

# INDEX

## Numbers

2.5G, mobile phone system, 168  
3G (*see* Third generation mobile phone)  
4B/5B, 285  
8B/10B, 289  
8B/6T, 285  
10Base-*x*, 272  
100Base-*x*, 285  
802 (*see* IEEE 802.*x*)  
802.3 (*see* Ethernet)  
802.15 (*see* Bluetooth)  
802.16 (*see* IEEE 802.16)  
1000Base-*x*, 288

## A

AAL (*see* ATM Adaptation Layer)  
AAL-SAP, 494  
Abramson, Norman, 65–66  
Abstract syntax notation 1, 768  
Access grant channel, 162  
Access point, 68  
Acknowledged datagram service, 33  
Acknowledgement frame, 38  
ACL (*see* Asynchronous ConnectionLess)

Active neighbor, 379  
Active repeater, 98  
Active Server Page, 646  
ActiveX control, 650  
ActiveX security, 817–818  
Ad hoc network, 68, 375–380  
Ad hoc on-demand distance vector routing, 375–380  
Adaptive routing algorithm, 351  
Adaptive tree-walk protocol, 263–265  
ADC (*see* Analog Digital Converter)  
ADCCP (*see* Advanced Data Communication Control Procedure)  
Address,  
    IP, 436–438, 441–444  
    transport, 493–496  
Address resolution protocol, 450–452  
    gratuitous ARP, 463  
    proxy, 452  
Addressing, 31  
Adjacent router, 457  
Admission control, 389, 406–408  
ADSL (*see* Asymmetric Digital Subscriber Line)  
Advanced data communication control procedure, 234  
Advanced encryption standard, 741–745  
    Rijndael, 743–745  
Advanced mobile phone system, 154–157  
Advanced networks and services, 55  
Advanced Research Projects Agency, 51

AES (*see* Advanced Encryption Standard)  
 Aggregate entry, 444  
 AH (*see* Authentication Header)  
 Alias, e-mail, 593  
 Alice, 731  
 ALOHA, 251–255  
     pure, 251–254  
     slotted, 254–255  
 American National Standards Institute, 74  
 Amplitude modulation, 126  
 AMPS (*see* Advanced Mobile Phone System)  
 Analog digital converter, 675  
 Anderson, Ross, 742  
 Andreessen, Mark, 57, 611  
 Anonymous remailer, 820–821  
 ANS (*see* Advanced Networks and Services)  
 ANSI (*see* American National Standards Institute)  
 ANSNET, 55  
 AODV (*see* Ad hoc On-demand Distance Vector routing)  
 Applet, 650  
 Application gateway, 778  
 Application layer, 41, 43, 579–720  
     DNS, 579–588  
     e-mail, 588–611  
     multimedia, 674–714  
     World Wide Web, 611–673  
 Area, 456  
 Area router, 457  
 ARP (*see* Address Resolution Protocol)  
 ARPA (*see* Advanced Research Projects Agency)  
 ARPANET, 50–54  
     routing algorithm, 357, 454  
 ARQ (*see* Automatic Repeat reQuest)  
 AS (*see* Autonomous System)  
 ASCII armor, 598  
 ASN.1 (*see* Abstract Syntax Notation 1)  
 ASP (*see* Active Server Page)  
 Association service, 802.11, 301  
 Assured forwarding, 414–415  
 Asymmetric digital subscriber line, 130–134  
     compared to cable, 175–176  
 Asynchronous connectionless link, Bluetooth, 315  
 Asynchronous transfer mode, 61–65  
 ATM (*see* Asynchronous Transfer Mode)  
 ATM adaptation layer, 64  
 ATM network, 61, 65, 417, 418  
 ATM physical medium dependent sublayer, 64  
 Attenuation, 125  
 Attribute,  
     certificate, 767  
     HTML, 630  
 Audio, 674–692  
     introduction to digital, 674–676  
 Audio CD, 676

Audio compression, 676–679  
     frequency masking, 677  
     MP3, 676–679  
     perceptual coding, 677  
     psychoacoustics, 677  
     temporal masking, 677  
 Authentication, 785  
     Diffie-Hellman, 791–792  
     Kerberos, 796–798  
     using a key distribution center, 793–796  
     Needham-Schroeder, 794–795  
     Otway-Rees, 795–796  
     public-key, 798–799  
     shared key, 786–790  
     using an HMAC, 790  
 Authentication header, 774–775  
 Authentication protocols, 785–799  
 Authentication service, 802.11, 302  
 Authenticode, 817  
 Authoritative record, DNS, 587  
 Automatic repeat request, 209  
 Autonomous System, 427, 432, 456–458

## B

B-frame, MPEG, 701, 703  
 Backbone area, 456  
 Backward learning, 323  
 Bandwidth, 88  
 Bandwidth-delay product, 559  
 Baran, Paul, 50  
 Barker sequence, 294  
 Base64 encoding, 598  
 Basic bit-map protocol, 259–260  
 Baud, 127  
 BB84 quantum cryptography, 731–734  
 Beacon frame, 298  
 Bearer layer, WAP, 664  
 Beauty contest, 105  
 Bell, Alexander Graham, 119  
 Bell Operating Companies, 122  
 Bellman-Ford routing algorithm, 357–360, 454  
 Bent pipe transponder, 109  
 Berkeley sockets, 487–488  
 Best-effort service, IEEE 802.16, 308  
 BGP (*see* Border Gateway Protocol)  
 Big endian computer, 433  
 Biham, Eli, 742  
 Binary count down protocol, 260–261  
 Binary exponential backoff algorithm, 278–279  
 Birthday attack, 763–765, 782  
 Bit stuffing, 190  
 Blaataand, Harald, 310

- Block cipher, 737
  - Blowfish, 751
  - Bluetooth, 21, 310–317
    - applications, 312–313
    - architecture, 311
    - asynchronous connectionless link, 315
    - baseband layer, 315–316
    - history, 310
    - link, 315
    - piconet, 311
    - profile, 312–313
    - protocol stack, 313–314
    - scatternet, 311
    - security, 783–784
    - synchronous connection-oriented link, 316
  - Bluetooth SIG, 310, 311
  - Bob, 731
  - BOC (*see* Bell Operating Companies)
  - Body, e-mail, 591
  - Boot protocol, 453
  - BOOTP (*see* BOOT Protocol)
  - Border gateway protocol, 459–461
  - Bridge, 317, 319–322
    - backward learning, 323
    - remote, 325–326
    - spanning tree, 323–325
    - transparent, 322–326
  - Broadband, 130
  - Broadband wireless (*see* IEEE 802.16)
  - Broadcast, 276
    - Ethernet, 276
  - Broadcast control channel, 161
  - Broadcast network, 15
  - Broadcast routing, 368–370
  - Broadcast storm, 330, 558
  - Broadcasting, 15, 368
  - Browser (*see* Web browser)
  - Bucket brigade attack, 792
  - Buffering, 506–510
  - Bush, Vannevar, 612
  - Byte stuffing, 189–190
- C**
- CA (*see* Certification Authority)
  - Cable modem, 173–175
  - Cable modem termination system, 173
  - Cable television, 169–175, 710
  - Caching, Web (*see* Web cache)
  - Caesar cipher, 727
  - Care-of address, 463
  - Carnivore, 13
  - Carrier extension, gigabit Ethernet, 287–288
  - Carrier hotel, 59
  - Carrier sense assumption, 250
  - Carrier sense multiple access,
    - 1-persistent, 255
    - nonpersistent, 256
    - with collision avoidance, 296–297
    - with collision detection, 255–258
    - p*-persistent, 256
  - Carrier sense protocol, 255
  - Category 3 wiring, 91
  - Category 5 wiring, 92
  - CCITT, 72
  - CD, audio, 676
  - CD (*see* Committee Draft)
  - CDMA (*see* Code Division Multiple Access)
  - CDMA2000, 167
  - CdmaOne, 162
  - CDN (*see* Content Delivery Network)
  - Cell,
    - mobile phone, 154
    - HTML, 633
  - Cell phone (*see* Mobile phone)
  - Certificate revocation list, 771
  - Certificates, 765–771
  - Certification authority, 766
  - Certification path, 770
  - CGI (*see* Common Gateway Interface)
  - Chain of trust, 770
  - Challenge-response protocol, 786
  - Channel allocation problem, 248–251, 337
  - Channel-associated signaling, 141
  - Character stuffing, 189–190
  - Chat room, 7
  - Checksum, CRC, 197
  - Chip sequence, 162
  - Choke packet, 391–394
  - Chord, 380–384
  - Chosen plaintext attack, 727
  - Chromatic dispersion, 95
  - Chrominance, 694
  - cHTML (*see* Compact HTML)
  - CIDR (*see* Classless InterDomain Routing)
  - Cipher, 724
    - Cipher block chaining mode, 746–747
    - Cipher feedback mode, 747–748
    - Cipher mode, 745–750
    - Ciphertext, 725
    - Ciphertext-only attack, 727
  - Circuit switching, 147–148
  - Clark, David, 46
  - Clark, Wesley, 51
  - Class A, B, C, D addresses, 437
  - Class-based service, 412–415
  - Classful addressing, 437

- Classic Ethernet, 286, 327
- Classless interdomain routing, 441–444
- Clear to send, 269
- CLEC (*see* Competitive LEC)
- Client, 4
- Client stub, 527–529
- Client-server model, 4–5
- Client-side dynamic Web pages, 647–651
- Clipper chip, 820
- CMTS (*see* Cable Modem Termination System)
- Coaxial cable, 92
- Code, 724
- Code division multiple access, 162–166
- Code signing, 817
- Codec, 140
- Codeword, 193
- Collision, 250
- Collision domain, Ethernet, 282
- Collision-free protocols, 259–270
- Colored thread, 417
- Committee Draft, 75
- Common carrier, 72
- Common control channel, 161
- Common gateway interface, 644–645
- Common-channel signaling, 141
- Communication medium, 5
- Communication satellite, 108–117
  - compared to fiber, 117–118
  - GEO, 109–113
  - Globalstar, 115–116
  - Iridium, 114–115
  - LEO, 114–116
  - MEO, 113–114
  - Teledesic, 116
  - VSAT, 112–113
- Communication security, 772–785
  - firewall, 776–779
  - IPsec, 772–776
  - VPN, 779–780
  - wireless, 780–785
- Communication subnet, 19, 344
- Community antenna television, 169–170
- Compact HTML,
  - compared to HTML 1.0, 668
  - example, 670
- Competitive LEC, 134
- Composite video, 694
- Composition, e-mail, 590
- Computer network, 2
  - 802.11, 68–71
  - ARPANET, 50–54
  - ATM, 61–65
  - connection-oriented, 59–65
  - Ethernet, 65–68
  - hardware, 14–16
- Computer network (*continued*)
  - home, 6–9, 23–25
  - IEEE 802.11, 68–71
  - NSFNET, 54–56
  - protocol hierarchy, 26–30
  - reference models, 37–49
  - software, 26–37
  - standardization, 71–77
  - use, 3–14
  - wireless, 21–23, 68–71
  - X.25, 61
- Computer network architecture, 28–30
- Congestion control, 384–396
  - choke packet, 391–394
  - datagram subnets, 391–395
  - jitter control, 395–396
  - principles, 386–388
  - TCP, 547–548
  - virtual-circuit subnets, 389–390
  - warning bit, 391
- Congestion window, TCP, 548–550
- Connection establishment, 496–502
  - TCP, 539–540
- Connection management modeling, 541–543
  - state machine, 486
- Connection release, 502–506
  - TCP, 541
- Connection-oriented service, 32–33, 347–348
- Connectionless internetworking, 423–425
- Connectionless service, 32–33, 345–347
- Constant bit rate service, IEEE 802.16, 308
- Constellation diagram, 128
- Content delivery network, 660–662
  - proxy, 662
- Contention, 251
- Continuous media, 674
- Continuous time assumption, 250
- Control-driven MPLS, 417
- Convergence sublayer, 65
- Cookie, Web, 626–629
- Copper wire, compared to fiber optics, 98–99
- Copyright, 826–828
- Cordless phone, 152
- Core-based tree, 372
- Count-to-infinity problem, 359–360
- Counter mode, 749–750
- Crash recovery, 511–513
- CRC (*see* Cyclic Redundancy Check)
- Credit message, 522
- CRL (*see* Certificate Revocation List)
- Cryptanalysis, 726, 750–751
  - differential, 750–751
  - linear, 751
  - power consumption attack, 751
  - timing attack, 751

- Cryptographic principles, 735–736
  - freshness, 736
  - Kerckhoff's, 726
  - redundancy, 735–736
- Cryptography, 724–755
  - AES, 741–745
  - cipher modes, 745–750
  - ciphertext, 725
  - cryptanalysis, 726
  - DES, 738–741
  - introduction, 725–727
  - Kerckhoff's principle, 726
  - one-time pad, 730–731
  - plaintext, 725
  - public-key, 752–755
  - quantum, 731–735
  - Rijndael, 743–745
  - symmetric-key, 737–751
  - traditional, 727–730
- Cryptology, 726
- CSMA (*see* Carrier Sense Multiple Access)
- CSMA/CA (*see under* Carrier Sense Multiple Access)
- CSMA/CD (*see under* Carrier Sense Multiple Access)
- CTS (*see* Clear To Send)
- Cut-through switch, 328
- Cyclic redundancy check, 196
- Cypherpunk remailer, 821–822
  
- D**
  
- D-AMPS (*see* Digital AMPS)
- D-frame, MPEG, 701, 703
- Daemen, Joan, 742
- Daemon, 590
- Data delivery, 302
- Data encryption standard, 738–741, 751
  - EDE mode, 741
  - EEE mode, 741
  - triple DES, 740–741
- Data frame, 38
- Data link layer, 38, 183–246
  - bit stuffing, 190–191
  - byte stuffing, 189–190
  - design issues, 184–192
  - elementary protocols, 200–211
  - error handling, 192–200
  - flow control, 192
  - HDLC protocol, 234–237
  - interface procedures, 202–204
  - LCP protocol, 239–242
  - NCP protocol, 239, 242
- Data link layer (*continued*)
  - PPP protocol, 238–242
  - protocol verification, 229–234
  - protocols, 200–228
  - sliding window protocols, 211–228
  - stop-and-wait protocol, 206–211
  - unrestricted simplex protocol, 204–206
- Data link layer switching, 317–336
- Data link protocols, 200–228, 234–242
  - elementary, 200–211
  - HDLC, 234–237
  - Internet, 238–242
  - sliding windows, 211–228
- Data over cable service interface specification, 173
- Data-driven MPLS, 417
- Datagram, 346
- Datagram service, 33
- Datagram subnet, 345–347
  - compared to virtual circuit, 348–350
  - congestion control, 391–395
- David and Goliath, 589
- Davies, Donald, 51
- DB, 674
- DCF (*see* Distributed Coordination Function)
- DCF interframe spacing, 299
- DCT (*see* Discrete Cosine Transformation)
- DDoS attack (*see* Distributed Denial of Service attack)
- De facto standard, 71
- De jure standard, 71
- Deadlock, Petri net, 232
- Deauthentication, 302
- Decibel, 89
- Decoding algorithm, video, 696
- Dedicated control channel, 161
- Delta modulation, 143
- Demultiplexing, 31
- Denial of service attack, 778
- Dense wavelength division multiplexing, 267
- DES (*see* Data Encryption Standard)
- Design issues, 30–31
  - data link layer, 184–192
  - network layer, 343–350
  - transport layer, 492–513
- Design principles, Internet, 431–432
- Designated router, 457
- Destination port, 447
- DHCP (*see* Dynamic Host Configuration Protocol)
- Diagonal basis, 732
- Dialog control, 40
- Differential cryptanalysis, 750–751
- Differential Manchester encoding, 274–5
- Differential pulse code, 142
- Differentiated services, 412–415
- Diffie-Hellman key exchange, 791–792
- DIFS (*see* DCF InterFrame Spacing)

- Digital AMPS, 157–159, 665
  - Digital audio, 674–676
  - Digital millennium copyright act, 827–828
  - Digital signature, 755–765
    - birthday attack, 763–764
    - message digest, 759–762
    - public-key, 757–759
    - symmetric-key, 756–757
  - Digital signature standard, 758–759
  - Digital subscriber line, 130–134
    - asymmetric, 130–134
  - Digital subscriber line access multiplexer, 134
  - Digital video, introduction, 692–696
  - Digram, 728
  - Dijkstra's shortest path algorithm, 353–355
  - Direct sequence spread spectrum, 102, 294
  - Directive, HTML, 630
  - Directory server, 495
  - DIS (*see* Draft International Standard)
  - Disassociation service, 802.11, 301
  - Discrete cosine transformation, 698–700
  - Discrete multitone, 132
  - Disk array, 708
  - Disk farm, 708
  - Display, e-mail, 590
  - Disposition, e-mail, 590
  - Distance vector multicast routing protocol, 712–713
  - Distance vector routing algorithm, 357–360
  - Distortion, 125
  - Distributed coordination function, 296, 298–299
  - Distributed denial of service attack, 778
  - Distributed system, 2
  - Distribution service, 802.11, 301
  - DIX Ethernet, 275–276, 278
  - DMCA (*see* Digital Millennium Copyright Act)
  - DMT (*see* Discrete MultiTone)
  - DNS (*see* Domain Name System)
  - DNS security, 809–811
  - DNSsec (*see* DNS security)
  - DOCSIS (*see* Data Over Cable Service Interface Specification)
  - Domain, top-level, 580
  - Domain name system, 54, 579–588
    - authoritative record, 588
    - name server, 586–588
    - name space, 580–582
    - security, 809–811
    - spoofing, 806–808
    - zone, 586
  - security, 809–811
  - DoS attack (*see* Denial of Service attack)
  - Dotted decimal notation, 437
  - Downward multiplexing, 511
  - Draft International Standard, 75
  - Draft standard, 77
  - Drop cable, 272
  - DSLAM (*see* Digital Subscriber Line Access Multiplexer)
  - DSSS (*see* Direct Sequence Spread Spectrum)
  - DVMRP (*see* Distance Vector Multicast Routing Protocol)
  - DWDM (*see* Dense Wavelength Division Multiplexing)
  - Dwell time, 294
  - Dynamic channel allocation, 249–251
  - Dynamic host configuration protocol, 453–454
  - Dynamic HTML, 647
  - Dynamic Web documents, 643–651
  - Dynamic Web page generation, 643–651
- E**
- E-commerce, 5
  - E-mail, 5, 57, 588–611
    - architecture and services, 579–591
    - ASCII armor, 598
    - base64 encoding, 598
    - composition, 590
    - delivery features, 609–610
    - display, 590
    - disposition, 590
    - filter, 609
    - final delivery, 605–611
    - headers, 595–596
    - mailbox, 591
    - message format, 594–602
    - message transfer, 602–605
    - MIME, 596–602
    - POP3, 605–608
    - quoted printable, 598
    - reading, 593–594
    - report generation, 590
    - sending, 592–593
    - SMTP, 602–605
    - transfer agent, 590
    - user agent, 591–594
    - user profile, 593
    - X.400, 589–590
  - E1 carrier, 142
  - ECB (*see* Electronic Code Book mode)
  - EDE mode, DES, 741
  - EDGE (*see* Enhanced Data rates for GSM Evolution)
  - EEE mode, DES, 741
  - EIFS (*see* Extended InterFrame Spacing)
  - Eisenhower, Dwight, 51
  - Electromagnetic spectrum, 100–102
    - politics of, 105–106
  - Electronic code book mode, 745–746

Electronic commerce, 5  
 Electronic mail (*see* E-mail)  
 Elephants, apocalypse of the, 46–47  
 Emoji, 669  
 Emoticon, 588  
 Encapsulating security payload, 775–776  
 Encoding algorithm, video, 696  
 Enhanced data rates for GSM evolution, 168  
 End office, 120  
 Envelope, e-mail, 591  
 Error control, 31, 191–192  
 Error detection and correction, 192–200  
 Error recovery, multimedia, 681  
 Error-correcting code, 193  
 Error-detecting code, 193  
 ESP (*see* Encapsulating Security Payload)  
 Eternity service, 823  
 Ethernet, 17, 65–68, 271–292 (*see also*  
   Fast Ethernet, Gigabit Ethernet)  
   10Base-F, 273  
   10Base-T, 272  
   binary exponential backoff, 278–279  
   broadcast, 276  
   cabling, 271–274  
   classic, 327  
   collision domain, 282  
   DIX, 67, 275–276, 278  
   drop cable, 272  
   fast, 283–285  
   frame format, 276  
   gigabit, 286–290  
   history, 65–67  
   Manchester encoding, 274–275  
   multicast, 276  
   performance, 279–281  
   protocol, 275–279  
   repeater, 274  
   retrospective, 291–292  
   switched, 328–336  
   thick, 271  
   thin, 271  
   vampire tap, 271  
 Example data link protocols, 204–228  
 Example Internet file server, 488–492  
 Example transport protocol, 513–524  
 Expedited forwarding, 413–414  
 Exposed station problem, 269  
 Extended HTML, 642–643  
 Extended HTML, Basic, 673  
 Extended hypertext markup language, 642  
 Extended interframe spacing, 299  
 Extensible markup language, 639–642  
 Extensible style language, 639–642  
 Extension header, 469  
 Exterior gateway protocol, 427, 454

**F**

Fair queuing, 408–409  
 Fair use doctrine, 827  
 FAQ (*see* Frequently Asked Questions)  
 Fast Ethernet, 283–286  
   4B/5B, 285  
   8B/6T, 285  
   100Base-FX, 285  
   100Base-T4, 285  
   100Base-TX, 284–285  
   autonegotiation, 286  
   cabling, 284–286  
   full-duplex, 285  
   hubbed, 285–286  
   switched, 286  
 Fast TPDU processing, 566–569  
 FDD (*see* Frequency Division Duplexing)  
 FDDI (*see* Fiber Distributed Data Interface)  
 FDM (*see* Frequency Division Multiplexing)  
 FEC (*see* Forwarding Equivalence Class)  
 Feedback-based flow control, 192  
 Felten, Edward, 827  
 FHSS (*see* Frequency Hopping Spread Spectrum)  
 Fiber channel (*see* Fibre channel)  
 Fiber distributed data interface, 283  
 Fiber node, 170  
 Fiber optic networks, 97–98  
 Fiber optics, 93–99  
   chromatic dispersion, 95  
   compared to satellite, 117–118  
   compared to wire, 98–99  
   multimode, 94  
   single mode, 94  
   soliton, 96  
 Fiber to the curb, 709–710  
 Fiber to the home, 710  
 Fibre channel, 283  
 Field, video, 693  
 File transfer, 57  
 File transfer protocol, 448, 624  
 Filter, e-mail, 609  
 Finite state machine,  
   model, 229  
   stop-and-wait protocol, 229–232  
   TCP, 541–543  
 Firewall, 776–779  
   gateway, 778  
   packet filter, 777  
 First generation mobile phone system, 153–157  
 Fixed wireless, 10, 135, (*see also* IEEE 802.16)  
 Flag byte, 189  
 Flash crowd, 660  
 Flooding algorithm, 355, 357  
 Flow, 397

Flow control, 31, 192, 506–510  
     feedback-based, 192  
     rate-based, 192  
 Flow specification, 407  
 Flow-based algorithms, 409–412  
 Footprint, 112  
 Forbidden region, 499–500  
 Ford-Fulkerson routing algorithm, 357–360  
 Foreign agent, 373  
 Form,  
     HTML, 634–638  
     PHP, 645–646  
     Web, 634–638  
 Forward error correction, 193, 307  
 Forwarding, 350  
 Forwarding equivalence class, 416  
 Fourier series, 86–87  
 Fourier transform, 676  
 Fragment burst, 298  
 Fragmentation, internetwork, 427–431  
 Frame,  
     data, 184  
     video, 692  
 Frame bursting, gigabit Ethernet, 288  
 Frame header, 201–203  
 Frame relay, 61  
 Framing, 187–191  
 Freedom of speech, 822–826  
 Frequency, 100  
 Frequency division duplexing, 307  
 Frequency division multiplexing, 137–140  
 Frequency hopping spread spectrum, 102, 294  
     dwell time, 294  
 Frequency masking, 677  
 Frequency modulation, 126  
 Frequency shift keying, 126  
 Frequently asked questions, 610  
 FTP (*see* File Transfer Protocol)  
 FTTC (*see* Fiber To The Curb)  
 FTTH (*see* Fiber to the Home)  
 Full-duplex line, 129  
 Fuzzball, 54

## G

G.711 PCM encoder, 686  
 G.723.1 telephony protocol, 687  
 Gatekeeper, H.323, 686  
 Gateway, 25, 326–328  
     H.323, 686  
     internetwork, 422  
 General packet radio service, 168  
 Generator polynomial, 197–200

GEO (*see* Geostationary Earth Orbit satellite)  
 Geostationary earth orbit satellite, 109–113  
 Gigabit Ethernet, 286–290  
     8B/10B, 289  
     10 Gbps, 290  
     1000Base-CX, 288  
     1000Base-LX, 288  
     1000Base-SX, 288  
     1000Base-T, 288  
     cabling, 288  
     carrier extension, 287–288  
     frame bursting, 288  
     operational modes, 287  
     UTP, 288  
 Gigabit protocols, 569–570  
 Global positioning system, 114  
 Global system for mobile communications, 159–162  
 Globalstar, 115–116  
 Go back n protocol, 216–223  
 Gopher, 624  
 GPRS (*see* General Packet Radio Service)  
 GPS (*see* Global Positioning System)  
 Gratuitous ARP, 463  
 Gray, Elisha, 119  
 Gray code, 294  
 Group, 138  
 GSM (*see* Global System for Mobile communications)  
 Guided transmission media, 90–99

## H

H.225 telephony protocol, 687  
 H.245 telephony protocol, 687  
 H.323, 683–689 (*see also* Voice over IP)  
     gatekeeper, 686  
 Half-duplex line, 129  
 Hamming code, 193–195, 307  
 Hamming distance, 193  
 Handoff, 155  
     hard, 155  
     soft, 155  
 Harmonic, 86  
 Hashed message authentication code, 775, 790  
 HDLC (*see* High-Level Data Link Control)  
 HDTV (*see* High Definition TeleVision)  
 Head end, 18, 169  
 Header, 29  
     e-mail, 591  
     Ethernet, 275–276  
     frame, 201–203  
     IPv4 packet 433–436  
     IPv6 packet, 466–469  
     TCP segment, 536–539

- Header prediction, 568
  - Helper application, 617
  - Hertz, 100
  - Hertz, Heinrich, 100
  - HFC (*see* Hybrid Fiber Coax)
  - Hidden station problem, 269
  - Hierarchical caching, Web, 658–659
  - Hierarchical routing algorithm, 366–368
  - Hierarchical Web caching, 658–659
  - High definition television, 694–695
  - High rate direct sequence spread spectrum, 295
  - High-level data link control, 234–237
  - High-water mark, 682
  - HMAC (*see* Hashed Message Authentication Code)
  - Home agent, 373
  - Home location, 373
  - Home network, 6–9, 23–25
  - Host, 19
  - HTML (*see* HyperText Markup Language)
  - HTTPS (*see* Secure HTTP)
  - Hub, 112, 272, 326–327
  - Hybrid fiber coax, 170
  - Hyperlink, 612
  - Hypertext, 612
  - Hypertext markup language, 615, 629–639
    - attribute, 630
    - cell, 630
    - directive, 630
    - form, 634–638
    - head, 630
    - heading, 630
    - hyperlink, 632–633
    - table, 633–634
    - tag, 630
    - style sheet, 634
    - title, 630
  - Hypertext transfer protocol, 41, 623, 651–656
    - 651–656
    - connection, 652
    - example usage, 656
    - message header, 654–656
    - method, 652–654
    - persistent connection, 652
    - request header, 654–656
    - response header, 654–656
  - Hz (*see* Hertz)
- I**
- I-frame, MPEG, 701–702
  - I-mode, 665–670
    - acceptance in the West, 667
    - billing, 666
  - I-mode (*continued*)
    - business model, 666
    - compared to WAP, 671
    - cHTML, 668–670
    - emoji, 669
    - handset, 667
    - official services, 666
    - protocol stack, 668
    - services, 666
    - software structure, 667–668
  - IAB (*see* Internet Architecture Board)
  - ICANN (*see* Internet Corp. for Assigned Names and Numbers)
  - ICMP (*see* Internet Control Message Protocol)
  - IDEA (*see* International Data Encryption Algorithm)
  - IEEE (*see* Institute of Electrical and Electronics Engineers)
  - IEEE 802.11, 292–302
    - 802.11a, 294–295
    - 802.11b, 295
    - 802.11g, 295
    - Barker sequence, 294
    - beacon frame, 298
    - clear to send, 297–298
    - compared to 802.16, 303–304
    - competition with WAP, 673
    - CSMA/CA, 296–297
    - DCF interframe spacing, 299
    - direct-sequence spread spectrum, 294
    - distributed coordination function, 296, 298–299
    - dwelt time, 294
    - exposed station problem, 296
    - extended interframe spacing, 299
    - fragment burst, 298
    - frame format, 299–300
    - frequency hopping spread spectrum, 294
    - hidden station problem, 296
    - high rate direct-sequence spread spectrum, 295
    - MAC sublayer protocol, 295–299
    - network allocation vector, 297
    - orthogonal frequency division multiplexing, 294–295
    - PCF interframe spacing, 299
    - physical layer, 293–295
    - point coordination function, 296, 298–299
    - protocol stack, 292–293
    - request to send, 297–298
    - security, 781–783
    - short interframe spacing, 299
    - Walsh-Hadamard code, 295
    - wired equivalent privacy, 300
  - IEEE 802.11 services, 301–302
    - association, 301
    - authentication, 302

- IEEE 802.11 services (*continued*)
  - data delivery, 302
  - deauthentication, 302
  - disassociation, 301
  - distribution, 301
  - integration, 301
  - privacy, 302
  - reassociation, 301
- IEEE 802.11a, 294–295
- IEEE 802.11b, 295
- IEEE 802.11g, 295
- IEEE 802.12, 283
- IEEE 802.15 (*see* Bluetooth)
- IEEE 802.16, 135, 302–310
  - best effort service, 308
  - compared to 802.11, 303–304
  - constant bit rate service, 308
  - frame structure, 309–310
  - frequency division duplexing, 307
  - MAC sublayer, 307–309
  - physical layer, 306–307
  - protocol stack, 305–306,
  - real-time variable bit rate service, 308
  - security, 307–308
  - service classes, 308–309
  - time division duplexing, 307
- IEEE 802.1Q, 333–336
- IEEE 802.2, 290–291
- IEEE 802.3u, 284
- IETF (*see* Internet Engineering Task Force)
- If-modified-since header, 659
- IGMP (*see* Internet Group Management Protocol)
- IGP (*see* Interior Gateway Protocol)
- IKE (*see* Internet Key Exchange)
- ILEC (*see* Incumbent LEC)
- IMAP (*see* Internet Message Access Protocol)
- IMP, 52
- Improved mobile telephone system, 153
- IMT (*see* International Mobile Telecommunications)
- IMTS (*see* Improved Mobile Telephone System)
- Incumbent LEC, 134
- Indirect TCP, 553–554
- Industrial, scientific, medical bands, 106, 292–293, 315
- Inetd, 533
- Information frame, 235
- Information-mode, 665–670
- Infrared wave, 106–107
- Initial connection protocol, 495
- Initial state, finite state machine, 230
- Initialization vector, 746
- Instant messaging, 7
- Institute of Electrical and Electronics Engineers, 75
- Integrated services, 409–412
- Integration service, 802.11, 301
- Intellectual property, 826
- InterAS traffic, 459
- Interexchange carrier, 122
- Interface, 27
- Interface message processor, 52
- Interferometer, 97, 266
- Interior gateway protocol, 427, 454
- Interlaced video, 693
- Intermediate system-intermediate system, 365–366
- International data encryption algorithm, 751, 799
- International mobile telecommunications, 166
- International Standard, 75
- International Standards Organization, 74–75
- International Telecommunication Union, 72–74
- Internet, 25, 50–59, 237–242, 431–473, 524–556
  - address, 436–448
  - Internet architecture, 58–59
  - design principles, 431–432
  - history, 50–56
  - introduction, 56–58
  - network layer, 431–473
- Internet Activities Board, 75
- Internet Architecture Board, 75
- Internet control message protocol, 449–450
- Internet control protocols, 449–454
- Internet Corp. for Assigned Names and Numbers, 437
- Internet daemon, 533
- Internet Engineering Task Force, 76
- Internet file server, example, 488–492
- Internet group management protocol, 462, 713
- Internet key exchange, 773
- Internet layer, 42
- Internet message access protocol, 608–609
  - compared to POP3, 609
- Internet multicasting, 461–462
- Internet over cable, 170–176
  - compared to ADSL, 175–176
- Internet protocol (IP), 432–444, 464–473 (*see also* IPv4 and IPv6)
- Internet protocols (*see under* Protocol)
- Internet radio, 683–685
- Internet Research Task Force, 76
- Internet security association and key management protocol, 773
- Internet service provider, 57
- Internet Society, 77
- Internet telephony, 685–692, (*see also* Voice over IP)
- Internetwork, 25–26
- Internetworking, 418–431
  - connectionless, 423–425
  - fragmentation, 427–431
  - local, 322–323
  - routing, 426–427
  - tunneling, 425–426
  - virtual circuits, 422–423

Interoffice trunk, 120  
 Intertoll trunk, 120  
 Interworking among networks, 418–431  
 Intranet, 59  
 Intruder, 725  
 IP, 432–444, 464–473, (*see also* IPv4 and IPv6)  
 IP security, 772–776  
   authentication header, 774–775  
   encapsulating security payload, 775–776  
   transport mode, 773  
   tunnel mode, 773  
 IPsec (*see* IP security)  
 IPv4, 432–444  
 IPv4 address, 436–448  
   class A, B, C, D, 437  
   classful, 437  
   classless, 441–444  
   header, 433–436  
   options, 436  
   subnet mask, 439–441  
 IPv5, 433  
 IPv6, 464–473  
   controversies, 471–473  
   extension headers, 469–471  
   main header, 466–469  
 Iridium, 114–116  
 IRTF (*see* Internet Research Task Force)  
 IS (*see* International Standard)  
 IS-IS (*see* Intermediate System-Intermediate System)  
 ISAKMP (*see* Internet Security Association and Key Management Protocol)  
 ISM (*see* Industrial, Scientific, Medical bands)  
 ISO, 74  
 ISO OSI Reference Model, 37  
 ISP (*see* Internet Service Provider)  
 ITU (*see* International Telecommunication Union)  
 IV (*see* Initialization Vector)  
 IXC (*see* IntereXchange Carrier)

## J

Jacobson's slow-start algorithm, 549–550  
 Japanese Telephone and Telegraph Company, 665–670  
 Java applet security, 817  
 Java virtual machine, 650, 817  
 JavaScript, 647–651  
 JavaScript security, 818  
 JavaServer page, 646  
 Jitter, 395–396  
 Joint photographic experts group, 697  
 JPEG (*see* Joint Photographic Experts Group)

JPEG compression, 697–700  
   block preparation, 697  
   DCT, 698  
   quantization, 698–699  
   run-length encoding, 699  
 JSP (*see* JavaServer Page)  
 Jumbogram, 470, 472  
 JVM (*see* Java Virtual Machine)

## K

Karn's algorithm, 552  
 KDC (*see* Key Distribution Center)  
 Keepalive timer, 552  
 Kerberos, 796–798  
 Kerckhoff's principle, 726  
 Key,  
   chord, 381  
   cryptographic, 725  
 Key distribution center, 785  
 Key escrow, 820  
 Keying, 126  
 Keystream, 748  
 Keystream reuse attack, 749  
 Known plaintext attack, 727  
 Knudsen, Lars, 742

## L

Label switching, 415–417  
 Lamarr, Hedy, 102  
 LAN (*see* Local Area Network)  
 LAP (*see* Link Access Procedure)  
 LAPB (*see* Link Access Procedure B)  
 Last modified header, 658–659  
 LATA (*see* Local Access and Transport Area)  
 Layer, 26  
   application, 41, 579–720  
   data link, 38, 183–246  
   design issues, 30–31  
   network, 39, 343–480  
   physical, 38, 85–182  
   presentation, 41  
   session, 40  
   transport, 481–578  
 LCP (*see* Link Control Protocol)  
 LDAP (*see* Lightweight Directory Access Protocol)  
 Leaky bucket algorithm, 400–403  
 Leasing, 454  
 LEC (*see* Local Exchange Carrier)  
 LEO (*see* Low Earth Orbit satellite)

- Level, 26
  - Lightwave transmission, 107–108
  - Lightweight directory access protocol, 588
  - Lightweight transport protocol, 667
  - Limited-contention protocol, 261–265
  - Linear cryptanalysis, 751
  - Link, Bluetooth, 315
  - Link access procedure, 234
  - Link access procedure B, 234–235
  - Link control protocol, 239–242
  - Link encryption, 723
  - Link level control, 239
  - Link state routing algorithm, 360–366
  - Little endian computer, 433
  - LLC (*see* Logical Link Control)
  - LMDS (*see* Local Multipoint Distribution Service)
  - Load shedding, 394
  - Local access and transport area, 122
  - Local area network, 16–17, 317–323
  - Local central office, 120
  - Local exchange carrier, 122
  - Local loop, 120, 124
  - Local multipoint distribution service, 135
  - Logical link control, 290–291
  - Lossless encoding, video, 696
  - Lossy encoding, video, 696
  - Low earth orbit satellite, 114–116
  - Low-water mark, 682
  - LTP (*see* Lightweight Transport Protocol)
  - Luminance, 694
- M**
- M-commerce, 11
  - MAC sublayer, 247–342
    - Bluetooth, 310–317
    - sublayer, channel allocation, 248–251
    - data link layer switching, 317–336
    - dynamic channel allocation, 249–251
    - Ethernet, 271–292
    - multiple access protocols, 251–270
    - static channel allocation, 248–249
    - wireless LANs, 292–302
  - MACA (*see* Multiple Access with Collision Avoidance)
  - MACA for wireless, 270–271
  - MACAW (*see* MACA for Wireless)
  - Macroblock, 702
  - MAHO (*see* Mobile Assisted HandOff)
  - Mailbox, e-mail, 591
  - Mailing list, 591
  - MAN (*see* Metropolitan Area Network)
  - Man-in-the-middle attack, 792
  - Manchester encoding, 274–275
  - MANET (*see* Mobile Ad hoc NETWORK)
  - Marconi, Guglielmo, 21
  - Markup language, 629
  - MARS, 742
  - Marshaling, parameter, 527–529
  - Mask, perceptual, 677
  - Mastergroup, 138
  - Matsunaga, Mari, 665
  - Maximum data rate of a channel,
    - Nyquist limit, 89
    - Shannon limit, 89–90
  - Maximum transmission unit, 535
  - Maxwell, James Clerk, 66
  - MBone, 711–714
  - MD5, 760
  - Measuring network performance, 560–562
  - Media player, 680–683
  - Media server, 681–683
  - Medium access control sublayer, 247–342 (*see also* MAC sublayer)
  - Medium earth orbit satellite, 113–114
  - MEO (*see* Medium Earth Orbit satellite)
  - Merkle, Ralph, 755
  - Message digest, 759–762
    - MD5, 760
    - SHA-1, 761–762
  - Message switching, 148–149
  - Message transfer agent, 590
  - Metafile, 680
  - Metcalfe, Bob, 23, 66
  - Method, 652
  - Metric units, 77–78
  - Metropolitan area network, 18
    - wireless (*see* IEEE 802.16)
  - MFJ (*see* Modified Final Judgment)
  - Michelson-Morley experiment, 66
  - Microcell, 154
  - Middleware, 2
  - Milk policy, 394
  - Millimeter wave, 106–107
  - MIME (*see* Multipurpose Internet Mail Extensions)
  - MIME type, 598–602, 617–618
  - Minislot, 174
  - Mirrored server, 659–660
  - MMDS (*see* Multichannel Multipoint Distribution Service)
  - Mobile ad hoc network, 375
  - Mobile assisted handoff, 159
  - Mobile code, 817
  - Mobile code security, 816–819
  - Mobile host, 372
  - Mobile host routing algorithm, 372–375
  - Mobile IP, 462–464
  - Mobile phone, 152

- Mobile phone system, 152–169
    - first generation, 153–157
    - second generation, 157–166
    - third generation, 166–169
  - Mobile switching center, 155
  - Mobile telephone switching office, 155
  - Mobile user, 9–12, 372
  - Mobile wireless, 10
  - Mobile-commerce, 11
  - Mockapetris, Paul, 47
  - Modem, 125–130
  - Modified final judgment, 122
  - Modulation, 142
    - amplitude, 126
    - delta, 143
    - frequency, 126
    - phase, 126
    - QAM, 127
    - quadrature, 127
    - trellis-coded, 128
  - Monoalphabetic substitution cipher, 728
  - Mosaic, 611
  - MOSPF (*see* Multicast Open Shortest Path First routing)
  - Motion picture experts group, 700
  - MP3, 676–679
  - MPEG (*see* Motion Picture Experts Group)
  - MPEG compression, 700–704
    - audio-video synchronization, 701
    - frame types, 701–702
    - MPEG-1, 700–703
    - MPEG-2, 700, 703–704
  - MPEG layer 3 audio, 676–679
  - MPLS (*see* MultiProtocol Label Switching)
  - Mrouter, 711
  - MSC (*see* Mobile Switching Center)
  - MTSO (*see* Mobile Telephone Switching Office)
  - MTU (*see* Maximum Transmission Unit)
  - Multiaccess channel, 247
  - Multiaccess network, 455
  - Multicast, 276
  - Multicast backbone, 711–714
  - Multicast protocol,
    - DVMRP, 712
    - MOSPF, 714
    - PIM, 714
    - PIM-DM, 714
    - PIM-SM, 714
  - Multicast open shortest path first routing, 714
  - Multicast router, 711–712
  - Multicast routing, 370
  - Multicasting, 15, 370
    - Internet, 461–462, 712–714
  - Multichannel multipoint distribution service, 135
  - Multiconnected network, 460
  - Multidestination routing, 368
  - Multidrop cable, 66
  - Multimedia, 674–714
    - audio compression, 676–679
    - audio, 674–692, (*see also* Audio)
    - digital audio, 674–676
    - Internet radio, 683–685
    - Internet telephony, 685–692
    - introduction to video, 692–696
    - MBone, 711–714
    - media player, 680–683
    - media server, 681–683
    - MP3, 676–679
    - RTSP, 680–683
    - streaming audio, 679–683
    - video compression, 696–704
    - video on demand, 704–711
    - voice over IP, 685–692, (*see also* Voice over IP)
  - Multimode fiber, 94
  - Multipath fading, 69, 104
  - Multiple access protocols, 251–270
  - Multiple access with collision avoidance protocol, 269–270
  - Multiplexing, 31, 510–511
    - downward, 511
    - upward, 510
  - MultiProtocol label switching, 415–417
  - Multiprotocol router, 421
  - Multipurpose Internet mail extensions, 596–602
- ## N
- Nagle's algorithm, 545–547
  - Name server, 495
    - DNS, 586–588
  - NAP (*see* Network Access Point)
  - NAT (*see* Network Address Translation)
  - National Institute of Standards and Technology, 75, 741
  - National Security Agency, 740
  - National television standards committee, 694
  - NAV (*see* Network Allocation Vector)
  - Navajo code talkers, 724
  - NCP (*see* Network Control Protocol)
  - Near video on demand, 704
  - Needham-Schroeder authentication, 794–795
  - Negotiation, 32
  - Neighbor discovery, 361
  - Network (*see* Computer network)
  - Network access point, 56
  - Network address translation, 444–448
  - Network allocation vector, 297
  - Network control protocol, 239, 242

Network hardware, 14–26  
 Network interconnection, 420–422  
 Network interface device, 133  
 Network layer, 39, 343–480  
   design issues, 343–350  
   Internet, 431–473  
   internetworking, 418–431  
   congestion control, 384–396  
   routing algorithms, 350–384  
   quality of service, 397–417  
 Network news transfer protocol, 624  
 Network security, 721–834  
 Network service access point, 494  
 Networked multimedia, 674–714  
 News, 57  
 NID (*see* Network Interface Device)  
 NIST (*see* National Institute of Standards and Technology)  
 NNTP (*see* Network News Transfer Protocol)  
 Node identifier, 381  
 Noise, 125  
 Non-real-time variable bit rate service, 308  
 Nonadaptive algorithm, 351  
 Nonce, 786  
 Nonpersistent cookie, Web, 626  
 Nonrepudiation, 756  
 NSA (*see* National Security Agency)  
 NSAP (*see* Network Service Access Point)  
 NSFNET, 55  
 NTSC (*see* National Television Standards Committee)  
 NTT DoCoMo, 665–670  
 Nyquist, Henry, 89

**O**

OFDM (*see* Orthogonal Frequency Division Multiplexing)  
 Olsen, Ken, 6  
 One-time pad, 730–734  
 ONU (*see* Optical Network Unit)  
 Open shortest path first protocol, 454–459  
 Optical fibers, 93–99  
 Optical network unit, 709  
 Optimality principle, 352–353  
 Orthogonal chip sequence, 164  
 Orthogonal frequency division multiplexing, 294  
 Oryctolagus cuniculus, 28  
 OSI reference model, 37–41  
   compared to TCP/IP, 44–46  
   critique, 46–48  
 OSPF (*see* Open Shortest Path First protocol)  
 Otway-Rees authentication protocol, 795–796

**P**

P-box, 737  
 P-frame, MPEG, 701–702  
 Packet, 15  
 Packet filter, 777  
 Packet scheduling, 408–409  
 Packet switching, 150–151, 344  
 Packet-switched subnet, 20  
 Page, Web (*see under* Web)  
 Paging channel, 161  
 PAL (*see* Phase Alternating Line)  
 PAR (*see* Positive Acknowledgement with Retransmission)  
 Parity bit, 194  
 Passive star, 98  
 Passkey, 784  
 PCF (*see* Point Coordination Function)  
 PCF interframe spacing, 299  
 PCM (*see* Pulse Code Modulation)  
 PCS (*see* Personal Communications Services)  
 Peer, 27  
 Peer-to-peer, 7–9  
 PEM (*see* Privacy Enhanced Mail)  
 Perceptual coding, 677  
 Performance issues, 557–573  
 Perl script, 644  
 Perlman, Radia, 324  
 Permanent virtual circuit, 62  
 Persistence timer, 552  
 Persistent connection, 652  
 Persistent cookie, Web, 626  
 Personal area network, 15  
 Personal communications services, 157  
 Petri net, 232  
 PGP (*see* Pretty Good Privacy)  
 Phase alternating line, 694  
 Phase modulation, 126  
 Photon, 732  
 PHP (*see* PHP Hypertext Preprocessor)  
 PHP hypertext preprocessor, 645–646  
 Physical layer, 38, 85–182  
   IEEE 802.11, 293–295  
   IEEE 802.16, 306–307  
   Internet over cable, 169–176  
   mobile telephone system, 152–169  
   satellite transmission, 109–118  
   telephone system, 118–151  
   wired media, 90–99  
   wireless transmission, 100–108  
 Physical medium, 27  
 Piconet, 311  
 PIFS (*see* PCF InterFrame Spacing)  
 Piggybacking, 212  
 PIM (*see* Protocol Independent Multicast)

- Pipelining, 217
- Pixel, 695
- PKI (*see* Public Key Infrastructure)
- Place, Petri net, 232
- Plain old telephone service, 132
- Plaintext, 725
- Plug-in, 616
- Point coordination function, 296, 298–299
- Point of Presence, 58, 122
- Point-to-point network, 15
- Point-to-point protocol, 238–242
- Poisoned cache, 807
- Polynomial code, 196
- POP (*see* Point of Presence)
- POP3 (*see* Post Office Protocol 3)
- Port, 494, 533
- Portal, 70
- Positive acknowledgement with retransmission, 209
- Post, Telegraph & Telephone Administration, 72
- Post office protocol 3, 605–608
  - compared to IMAP, 609
- POTS (*see* Plain Old Telephone Service)
- PPP (*see* Point-to-Point Protocol)
- Predictive encoding, 143
- Premaster key, 814
- Presentation layer, 41
- Pretty good privacy, 799–804
  - IDEA, 799
  - keys, 802
  - message format, 802
  - operation, 801
- Primitive, 34
- Principal, 731
- Privacy, 302, 819920
- Privacy amplification, 734
- Privacy enhanced mail, 803–804
- Private key, 753
- Private key ring, 803
- Private network, 779
- Private peering, 59
- Process server, 495
- Product cipher, 738
- Profile, Bluetooth, 312–313
- Progressive video, 693
- Promiscuous mode, 319
- Proportional routing algorithm, 408
- Proposed standard, 77
- Protocol, 27
  - AODV, 375
  - ARP, 450–452
  - ARQ, 209–211
  - BGP, 459–461
  - BOOTP, 453
  - CSMA, 255–255
  - CSMA/CA, 296–297
- Protocol (*continued*)
  - CSMA/CD, 257–258
  - DHCP, 453–454
  - DVMRP, 712–713
  - Ethernet, 275–279
  - FTP, 448
  - H.323, 683–689
  - HDLC, 234–237
  - HTTP, 41, 623, 651–656
  - ICMP, 449–450
  - IGMP, 462
  - IKE, 773
  - IMAP, 608–609
  - IPv4, 433–444
  - IPv6, 464–473
  - IS-IS, 365–366
  - ISAKMP, 773
  - LAP, 234
  - LAPB, 234–245
  - LCP, 239–242
  - LDAP, 588
  - LTP, 667
  - MOSPF, 714
  - MACA, 269–270
  - MACAW, 269–270
  - NCP, 239, 242
  - NNTP, 624
  - OSPF, 454–459
  - PAR, 209–211
  - PIM, 714
  - POP3, 605–608
  - PPP, 238–242
    - reverse ARP, 453
  - RSVP, 410–412
  - RTCP, 531–532
  - RTP, 529–532
  - RTSP, 680–683
  - SCTP, 556
  - SDLC, 234
  - SIPP, 465
  - SMTP, 602–605
  - SOAP, 642
  - TCP, 532–566
  - UDP, 524–532
  - WAP, 663–665, 670–673
  - WDMA, 265–267
  - WDP, 664
- Protocol 1 (utopia), 204–206
- Protocol 2 (stop-and-wait), 206–211
- Protocol 3 (PAR), 208–211
- Protocol 4 (sliding window), 211–216
- Protocol 5 (go back n), 216–223
- Protocol 6 (selective repeat), 223–22
- Protocol correctness, 229–234
- Protocol hierarchy, 26–30

Protocol independent multicast, 714  
 Protocol machine, 229  
 Protocol stack, 28  
   802.11, 292–293  
   Bluetooth, 313–314  
   H.323, 687  
   i-mode, 668  
   IEEE 802.16, 305–306  
   OSI, 39  
   TCP/IP, 43  
   WAP 1.0, 664  
   WAP 2.0, 672  
 Protocol verification, 229–234  
 Proxy, Web, 657–659  
 Proxy ARP, 452  
 PSTN (*see* Public Switched Telephone Network)  
 Psychoacoustics, 677  
 PTT (*see* Post, Telegraph & Telephone administration)  
 Public key, 753  
 Public key infrastructure, 768–770  
 Public key ring, 803  
 Public switched telephone network, 118–151  
 Public-key certificate, 765–771  
 Public-key cryptography, 752–755  
   El Gamal algorithm, 755  
   elliptic curve algorithms, 755  
   RSA algorithm, 753–755  
 Pull server, multimedia, 681  
 Pulse code modulation, 140  
 Pure ALOHA, 251–254  
 Push server, multimedia, 682  
 Push-to-talk system, 153

## Q

Q.931, 687  
 Q.931 telephony protocol, 687  
 QAM (*see* Quadrature Amplitude Modulation)  
 QoS (*see* Quality of Service)  
 QPSK (*see* Quadrature Phase Shift Keying)  
 Quadrature amplitude modulation, 127, 710  
 Quadrature phase shift keying, 127, 306  
 Quality of service, 32  
   admission control, 406–408  
   assured forwarding, 414–415  
   buffering, 399  
   class-based service, 412–415  
   differentiated services, 412–415  
   expedited forwarding, 413–414  
   fair queueing, 408–409  
   flow specification, 407  
   flow-based algorithms, 409–412

Quality of service (*continued*)  
   integrated services, 409–412  
   label switching, 415–417  
   leaky bucket algorithm, 400–403  
   MPLS, 415–417  
   network layer, 397–417  
   packet scheduling, 408–409  
   proportional routing, 408  
   requirements, 397–398  
   resource reservation, 405–406  
   RSVP, 410–412,  
   techniques for achieving, 398–409  
   token bucket algorithm, 402–405  
   traffic shaping, 399–400  
 Quantization, JPEG, 698  
 Quantization noise, 675  
 Quantum cryptography, 731–734  
 Qubit, 733  
 Quoted-printable encoding, 598

## R

Radio transmission, 103–104  
 RAID (*see* Redundant Array of Inexpensive Disks)  
 Random access channel, 162, 247  
 Random early detection, 395  
 Ranging, cable TV, 174  
 RARP (*see* Reverse ARP)  
 RAS (*see* Registration/Admission/Status channel)  
 Rate-based flow control, 192  
 RC4, 751, 781, 815  
 RC5, 751  
 RC6, 742  
 Reachability analysis, 230  
 Real-time streaming protocol, 680–683  
 Real-time control protocol, 531–532  
 Real-time protocol, 529–532  
 Real-time transport control protocol, 531–532, 687  
 Real-time transport protocol, 529–532, 680–683  
 Real-time variable bit rate service, IEEE 802.16, 308  
 Realm, Kerberos, 797  
 Reassociation service, 802.11, 301  
 Receiving window, 212  
 Rectilinear basis, 732  
 Recursive query, 588  
 RED (*see* Random Early Detection)  
 Redundant array of inexpensive disks, 708  
 Reference model, 37–49  
   comparison, 44–46  
   OSI, 37–41  
   TCP/IP, 41–44  
 Reflection attack, 787–790  
 Region, 366

- Regional authority, 769
- Registration/admission/status channel, 687
- Remote bridge, 325–326
- Remote login, 57
- Remote procedure call, 526–529
  - client stub, 527–529
  - marshaling, 527–529
  - server stub, 527–529
- Repeater, 274, 326–327
- Replay attack, 794
- Report generation, e-mail, 590
- Request for comments, 76
- Request header, 654
- Request to send, 269
- Request-reply service, 33
- Reservation protocol, 260
- Resolver, 580
- Resource record, DNS, 582–586
- Resource record set, 809
- Resource reservation, 405–406
- Resource reservation protocol, 410–412
- Resource sharing, 3
- Response header, 654
- Retransmission timer, 550
- Reverse ARP, 453
- Reverse lookup, 584
- Reverse path forwarding algorithm, 369–370
- Revocation, certificate, 771
- RFC (*see also* Request For Comments)
  - RFC 768, 525
  - RFC 793, 532
  - RFC 821, 589, 594
  - RFC 822, 421, 589, 589, 590, 590, 594, 594, 595, 596, 597, 599, 651, 716, 801, 804, 821
  - RFC 903, 453
  - RFC 951, 453
  - RFC 1034, 580
  - RFC 1048, 453
  - RFC 1058, 360
  - RFC 1084, 453
  - RFC 1106, 539
  - RFC 1112, 462
  - RFC 1122, 532
  - RFC 1323, 532, 539, 570
  - RFC 1379, 556
  - RFC 1424, 803
  - RFC 1519, 442
  - RFC 1550, 465
  - RFC 1644, 556
  - RFC 1661, 238, 241
  - RFC 1662, 239
  - RFC 1663, 239, 240
  - RFC 1700, 435
  - RFC 1771, 461
  - RFC 1889, 529
- RFC (*continued*)
  - RFC 1939, 605
  - RFC 1958, 431
  - RFC 2045, 597, 599
  - RFC 2060, 608, 609
  - RFC 2109, 626
  - RFC 2131, 453
  - RFC 2132, 453
  - RFC 2141, 625
  - RFC 2205, 409, 410
  - RFC 2210, 407
  - RFC 2211, 407
  - RFC 2246, 816
  - RFC 2251, 588
  - RFC 2326, 682, 680
  - RFC 2328, 455
  - RFC 2362, 714
  - RFC 2401, 772
  - RFC 2410, 772
  - RFC 2440, 800
  - RFC 2459, 767
  - RFC 2460, 466
  - RFC 2535, 809, 811
  - RFC 2597, 414, 415
  - RFC 2616, 651, 654, 659
  - RFC 2617, 785
  - RFC 2632, 804
  - RFC 2806, 669
  - RFC 2821, 605, 715
  - RFC 2822, 594
  - RFC 2993, 448
  - RFC 3003, 600
  - RFC 3022, 445
  - RFC 3023, 599
  - RFC 3119, 681
  - RFC 3168, 549
  - RFC 3174, 762
  - RFC 3194, 469
  - RFC 3246, 413
  - RFC 3261, 689
  - RFC 3280, 767
- Rijmen, Vincent, 742
- Rijndael, 743–745, 751
- Rivest, Ronald, 302, 751, 754, 755, 781
- Roberts, Larry, 51
- Round, 738
- Route discovery, ad hoc networks, 376–379
- Route maintenance, ad hoc networks, 380–384
- Router, 19, 326, 328
- Routing, 31
  - internetwork, 426–427
- Routing algorithm, 20, 347, 350–384
  - ad hoc network, 375–380
  - adaptive, 351–352
  - ARPANET, 357, 454

- Routing algorithm (*continued*)
    - Bellman-Ford, 357–360, 454
    - distance vector, 357–360
    - flooding, 355–357
    - Ford-Fulkerson, 357–360
    - hierarchical, 366–368
    - IS-IS, 365–366
    - link state, 360–366
    - mobile host, 372–375
    - multicast, 370–372
    - nonadaptive, 351
    - optimal, 352–353
    - OSPF, 454–459
    - proportional, 408
    - reverse path forwarding, 369–370
    - shortest path, 353–356
  - RPC (*see* Remote Procedure Call)
  - RRSets (*see* Resource Record Set)
  - RSA algorithm, 753–755
  - RSVP (*see* Resource reSerVation Protocol)
  - RTCP (*see* Real-time Transport Control Protocol)
  - RTP (*see* Real-time Transport Protocol)
  - RTS (*see* Request to Send)
  - RTSP (*see* Real-Time Streaming Protocol)
  - Run-length encoding, 699
- S**
- S-box, 737
  - S/MIME, 804
  - SA (*see* Security Association)
  - SAFER+, 784
  - Sandbox, 817
  - Satellite (*see* Communication satellite)
  - Scatternet, 311
  - Scheme, World Wide Web, 623–625
    - ftp, 624
    - gopher, 624–625
    - http, 623–624
    - mailto, 624–625
    - news, 624
    - rtsp, 684
    - telnet, 624–625
    - URL, 623
  - Schneier, Bruce, 742
  - SCO (*see* Synchronous Connection Oriented)
  - SDTP (*see* Stream Control Transmission Protocol)
  - SDH (*see* Synchronous Digital Hierarchy)
  - SDLC (*see* Synchronous Data Link Control)
  - SECAM (*see* Système Electronique Colour Avec Mémoire)
  - Second generation mobile phone system, 157–166
  - Secret key, 753
  - Secure DNS, 809–811
  - Secure file system, 811
  - Secure hash algorithm, 381, 761–762
  - Secure HTTP, 813
  - Secure naming, 806–813
  - Secure sockets layer, 813–816
  - Security, 721–834
    - ActiveX, 817–818
    - authentication protocols, 785–799
    - certificates, 765–771
    - communication, 772–785
    - cryptography, 724–736
    - digital signatures, 755–765
    - DNS, 806–811
    - e-mail, 799–804
    - firewall, 776–779
    - IPsec, 772–776
    - Java applet, 817
    - JavaScript, 818
    - management of public keys, 765–772
    - mobile code, 816–819
    - PGP, 799–803
    - PKI, 769
    - public-key algorithms, 752–755
    - social issues, 819–828
    - SSL, 813–816
    - symmetric-key algorithms, 737–751
    - VPN, 779–780
    - Web, 805–819
    - wireless, 780–785
  - Security association, 773
  - Security attack,
    - birthday, 763–765, 782
    - bucket brigade, 792
    - chosen plaintext, 727
    - ciphertext-only, 727
    - DDoS, 778
    - DoS, 778
    - keystream reuse, 749
    - known plaintext, 727
    - man-in-the-middle, 792
    - reflection, 787–790
    - replay, 794
    - power consumption, 751
    - timing, 751
  - Security by obscurity, 726
  - Segment, UDP, 525
  - Segmentation and reassembly, 65
  - Selective flooding, 355
  - Selective repeat protocol, 223–228
  - Self-certifying URL, 811–813
  - Sending window, 212
  - Serpent, 742, 751
  - Server, 4
  - Server farm, 621–622

- Server replication, Web, 659–660
- Server stub, 527–529
- Server-side dynamic Web pages, 643–647
- Service,
  - connection-oriented, 32–33, 347–348
  - connectionless, 32–33, 345–347
  - relation to protocol, 36–37
- Service classes, IEEE 802.16, 308–309
- Service level agreement, 400
- Service primitive, 34–36
- Services,
  - data link layer, 184–192
  - network, 344–345
  - transport, 481–482
- Session, 40
- Session initiation protocol, 689–692, (*see also* Voice over IP)
- Session key, 787
- Session routing, 350
- Set-top box, 705
- SHA-1 (*see* Secure Hash Algorithm)
- Shannon, Claude, 89, 90
- Short interframe spacing, 299
- Short message service, 666
- Shortest path, 353
- Shortest path routing, 353–356
- SIFS (*see* Short InterFrame Spacing)
- Signal-to-noise ratio, 89
- Silly window syndrome, 545–547
- Simple Internet protocol plus, 465
- Simple mail transfer protocol, 602–605
- Simple object access protocol, 642
- Simplex line, 129
- Sine wave carrier, 126
- Single-mode fiber, 94
- Sink tree, 352
- SIP (*see* Session Initiation Protocol) (*see also* Voice over IP)
- SIPP (*see* Simple Internet Protocol Plus)
- Skin, media player, 680
- Sliding window protocol, 211–228
  - 1-bit 211–214
  - go back n, 216–223
  - selective repeat, 223–228
- Slotted ALOHA, 254–255
- Slotted time assumption, 250
- Slow start, TCP, 549–550
- Smiley, 588–589
- SMTP (*see* Simple Mail Transfer Protocol)
- Snail mail, 588
- SOAP (*see* Simple Object Access Protocol)
- Social issues, 12–14, 819–828
- Socket, 487–492
- Socket programming, 488–492
- Soliton, 96
- SONET (*see* Synchronous Optical Network)
- Source port, 447
- Spanning tree, 368
- Spanning tree bridge, 323–325
- SPE (*see* Synchronous Payload Envelope)
- Speech, human, 676
- Speed of light, 100
- Spot beam, 112
- Spread spectrum,
  - 802.11, 294–295
  - direct sequence, 102, 294
  - frequency hopping, 102, 294
  - history, 102
- SSL (*see* Secure Sockets Layer)
- Stale Web page, 658
- Standard,
  - de facto, 71
  - de jure, 71
- Standardization, 71–77
- Static channel allocation, 248–249
- Static routing, 351
- Static Web documents, 623–643
- Station, 249
- Station keeping, 111
- Station model, 249
- Steganography, 824–825
- Stop-and-wait protocol, 206–211
- Store and forward packet switching, 20, 344
- Store-and-forward switching, 149
- Stream cipher mode, 748–749
- Stream control transmission protocol, 556
- Streaming audio, 679–683
  - media player, 680–683
  - metafile, 680
  - MIME type, 679–680
  - pull server, 681–682
  - push server, 682
- Streaming media, 674
- Striping, 708
- STS (*see* Synchronous Transport Signal)
- Stub network, 460
- Style sheet, HTML, 634
- Subnet, 19, 439
  - communication, 344
  - comparison of datagram and virtual circuit, 348–350
  - datagram, 345–347
  - virtual-circuit, 347–348
- Subnet mask, 439
- Substitution cipher, 727–729
- Supergroup, 138
- Supervisory frame, 235
- Switch, 326–328
  - cut-through, 328
  - Ethernet, 281

- Switched Ethernet, 281–283, 328–336
  - Switched fast Ethernet, 286
  - Switching element, 19
  - Symbol, 127
  - Symmetric-key cryptography, 737–751
    - AES, 741–745
    - cipher modes, 745–751
    - DES, 738–741
    - Rijndael, 743–745
  - Synchronization, 41
  - Synchronous connection oriented-channel,
    - Bluetooth, 316
  - Synchronous connection-oriented link, Bluetooth, 316
  - Synchronous data link control, 234
  - Synchronous digital hierarchy, 144
  - Synchronous optical network, 144–146
  - Synchronous payload envelope, 145
  - Synchronous transport signal, 145
  - System design for performance, 566–569
  - Système Electronique Colour Avec Mémoire, 694
- T**
- T1 carrier, 140–143, 709
  - T2–T4 carriers, 143
  - Table, HTML, 633–634
  - Tag, HTML, 630
  - Tag switching, 415
  - Tandem office, 120
  - Tariff, 72
  - TCM (*see* Trellis Coded Modulation)
  - TCP (Transmission Control Protocol), 532–556
    - congestion control, 547–548
    - connection establishment, 539–540
    - connection management modeling, 541–543
    - connection release, 541
    - finite state machine, 541–543
    - handoff, 622
    - header, 535–539
    - indirect, 553–554
    - Internet radio, 684–685
    - Jacobson's algorithm, 549–550
    - Karn's algorithm, 552
    - Nagle's algorithm, 545–547
    - segment, 535–539
    - service model, 533–535
    - silly window syndrome, 545–547
    - timer management, 550–553
    - transactional, 555–556
    - transmission policy, 543–547
    - urgent data, 535
    - wireless, 553–555
  - TCP/IP reference model, 41–44
    - compared to OSI, 44–46
    - critique, 48–49
  - TCPA (*see* Trusted Computing Platform Alliance)
  - TDD (*see* Time Division Duplexing)
  - TDM (*see* Time Division Multiplexing)
  - Teledesic, 116
  - Telephone system, 118–151
    - frequency division multiplexing, 137–138
    - local loop, 124–137
    - mobile, 152–169
    - politics, 122–123
    - structure, 119–121
    - time division multiplexing, 140–143
    - trunk, 137–143
    - wavelength division multiplexing, 138–140
  - Telephony over the Internet (*see* Voice over IP)
  - Temporal masking, 677
  - Terminal, 249, 686
  - Third generation mobile phone system, 166–169
  - Three bears problem, 441
  - Three-way handshake, 499–502, 539–540
  - Time division duplexing, 307
  - Time division multiplexing, 137, 140–143
  - Time domain reflectometry, 272
  - Timer management, TCP, 550–553
  - Timing wheel, 569
  - TLS (*see* Transport Layer Security)
  - Token, 67
    - Petri net, 232
  - Token bucket algorithm, 402–405
  - Token management, 40
  - Toll connecting trunk, 120
  - Toll office, 120
  - Top-level domain, 580
  - Torn tape office, 149
  - TPDU (*see* Transport Protocol Data Unit)
  - Traffic analysis, 774
  - Traffic policing, 400
  - Traffic shaping, 399–400
  - Trailer, data link, 184, 200
  - Transactional TCP, 555–556
  - Transceiver, 272
  - Transceiver cable, 272
  - Transfer agent, e-mail, 590
  - Transit network, 460
  - Transition, 232
    - finite state machine, 229
  - Transmission control protocol, 42, 532–556,
    - (*see also* TCP)
  - Transmission convergence sublayer, 64
  - Transmission line, 19
  - Transponder, satellite, 109
  - Transport addressing, 493–496
  - Transport entity, 482

- Transport layer, 40, 42, 481–578
    - addressing, 493–496
    - buffering, 506–510
    - connection establishment, 496–502
    - connection release, 502–506
    - crash recovery, 511–513
    - design issues, 492–513
    - example protocol, 513–524
    - flow control, 506–510
    - Internet, 524–556
    - multiplexing, 510–511
    - performance issues, 557–573
    - security, 816
    - service, 481–492
    - TCP, 532–566
    - three-way handshake, 499–502
    - UDP, 524–532
  - Transport mode, IPsec, 773
  - Transport protocol, 492
    - example, 513–524
    - C code, 518–521
    - finite state machine, 522–524
    - primitives, 513–515
    - transport entity, 515–522
  - Transport protocol data unit, 485
  - Transport service, 481–492
    - access point, 494
    - primitives, 483–486
    - provider, 483
    - user, 483
  - Transposition cipher, 729–730
  - Tree-walk protocol, 263–265
  - Trellis-coded modulation, 128
  - Trigram, 728
  - Triple DES, 740–741, 751
  - Trudy, 732
  - Trunk, telephone, 137–143
  - Trust anchor, 770
  - Trusted computing platform alliance, 828
  - TSAP (*see* Transport Service Access Point)
  - Tunnel mode, IPsec, 773
  - Tunneling, 425–427
  - Twisted pair, 91–92
  - Two-army problem, 503–504
  - Twofish, 742, 751
- U**
- UDP (User Datagram Protocol), 43, 524–532
    - header, 526
    - segment, 525–526
    - wireless, 553–555
  - UMTS (*see* Universal Mobile Telecommunications System)
  - Unicasting, 15
  - Uniform resource locator, 614, 622–625
  - Uniform resource name, 625
  - Universal mobile telecommunications system, 167
  - Universal resource name, 625
  - Unnumbered frame, 235
  - Unshielded twisted pair, 91–92
    - category 3, 91
    - category 5, 92
  - Upward multiplexing, 510
  - Urgent data, 535
  - URL (*see* Uniform Resource Locator)
  - URN (*see* Uniform Resource Name)
  - User agent, e-mail, 590
  - User datagram protocol, 43, 524–532, (*see also* UDP)
  - User profile, e-mail, 593
  - UTP (*see* Unshielded Twisted Pair)
- V**
- V.32 bis modem, 128
  - V.34 bis modem, 128
  - V.34 modem, 128
  - V.90 modem, 130
  - V.92 modem, 130
  - Vacation daemon, 610
  - Vampire tap, Ethernet, 271
  - VC (*see* Virtual Circuit)
  - Very small aperture terminal, 112
  - Video, 692–711, (*see also* Video compression)
    - chrominance, 694
    - encoding, 696
    - field, 693
    - frame, 693
    - HDTV, 694–695
    - interlaced, 693
    - luminance, 694
    - NTSC, 693, 694
    - PAL, 693, 694
    - progressive, 693
    - scanning parameters, 693, 695
    - SECAM, 693, 694
  - Video compression, 696–704
    - decoding algorithm, 696
    - encoding algorithm, 696
    - JPEG, 697–700
    - lossless, 696
    - lossy, 696
    - MPEG, 700–704

Video on demand, 704–711  
 distribution network, 709–711  
 Video server, 706–709  
 architecture, 707–708  
 Virtual-circuit, 62, 346  
 Virtual-circuit subnet, 346–347  
 compared to datagram, 348–350  
 congestion control, 389–390  
 Virtual circuits, concatenated, 422–423  
 Virtual LAN, 328–336  
 Virtual Private Network, 779–780  
 Virus, 818–819  
 VLAN (*see* Virtual LAN)  
 Vocal tract, 676  
 Vocoder, 158  
 Voice over IP, 685–692  
 comparison between H.323 and SIP, 691–692  
 G.711, 686  
 G.723.1, 687  
 H.245, 687  
 H.323 gatekeeper, 686  
 H.323 protocol stack, 687  
 H.323, 683–689  
 Q.931, 687  
 RAS, 687  
 RTCP, 687  
 RTP, 687  
 setting up a call, 687–689  
 SIP methods, 690  
 SIP protocol, 690  
 SIP telephone numbers, 689  
 SIP, 689–692  
 Voice-grade line, 88  
 VPN (*see* Virtual Private Network)  
 VSAT (*see* Very Small Aperture Terminal)

## W

W3C (*see* World Wide Web Consortium)  
 WAE (*see* Wireless Application Environment)  
 Walsh code, 164  
 Walsh/Hadamard code, 295  
 WAN (*see* Wide Area Network)  
 WAP, 11, 663–665, 670–673, (*see also* WAP 1.0, WAP 2.0)  
 architecture, 665–665  
 bearer layer, 664  
 compared to 802.11, 673  
 compared to i-mode, 671  
 emoji, 672  
 protocol stack, 664, 672

WAP (*continued*)  
 security, 785  
 use of XHTML basic, 673  
 use of XML, 664  
 wireless application environment, 664  
 wireless datagram protocol, 664  
 wireless session protocol, 664  
 wireless transaction protocol, 664  
 wireless transport layer security, 664  
 WAP 1.0, 663–665  
 architecture, 664–665  
 protocol stack, 664  
 WAP 2.0, 670–673  
 compared to WAP 1.0, 671–672  
 competition with 802.11, 673  
 emoji, 672  
 protocol stack, 672  
 XHTML basic, 673  
 Watermarking, 826  
 Watson, Thomas, J., 23  
 Waveform coding, 676  
 Wavelength, 100  
 Wavelength division multiplexing, 138–140  
 Wavelength division multiple access protocol, 265–267  
 WDM (*see* Wavelength Division Multiplexing)  
 WDMA (*see* Wavelength Division Multiple Access)  
 WDP (*see* Wireless Datagram Protocol)  
 Web (World Wide Web), 2, 611–673  
 architectural overview, 612–629  
 client side 614–618  
 content delivery network, 660–662  
 cookie, 625–629  
 flash crowd, 660  
 form, 634–638  
 history, 57–58, 611–612  
 HTML, 615, 629–639  
 HTTP 41, 623, 651–656  
 hyperlink, 612  
 i-mode (*see* i-mode)  
 page, 612  
 performance, 665–662  
 scheme, 623–625  
 wireless, 662–673  
 XML, 639–642  
 XSL, 639–642  
 Web browser, 612, 614–618  
 helper application, 617–618  
 Mosaic, 611  
 plug-in, 616–617  
 Web cache, 657–659  
 stale, 658–659  
 hierarchical, 658–659  
 if-modified-since header, 659  
 last modified header, 658–659

Web document,  
   dynamic, 643–651  
   static, 623–643  
 Web security, 805–819  
   mobile code, 816–819  
   secure naming, 806–813  
   SSL, 813–816  
   threats, 805–806  
 Web server, 618–622  
   mirrored, 659–660  
   replicated, 659–660  
   TCP handoff, 622  
 Web server farm, 621–622  
 Web site, this book's, 79  
 Web URL, 614, 622–625  
 Webmail, 610–611  
 Weighted fair queueing, 409  
 Well-known port, 533  
 WEP (*see* Wired Equivalent Privacy)  
 Whitening, 740  
 Wide area network, 19–21  
 WiFi (*see* IEEE 802.11)  
 Wine policy, 394  
 Wired equivalent privacy, 300, 781–783  
 Wireless application environment, 664  
 Wireless application protocol (*see* WAP)  
 Wireless broadband (*see* IEEE 802.16)  
 Wireless datagram protocol, 664  
 Wireless LAN (*see* IEEE 802.11)  
 Wireless LAN protocol, 265–270  
 Wireless local loop (*see* IEEE 802.16)  
 Wireless MAN (*see* IEEE 802.16)  
 Wireless markup language, 664  
 Wireless network, 21–23  
 Wireless security, 780–785  
   802.11, 781–783  
   Bluetooth, 783–784  
   WAP, 785  
 Wireless Session Protocol, 664  
 Wireless TCP, 553–555  
 Wireless transaction protocol, 664  
 Wireless transmission, 100–108  
 Wireless transport layer security, 664  
 Wireless UDP, 553–555  
 Wireless Web, 662–673  
   second generation, 670–673  
   WAP 1.0, 663–665  
   WAP 2.0, 670–673  
 Wiring closet, 91  
 WLL (Wireless Local Loop) (*see* IEEE 802.16)  
 WML (*see* Wireless Markup Language)  
 Work factor, 727  
 World Wide Wait, 660  
 World Wide Web (*see* Web)  
 World Wide Web Consortium, 612

WSP (*see* Wireless Session Protocol)  
 WTLS (*see* Wireless Transport Layer Security)  
 WTP (*see* Wireless Transaction Protocol)  
 WWW (*see* Web)

## X

X.25, 61  
 X.400, 589–590  
 X.500, 588  
 X.509, 767–768  
 XDSL, 130  
 XHTML (*see* eXtended HyperText Markup Language)  
 XML (*see* eXtensible Markup Language)  
 XSL (*see* eXtensible Style Language)

## Z

Zimmermann, Phil, 799  
 Zipf's law, 706  
 Zone, 686  
   DNS, 586