
- On-line help, 18
- On-line metering, 175
- Open bundling, 163
- Open-edi:
 - conceptual model, 21–23, 53
 - defined, 21
 - MoU management group, 27–28
 - reference model, *see* Open-edi Reference Model
 - vision, 21
- Open-edi Reference Model:
 - Business Operational View (BOV):
 - defined, 29
 - methodology, 30–33
 - requirements, 29–30
 - semantics, 28–29
 - characteristics of, 23
 - problems with, 24–26
 - solutions, 26–27
- Open networks, 17
- Open shortest path first (OSPF), 97, 101, 125–126, 216–217
- Operation, administration, maintenance, and provisioning (OAM&P) bridge, 12
- Operation support systems (OSSs), 174
- Operations, functions of, 10–11
- Optical add/drop multiplexers (OADMs), 291, 294–295, 298
- Optical amplifiers (Oas), 289–290, 294
- Optical burst switching (OBS) networks, 303, 323
- Optical channel selection (OCS), 293, 326–327
- Optical cross connects (OXC)s, 291–292, 294–295, 298, 313
- Optical Internet (OI):
 - challenges of:
 - IP over WDM networks, 326–328
 - traffic engineering, 325–326
 - defined, 288
 - first-generation (FGON), 288, 294–296, 305–309
 - future directions for, 328
 - second-generation (SGON), 288, 309–315
 - traffic engineering:
 - challenges to, 325–326
 - flow-level analysis, 321–323
 - influential factors, 323–325
 - self-similarity, 315–321
- Optical Layer (OL):
 - characteristics of, generally, 292–293
 - optical channel selection (OCS), 293, 326–327
 - optical multiplex section (OMS), 294, 326–327
 - optical transmission section (OTS), 294
- Optical line terminals (OLTs), 293
- Optical multiplex section (OMS), 294, 326–327
- Optical network(s):
 - all-optical networks, architectures:
 - dynamic lightpath networks, 297–300

- optical burst switching networks, 303
- optical packet-switching networks, 300–302
- overview, 294–295
- static and semistatic lightpath networks, 295–297
- characteristics of, generally, 141
- ISO/OSI model, 287, 292
- protocol architectures, 303–305
- technologies:
 - all-optical network architectures, 294–303
 - optical components, 289–292
 - optical layer, 292–294
- Optical network for regional access using multiwavelength protocols (ONRAMP), 299
- Optical packet-switching networks, 288, 300–302, 315
- Optical receivers, 293
- Optical switches, 292, 294, 301
- Optical technology, 12
- Optical transmission section (OTS), 294
- Optical transport network (OTN), 292
- Organization for the Advancement of Structured Information Standards (OASIS), 43
- OSI/CMIP, 30
- OSI-TCP/IP, 328
- OSU-I/OSU-II, 302
- Out-of-bound traffic, 77, 84
- Out-of-profile:
 - packets, 117
 - traffic, 122
- Output feedback (OFB), 267, 271–273
- Overdimensioning, 79–80
- Overload, 299
- Overprovisioning, 169, 183–184, 186
- Packet(s), generally:
 - conditioning, quality of service, 80–84
 - delay, 9
 - DiffServ architecture:
 - classification, 115–116
 - dropping, 118
 - marking, 117–118
 - scheduling, 118
 - filtering, 236
 - forwarding, 62
 - latency, 81
 - loss, 67, 74, 81, 90
 - markup, 82
 - networks, 9
 - prioritization, 82
 - rate, 161
 - scheduler module, RSVP, 102
 - synchronization, 301
- Packet-based services, 11
- Packet-counting process, 316–317
- Packets per second (PPS), 68
- Packet-switched communication, 161
- Packet-switched networks, 89–90, 175
- Pareto efficiency, 144
- Pareto random variables, 321
- Participant:
 - authentication, 215
 - identification methods:
 - biometric, 231–234, 266
 - overview, 215, 230, 266
- Partner agreements, pair-wise trading, 32
- Partners, REA ontology, 46, 48–49
- Passive attacks, 213
- Passive hub, 294
- Passive probing, 147
- Passwords, 216, 235, 237, 265
- PATH messages, RSVP, 103–106, 108
- PATHTear, 104
- Payment, 158–159, 160
- PCMCIA, 250
- PDH 565 Mb/s, 293
- Peer modeling, flow switching, 326
- Per-call charges, 182
- Per-domain behavior (PDB), 118
- Perfect forward secrecy, 249
- Per-hop behavior (PHB), 113, 115, 118–124
- Per-packet charges, 187
- Permanent virtual circuits (PVCs), 305
- Photodetectors, 289
- Photodiodes, 293
- Photonic routers, 9
- Physical layer, 214, 287
- Picopayments, 175
- Points of presence (POP), 7–8
- Point-to-multipoint automatic key distribution, 241
- Point-to-point automatic key distribution, 241
- Point-to-point (PPP) encapsulation, 134, 141, 217, 305
- Point-to-point on-demand circuits (SVCs), 310
- Poisson process, 316, 318–319, 323
- Polarization, optical amplifiers, 290
- Policing, 118, 163
- Policy control module, RSVP, 102
- POP3, 321
- Post, Telephone, Telegraph (PTTs), 167
- PPP over SDL standard, 307–308
- Praseodymium-Doped Fiber Amplifier (PDFA), 290
- Prefix address, 131
- Premium IP services, 165
- Preplanned protection, 326
- Presentation layer, 215
- Pretty Good Privacy (PGP), 250, 277–278
- Pricing:
 - congestion-based, 168
 - defined, 160
 - dynamic, 168
 - importance of, 147, 156–157
 - models:
 - classification approaches, 185–187
 - dimensions of, 179–182
 - flat-fee, 182–183, 185, 202–203

356 INDEX

- Pricing, models (*continued*)
 overprovisioning, 183–184, 186
 overview, 176–177
 properties of, 178–179
 quality of service (QoS) issues, 185–186
 static and dynamic, 182–185
 time scales, 177–178
 usage-sensitive, 184–185
 schemes:
 congestion, 164
 cumulus (CPS), 164
 edge, 163
 Priority queuing (PQ), 85–86, 120–121
 Priority setting, 18
 Privacy, 17, 158
 Private branch exchanges (PBXs), 174
 Private network-to-network interface (PNNI), 125,
 141, 216–217
 Privilege management infrastructure (PMI), 262
 Processing, 9
 Processing delays, 98–99
 Propagation delays, 71, 98
 Protocol identification, 101
 Protocol type, 116
 Public Key Cryptography Standards (PKCS),
 276–277
 Public keys:
 algorithms, one-way hash functions, 226–228, 250
 cryptography, generally:
 characteristics of, 222–223
 security management, 240–243
 encryption principles:
 elliptic curve cryptography (ECC), 278–279
 pretty good privacy (PGP), 277–278
 RSA, 275–276
 standards (PKCA), 276–277
 exchange methods:
 Diffie-Hellman exchange, 247–248, 266
 Internet Security Association and Key
 Management Protocol (ISAKMP), 248–249,
 266
 Key Exchange Algorithm (KEA), 250
 Simple Key Management for Internet Protocols
 (SKIP), 249–250
 Kerberos, 246–247
 Public networks, 10
 Public switched telephone network (PSTN), 11
 Public utilities, 157
 Pump, optical amplifiers, 290
 Purchase Order (PO), UN/EDIFACT, 25–26
 Pure Internet service provider (PISP), 197–199
 Quality of service (QoS):
 applications:
 adaptable, 65–66
 asynchronous, 66
 bulk-transfer, 66
 burst, 66
 real-time, 65–67
 tolerant, 67
 approaches to:
 class-based packet processing, 76
 flow-based IP processing, 75–76
 summary of, 141–142
 token bucket, 76–78
 business models, 201–202
 charges and, 144, 158, 160–161
 controls:
 congestion, 89–95
 importance of, 78–79
 overdimensioning, 79–80
 defined, 64
 differentiated services (DiffServ) architecture,
 114–124
 eCommerce standards, 18
 enforcement of, 78
 IETF strategies and initiatives:
 basics of, 95–96
 goals, 95
 integrated service architecture, 96–97
 multiprotocol label switching (MPLS), 124–141
 overview, 95
 resource reservation protocol (RSVP), 100–110
 services, 97–100
 implementation, 64–65
 IP context and, 58–64
 multiprotocol label switching (MPLS), 124–131,
 136, 138–140
 packet conditioning, 80–84
 parameters:
 bandwidth, 67–69
 jitter, 67, 73
 latency, 67, 69–72
 packet loss, 67, 74
 reliability, 67, 74
 pricing models and, 179–180, 183, 186–187
 queue scheduling, 80, 84–89
 scheduling approaches, generally, 89
 significance of, generally, 8, 10–12, 58–59, 61–64
 switched networks, 59–61
 Quasi-optical approach, 301
 Query/Response, business application contracts, 51
 Queue management techniques, *see* Congestion
 control; Queue scheduling
 flow switching and, 326
 importance of, 65. *See also* Congestion control
 overflow, 81
 Queue scheduling:
 class-based queuing (CBQ), 89
 deficit round-robin (DRR) queuing, 89
 distributed weighted-fair queuing (DWFQ), 89
 EF PHB, 120
 first-in first-out (FIFO), 84–85, 91, 168
 priority queuing (PQ), 85–86, 120–121
 round-robin (RR) queuing, 86
 significance of, 80, 84

- virtual clock queuing, 89
- weighted-fair queuing (WFQ), 87–89, 168
- weighted round-robin (WRR) queuing, 87, 120–121
- Radio broadcast, 143
- Raman amplifiers (Ras), 290
- Random early detection (RED), 90–92, 172
- Rating systems, eCommerce, 18
- rcp, 220
- Real-time flow measurement (RTFM), 174
- Real-time protocol (RTP), 73
- Recovery time, dynamic lightpath network, 300
- Reengineering, 12
- REFRESH, 100
- Regeneration, optical transmission, 294
- Registering authority, 235
- Reliability:
 - eCommerce standards, 18
 - multiservice networks, 151
 - quality of service, 67, 74
 - significance of, 11
- Remote-access dial-in user service (RADIUS),
 - accounting record (RAC), 174
- Remote-access servers, equipment latency, 72
- Remote Authentication Dial in User Service (RADIUS), 236–237
- Request/Confirm, business application contracts, 51
- Request/Response, business application contracts, 51
- Resilience techniques, 326–328
- Resource-event-agent (REA):
 - basic exchange ontology:
 - adding commitments, 46–48
 - adding types to, 48–49
 - Business Collaboration, 49
 - components of, 46
 - defined, 46
- Resource reservation protocol (RSVP), IntServ:
 - accounting services, 169
 - applications, 108–110
 - data flow, 101
 - defined, 96, 100
 - functionalities, 101–102
 - granularity, 110
 - IPv4/IPv6, 61–63, 93, 101, 103–104
 - messages, 104–106
 - modified, 328
 - operations, 102–104
 - receiver-oriented protocol, 100
 - reservation merging, 108
 - reservation models, 106–108
 - routing protocols and, 101
 - simplex operation, 101
 - soft state, 100, 109, 170
- Resource sharing, 299
- Restoration blocking probability, 300
- Restoration schemes, dynamic lightpath network, 299–300
- RESV (reservation request) message, 103–105, 108
- RESVTear, 104
- Retinal recognition systems, 232
- Reverse bit coding, 291
- RIP, 101
- rlogin, 220
- Role-based access control (RBAC), 235, 263
- Root authority (RA), 255
- RosettaNet, 30, 44
- Round-robin (RR) queuing, 86
- Round-trip delay, 9
- Router(s):
 - core, 113, 116, 171
 - edge, 171
 - egress, 115, 170
 - equipment latency, 71–72
 - gigabit, 309–312
 - high-speed, 109
 - ingress, 113, 170
 - MPLS, 125–126
 - overdimensioning, 79
 - throughput, 79, 298
 - transmission speed, 71
- Routing process, 9, 39, 130–131, 301
- Routing and wavelength assignment (RWA), 295, 298
- RSA algorithm, 275–279
- RSA Data Security, Inc. (RSADSI), 218, 275
- rsh, 220
- RSpec, 97, 103, 106, 108
- Scalability, DiffServ architecture, 124
- Scientific language, 20
- Second-generation optical network (SGON):
 - defined, 288
 - IP over WDM:
 - overlay models, 309–312
 - peer models, 312–315, 326
 - resilience techniques, 326–328
 - traffic engineering issues, 315
- Second windows, 289–290
- Secure flag, 265
- Secure Multipurpose Internet Mail Extensions (S/MIME), 277
- Secure Shell (SSH), 220
- Secure socket layer (SSL)/transmission layer security (TLS), 216
- Secure Wide-Area Network (S/WAN), 218
- Security of information, *see* Security systems
 - eCommerce standards, 17–18
 - importance of, 11
- Security systems:
 - access control, 235–239, 267
 - certificate management, 250–263
 - charging support systems (CSS), 192
 - cryptographic, OSI model, 214–220
 - cryptographic keys, 240–234, 266
 - data integrity, 223–230, 266

358 INDEX

- Security systems (*continued*)
- digital signature algorithm (DSA), 279–280
 - encryption:
 - cracks, 264–266
 - public keys, principles of, 275–279
 - symmetric, principles of, 267–275
 - importance of, 212
 - Kerberos, 243–247, 266
 - message confidentiality:
 - approaches to, 220–221, 266
 - public key cryptography, 222–223
 - symmetric cryptography, 221–222
 - network management applications, 263–264
 - nonrepudiation, 239–240, 266
 - objectives of, 213–214
 - overview, 211–213
 - participants:
 - authentication of, 234–235
 - identification, 230–234
 - public keys, exchange of, 247–250
 - security policies, 267
 - Self-similarity, 315–321, 323
 - Semantic Components (Scs), 29
 - Semiconductor optical amplifiers (SOAs), 290
 - Semistatic lightpath networks, 288, 295–297
 - Sequence numbering, 240, 267
 - Service level agreements (SLAs):
 - characteristics of, 64, 72, 74, 84, 112–115, 158–159, 161, 163
 - commercial, 172–173
 - flow-based, 173
 - DiffServ, 171–173
 - Service-level specifications (SLS), 114–115, 117–118
 - Service profiles, 115
 - Service providers, functions of:
 - generally, 35
 - Internet, *see* Internet service providers (ISPs)
 - ITU-T Recommendations M.1400, 38
 - Service provisioning, 144
 - Service Provisioning Layer (SPL), 197–198
 - Service usage, 144
 - Session layer, 214
 - Settlements, 161
 - Setup delay, 298
 - Shared filter (SF) reservations, 106–108
 - Shared Information/Data Model (SID) (NGOSS), 53
 - Shim headers, 134
 - Short wavelength band, 290
 - Signaling, PSTN, 11
 - Simple authentication, 217
 - Simple authentication and security layer (SASL), 253
 - Simple distributed security infrastructure (SDSI), 258
 - Simple Guide to UMM*, 49
 - Simple Key Management for Internet Protocols (SKIP), 249–250
 - Simple network-management protocol (SNMP), 156, 165, 263–264
 - Simple public key infrastructure (SPKI), 258
 - Single-hop (SH) network, 296
 - Single-mode fiber optics, 289
 - Single multiservice network, 146
 - SKEME, 249
 - SKIPJACK, 250, 271, 275
 - Slowly decaying variance, 316
 - Small- and medium-size enterprises (SMEs), 42
 - Small Exchange Carrier Access Billing (SECAB), 38
 - Smart cards, 234, 265
 - SMTP, 321
 - SNMPv3, 263–264
 - Source address, 131
 - Source of authority (SOA), 40, 263, 291
 - Source port, 116
 - Speaker identification technology, 231
 - Special Working Group on Electronic Data Interchange (SWG-EDI), 21–22
 - Splitter, passive optical, 294
 - Spread spectrum, 216
 - SPR with proportional weighted path (SPR-PW), 300
 - Stability, multiservice networks, 151
 - Standards/standardization, eCommerce, 15–18
 - Standards Development Organization (SDO), 35
 - State explosion problem, 109
 - Static lightpath networks, 288, 295–297
 - Static pricing models, 182–185
 - Station message detail record (SMDR), 173–174
 - Stochastic preplanned restoration (SPR), 300
 - Strong authentication, 217
 - Subnetwork granularity, 311
 - Superouters, 9
 - Support services, eCommerce standards, 22, 34
 - Surfing, 287
 - Survivability, dynamic lightpath networks, 299
 - Survivable network, defined, 296
 - Survival function, optical Internet traffic engineering, 319, 323
 - Swedish Institute of Computer Science, 247
 - SWIFT, 30
 - Switched virtual circuits (SVCs), 303, 305
 - Switches, characteristics of, 7–8. *See specific types of switches*
 - Switching technology, 9–10, 301
 - Symmetric cryptography:
 - block encryption algorithms:
 - advanced encryption standard (AES), 273
 - data encryption standard (DES), 273–274
 - international data encryption algorithm (IDEA), 275
 - SKIPJACK, 275
 - triple DES, 274
 - utilization of, 267–272
 - message confidentiality, 221–222
 - principles of, 267–275
 - security management, 240–243

- Synchronous digital hierarchy (SDH):
 - characteristics of, generally, 79, 141, 288
 - first-generation optical networks, 294
 - framing alarm, 328
 - STM-N, 293
 - telephony, physical layer, 305
- Synchronous optical networks (SONET):
 - characteristics of, generally, 69, 79, 129, 141, 288
 - framing alarms, 328
 - first-generation optical networks:
 - characteristics of, 294
 - IP over Gigabit Ethernet, 309
 - IP over SONET, 305–308
 - scrambling, 306–307
 - STS-N, 293
 - telephony, physical layer, 305
- Synchronization, 33
- Syncookies, 248
- SYN flooding attack, 238–239, 248
- System development, eCommerce, 18
- System stability, eCommerce, 16
- System status, eCommerce standards, 16

- T1M1 GTDD, 53
- Tag switching, 311
- Tail drop, 91
- Tariffing, 147, 157, 161, 164–165, 167, 183, 203
- TCP ACK (ECN-echo ACK packet), 94–95
- Technical language, 20
- Telecom Operations Map (e-TOM), 52
- Telecommunications Internet Service Provider (TISP), 197–199
- Telecommunications Management Network (TMN):
 - certification management, 251
 - X-Interface, 34, 38, 50
- Telecommunications Markup Language (tML), 49–51
- TeleManagement Forum (TM Forum):
 - Business Agreement (BA), 52
 - business application contracts:
 - business view, 51–52
 - characteristics of, generally, 51
 - systems view, 52–53
 - Common Information Structure, 52
 - Systems Integration Map (SIM), 53
 - Telecom Operations Map (e-TOM), 52
- Telemanagement software, 157
- Telephone/telephony, generally:
 - charges, 176
 - local calling, 7
 - long-distance calls, 8
 - networks, 143, 149
 - physical layer, 305
 - voice over IP, 9, 12, 73, 86
- Tell-and-go reservation, 303
- telnet, 220

- Terabit packet processing, 62
- Third windows, 289–290
- Three-tier billing, 165
- Three-way authentication, certificate management, 259–261
- Throughput routers, 79, 298
- Ticket-granting server (TGS), 243–246
- Time-division multiplexing (TDM) technology, 9
- Time-of-day pricing, 177, 184
- Time scales, in pricing, 177–178
- Time-stamping, 240, 267
- Time-to-life (TTL), 63, 80, 134
- tML Framework, 49–51
- Token bucket scheme/principle, 76–78, 89
- Total delay, 9
- Traffic, generally:
 - congestion control, 143–144
 - control, 11
 - DiffServ architecture:
 - conditioning, 117
 - monitoring, 116–117
 - shaping, 83, 118
 - engineering strategies, *see* Traffic engineering
 - shaping, 83
- Traffic class byte, 64, 111
- Traffic conditioning agreements (TCA), 113–115
- Traffic conditioning specifications (TCS), 114, 117
- Traffic engineering (TE):
 - flow switching, 311
 - functions of, generally, 126, 131
- Transmission, generally:
 - delays, 98–99
 - link, 9
 - PSTN, 11–12
 - rates, 124
 - speed:
 - network latency, 71
 - quality of service and, 81
- Transmission control protocol/IP (TCP/IP), 57
- Transponders, 326
- Transport layer, 214
- Transport protocols (TCP):
 - congestion controls, 90–92
 - traffic engineering, 319, 321
- TSpec (transmitter specification), 97, 100, 103–106
- Tunneling, 126, 141, 174
- Two-way authentication, certificate management, 259–260
- Type of Service (ToS) byte, 61–62, 116

- UN/ECE WP.4, 42
- UN/EDIFACT, 24–26, 29, 31–32, 40–41
- UNI, 141
- Unicast routing, RSVP, 102
- Unified Modeling Language (UML), 30–32, 41, 45
- Unified TNM Requirements, Analysis, and Design (UTRA), 31
- Uniform Code Council/UCC/EAN, 30

360 INDEX

- Uniform resource locator (URL), 254, 265
- United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT):
 - Business Process Analysis Working Group (BPAWG), 42
 - business service interaction design patterns, 52
 - e-Business Transition Working Group, 49
 - functions of, 30–31
 - interoperability, 45
 - Modeling Methodology (UMM):
 - Analysis Workflow, 32, 41
 - business collaboration, 51–52
 - Business Domain View (BDV), 45, 49
 - Business Modeling Workflow, 32
 - Business Requirements View (BRV), 45–46, 49
 - Business Service View (BSV), 45–46
 - Business Transaction View (BTV), 45, 49
 - Design Workflow, 33
 - Library(ies), 32–33
 - Simple Guide to UMM*, 49
 - Techniques and Methodologies Working Group (TMWG), 40–42, 44
- United Nations Economic Commission for Europe (UN/ECE), 27, 31, 42
- U.S. Department of Defense (DOD), 233, 249
- U.S. National Security Agency (NSA), 250, 275
- Universal Mobile Telecommunications System (UMTS), 203
- Unsolicited downstream, 132
- Usability, eCommerce standards, 15–16
- Usage-sensitive pricing models, 184–185
- User datagram protocol (UDP), 60, 90, 92, 136, 217, 248
- Utility functions, charging support systems (CSS), 152–153
- UTRAD, 38–39
- UUNet, 172

- Value-added services, 145, 149, 185, 188, 197
- Vertical cavity surface emitting laser (VCSEL), 290
- Very large-scale integrated (VLSI) chips, 275
- Video conferencing, 179
- Video on demand (VoD), 49, 185, 199, 201
- Virtual circuits (VCs), 125
- Virtual clock queuing, 89
- Virtual E-marketplace, 26

- Virtual private networks (VPNs), 126, 131, 138, 143, 148–149, 185, 212
- Voice over ATM (VoATM), 60
- Voice over frame relay (VoFR), 60
- Voice over IP (VoIP) telephony, 9, 12, 73, 86
- Voice prints, 230
- Voice technology:
 - historical perspective, 8
 - quality, 9
 - voice over IP (VoIP) telephony, 9, 12, 73, 86

- Waveband cross connect (WBXC), 291
- Wavelength continuity, 295–296
- Wavelength converter, 290–291, 294, 296
- Wavelength division multiplexing (WDM):
 - coarse (CWDM), 289
 - development of, 287
 - lightpath networks, 296–297, 299
 - optical add/drop multiplexers (OADM), 291, 294–295, 298
 - optical amplifiers, 290
 - self-healing, 296–297
- Wavelength routed networks, 295
- Wavelength routing optical cross connects (WR-OXC), 291–292
- Wavelength switched-packet network (WASPNET), 302
- Wavelength translating optical cross connects (WT-OXC), 291, 294
- Weighted-fair queuing (WFQ), 87–89, 172
- Weighted round-robin (WRR) queuing, 87, 120–121
- Westerlund, Assar, 247
- Wide area network (WAN) technology:
 - characteristics of, 60, 67, 80
 - physical layer (PHY), 309
- Wildcard-filter (WF) reservations, 106, 108
- Windows, defined, 289
- World Wide Web (WWW), 30, 74, 198, 287, 319, 321
- World Wide Web Consortium (W3C), Digital Signal Initiative, 250

- x-doped filter amplifiers (xDFAs), 290
- X.509, 251, 253–254, 261–262
- XORed, 306
- X12 EDI, 24, 26, 32, 41
- X.25, 175