

Index

Note to the Reader: Throughout this index **boldfaced** page numbers indicate primary discussions of a topic. *Italicized* page numbers indicate illustrations.

A

- AAA (Authentication, Authorization, and Accounting)
 defined, 852
 wireless networks, 721
- AAL (ATM Adaptation Layer), 852
- AAL1 (ATM Adaptation Layer 1), 852
- AAL2 (ATM Adaptation Layer 2), 852
- AAL3/4 (ATM Adaptation Layer 3/4), 852
- AAL5 (ATM Adaptation Layer 5), 852
- AARP (AppleTalk Address Resolution Protocol), 853
- AARP probe packets, 853
- A&B bit signaling, 852
- ABM (Asynchronous Balanced Mode), 853
- ABRs (Area Border Routers)
 defined, 853
 with OSPF, 445, 445
- absolute option with aging, 536
- Abstract Syntax Notation One (ASN.1), 856
- access-class command, 625
- access-enable command, 185
- access layer, 47, 49, 853
- access links
 defined, 853
 VLANs, 560–561, 561
- access-list command, 186, 619–620, 626
- access-list deny command, 619–624, 627
- access-list deny host command, 620
- access-list deny tcp command, 627
- access-list deny tcp any command, 628
- access-list deny tcp any host command, 628–630
- access-list permit command, 625
- access-list permit any command, 622
- access-list permit ip command, 630
- access-list permit ip any any command, 630
- access-list remark command, 638–639
- access lists, 615–618
- authentication proxy, 640
- Context-Based Access Control, 639–640, 639
- defined, 853
- dynamic, 636–637
- exam essentials, 655
- hands-on lab, 656–660, 656
- IP
 extended, 626–632, 657–660, 874
 monitoring, 640–642
 standard, 619–624, 622–624, 657, 903
 for Telnet, 625–626
 wildcards with, 620–622
- IPX
 extended, 874
 standard, 903
- named, 632–634
- reflexive, 637
- remarks, 638–639
- review questions, 661–667
- SDM for
 creating, 643–647, 643–646
 firewalls, 647–654

- security issues mitigated by, 618
 - summary, 654–655
 - switch port, 634–636
 - time-based, 637–638
 - written lab for, 655–656, 667
- access methods, 853
- access ports in VLANs, 559–560
- access-profile command, 185
- access rates, 853
- access servers, 853
- access state, 854
- access-template command, 185
- accounting, 853
- Acknowledgment number field, 76
- acknowledgments
- defined, 853
 - Transport layer, 21, 21
- ACR (Allowed Cell Rate), 853
- active monitors, 853
- active state
- EIGRP, 441
 - LMI, 804
- AD (administrative distances)
- defined, 854
 - EIGRP, 422
 - IP routing, 377–378
 - static routing, 363
- Adaptive Wireless Path Protocol (AWPP), 718
- Add DHCP Pool dialog box, 230, 230
- address masks, 854
- address resolution, 854
- Address Resolution Protocol (ARP)
- defined, 856
 - IP routing process, 332–336, 339–340
 - operation, 46, 90–92, 90
- Address Translation Gateway (ATG), 857
- addresses
- ARP for, 46, 90–92, 90
 - Ethernet networking, 34–35, 34
 - IP. *See* IP addresses
 - IPv6 protocol
 - special, 745
 - structure, 742–743, 743
 - types, 744–745
 - learning
 - defined, 854
 - by layer 2 switching, 499–501, 500–501
 - MAC. *See* MAC (Media Access Control) addresses
 - mapping, 854
 - RARP for, 91, 92
- adjacencies
- defined, 854
 - OSPF, 446, 465–466
- administrative distances (ADs)
- defined, 854
 - EIGRP, 422
 - IP routing, 377–378
 - static routing, 363
- administrative weight, 854
- ADSL (asymmetrical DSL), 782–785, 784
- ADSU (ATM Data Service Unit), 854
- Advanced Firewall Configuration Wizard, 653–654, 653–654
- Advanced NAT configuration, 684
- advertised distances in EIGRP, 420, 441
- advertising, 854
- AEP (AppleTalk Echo Protocol), 854
- AFI (Authority and Format Interface), 854
- AFP (AppleTalk Filing Protocol), 854
- agencies for wireless technologies, 705
- agents in SNMP, 73
- aggregate rates, 33

- aging command, 536
- AH (Authentication Header) for IPSec, 827
- AIP (ATM Interface Processor), 854
- algorithms, 854
- alignment errors, 854
- all 1s broadcasts, 96
- all networks address, 96
- all nodes address, 96
- all-routes explorer packets, 855
- Allowed Cell Rate (ACR), 853
- Alternate Mark Inversion (AMI), 855
- AM (Amplitude Modulation), 855
- American National Standards Institute (ANSI), 855
- American Standard Code for Information Interchange (ASCII), 856
- AMI (Alternate Mark Inversion), 855
- amplitude, 855
- Amplitude Modulation (AM), 855
- analog transmissions, 855
- anonymous FTP users, 71
- ANSI (American National Standards Institute), 855
- ANSI format, 804
- anti-replay service, 827
- any command, 622
- anycasts
 - defined, 855
 - IPv6, 742, 745
- applet blocking, 615
- AppleTalk Address Resolution Protocol (AARP), 853
- AppleTalk Control Program (ATCP), 856
- AppleTalk Echo Protocol (AEP), 854
- AppleTalk Filing Protocol (AFP), 854
- AppleTalk protocols, 855
- AppleTalk Remote Access (ARA), 855
- AppleTalk Session Protocol (ASP), 856
- AppleTalk Transaction Protocol (ATP), 857
- AppleTalk Update-based Routing Protocol (AURP), 857
- Application layer
 - attacks, 612
 - defined, 855
 - tasks, 15–16
- Application-Specific Integrated Circuits (ASICs), 25
 - defined, 856
 - filter tables, 497–498
- ARA (AppleTalk Remote Access), 855
- archive command, 185
- Area Border Routers (ABRs)
 - defined, 853
 - with OSPF, 445, 445
- area IDs, 465
- areas
 - defined, 855
 - OSPF, 447, 450–453, 452
- ARM (Asynchronous Response Mode), 856
- ARP (Address Resolution Protocol)
 - defined, 856
 - IP routing process, 332–336, 339–340
 - operation, 46, 90–92, 90
- arp command, 152
- AS path prepending, 856
- ASBRs (Autonomous System Boundary Routers)
 - defined, 856
 - OSPF, 446
- ASCII (American Standard Code for Information Interchange), 856
- ASICs (Application-Specific Integrated Circuits), 25
 - defined, 856
 - filter tables, 497–498

914 ASN.1 (Abstract Syntax Notation One) – auto-summarization in EIGRP

- ASN.1 (Abstract Syntax Notation One), 856
- ASP (AppleTalk Session Protocol), 856
- ASs (autonomous systems)
 - defined, 856
 - EIGRP, 420, 422–423
 - IGRP, 377
- AST (Automatic Spanning Tree), 856
- asymmetrical DSL (ADSL), 782–785, 784
- Asynchronous Balanced Mode (ABM), 853
- Asynchronous Response Mode (ARM), 856
- Asynchronous Time-Division Multiplexing (ATDM), 856
- Asynchronous Transfer Mode (ATM)
 - for ADSL, 783
 - defined, 857
 - description, 779
 - asynchronous transmissions, 856
- ATCP (AppleTalk Control Program), 856
- ATDM (Asynchronous Time-Division Multiplexing), 856
- ATG (Address Translation Gateway), 857
- ATM (Asynchronous Transfer Mode)
 - for ADSL, 783
 - defined, 857
 - description, 779
- ATM Adaptation Layer (AAL), 852
- ATM Adaptation Layer 1 (AAL1), 852
- ATM Adaptation Layer 2 (AAL2), 852
- ATM Adaptation Layer 3/4 (AAL3/4), 852
- ATM Adaptation Layer 5 (AAL5), 852
- ATM ARP servers, 857
- ATM Data Service Unit (ADSU), 854
- ATM endpoints, 857
- ATM Forum, 857
- ATM Interface Processor (AIP), 854
- ATM layer, 857
- ATM Management (ATMM), 857
- ATM user-user connections, 857
- ATP (AppleTalk Transaction Protocol), 857
- attenuation, 857
- AUIs (Attachment Unit Interfaces), 38
- AURP (AppleTalk Update-based Routing Protocol), 857
- AURP tunnels, 858
- authentication
 - defined, 858
 - ESP for, 827
 - LCP, 789
 - OSPF, 465
 - peer route, 615
 - PPP, 790–794, 813–818, 813–816
 - RIPv1 vs. RIPv2, 391
 - wireless networks, 719–720
- Authentication, Authorization, and Accounting (AAA)
 - defined, 852
 - wireless networks, 721
- Authentication Header (AH) for IPSec, 827
- authentication proxy
 - access lists, 640
 - IOS firewall, 614
- Authentication screen, 815, 815
- Authority and Format Interface (AFI), 854
- authority zones, 858
- authorization, 858
- auto-detect mechanisms, 34, 858
- auto duplex, 858
- auto RF controls, 714
- auto-summarization in EIGRP, 424, 424

autoconfiguration in IPv6,
 746–747, 747
 automatic call reconnect, 858
 Automatic Spanning Tree (AST), 856
 autonomous confederation, 858
 autonomous switching, 858
 autonomous system (AS) number, 393
 Autonomous System Boundary
 Routers (ASBRs)
 defined, 856
 OSPF, 446
 autonomous systems (ASs)
 defined, 856
 EIGRP, 420, 422–423
 IGRP, 377
 autoreconfiguration, 858
 autorooter attacks, 612
 aux command, 195
 auxiliary passwords, 195–196
 auxiliary ports
 connecting through, 174
 defined, 858
 AWPP (Adaptive Wireless Path
 Protocol), 718

B

B (Bearer) channels, 859
 B8ZS (Binary 8-Zero Substitution), 858
 back ends, 858
 BackboneFast feature, 513, 524–525
 backbones
 collapsed, 494–495, 495
 defined, 858
 backdoor attacks, 612
 backoff algorithms, 32–33
 Backspace command, 187
 Backup Designated Routers (BDRs)
 defined, 859
 elections, 465–466
 OSPF, 447
 backups
 IOS, 264–265, 314
 router, 274–276
 hands-on lab, 314–315
 SDM, 280–283, 280–283
 Backward-Explicit Congestion
 Notification (BECN) bit
 defined, 859
 Frame Relay, 804
 bandwidth
 default, 219
 defined, 858
 displaying, 218
 EIGRP, 425
 Frame Relay, 799–800
 IGRP, 393
 multimedia applications, 554
 OSPF, 448
 serial links, 786
 UDP, 77
 bandwidth command, 211–212
 bandwidth on demand (BoD), 859
 banner command, 192–193
 banners, 192–194
 baseband technology, 38, 859
 baseline information, 73, 859
 Basic Firewall Configuration Wizard,
 648–651, 648–649
 Basic Management Setup mode, 859
 Basic NAT Wizard, 684–686, 685–686
 Basic Rate Interface (BRI), 860
 basic router information, command-line
 interface for, 189–191
 Basic Service Set (BSS), 713
 baud, 859
 BDRs (Backup Designated
 Routers), 859
 defined, 859
 elections, 465–466
 OSPF, 447
 beacons, 859

- Bearer (B) channels, 859
- BECN (Backward-Explicit Congestion Notification) bit
 - defined, 859
 - Frame Relay, 804
- bfe command, 185
- BGP (Border Gateway Protocol), 377
- BGP Identifier field, 859
- BGP neighbors, 859
- BGP speakers, 859
- BGP4 protocol, 859
- bidirectional shared trees, 859
- Binary 8-Zero Substitution (B8ZS), 858
- binary numbering system
 - conversions with, 26–30, 53–55
 - defined, 860
 - for IP addresses, 93
- binding, 12
- BISDN (Broadband ISDN), 860
- Bit Interleaved Parity (BIP), 860
- bit-oriented protocols
 - control information in, 787
 - defined, 860
- bits, 27–29
 - defined, 860
 - in IP, 93
- block sizes
 - summarization, 147–150
 - VLSMs, 140–142
 - with wildcards, 620–621
- blocked ports in STP, 507
- blocking state in STP, 510
- BNC connectors, 38
- BoD (bandwidth on demand), 859
- Boot default ROM software bit, 255
- Boot field, 255
- Boot image from ROM field, 255
- Boot ROM, 860
- boot sequence
 - defined, 860
 - routers, 253–254, 259
- boot system commands, 261–262
- bootstrap protocols
 - defined, 860
 - routers, 252–253
- Border Gateway Protocol (BGP), 377
- border gateways, 860
- border peers, 860
- border routers, 860
- BPDU (Bridge Protocol Data Unit)
 - defined, 860
 - STP, 507–508
- BPDUFilter, 523–524
- BPDUGuard, 523
- Break disabled bit, 255
- breaks, 259
- BRI (Basic Rate Interface), 860
- bridge groups, 861
- bridge priority, 861
- Bridge Protocol Data Unit (BPDU)
 - defined, 860
 - STP, 507–508
- bridges, 8, 9
 - Data Link layer, 25–26
 - defined, 861
 - identifiers for, 507, 509–510, 861
 - for network segmentation, 6
 - STP, 506, 508–510, 532–534
 - vs. switches, 8, 499
 - before switching, 496
- bridging loops, 861
- bringing up router interfaces
 - no shutdown command, 206–207
 - steps, 175–179
- Broadband ISDN (BISDN), 860
- broadband transmissions, 861
- broadcast addresses, 93, 100–101
- broadcast and unknown servers (BUS), 862
- broadcast domains, 4–5, 53, 53
 - breaking up, 6–8, 6
 - defined, 861

- flat networks, 553, 553
- layer 2 switching, 499
- broadcast OSPF networks, 447
- broadcast storms
 - defined, 861
 - loop avoidance for,
504–505, 504
- broadcasts
 - defined, 861
 - flat networks, 552–553
 - IPv6, 742
 - multimedia applications, 554
 - routers, 23
 - VLANs, 554
- brute force attacks, 613
- BSS (Basic Service Set), 713
- Buffer Full message, 87
- buffers
 - connection-oriented
 - communication, 18–19
 - defined, 861
 - IP routing process, 333
- bundling links in EIGRP, 436
- bursting, 862
- bursty traffic, 800
- BUS (broadcast and unknown servers), 862
- bus topology, 862
- buses, 862
- BX.25 standard, 862
- bypass mode, 862
- bypass relays, 862
- byte-oriented protocols
 - control information in, 787
 - defined, 862
- bytes, 27–29
 - defined, 862
 - in IP, 93

C

- cable ranges, 862
- cablings
 - Catalyst switches, 517
 - description, 779
 - Ethernet networking, 39–41, 39–42
 - WANs, 779–782, 780–781,
785–786, 786
- CAC (Connection Admission Control), 862
- calendar command, 185
- call admission control, 862
- call establishment, 862
- call priority, 862
- call set-up
 - connection-oriented
 - communication, 17
 - time for, 862
- callback, PPP, 789
- Capability field, 285
- carets (^) as error indicators, 186
- Carrier Detect (CD) signal, 863
- Carrier Sense Multiple Access with Collision Detect (CSMA/CD)
 - 2.4 GHz wireless, 708–709, 708
 - defined, 867
 - operation, 31–32, 32
- Catalyst switch configuration,
 - 514–517, 515–516
 - BackboneFast, 524–525
 - BPDUFILTER, 523–524
 - BPDUGuard, 523
 - Core, 519–521
 - EtherChannel, 526–527
 - port security, 521–522
 - PortFast, 522–523
 - RSTP, 525–526
 - S1, 517–518
 - S2, 518–519

918 CBAC (Context-Based Access Control) – Cisco Discovery Protocol (CDP)

- trunking, 572
- UplinkFast, 524
- verifying, 528–534
- CBAC (Context-Based Access Control), 639–640, 639, 651
- CBR (Constant Bit Rate), 863
- CD (Carrier Detect) signal, 863
- cd command, 185, 266, 268
- CDP (Cisco Discovery Protocol), 283, 315–316
 - defined, 863
 - neighbor information, 284–289
 - network topology, 292–294, 292, 294
 - port and interface information, 290–291
 - timers and holdtime information, 283–284
 - traffic information, 289
 - VLAN telephony, 586–588
- cdp enable command, 284, 290
- cdp holdtime command, 284, 863
- cdp timer command, 284, 863
- CDVT (Cell Delay Variation Tolerance), 863
- Cell Error Ratio (CER), 863
- Cell Loss Priority (CLP), 865
- Cell Loss Ratio (CLR), 865
- cell payload scrambling, 863
- cell relay, 863
- Cell Transfer Delay (CTD), 867–868
- cells, 863
- central office (CO)
 - defined, 865
 - WANs, 775
- Centrex service, 863
- CER (Cell Error Ratio), 863
- CGMP (Cisco Group Management Protocol), 863
- Challenge Handshake Authentication Protocol (CHAP)
 - defined, 864
 - PPP, 790–791, 793–794
- Channel Interface Processor (CIP), 864
- Channel Service Unit (CSU), 867
- Channel Service Unit/Data Service Unit (CSU/DSU)
 - Physical layer, 30
 - WANs, 786, 786
- channelized E1, 863
- channelized T1, 864
- CHAP (Challenge Handshake Authentication Protocol)
 - defined, 864
 - PPP, 790–791, 793–794
- Checksum field, 76
- checksums, 864
- choke packets, 864
- CIDR (Classless Interdomain Routing)
 - defined, 864
 - subnetting, 116–118
- CIP (Channel Interface Processor), 864
- CIR (Committed Information Rate)
 - defined, 864
 - Frame Relay, 799–800
- circuit switching
 - defined, 864
 - WANs, 776, 776
- Cisco Discovery Protocol (CDP), 283, 315–316
 - defined, 863
 - neighbor information, 284–289
 - network topology, 292–294, 292, 294
 - port and interface information, 290–291
 - timers and holdtime information, 283–284
 - traffic information, 289
 - VLAN telephony, 586–588

- Cisco encapsulation, 800, 806
- Cisco format in LMI, 804
- Cisco FRAD (Cisco Frame Relay Access Device), 864
- Cisco Group Management Protocol (CGMP), 863
- Cisco IOS. *See* IOS (Internetwork Operating System)
- Cisco Network Assistant (CNA)
 - inter-VLAN routing configuration, 588–597, 589–596
 - overview, 534–541, 535, 538–541
- CiscoFusion architecture, 864
- CiscoView software, 864
- Class A networks, 94–95, 94
 - defined, 865
 - format, 96–97
 - reserved address space, 99
 - subnetting, 115–116, 134–136
- Class B networks, 94–95, 94
 - defined, 865
 - format, 97–98
 - reserved address space, 99
 - subnetting, 115–116, 127–133
- Class C networks, 94–95, 94
 - defined, 865
 - format, 98
 - reserved address space, 99
 - subnetting, 115–116, 118–127, 120, 122
- Class D addresses, 94–96, 94
- Class E addresses, 94–96, 94
- class of service (CoS), 586–588
- classes of protocols, 378–379
- classful networks, 137, 137
- classful routing, 374–375
 - defined, 865
 - RIP, 383–384
- classical IP over ATM, 865
- Classless Interdomain Routing (CIDR)
 - defined, 864
 - subnetting, 116–118
- classless networks, 137–138
- classless protocols, 419
- classless routing
 - defined, 865
 - RIP, 383
- clear command, 185
- clear counters command, 220
- clear ip nat translation command, 677
- clear line command, 299
- Clear To Send (CTS) signal, 708
- clearing
 - counters, 220
 - Telnet connections, 299
- CLI. *See* command-line interface (CLI)
- client mode in VTP, 564
- clock command, 185–186
- clock rate command, 210–211, 222, 346
- clock set command, 186
- clocking, 210–211, 222
- closing Telnet sessions, 298–299
- CLP (Cell Loss Priority), 865
- CLR (Cell Loss Ratio), 865
- CNA (Cisco Network Assistant)
 - inter-VLAN routing configuration, 588–597, 589–596
 - overview, 534–541, 535, 538–541
- cns command, 185
- CO (central office)
 - defined, 865
 - WANs, 775
- Code bits field, 76
- collapsed backbones
 - defined, 865
 - before switching, 494–495, 495
- collision domains, 4, 6–11, 6
 - defined, 865
 - flat networks, 553
 - identifying, 53, 53
 - layer 2 switching, 499
 - switches for, 26

920 collisions – configuration

- collisions
 - 2.4 GHz wireless, 708–709
 - CSMA/CD for, 31–32, 32
 - defined, 865
- COM1 Properties dialog box, 41, 41
- command-line interface (CLI), 179–180
 - for banners, 192–194
 - for basic routing information, 189–191
 - for configurations
 - deleting, 214
 - saving, 212–213, 237
 - verifying, 214–223, 222–223
 - viewing, 213–214
 - defined, 865
 - for descriptions, 201–203, 240
 - do command, 203–204
 - editing and help features, 185–189, 236–237
 - for hostnames, 191–192, 239
 - for logging onto routers, 235–236
 - from non-ISR routers, 180–181
 - for passwords
 - auxiliary, 195–196
 - console, 196–197
 - encrypting, 199–201
 - setting, 194–195, 237–239
 - Telnet, 197–198
 - prompts, 182
 - for interfaces, 182–183
 - line commands, 183–184
 - for routing protocol configurations, 184
 - for subinterfaces, 183
 - for router interfaces, 204–212, 209–210
 - router modes, 181–182
 - for SSH, 198–199
- comments for access lists, 638–639
- Committed Information Rate (CIR)
 - defined, 864
 - Frame Relay, 799–800
- Common Part Convergence Sublayer (CPCS), 867
- composite metrics
 - defined, 865
 - IGRP, 392
- compression
 - defined, 866
 - LCP, 789
- confidentiality, ESP for, 827
- config-register command, 256, 259, 261
- configuration
 - backing up
 - IOS, 212–213, 264–265, 314
 - router, 237, 274–276, 314–315
 - SDM, 280–283, 280–283
 - Catalyst switches. *See* Catalyst switch configuration
 - command-line
 - deleting, 214
 - saving, 212–213, 237
 - verifying, 214–223, 222–223
 - viewing, 213–214
 - copying
 - to NVRAM, 275–276
 - to TFTP server, 276
 - EIGRP, 426–429, 427
 - Corp, 429
 - discontiguous networks, 434–435
 - R1, 429–430
 - R2, 430
 - R3, 430–432, 430
 - summary routes, 474–476, 475–476
 - verifying, 438–443
 - erasing, 214, 277–278
 - IFS for, 278–279
 - IP address, 207–208

- IP routing, 341–343, 341
 - 871W router, 359–361
 - 1242AP router, 361–362
 - 2621A router, 393–401, 399
 - Corp router, 343–346
 - R1 router, 346–349
 - R2 router, 349–352
 - R3 router, 352–359, 352–359
 - verifying, 373–374, 393–401, 399
 - IPv6 protocol
 - autoconfiguration, 746–747, 747
 - Corp, 756–758
 - DHCPv6 servers, 747–749
 - ICMPv6 servers, 749–750
 - OSPFv3, 763–766
 - R1, 758
 - R2, 758–759
 - R3, 759
 - RIPng, 759–763
 - routers, 747–748
 - NAT, 679–684, 680
 - dynamic, 675, 692–693
 - overloading, 675–676, 694–695
 - SDM for, 684–687, 685–686
 - static, 674–675
 - verifying, 676
 - OSPF, 449
 - 871W, 457
 - areas, 450–453, 452
 - Corp, 453–454
 - debugging, 462–464
 - enabling, 449
 - R1, 454
 - R2, 454
 - R3, 454–456, 455–456
 - summary routes, 474–476, 475–476
 - troubleshooting, 471–473, 472–474
 - verifying, 457–462
 - PPP, 791–792, 838–839, 838
 - PPPoE, 796–797, 818–822, 819–822
 - restoring, 276–277, 280–283, 280–283
 - RIP, 405–406
 - 871W router, 387
 - Corp router, 383–384
 - example, 389–390, 389
 - R1 router, 384–385
 - R2 router, 385
 - R3 router, 385–387, 386
 - saving, 212–213, 237
 - verifying. *See* verifying
 - viewing, 213–214
 - VLANs, 568–570
 - inter-VLAN routing, 575–580, 576–578, 580, 588–597
 - switch port assignments, 570–571
 - trunk ports, 571–574
 - voice, 586–588
 - VPNs, 828–836, 828–835
 - VTP, 580–583
 - wireless networks, 721–728, 722–728
- configuration registers, 253
 - bits in, 254–255
 - boot system commands, 261–262
 - changing values, 256–257
 - checking values, 256
 - defined, 866
 - for password recovery, 258–261
 - configure command, 182, 185
 - configure memory command, 181
 - configure network command, 181
 - configure terminal command, 181–182
 - congestion, 866
 - congestion avoidance
 - defined, 866
 - Frame Relay, 804–805
 - congestion collapse, 866

922 connect command – CPCS (Common Part Convergence Sublayer)

- connect command, 185
- Connect To dialog box, 41, 41
- Connection Admission Control (CAC), 862
- Connection Description dialog box, 41, 41
- connection IDs, 866
- connection-oriented
 - communication, 75
 - defined, 866
 - Transport layer, 17–20, 18–19
- connectionless protocols, 78, 866
- connections
 - console port, 173
 - routers, 173–175, 174–175
 - Telnet, 297
 - WANs, 775–776, 776
- connectivity, 305
 - debugging, 308–310
 - ping command for, 305–306
 - processes, 310–311
 - SDM for, 306, 306
 - traceroute command for, 307–308
- connectors, WANs, 785
- console
 - connections to, 173
 - passwords for, 196–197
 - port commands from, 196–197
- console command, 195
- Console line speed field, 255
- console ports, 173–174
 - Catalyst switches, 516
 - defined, 866
- Constant Bit Rate (CBR), 863
- Context-Based Access Control (CBAC), 639–640, 639, 651
- control direct VCC, 866
- control distribute VCC, 866
- convergence
 - defined, 866
 - EIGRP, 422
 - OSPF, 444
 - STP, 511–512, 511
- conversions, number system, 26–30, 53–55
- copy command, 185, 266–267
- copy flash tftp command, 264–265
- copy running-config startup-config command, 212–213, 261, 275
- copy running-config tftp command, 275–276
- copy source-url destination-url command, 267
- copy startup-config running-config command, 261, 276–277
- copy startup-config tftp command, 275
- copy tftp flash command, 265–266
- copy tftp running-config command, 277
- copy tftp startup-config command, 277
- core layer
 - defined, 866
 - internetworking, 47–48, 47
- Core switch configuration, 519–521
- Corp router configuration
 - EIGRP, 429
 - IP routing, 343–346
 - IPv6, 756–758
 - NAT, 680–681
 - OSPF, 453–454
 - RIP, 383–384
 - static, 364–366
- CoS (class of service), 586–588
- costs
 - defined, 867
 - OSPF, 448
- counters, clearing, 220
- counting to infinity
 - defined, 867
 - from routing loops, 382
- CPCS (Common Part Convergence Sublayer), 867

CPE (customer premises equipment)
 defined, 867
 WANs, 775

crankback technique, 867

CRC (cyclic redundancy check)
 defined, 867
 Ethernet frames, 35–36, 46
 IP header, 85
 IP routing process, 332–336
 TCP segment, 76
 UDP segment, 78

Create Connection screen, 723, 813

Create Firewall screen, 643, 643,
 648, 648

Create NAT Configuration screen,
 685, 685

Create New Connection option, 353

Create Site to Site VPN tab, 828, 828

crossover cables
 Catalyst switches, 517
 defined, 867
 Ethernet networking, 40, 40, 42

crypto command, 185, 831

crypto key generate rsa command, 198

crypto pki command, 231

CSMA/CD (Carrier Sense Multiple
 Access with Collision Detect)
 2.4 GHz wireless, 708–709, 708
 defined, 867
 operation, 31–32, 32

CSU (Channel Service Unit), 867

CSU/DSU (Channel Service Unit/Data
 Service Unit)
 Physical layer, 30
 WANs, 786, 786

ct-isdn command, 185

CTD (Cell Transfer Delay), 867–868

Ctrl+A command, 187

Ctrl+D command, 187

Ctrl+E command, 187

Ctrl+F command, 187

Ctrl+R command, 187

Ctrl+Shift+6 command, 297

Ctrl+U command, 187

Ctrl+W command, 187

Ctrl+Z command, 187

CTS (Clear To Send) signal, 708

cumulative interface delay, 868

cumulative line delay in EIGRP, 425

customer premises equipment (CPE)
 defined, 867
 WANs, 775

cut-through switching method, 868

cyclic redundancy check (CRC)
 defined, 867
 Ethernet frames, 35–36, 46
 IP header, 85
 IP routing process, 332–336
 TCP segment, 76
 UDP segment, 78

D

D (Data) channels, 869

DA (Destination address) field, 36

data circuit-terminating equipment, 868

data communications equipment (DCE)
 defined, 869
 Physical layer, 30
 WANs, 786, 786

Data Country Code (DCC), 868

data direct VCC, 868

data encapsulation
 defined, 868
 Frame Relay, 800–801
 internetworking, 43–46, 43–44
 PPP, 792–795, 792–794

Data Exchange Interface (DXI), 871

Data field
 Ethernet frames, 36
 IP header, 85

924 data frames – deleting configurations

- TCP segment, 76
 - UDP segment, 78
 - data frames, 24, 868
 - Data Link Connection
 - Identifiers (DLCIs)
 - defined, 870
 - Frame Relay, 801–803, 802
 - Data Link Control layer, 868
 - Data Link layer, 24–25, 24
 - defined, 868
 - Ethernet networking at, 34–37, 34–35
 - number system conversions, 26–30
 - switches and bridges at, 25–26, 26
 - Data Link Switching (DLSw), 870–871
 - data over cable service interface
 - specification (DOCSIS), 781, 781
 - data packets, 43
 - defined, 892
 - Network layer, 22
 - Data Service Units (DSUs), 871
 - Data Set Ready (DSR) circuits, 871
 - data terminal equipment (DTE)
 - defined, 871
 - Physical layer, 30
 - WANs, 786, 786
 - Data Terminal Ready (DTR)
 - circuits, 871
 - Datagram Delivery Protocol (DDP), 869
 - datagrams, 43, 868
 - DCC (Data Country Code), 868
 - DCE (data communications equipment)
 - defined, 869
 - Physical layer, 30
 - WANs, 786, 786
 - DDP (Datagram Delivery Protocol), 869
 - DDR (dial-on-demand routing), 869
 - DE (Discard Eligibility) bit
 - defined, 869
 - Frame Relay, 804
 - de-encapsulation
 - defined, 869
 - packets, 44
 - Dead intervals in OSPF, 465
 - debug command, 185, 308
 - debug all command, 309
 - debug eigrp command, 438, 442–443
 - debug frame lmi command, 811
 - debug ip eigrp command, 438, 442
 - debug ip nat command, 676, 682–683
 - debug ip ospf adj command, 464
 - debug ip ospf hello command, 463–464
 - debug ip ospf packet command, 463
 - debug ip rip command, 309, 394–398
 - debug ipv6 ospf hello command, 764
 - debug ipv6 ospf packet command, 764
 - debug ipv6 rip command, 762
 - debug ppp authentication command, 793, 817
- debugging
 - connectivity, 308–310
 - OSPF, 462–464
 - PPP, 793–796, 794–795
 - decimal number conversions, 26–30, 53–55
 - dedicated lines
 - defined, 869
 - WANs, 776, 776
 - defaults
 - administrative distances, 378
 - bandwidth, 219
 - gateways, 331–332, 334
 - routes, 96, 869
 - routing, 374–377, 375–376
 - delay
 - defined, 869
 - EIGRP, 425
 - IGRP, 393
 - delete command, 185, 266, 268–269
 - deleted state in LMI, 804
 - deleting configurations, 214, 277–278

- demarcs
 - defined, 869
 - WANs, 775
- demodulation, 869
- demultiplexing, 869
- denial of service (DoS) attacks
 - detection and prevention, 615
 - types, 612
- deny any any command, 635
- description command, 201–203
- descriptions, command-line interface
 - for, 201–203, 240
- designated bridges, 869
- designated ports
 - defined, 869
 - STP, 507
- designated routers (DRs)
 - defined, 870
 - elections, 465–466
 - OSPF, 447
- desktop layer
 - defined, 870
 - internetworking, 49
- Destination address (DA) field, 36
- destination addresses
 - defined, 870
 - IP routing process, 333–340
- destination hosts, 333–334
- Destination IP address field, 85
- destination network parameter, 363
- Destination port field, 76, 78
- destination ports in TCP, 81–82
- Destination Service Access Points (DSAPs), 871
- Destination Unreachable message, 87
- destination URL policy
 - management, 614
- Device ID field, 285
- Device Manager, 541
- DFS (Dynamic Frequency Selection), 710
- DHCP (Dynamic Host Configuration Protocol)
 - defined, 870
 - IP addresses, 73–74
- DHCPv6 server configuration, 747–749
- diagnostic addresses, 151
- dial backup, 870
- dial-on-demand routing (DDR), 869
- dialer pool command, 797
- Diffusing Update Algorithm (DUAL)
 - defined, 871
 - EIGRP, 421–422
 - EIGRPv6, 751
- Digital, Intel, Xerox (DIX) group, 37
- digital subscriber line (DSL)
 - description, 779
 - WANs, 782–785, 782, 784
- Dijkstra algorithm, 444
- dir command, 266–267
- Direct Sequence Spread Spectrum (DSSS) technique, 709
- directed broadcasts, 870
- disable command, 180, 185
- disabled state in STP, 510
- Discard Eligibility (DE) bit
 - defined, 869
 - Frame Relay, 804
- disconnect command, 185, 298
- discontiguous networks
 - EIGRP, 423–424, 423, 434–435
 - RIPv1 vs. RIPv2, 391
- Discover messages, 74
- discovery mode, 870
- Distance Vector Multicast Routing Protocol (DVMRP), 871
- distance-vector protocols, 378–382, 379–381
- distance-vector routing algorithm, 870
- distribute lists, 616
- distribution layer
 - defined, 870
 - internetworking, 47, 48

- distribution networks, cable systems, 781
- DIX (Digital, Intel, Xerox) group, 37
- DLCIs (Data Link Connection Identifiers)
 - defined, 870
 - Frame Relay, 801–803, 802
- DLSw (Data Link Switching), 870–871
- DLSw+, 871
- DNS (Domain Name System)
 - defined, 871
 - name resolution, 5, 73, 302–304
- do command, 203–204
- DOCSIS (data over cable service interface specification), 781, 781
- DoD model and TCP/IP, 68–70, 69–70
- dollar signs (\$) for scrolling, 188
- Domain Name System (DNS)
 - defined, 871
 - name resolution, 73, 302–304
- domains
 - broadcast, 4–5, 53, 53
 - breaking up, 6–8, 6
 - defined, 861
 - flat networks, 553, 553
 - layer 2 switching, 499
 - collision, 4, 6–11, 6
 - defined, 865
 - flat networks, 553
 - identifying, 53, 53
 - layer 2 switching, 499
 - switches for, 26
 - VTP, 584
- DoS (denial of service) attacks
 - detection and prevention, 615
 - types, 612
- dotted-decimal notation, 93
- DRs (designated routers)
 - defined, 870
 - elections, 465–466
 - OSPF, 447
- DSAPs (Destination Service Access Points), 871
- DSL (digital subscriber line)
 - description, 779
 - WANs, 782–785, 782, 784
- DSLAM switch, 783
- DSR (Data Set Ready) circuits, 871
- DSSS (Direct Sequence Spread Spectrum) technique, 709
- DSUs (Data Service Units), 871
- DTE (data terminal equipment)
 - defined, 871
 - Physical layer, 30
 - WANs, 786, 786
- DTR (Data Terminal Ready)
 - circuits, 871
- DUAL (Diffusing Update Algorithm)
 - defined, 871
 - EIGRP, 421–422
 - EIGRPv6, 751
- dual stacking in IPv6 migration, 754
- duplex in Ethernet networking, 33–34
- DVMRP (Distance Vector Multicast Routing Protocol), 871
- DXI (Data Exchange Interface), 871
- dynamic access lists, 636–637
- dynamic command, 571–572
- dynamic entries, 871
- Dynamic Frequency Selection (DFS), 710
- Dynamic Host Configuration Protocol (DHCP)
 - defined, 870
 - IP addresses, 73–74
- dynamic NAT, 672, 675, 692–693
- Dynamic NAT-PT, 756
- dynamic port mapping, 615
- dynamic routing, 328
 - defined, 871
 - IGRP. *See* IGRP (Interior Gateway Routing Protocol)

IP, 377–379
 RIP. *See* RIP (Routing Information Protocol)
 dynamic VLANs
 benefits, 559
 defined, 872

E

E.164 standard, 872
 E channels, 872
 e-mail
 Application layer for, 15
 SMTP for, 72
 E1 transmissions, 872
 EAP (Extensible Authentication Protocol), 721
 eBGP (External Border Gateway Protocol), 872
 edge devices, 872
 Edit Firewall Policy/ACL tab, 644, 644
 Edit Interface/Connection tab, 228, 228, 722, 722, 813, 816
 editing features in command-line interface, 185–189, 236–237
 EEPROM (electronically erasable programmable read-only memory)
 defined, 872
 loading from, 175
 EFCI (Explicit Forward Congestion Indication), 872
 EGP (Exterior Gateway Protocol), 377
 EIA/TIA-232-C standard, 788
 802.1 specification, 562–563, 879
 802.3 specification, 879
 802.5 specification, 879
 802.11 standards, 706–712, 712
 871W router
 configuration
 IP routing, 359–361
 NAT, 681
 OSPF, 457
 RIP, 387
 static routing, 372
 redistribution, 432–434
 1841 router, 175, 175
 EIGRP (Enhanced IGRP), 418
 ASs in, 422–423
 configuration, 426–429, 427
 Corp, 429
 discontiguous
 networks, 434–435
 R1, 429–430
 R2, 430
 R3, 430–432, 430
 summary routes, 474–476, 475–476
 verifying, 438–443
 default ADs, 378
 defined, 873
 DUAL with, 421–422
 exam essentials, 476–477
 features and operation, 418–419
 hands-on labs, 478–483, 478, 482
 large network support, 422–426, 423–424
 load balancing, 435–438, 442
 maximum paths and hop counts, 425–426
 metrics, 425
 neighbor discovery, 419–421
 protocol-dependent modules, 419
 redistribution, 423, 432–434
 review questions, 484–490
 route discovery and maintenance, 424–425
 RTP with, 421
 summary, 476–477
 VLSM support and summarization, 418–419, 423–424, 423–424
 written lab, 477–478, 491
 EIGRPv6 protocol, 751–752

- EIP (Ethernet Interface Processor), 872–873
- ELANs (Emulated LANs), 872
- ELAP (EtherTalk Link Access Protocol), 872
- elections, DR and BDR, 465–466
- electronically erasable programmable read-only memory (EEPROM)
 - defined, 872
 - loading from, 175
- Emulated LANs (ELANs), 872
- enable command, 180, 185, 194–195, 296
- Enable diagnostic messages bit, 255
- enable passwords
 - secret, 195
 - setting, 194–195
 - show running-config for, 201
 - Telnet, 296
- enabling
 - OSPF configuration, 449
 - RIPv2, 398–401, 399
- Encapsulating Security Payload (ESP), 827
- encapsulation
 - defined, 873
 - Frame Relay, 800–801
 - internetworking, 43–46, 43–44
 - PPP, 792–795, 792–794
 - VLANs, 575–576
 - WANs, 777
- encapsulation command, 575, 777
- encapsulation frame-relay command, 800, 806–807, 812
- encryption
 - defined, 873
 - password, 199–201
 - wireless networks, 721
- end-to-end VLANs, 873
- Enhanced IGRP. *See* EIGRP (Enhanced IGRP)
- enterprise networks, 873
- Erasable Programmable Read-Only Memory (EPROM), 873
- erase command, 266, 268
- erase start command, 346–347
- erase startup-config command, 214, 277, 343
- erasing configurations, 214, 277–278
- error checking and detection
 - Ethernet frames, 35–36
 - LCP, 789
 - TCP, 75
- Esc+B command, 187
- Esc+F command, 187
- ESFs (Extended Superframes), 873
- ESP (Encapsulating Security Payload), 827
- ESS (Extended Service Set), 713
- EtherChannel
 - Catalyst switch configuration, 526–527
 - STP, 514
- Ethernet Interface Processor (EIP), 872–873
- Ethernet networking, 31–33, 32
 - addressing in, 34–35, 34
 - cabling, 39–41, 39–42
 - at Data Link layer, 34–37, 34–35
 - defined, 873
 - frames, 35–37, 35
 - half-duplex and full-duplex, 33–34
 - at Physical layer, 37–39, 37
- Ethernet WAN Configuration Wizard, 819–820, 819–820
- EtherTalk Link Access Protocol (ELAP), 872
- EtherTalk product, 873
- exam essentials
 - access lists, 655
 - EIGRP and OSPF, 476–477
 - internetworking, 49–50

- IOS, 233–234
- IP routing, 401–402
- IPv6 protocol, 767
- layer 2 switching and STP, 542
- management, 311–312
- NAT, 688
- subnetting, 158
- TCP/IP, 102
- VLANs, 598
- WANs, 836–837
- wireless networks, 729
- excess burst size, 873
- excess rate, 873
- exec banners, 193
- EXEC sessions, 173, 873
- exec-timeout command, 196–197
- exit command
 - for logging out, 182
 - Telnet, 297–298
- exit interface parameter, 363
- expansion, 874
- expedited delivery, 874
- Explicit Forward Congestion Indication (EFCI), 872
- explorer frames, 874
- explorer packets, 874
- exponents, 114
- Express Setup HTTP screen, 516–517, 516
- extended access lists
 - IP, 626–632, 657–660, 874
 - IPX, 874
- Extended Service Set (ESS), 713
- Extended Setup mode, 874
- Extended Superframes (ESFs), 873
- Extensible Authentication Protocol (EAP), 721
- Exterior Gateway Protocol (EGP), 377
- External Border Gateway Protocol (eBGP), 872

- external EIGRP
 - default ADs, 378
 - routes, 422, 874
- extranet VPNs, 826

F

- failure domains, 874
- fallback mechanism, 874
- Fast Ethernet Interface Processor (FEIP), 875
- Fast Ethernet technology
 - defined, 874
 - speed of, 38
- Fast Serial Interface Processor (FSIP), 877
- fast switching, 874
- fault tolerance
 - core layer, 48
 - defined, 875
- FCC (Federal Communications Commission), 705–706
- FCS (Frame Check Sequence) field
 - Ethernet frames, 36
 - IP routing process, 333–336
 - UDP segment, 78
- FDDI (Fiber Distributed Data Interface), 875
- FDM (Frequency-Division Multiplexing), 875
- feasible distances in EIGRP, 420, 441
- feasible successors in EIGRP, 420
- FECN (Forward-Explicit Congestion Notification) bit
 - defined, 875
 - Frame Relay, 804
- Federal Communications Commission (FCC), 705–706
- FEIP (Fast Ethernet Interface Processor), 875

930 Fiber Distributed Data Interface (FDDI) – Frame Relay

Fiber Distributed Data Interface (FDDI), 875

file prompt command, 267

File Transfer Protocol (FTP)

defined, 877

for file transfer, 71–72

files, transferring, 71–72

filter tables, 497

filtering

defined, 875

frame, 502

IOS firewall, 615

firewalls, 610–611, 611

creating, 647–654, 648–650, 653–654

defined, 875

IOS, 614–615

5GHz wireless, 709–712, 710

fixed configuration routers, 875

Flags field, 85

flapping

defined, 875

preventing, 382

flash memory

defined, 875

loading, 175

managing, 270–274, 271–274

routers, 253

verifying, 263–264

flat networks

defined, 875

structure of, 552–553, 553

flexibility in VLANs, 555–558, 556–557

floating routes, 875

flooding, 875

flow control

defined, 876

Transport layer, 17

format command, 266, 268

Forward-Explicit Congestion

Notification (FECN) bit

defined, 875

Frame Relay, 804

forward/filter decisions, 501–504, 502

forward/filter tables, 499–504, 500–501

forwarding ports in STP, 507

forwarding state in STP, 510

FQDNs (Fully Qualified Domain Names)

defined, 876

DNS, 73, 303

FRADs (Frame Relay Access Devices), 876

Fragment offset field, 85

fragmentation, 876

FragmentFree switching method, 876

fragments, 876

Frame Check Sequence (FCS) field

Ethernet frames, 36

IP routing process, 333–336

UDP segment, 78

frame identification, 876

Frame Relay, 798

CIR in, 799–800

congestion control, 804–805

defined, 876

description, 778

DLCIs in, 801–803, 802

encapsulation, 800–801

LMI in, 803–804

monitoring, 808–811

overview, 798–799, 799

SDM for, 822–825, 823–824

single interfaces, 806

subinterfaces, 806–808, 840–841, 840

troubleshooting, 811–813, 812

virtual circuits, 801

Frame Relay Access Devices (FRADs), 876

Frame Relay Access Support (FRAS), 877

frame relay bridging, 876

frame-relay interface-dlci command, 802

frame-relay lmi-type command, 803, 806

frame-relay map command, 802, 812

Frame Relay switching, 877

frame tagging

- defined, 876
- VLANs, 561–562

frames

- Data Link layer, 44
- defined, 876
- Ethernet, 35–37, 35
- filtering, 502

framing, 877

FRAS (Frame Relay Access Support), 877

frequency, 877

Frequency-Division Multiplexing (FDM), 875

FSIP (Fast Serial Interface Processor), 877

FTP (File Transfer Protocol)

- defined, 877
- for file transfer, 71–72

full duplex

- defined, 877
- in networking, 33–34
- Session layer, 16

full mesh topology, 877

Fully Qualified Domain Names (FQDNs)

- defined, 876
- DNS, 73, 303

G

gateways

- IP routing, 331–332, 334
- of last resort, 375, 375

Generic Routing Encapsulation (GRE)

- defined, 877–878
- IP header, 86
- VPNs, 826

geographical distances, subnetting

- for, 113

Get Nearest Server (GNS) requests, 877

Gigabit Media Independent Interface (GMII), 38, 877

global addresses in LMI, 803

global commands, 184, 877

global configuration mode, 184

global NAT names, 672–673, 673–674

global unicast addresses in IPv6, 744, 746

GMII (Gigabit Media Independent Interface), 38, 877

GNS (Get Nearest Server) requests, 877

gossip protocol, 387

grafting, 877

GRE (Generic Routing Encapsulation)

- defined, 877–878
- IP header, 86
- VPNs, 826

guard bands, 878

guest-mode command, 351

H

H channels, 878

H field in EIGRP, 440

half duplex

- defined, 878
- Ethernet networking, 33–34
- Session layer, 16

- hands-on labs
 - access lists, 656–660, 656
 - EIGRP and OSPF, 478–483, 478, 482
 - IOS, 235–241
 - IP routing, 403–406, 403
 - management, 313–317
 - NAT, 689–695, 690
 - WANs, 838–841, 849
- handshakes, 17, 878
- hardware addresses, 84, 329
 - Data Link layer, 34
 - Ethernet addressing, 34
 - IP routing process, 334–336
- HDLC (High-Level Data Link Control) protocol
 - defined, 878
 - description, 778
 - hands-on lab, 839
 - operation, 787, 787
- headends, cable systems, 781
- Header checksum field, 85
- Header length field
 - IP header, 85
 - TCP segment, 76
- Hello messages in EIGRP, 419–420
- Hello protocol in OSPF, 446, 465
- help features in command-line interface, 185–189, 236–237
- helper address, 878
- hexadecimal numbering system, 36
 - conversions, 26–30, 53–55
 - IP addresses, 93
 - notation for, 255
- HFC (hybrid fibre-coaxial)
 - cable systems, 781, 781
 - description, 779
- hierarchical addressing, 93–94, 878
- hierarchical internetworking model, 46–49, 47
- hierarchies, 878
- High-Level Data Link Control (HDLC) protocol
 - defined, 878
 - description, 778
 - hands-on lab, 839
 - operation, 787, 787
- High-Speed Communication Interface (HSCI), 879
- High-Speed Serial Interface (HSSI), 879
- HIP (HSSI Interface Processor), 878
- history, command, 188–189
- hold time in EIGRP, 440
- holddown state, 878
- holddown timers, 383
- holddowns in IP routing, 382
- Holdtime field, 285
- holdtime information, 283–284
- hop counts
 - defined, 878
 - EIGRP, 418, 425–426
 - IGRP, 392–393
 - maximum, 382
 - RIPv1 vs. RIPv2, 391
 - routing tables, 23
- hops
 - defined, 878
 - distance-vector protocols, 378–379
- Hops message, 87–88
- host addresses
 - defined, 878
 - IP addresses, 94
- host tables, 300–302
- host-to-host layer, 69, 69–70, 74
 - defined, 879
 - key concepts of, 79
 - port numbers in, 80–82, 80
 - TCP, 75–77, 75
 - UDP, 77–79, 78
- hostname command, 191, 791

- hostnames
- command-line interface for, 191–192, 239
 - host tables for, 300–302
 - resolving, 73, 300–304, 316–317
- Hot Standby Router Protocol (HSRP), 879
- HSCI (High-Speed Communication Interface), 879
- HSRP (Hot Standby Router Protocol), 879
- HSSI (High-Speed Serial Interface), 879
- HSSI Interface Processor (HIP), 878
- hubs, 4, 4, 8–9, 9
- defined, 879
 - at Physical layer, 30–31
 - vs. switches, 26
 - before switching, 495–496, 496
- hybrid fibre-coaxial (HFC)
- cable systems, 781, 781
 - description, 779
- hybrid protocols, 379
- defined, 879
 - EIGRP, 418
- HyperTerminal program, 41, 41, 259
-
- I**
- IARP (Inverse ARP)
- defined, 881
 - for DLCIs, 801–802
- ICD (International Code Designator), 879
- ICMP (Internet Control Message Protocol), 87–90, 87, 89
- defined, 879
 - IOS firewall, 614
 - in IP header, 86
 - in IP routing process, 331, 334, 336, 338–339, 338
- ICMPv6 server configuration, 749–750
- Identification field in IP header, 85
- identifying VLANs, 559–563, 561
- IEEE (Institute of Electrical and Electronics Engineers)
- defined, 879
 - wireless standards, 705
- IEEE 802.1 specification, 562–563, 879
- IEEE 802.3 specification, 879
- IEEE 802.5 specification, 879
- IEEE 802.11 standards, 706–712, 712
- IETF (Internet Engineering Task Force)
- encapsulation, 800–801, 806
- IFS (IOS file system), 266–268
- for configuration, 278–279
 - for IOS upgrades, 268–270
- IG address in NAT, 678
- IGMP (Internet Group Management Protocol), 880
- Ignore NVRAM contents bit, 255
- IGP (Interior Gateway Protocol)
- defined, 880
 - function, 377
- IGRP (Interior Gateway Routing Protocol), 392–393
- default ADs, 378
 - defined, 880
 - enhanced. *See* EIGRP (Enhanced IGRP)
 - in IP header, 86
- ILMI (Integrated Local Management Interface), 880
- implicit denies, 616–617, 630
- in-band management, 174, 880
- in-band signaling, 880
- inactive state in LMI, 804
- inactivity option with aging, 536
- inbound access lists, 617
- incoming banners, 193

- Industrial, Scientific, and Medical (ISM) bands, 706
- infinite networks, 382
- inside NAT networks
 - defined, 880
 - names, 672–673, 673–674
- inspect command, 651–652
- Institute of Electrical and Electronics Engineers (IEEE)
 - defined, 879
 - wireless standards, 705
- insured bursts, 880
- Integrated Local Management Interface (ILMI), 880
- Integrated Services Digital Network (ISDN)
 - defined, 882
 - description, 778
- Inter-Switch Link (ISL) routing
 - defined, 882
 - VLANs, 562
- inter-VLAN routing, 575–580, 576–578, 580, 588–597, 589–596
- interarea routing, 880
- interface command, 182, 193
- interface configuration mode
 - defined, 880
 - EIGRP, 426
- interface ethernet command, 204
- interface fastethernet command, 205–206
- interface loopback command, 467
- interface port-channel command, 526–527
- interface processors, 880
- interface range command, 513, 570–571
- interface serial command, 204–206
- interface tunnel command, 755–756
- interface type number sequence, 204–205
- interfaces, 182–183, 204–205
 - bringing up, 175–179, 206–207
 - CDP for, 290–291
 - CLI prompts for, 182–183
 - displaying, 221–223
 - IP address configuration on, 207–208
 - pipes, 208–209
 - in routing tables, 23
 - serial, 209–212, 209–210
 - traffic information for, 289
- Interior Gateway Protocol (IGP)
 - defined, 880
 - function, 377
- Interior Routing Gateway Protocol, 392–393
 - default ADs, 378
 - defined, 880
 - enhanced. *See* EIGRP (Enhanced IGRP)
 - in IP header, 86
- Intermediate System-to-Intermediate System (IS-IS), 419, 880
- internal EIGRP routes, 422, 880
- internal router components, 252–253
- internal routers, 610–611, 611
- International Code Designator (ICD), 879
- International Organization for Standardization (ISO), 11, 14
- International Telecommunication Union-Telecommunication Standardization Sector (ITU-T), 882
- Internet, 880–881
- Internet Control Message Protocol (ICMP), 87–90, 87, 89
 - defined, 879
 - IOS firewall, 614

- in IP header, 86
 - in IP routing process, 331, 334, 336, 338–339, 338
- Internet Engineering Task Force (IETF) encapsulation, 800–801, 806
- Internet Group Management Protocol (IGMP), 880
- Internet layer, 69, 69–70, 83
 - ARP, 90–92, 90
 - defined, 881
 - ICMP, 87–90, 87, 89
 - IP, 84–87, 84, 86
 - RARP, 91, 92
- Internet Protocol (IP), 84–87, 84, 86, 881
- Internet protocols
 - defined, 881
 - IP addresses. *See* IP addresses
 - TCP/IP. *See* TCP/IP (Transmission Control Protocol/Internet Protocol)
 - Version 6. *See* IPv6 protocol
- internets, 881
- Internetwork Operating System.
 - See* IOS (Internetwork Operating System)
- Internetwork Packet Exchange (IPX), 882
- internetworking, 3
 - basics, 4–11, 4, 7, 9–10
 - data encapsulation, 43–46, 43–44
 - defined, 881
 - Ethernet. *See* Ethernet networking
 - exam essentials, 49–50
 - models, 11–13
 - OSI reference model. *See* OSI (Open System Interconnection) reference model
 - review questions, 56–61
 - summary, 49
 - three-layer hierarchical model, 46–49, 47
 - written lab, 50–55, 53, 62–66
- internetworks, 881
 - intra-area routing, 881
 - intrusion detection, 614
 - Inverse ARP (IARP)
 - defined, 881
 - for DLCIs, 801–802
 - IOS (Internetwork Operating System), 172–173
 - backing up, 264–265, 314
 - for bringing up routers, 175–179
 - command-line interface. *See* command-line interface (CLI)
 - for connecting to routers, 173–175, 174–175
 - defined, 865
 - exam essentials, 233–234
 - flash memory
 - managing, 270–274, 271–274
 - verifying, 263–264
 - hands-on lab, 235–241
 - IFS for, 266–270
 - restoring, 265–266, 314
 - review questions, 242–248
 - summary, 232
 - upgrading, 265–266, 268–270
 - written labs, 234, 249
 - IOS file system (IFS), 266–268
 - for configuration, 278–279
 - for IOS upgrades, 268–270
 - IOS firewall, 614–615
 - for Context-Based Access Control, 639–640, 639
 - creating, 647–654, 648–650, 653–654
 - IP (Internet Protocol), 84–87, 84, 86, 881
 - ip access-group in command, 630
 - ip access-group out command, 623, 630–631, 634
 - ip access-list command, 633
 - ip access-list standard command, 633–634
 - IP access lists
 - extended, 626–632, 657–660
 - monitoring, 640–642

- standard, 619–624, 622–624, 657
 - for Telnet, 625–626
 - wildcards with, 620–622
- ip address command, 207–208
- ip address negotiated command, 797
- IP Address screen, 815, 815
- IP addresses, 4–5, 84, 92–93
 - broadcast, 100–101
 - command-line interface for, 240
 - configuring, 207–208
 - defined, 881
 - DHCP, 73–74
 - hierarchical scheme, 93–94
 - Class A addresses, 96–97
 - Class B addresses, 97–98
 - Class C addresses, 98
 - network addressing, 94–98, 94
 - in IP routing process, 333–340
 - IPv6 protocol. *See* IPv6 protocol
 - NAT. *See* Network Address Translation (NAT)
 - private, 98–99
 - terminology in, 93
 - troubleshooting, 150–157, 150, 153–157
- IP broadcast with all zeros bit, 255
- IP broadcasts do not have net numbers bit, 255
- ip classless command, 374–375
- IP Control Program (IPCP), 881
- ip default-gateway command, 521
- ip default-network command, 375–377
- ip dhcp command, 231
- ip dhcp pool admin command, 351
- ip domain-lookup command, 303
- ip domain-name command, 303
- IP headers, 84–86, 84, 86
- ip host name command, 300
- ip http command, 225, 227
- ip inspect command, 639, 651–652
- IP multicasts, 881
- ip name-server command, 303
- ip nat inside source command, 674–676, 679
- ip nat outside source command, 675
- ip nat pool command, 675–676, 678–679
- ip nat translation max-entries command, 677
- ip nat translation timeout command, 678
- ip ospf cost command, 448
- ip route command, 363–364
- IP routing, 328
 - basics, 329–331, 330
 - configuration, 341–343, 341
 - 871W router, 359–361
 - 1242AP router, 361–362
 - 2621A router, 393–401, 399
 - Corp router, 343–346
 - R1 router, 346–349
 - R2 router, 349–352
 - R3 router, 352–359, 352–359
 - verifying, 373–374, 393–401, 399
 - default routing, 374–377, 375–376
 - dynamic routing, 377–379
 - exam essentials, 401–402
 - examples, 336–341, 337–340
 - hands-on lab, 403–406, 403
 - holddowns, 382
 - maximum hop counts, 382
 - process, 331–336, 331
 - protocols
 - administrative distances in, 377–378
 - classes, 378–379
 - distance-vector, 378–382, 379–381
 - IGRP, 392–393
 - RIP, 383–392
 - review questions, 407–414
 - route poisoning, 382

- routing loops, 380–382, 381
- split horizon, 382
- static routing, 363–364
 - 871W router, 372
 - Corp router, 364–366
 - R1 router, 366–368
 - R2 router, 368–370
 - R3 router, 370–372, 370–371
- summary, 401
- written lab, 402–403, 415
- IP spoofing, 612
- ip ssh command, 199
- ip subnet-zero command, 113, 142
- IP Unnumbered option, 356
- ipconfig command, 152, 781
- IPCP (IP Control Program), 881
- IPSec
 - configuration, 828–836, 828–835
 - security protocols, 827
 - transforms, 826–827
- ipv6 address command, 747
- ipv6 dhcp pool command, 748–749
- ipv6 dhcp server command, 749
- ipv6 eigrp command, 752
- ipv6 enable command, 748
- ipv6 ospf command, 753, 763
- IPv6 protocol, 86, 740
 - addresses
 - special, 745
 - structure, 742–743, 743
 - types, 744–745
 - benefits and uses, 741–742
 - configuration
 - autoconfiguration, 746–747, 747
 - Corp, 756–758
 - DHCPv6 servers, 747–749
 - ICMPv6 servers, 749–750
 - OSPFv3, 763–766
 - R1, 758
 - R2, 758–759
 - R3, 759
 - RIPng, 759–763
 - routers, 747–748
 - EIGRPv6, 751–752
 - exam essentials, 767
 - migrating to, 753
 - 6to4 tunneling, 754–755, 755
 - dual stacking, 754
 - NAT-PT, 755–756
 - need for, 740–741
 - OSPFv3, 752–753
 - review questions, 768–771
 - RIPng, 750–751
 - shortened expressions, 743–744
 - summary, 766
 - written labs, 767, 772
- ipv6 rip command, 751, 759–760
- ipv6 router eigrp command, 752
- ipv6 router ospf command, 753
- ipv6 router rip command, 751
- ipv6 unicast-routing command, 747, 754
- IPX (Internetwork Packet Exchange), 882
- IPX Control Program (IPXCP), 882
- IPXCP (IPX Control Program), 882
- IPXWAN protocol, 882
- IS-IS (Intermediate System-to-Intermediate System), 419, 880
- ISDN (Integrated Services Digital Network)
 - defined, 882
 - description, 778
- ISL (Inter-Switch Link) routing
 - defined, 882
 - VLANs, 562
- ISM (Industrial, Scientific, and Medical) bands, 706
- ISO (International Organization for Standardization), 11, 14
- isochronous transmission, 882

ITU-T (International Telecommunication Union-Telecommunication Standardization Sector), 882
 ITU-T format, 804

J

jam signals, 32, 32
 Java applet blocking, 615

K

keepalives, 803
 Kerberos authentication, 882
 keys, wireless networks, 720

L

L2F (Layer 2 Forwarding), 826
 L2TP (Layer 2 Tunneling Protocol)
 defined, 826
 in IP header, 86
 LACP (Link Aggregation Control Protocol), 514
 LAN emulation (LANE), 882
 LAN Emulation Address Resolution Protocol (LE ARP), 883
 LAN Emulation Client (LEC), 883
 LAN Emulation Configuration Server (LECS), 883
 LAN Emulation Network-to-Network Interface (LNNI), 884
 LAN Emulation Server (LES), 884
 LAN Emulation User-to-Network Interface (LUNI), 885
 LAN switches, 882
 LANE (LAN emulation), 882
 LANs (Local Area Networks)
 defined, 882
 VLANs. *See* VLANs (virtual LANs)

LAPB (Link Accessed Procedure, Balanced)
 defined, 883
 description, 778
 LAPD (Link Access Procedure, D channel)
 defined, 883
 description, 778
 large network support in EIGRP, 422–426, 423–424
 last-resort command, 194
 latency
 defined, 883
 ports, 25
 Layer 2 broadcasts, 100
 Layer 2 Forwarding (L2F), 826
 layer 2 switching, 494
 address learning by, 499–501, 500–501
 benefits, 497–498
 vs. bridging, 499
 exam essentials, 542
 forward/filter decisions by, 501–504, 502
 limitations, 498–499
 loop avoidance, 504–505, 504–505
 review questions, 543–549
 STP in. *See* STP (Spanning Tree Protocol)
 summary, 541
 switching before, 494–497, 495–497
 written lab for, 542, 550
 Layer 2 Tunneling Protocol (L2TP)
 defined, 826
 in IP header, 86
 layered architecture
 defined, 883
 in internetworking, 12
 layers, 883
 LCP (Link Control Protocol)
 defined, 883
 options, 789

- LE ARP (LAN Emulation Address Resolution Protocol), 883
- leaky buckets, 883
- learning bridges, 883
- learning state in STP, 510
- leased lines
 - defined, 883
 - WANs, 776
- LEC (LAN Emulation Client), 883
- LECS (LAN Emulation Configuration Server), 883
- Length field, 36
- Length of segment field, 78
- LES (LAN Emulation Server), 884
- licensing for wireless technologies, 705–706, 706
- Lightweight Access Point Protocol (LWAPP), 714–717, 717–718
- line command, 183–184, 195
- line aux command, 195
- line console command, 184, 196
- line delay in EIGRP, 425
- Line Printer Daemon (LPD)
 - defined, 885
 - function, 72
- line vty command, 197–198
- Link Access Procedure, D
 - channel (LAPD)
 - defined, 883
 - description, 778
- Link Accessed Procedure, Balanced (LAPB)
 - defined, 883
 - description, 778
- Link Aggregation Control Protocol (LACP), 514
- Link Control Protocol (LCP)
 - defined, 883
 - options, 789
- link-establishment phase for PPP
 - sessions, 790
- link-local addresses in IPv6, 744
- Link-State Advertisements (LSAs)
 - defined, 885
 - OSPF, 447
- link-state protocols, 378–379
- link-state routing algorithm, 884
- links, OSPF, 446
- listening state in STP, 510
- LLAP (LocalTalk Link Access Protocol), 884
- LLC (Logical Link Control) layer
 - defined, 884
 - function, 25
- LMI (Local Management Interface)
 - defined, 884
 - Frame Relay, 803–804
- LNNI (LAN Emulation Network-to-Network Interface), 884
- load balancing
 - defined, 884
 - EIGRP, 435–438, 442
 - RIP, 379
- Local Area Network Emulation (LANE), 882
- Local Area Networks (LANs)
 - defined, 882
 - VLANs. *See* VLANs (virtual LANs)
- local explorer packets, 884
- Local Interface field, 285
- local loops
 - defined, 885
 - WANs, 775
- Local Management Interface (LMI)
 - defined, 884
 - Frame Relay, 803–804
- local NAT names, 672–673, 673–674
- locally unique addresses, 746
- LocalTalk protocol, 885
- LocalTalk Link Access Protocol (LLAP), 884

- lock and key access lists, 636–637
 - log command, 630
 - logging into routers, 235–236
 - logging synchronous command, 196–197
 - logical addresses, 84, 329, 885
 - Logical Link Control (LLC) layer
 - defined, 884
 - function, 25
 - login banners, 193–194
 - login command, 195
 - logout command, 181
 - Long Range Ethernet (LRE), 784–785
 - loopback addresses, 151
 - loopback interfaces, 466–471
 - loopback tests, 96
 - loops
 - avoiding, 504–505, 504–505, 885
 - routing, 380–382, 381
 - LPD (Line Printer Daemon)
 - defined, 885
 - function, 72
 - LRE (Long Range Ethernet), 784–785
 - LSAs (Link-State Advertisements)
 - defined, 885
 - OSPF, 447
 - LUNI (LAN Emulation
 - User-to-Network Interface), 885
 - LWAPP (Lightweight Access Point
 - Protocol), 714–717, 717–718
-
- M**
- mac access-list command, 635
 - MAC (Media Access Control)
 - addresses, 25
 - Catalyst switches, 528–530
 - Data Link layer, 34
 - defined, 885
 - Ethernet addressing, 4–5, 34–35, 34
 - IPv6 autoconfiguration, 746
 - RARP for, 91
 - split-MAC architecture, 715–716, 715
 - STP, 521–522
 - VLANs, 559
 - wireless network authentication, 719–720
 - MAC forward/filter tables, 499–504, 500–501
 - MAC frame format in Ethernet frames, 34–35
 - MAC (Media Access Control) layer
 - defined, 885
 - Ethernet, 38
 - function, 25
 - MacIP protocol, 885
 - macro command, 536–537
 - major commands, 184
 - man-in-the-middle attacks, 613
 - Management Information Base (MIB), 886
 - management of routers, 252
 - CDP for, 283–289, 315–316
 - configuration backups and restoration
 - backups, 274–276
 - erasing, 277–278
 - IFS for, 278–279
 - restoring, 276–277
 - SDM for, 280–283, 280–283
 - configuration registers, 254–262
 - exam essentials, 311–312
 - hands-on lab, 313–317
 - hostname resolution, 300–304, 316–317
 - and internal router components, 252–253
 - IOS backups and restoration, 262–263, 263
 - backups, 264–265
 - flash memory management, 270–274, 271–274

- flash memory verification, 263–264
- IFS for, 266–270
- restoring and upgrading, 265–266
- network connectivity, 305–311, 306
- review questions, 318–324
- and router boot sequence, 253–254
- subnetting for, 113
- summary, 311
- Telnet for, 295–299, 316
- written lab, 313, 325
- Manchester encoding, 885
- MANs (metropolitan area networks), 885
- map command, 802, 810–812
- MAPs (Mesh Access Points), 717
- mask parameter, 363
- masks
 - OSPF, 450
 - subnet, 115–116, 137–138
- Maximum Burst Size (MBS), 886
- maximum bursts, 886
- Maximum Cell Delay Variation (MCDV), 886
- Maximum Cell Loss Ratio (MCLR), 886
- Maximum Cell Transfer Delay (MCTD), 886
- maximum hop counts
 - defined, 886
 - EIGRP, 425
 - for routing loops, 382
- maximum-hops command, 425
- maximum-paths command, 425
- maximum paths in EIGRP, 425–426
- maximum rates, 886
- Maximum Transmission Units (MTUs)
 - defined, 887
 - displaying, 218–219
 - EIGRP, 425
 - Ethernet, 38
 - ICMPv6 servers, 750
 - IGRP, 392
- MBONEs (multicast backbones), 886
- MBS (Maximum Burst Size), 886
- MCDV (Maximum Cell Delay Variation), 886
- MCLR (Maximum Cell Loss Ratio), 886
- MCR (Minimum Cell Rate), 886
- MCTD (Maximum Cell Transfer Delay), 886
- Media Access Control (MAC) layer
 - defined, 885
 - Ethernet, 38
 - function, 25
- Media Access Control addresses.
 - See* MAC (Media Access Control) addresses
- Media Independent Interface (MII)
 - defined, 886
 - throughput in, 38
- media translation
 - defined, 886
 - LAN switching, 30
- Mesh Access Points (MAPs), 717
- Mesh wireless topology, 716–717, 717–718
- metrics
 - defined, 898
 - EIGRP, 425
 - IGRP, 392
 - routing tables, 23
- metropolitan area networks (MANs), 885
- MIB (Management Information Base), 886
- migrating to IPv6 protocol, 753
 - 6to4 tunneling, 754–755, 755
 - dual stacking, 754
 - NAT-PT, 755–756
- MII (Media Independent Interface)
 - defined, 886
 - throughput in, 38

942 millions of instructions per second (mips) – NAT-PT (NAT protocol translation)

millions of instructions per second (mips), 887

MIMO (Multiple-Input Multiple Output), 711–712

mini-OS component, 253

Minimum Cell Rate (MCR), 886

MIP (Multichannel Interface Processor), 887

mips (millions of instructions per second), 887

mkdir command, 266, 268

MLP (Multilink PPP), 887

mls qos command, 587–588

MMP (Multichassis Multilink PPP), 887

modem eliminators, 887

modems, 887

modulation, 887

more command, 266–267

MOSPF (Multicast OSPF), 887

MOTD banners, 193–194

MPLS (MultiProtocol Label Switching), 779

MPOA (Multiprotocol over ATM), 887

MTUs (Maximum Transmission Units)

defined, 887

displaying, 218–219

EIGRP, 425

Ethernet, 38

ICMPv6 servers, 750

IGRP, 392

multi-access networks, 447

multicast addresses, 887

multicast backbones (MBONEs), 886

multicast group addresses, 101

multicast groups, 887

Multicast OSPF (MOSPF), 887

multicast send VCC, 888

multicasts, 100

defined, 887

IPv6, 742, 745

layer 2 switching, 499

LMI, 803

multimedia applications, 554

reliable, 421

Multichannel Interface Processor (MIP), 887

Multichassis Multilink PPP (MMP), 887

multilayer switches, 888

Multilink PPP (MLP), 887

multilinks

defined, 888

LCP, 789

multimedia applications, 554

multiple autonomous systems, 422–423

multiple devices, Telnet with, 297

Multiple-Input Multiple Output (MIMO), 711–712

multiplexing, 888

multipoint subinterfaces, 807

MultiProtocol Label Switching (MPLS), 779

Multiprotocol over ATM (MPOA), 887

N

NAK (Negative Acknowledgment) responses, 888

Name Binding Protocol (NBP), 888

named access lists

defined, 888

working with, 632–634

names

NAT, 672, 673–674

R3 router configuration, 353, 353

NAPT-PT (Network Address Port Translation), 756

NAT. *See* Network Address Translation (NAT)

NAT-PT (NAT protocol translation), 755–756

- native VLANs, 559
 - defined, 888
 - modifying, 573–574
 - NBAR (Network Based Application Recognition), 834
 - NBMA (non-broadcast multi-access) networks, 447
 - NBP (Name Binding Protocol), 888
 - NCP (Network Control Protocol), 788, 790
 - Negative Acknowledgment (NAK) responses, 888
 - neighbor databases, 446
 - neighbor discovery, 419–421
 - neighboring routers, 888
 - neighbors
 - CDP, 284–289
 - defined, 888
 - EIGRP, 419–421
 - OSPF, 446, 465
 - neighborship tables
 - defined, 888
 - EIGRP, 420, 425
 - NetBEUI (NetBIOS Extended User Interface), 889
 - NetBIOS (Network Basic Input/Output System), 889
 - netmask command, 679
 - NetView product, 889
 - NetWare Link Services Protocol (NLSP), 890
 - NetWare operating system, 889
 - Network Access layer
 - defined, 889
 - function, 69, 69–70
 - Network Address Translation (NAT), 98–99, 670
 - configuration, 679–684, 680
 - dynamic, 675, 692–693
 - overloading, 675–676, 694–695
 - SDM for, 684–687, 685–686
 - static, 674–675
 - verifying, 676
 - defined, 888
 - exam essentials, 688
 - hands-on labs, 689–695, 690
 - names, 672, 673–674
 - NAT-PT, 755–756
 - operation, 673–674, 673–674
 - review questions, 696–700
 - summary, 688
 - testing and troubleshooting, 677–679, 678–679
 - types, 671–672
 - uses, 670, 671
 - written labs, 688–689, 701
- network addresses, 93
 - defined, 889
 - IP addressing, 94–98, 94
 - routing tables, 22
 - Network Based Application Recognition (NBAR), 834
 - Network Basic Input/Output System (NetBIOS), 889
 - network command
 - EIGRP, 426
 - OSPF, 450
 - RIP, 384
 - network connectivity, 305
 - ping command for, 305–306
 - traceroute command for, 307–308
 - Network Control Protocol (NCP), 788, 790
 - Network File System (NFS)
 - defined, 889
 - file sharing, 71
 - Network Interface Cards (NICs)
 - defined, 890
 - MAC addresses in, 34–35, 34
 - Network layer
 - defined, 889
 - encapsulation, 45–46
 - OSI reference model, 22–23, 22–23

- network-layer protocol phase in PPP sessions, 790
 - Network Management Processor (NMP), 890
 - network performance, subnetting for, 113
 - network reconnaissance attacks, 613
 - network segmentation, 6–8, 6
 - network termination (NT) devices
 - NT1, 890
 - NT2, 890
 - Network Time Protocol (NTP), 637
 - network traffic, subnetting for, 113
 - networks
 - classless, 137–138
 - topology documentation, 292–294, 292, 294
 - next hop address parameter, 363
 - Next Hop Resolution Protocol (NHRP), 889
 - Next Hop Server (NHS), 889
 - NFS (Network File System)
 - defined, 889
 - file sharing, 71
 - NHRP (Next Hop Resolution Protocol), 889
 - NHS (Next Hop Server), 889
 - nibbles, 27–29
 - defined, 890
 - in MII, 38
 - NICs (Network Interface Cards)
 - defined, 890
 - MAC addresses in, 34–35, 34
 - NLSP (NetWare Link Services Protocol), 890
 - NMP (Network Management Processor), 890
 - no auto-summary command, 435
 - no cdp enable command, 284, 290
 - no cdp run command, 284, 290
 - no ip domain-lookup command, 303
 - no ip host command, 302
 - no login command, 195, 295
 - no shutdown command, 219, 579
 - node addresses
 - defined, 890
 - in IP addresses, 94
 - non-broadcast multi-access (NBMA) networks, 447
 - non-designated ports, 890
 - non-stub areas, 890
 - non-volatile RAM (NVRAM), 175
 - copying configuration to, 275–276
 - defined, 890
 - displaying, 278
 - for startup-config file, 253–254, 258
 - nondesignated ports, 507
 - nonegotiate command, 572
 - nonroot bridges, 507
 - NRZ (Nonreturn to Zero) encoding, 890
 - NRZI (Nonreturn to Zero Inverted) encoding, 890
 - NT (network termination) devices
 - NT1, 890
 - NT2, 890
 - NTP (Network Time Protocol), 637
 - number system conversions, 26–30, 53–55
 - NVRAM (non-volatile RAM), 175
 - copying configuration to, 275–276
 - defined, 890
 - displaying, 278
 - for startup-config file, 253–254, 258
-
- O**
- o/r command, 259
 - OC (Optical Carrier) protocols, 891
 - octets, 93, 891
 - OEM bit enabled bit, 255
 - OFDM (Orthogonal Frequency Division Multiplexing) technique, 709

- 100BaseFX technology, 38
- 100BaseT technology, 852
- 100BaseTX technology, 38, 852
- 1000BaseCX technology, 38
- 1000BaseLX technology, 39
- 1000BaseSX technology, 39
- 1000BaseT technology, 39
- ones density clocking, 891
- open-access mode in wireless networks, 719
- Open Shortest Path First protocol.
See OSPF (Open Shortest Path First) protocol
- Open System Interconnection (OSI), 891
- Optical Carrier (OC) protocols, 891
- optimized network performance, subnetting for, 113
- Options field
 - IP header, 85
 - TCP header, 76
- Organizationally Unique Identifiers (OUIs)
 - defined, 891
 - format of, 34
- Orthogonal Frequency Division Multiplexing (OFDM) technique, 709
- OSI (Open System Interconnection), 891
- OSI (Open System Interconnection) reference model, 11–15, 13–15, 50–52
 - Application layer, 15–16
 - Data Link layer, 24–30, 24, 26
 - defined, 891
 - Network layer, 22–23, 22–23
 - Physical layer, 30–31
 - Presentation layer, 16
 - Session layer, 16
 - Transport layer, 16–21, 18–21
- OSPF (Open Shortest Path First) protocol
 - adjacencies, 465–466
 - configuration, 449
 - 871W, 457
 - areas, 450–453, 452
 - Corp, 453–454
 - debugging, 462–464
 - enabling, 449
 - R1, 454
 - R2, 454
 - R3, 454–456, 455–456
 - summary routes, 474–476, 475–476
 - troubleshooting, 471–473, 472–474
 - verifying, 457–462
 - default ADs, 378
 - defined, 891
 - DR and BDR elections, 465–466
 - exam essentials, 476–477
 - hands-on labs, 478–483, 478, 482
 - as link-state protocol, 379
 - loopback interfaces, 466–471
 - neighbors, 465
 - overview, 444–446, 445
 - priorities, 469–471, 470
 - review questions, 484–490
 - vs. RIP, 444–445
 - SPF tree calculation, 448–449
 - summary, 476–477
 - terminology, 446–448
 - wildcards, 450–453, 452
 - written lab, 477–478, 491
- OSPFv3 protocol
 - IPv6 configuration, 763–766
 - overview, 752–753
- OUIs (Organizationally Unique Identifiers)
 - defined, 891
 - format of, 34

out-of-band management, 174, 891
out-of-band signaling, 892
outbound access lists, 617
outside NAT names, 672–673, 674
overload command, 676
overloading NAT, 672–674, 674
 configuration, 675–676, 694–695
 defined, 892

P

Packet InterNet Group command.
 See Ping (Packet Internet Groper) command
Packet Level Protocol (PLP), 893
packet sniffer attacks, 613
packet switch exchange (PSE), 895
packet-switched networks (PSNs), 895
packet switches, 892
packet switching
 defined, 892
 WANs, 776, 776
packets, 43
 defined, 892
 Network layer, 22
PAGP (Port Aggregation Protocol), 514
PAP (Password Authentication Protocol)
 defined, 892
 PPP, 790–791
parity checking, 892
partial meshed networks, 892
passive-interface command
 EIGRP, 426–427
 RIP, 390
passive interfaces, 386
passive state in EIGRP, 441
password attacks, 613
Password Authentication Protocol (PAP)
 defined, 892
 PPP, 790–791
password command
 for enable passwords, 194
 in PPP, 791
passwords
 auxiliary, 195–196
 console, 196–197
 enable. *See* enable passwords
 encrypting, 199–201
 FTP, 71
 R3 router configuration, 353, 353
 recovering, 258–261
 SDM, 227
 setting, 194–195, 237–239
 Telnet, 197–198, 295–296
PAT (Port Address Translation),
 672–674, 674
 configuration, 675–676, 694–695
 defined, 892
paths in EIGRP, 425–426
PCM (pulse code modulation), 892
PCR (peak cell rate), 892
PDMs (protocol-dependent modules)
 defined, 895
 EIGRP, 419
PDNs (public data networks), 892
PDUs (Protocol Data Units)
 defined, 893
 in encapsulation, 43, 43–44
peak cell rate (PCR), 892
peer route authentication, 615
per-user firewalls, 614
performance, subnetting for, 113
perimeters, 610–611, 611
periodic command, 637
permanent parameter, 364
permanent virtual circuits (PVCs)
 defined, 895
 Frame Relay, 801
permanent virtual paths (PVPs), 895
permit ip any command, 646

- PGP (Pretty Good Privacy)
 - encryption, 893
- phantom routers, 893
- phone calls in VLANs, 586–588
- Physical layer, 30–31
 - defined, 893
 - Ethernet networking at, 37–39, 37
- PIM (Protocol Independent Multicast) protocol, 893
- PIM-DM (Protocol Independent Multicast Dense Mode), 893
- PIM-SM (Protocol Independent Multicast Sparse Mode), 893
- Ping (Packet Internet Groper) command
 - defined, 893
 - ICMP, 88
 - IP addresses, 151–152
 - for network connectivity, 305–306
 - protocols with, 214–215
 - TFTP, 265
 - for verifying configuration, 373–374
- ping of death attacks, 612
- pinhole congestion, 380, 380, 893
- pipes, 208–209
- plain old telephone service (POTS), 894
- Platform field, 285
- pleisochronous transmissions, 893
- PLP (Packet Level Protocol), 893
- PNNI (Private Network-Network Interface), 893
- PoE (Power over Ethernet) light, 516
- point-to-multipoint connections
 - defined, 893
 - OSPF, 448
- point-to-point connections
 - defined, 894
 - OSPF, 448
 - WANs, 776
- Point-to-Point Protocol. *See* PPP (Point-to-Point Protocol)
- Point-to-Point Protocol over Ethernet (PPPoE)
 - for ADSL, 783–784, 784
 - configuration, 796–797, 818–822, 819–822
 - description, 778
- point-to-point subinterfaces, 807
- Point-to-Point Tunneling Protocol (PPTP), 826
- points of presence (POPs)
 - defined, 894
 - WANs, 775
- poison reverse updates
 - defined, 894
 - function, 382
- poisoning, route, 382
- policy-based, multi-interface filtering, 615
- polling access method, 894
- POP (Post Office Protocol), 894
- POPs (points of presence)
 - defined, 894
 - WANs, 775
- Port Address Translation (PAT),
 - 672–674, 674
 - configuration, 675–676, 694–695
 - defined, 892
- Port Aggregation Protocol (PAgP), 514
- Port ID field, 285
- port redirection attacks, 613
- port-security aging command, 536
- port-security command, 503–504
- PortFast, Catalyst switch configuration, 522–523
- portfast command, 512–513, 522–523
- ports and port numbers
 - access lists, 634–636
 - Catalyst switches, 516, 521–522
 - CDP for, 290–291
 - CNA, 535–536, 535, 538, 538

- console commands for, 196–197
- defined, 894
- dynamic mapping, 615
- forward/filter decisions, 503–504
- host-to-host layer protocols, 80–82, 80
- NAPT-PT, 756
- security for, 503–504, 521–522, 894
- STP, 507–511
- TCP, 76, 80–82
- Transport layer, 45, 45
- UDP segment, 78
- VLANs, 570–574, 586
- positive acknowledgment with
 - retransmission technique, 21, 894
- POST (power-on self test)
 - in bringing up routers, 175–176
 - as router component, 252–253
- Post Office Protocol (POP), 894
- POTS (plain old telephone service), 894
- Power over Ethernet (PoE) light, 516
- powers of 2, 114
- PPP (Point-to-Point Protocol),
 - 788–789, 788
 - authentication, 790–794, 813–818, 813–816
 - configuring, 791–792, 838–839, 838
 - debugging, 793–796, 794–795
 - defined, 894
 - description, 778
 - encapsulation, 792–795, 792–794
 - LCP in, 789
 - sessions, 790
- ppp authentication command, 791, 797
- PPP callback, 789
- ppp chap command, 797
- PPP over ATM (PPPoA), 783
- PPPoE (Point-to-Point Protocol over Ethernet)
 - for ADSL, 783–784, 784
 - configuration, 796–797, 818–822, 819–822
 - description, 778
 - pppoe-client command, 797
 - pppoe enable command, 796–797
- PPTP (Point-to-Point Tunneling Protocol), 826
- Pre-Shared Key (PSK), 720
- preambles in Ethernet frames, 36
- prefix-length command, 679
- prefix routing, 383, 894
- Presentation layer
 - defined, 894
 - OSI reference model, 16
- Pretty Good Privacy (PGP)
 - encryption, 893
- PRI (Primary Rate Interface), 894
- priorities
 - datagrams, 85
 - OSPF, 469–471, 470
 - STP, 508–510
- Priority field, 85
- priority queueing, 895
- private IP addresses, 98–99
- Private Network-Network Interface (PNNI), 893
- privileged mode
 - defined, 184, 895
 - entering, 180, 260
- Process/Application layer, 69, 69–70
 - defined, 895
 - protocols in, 70–74
- process switching, 895
- processes, connectivity, 310–311
- PROM (Programmable Read-Only Memory), 895
- prompts in command-line interface, 182
 - for interfaces, 182–183
 - line commands, 183–184
 - for routing protocol
 - configurations, 184
 - for subinterfaces, 183
- propagation delay, 895
- propagations in RIP, 390

Protocol Data Units (PDUs)
 defined, 893
 in encapsulation, 43, 43–44
protocol-dependent modules (PDMs)
 defined, 895
 EIGRP, 419
Protocol field, 85–87
Protocol Independent Multicast (PIM)
 protocol, 893
Protocol Independent Multicast Dense
 Mode (PIM-DM), 893
Protocol Independent Multicast Sparse
 Mode (PIM-SM), 893
protocol stacks, 895
protocols. *See also specific protocols*
 by name
 administrative distances in, 377–378
 classes, 378–379
 CLI prompts for, 184
 defined, 895
Proxy ARP (Proxy Address
 Resolution Protocol)
 defined, 895
 operation, 91–92
pruning
 defined, 895
 VTP, 565–566
PSE (packet switch exchange), 895
PSK (Pre-Shared Key), 720
PSNs (packet-switched networks), 895
PSTNs (public switched telephone
 networks), 895
public data networks (PDNs), 892
pulse code modulation (PCM), 892
PVCs (permanent virtual circuits)
 defined, 895
 Frame Relay, 801
PVP tunneling, 896
PVPs (permanent virtual paths), 895
pwd command, 266, 268

Q

QoS (Quality of Service)
 defined, 896
 VLAN telephony, 586
 VPN tunnels, 832–836, 832–835
QoS Policy Generation screen, 834, 834
QoS Wizard, 833–835, 833–835
question marks (?) for commands,
 185–186
queues, 896

R

R reference point, 896
R1 router configuration
 EIGRP, 429–430
 IP, 346–349
 IPv6, 758
 NAT, 681
 OSPF, 454
 RIP, 384–385
 static routing, 366–368
R2 router configuration
 EIGRP, 430
 IP, 349–352
 IPv6, 758–759
 NAT, 681
 OSPF, 454
 RIP, 385
 static routing, 368–370
R3 router configuration
 EIGRP, 430–432, 430
 IP, 352–359, 352–359
 IPv6, 759
 NAT, 681
 OSPF, 454–456, 455–456
 RIP, 385–387, 386
 static routing, 370–372, 370–371

950 RA (router advertisement) requests – remote VPNs

- RA (router advertisement) requests
 - DHCPv6 servers, 748
 - ICMPv6 servers, 750
 - IPv6 autoconfiguration, 746, 747
- radio frequencies (RF) for wireless technologies, 704
- RADIUS (Remote Authentication Dial-In User Service)
 - defined, 896
 - wireless networks, 721
- RAM (random access memory)
 - defined, 896
 - routers, 253
- range command
 - STP, 512–513
 - VLANs, 570–571
- Rapid Spanning Tree Protocol (RSTP)
 - benefits, 513–514
 - Catalyst switch configuration, 525–526
- RAPs (Route Access Points), 717–718
- RARP (Reverse Address Resolution Protocol)
 - defined, 896
 - operation, 91, 92
- RARP servers, 91, 896
- rate queues, 896
- RCP (Remote Copy Protocol), 896
- read-only memory (ROM)
 - defined, 897
 - routers, 253
- recovering passwords, 258–261
- redirection attacks, 613
- redistribute eigrp command, 433
- redistribute rip command, 432
- redistribution
 - EIGRP, 423, 432–434
 - OSPF, 444
 - RIP, 391
- reduced network traffic, subnetting
 - for, 113
- redundancy, 896
- refcount command, 677
- reference models
 - defined, 896
 - OSI. *See* OSI (Open System Interconnection) reference model
- reflexive access lists, 637
- registered jack (RJ) connectors
 - console ports, 173–174
 - defined, 897
 - Ethernet, 37, 41, 42
- registers, configuration, 253
 - bits in, 254–255
 - changing values, 256–257
 - checking values, 256
 - defined, 866
 - for password recovery, 258–261
- Registry, hexadecimal addresses in, 93
- reliability
 - defined, 896
 - displaying, 218
 - EIGRP, 425
- reliable data delivery, 21, 21
- reliable multicasts, 421, 896–897
- reliable networking, 17
- Reliable Transport Protocol (RTP), 421
- reloading
 - defined, 897
 - routers, 260
- remark command, 638–639
- remarks in access lists, 638–639
- Remote Authentication Dial-In User Service (RADIUS)
 - defined, 896
 - wireless networks, 721
- remote client machines, Telnet for, 71
- Remote Copy Protocol (RCP), 896
- remote VPNs, 825

- repeaters, 30–31
- reported distances in EIGRP, 420
- “request timed out” message, 335
- Request To Send (RTS) signal
 - CSMA/CD, 708
 - defined, 898
- reserved addresses
 - IP, 96, 99
 - IPv6, 745
- Reserved field, 76
- Reset Router option, 352
- resolving host names, 73, 300–304, 316–317
- restoration
 - configuration, 276–277, 280–283, 280–283
 - IOS, 265–266, 314
- Retransmission Time Out (RTO)
 - field, 440
- Reverse Address Resolution Protocol (RARP)
 - defined, 896
 - operation, 91, 92
- RF (radio frequencies) for wireless technologies, 704
- RFC1483 routing, 783
- RIDs (Router IDs)
 - OSPF, 446, 466
 - OSPFv3, 752
- RIF (Routing Information Field), 897
- ring stations, 897
- ring topology, 897
- RIP (Routing Information Protocol), 383
 - configuration, 405–406
 - 871W router, 387
 - Corp router, 383–384
 - example, 389–390, 389
 - R1 router, 384–385
 - R2 router, 385
 - R3 router, 385–387, 386
 - default ADs, 378
 - defined, 897
 - load balancing, 379
 - need for, 391
 - vs. OSPF, 444–445
 - propagations, 390
 - RIPv2
 - enabling, 398–401, 399
 - vs. RIPv1, 390–392
 - timers, 383
 - verifying routing tables, 387–389
- RIPng protocol
 - configuration, 759–763
 - overview, 750–751
- RJ connectors
 - console ports, 173–174
 - defined, 897
 - Ethernet, 37, 41, 42
- rmdir command, 266, 268
- robbed-bit signaling, 897
- rolled cable
 - defined, 897
 - Ethernet networking, 40–41, 40
- ROM (read-only memory)
 - defined, 897
 - routers, 253
- ROM monitor component, 252
- ROM monitor mode field, 255
- rommon 1 prompt, 259
- root bridges
 - defined, 897
 - STP, 506, 508–510, 532–534
- root ports in STP, 507
- round-robin load balancing, 379
- Route Access Points (RAPs), 717–718
- route aggregation, 147–150, 147, 149
- route discovery in EIGRP, 424–425
- route flaps, 897
- route flush timers, 383
- route invalid timers, 383

952 route poisoning – RSTP (Rapid Spanning Tree Protocol)

- route poisoning
 - defined, 897
 - IP routing, 382
- Route Processors (RPs), 898
- route redistribution
 - EIGRP, 423, 432–434
 - OSPF, 444
 - RIP, 391
- route summarization
 - defined, 898
 - EIGRP, 423–424, 424
 - process, 147–150, 147, 149
- Route/Switch processors (RSPs), 898
- route update packets, 22
- route update timers, 383
- routed protocols
 - defined, 898
 - Network layer, 22
- router advertisement (RA) requests
 - DHCPv6 servers, 748
 - ICMPv6 servers, 750
 - IPv6 autoconfiguration, 746, 747
- router configuration mode, 426
- router eigrp command, 426, 429
- Router IDs (RIDs)
 - OSPF, 446, 466
 - OSPFv3, 752
- router ospf command, 449–450
- router rip command, 383–384
- router solicitation (RS) requests
 - DHCPv6 servers, 748
 - ICMPv6 servers, 750
 - IPv6 autoconfiguration, 746, 747
- routers, 8–11, 9–10, 23, 23
 - boot sequence, 253–254, 259
 - bringing up, 175–179
 - configuring. *See* configuration
 - connecting to, 173–175, 174–175
 - defined, 898
 - interfaces for. *See* interfaces
 - logging into, 235–236
 - managing. *See* management of routers
 - Network layer, 22
 - network segmentation, 6–7
 - reloading, 260
 - before switching, 494–495
- routing
 - command-line interface for, 189–191
 - defined, 898
 - Internet layer protocols for, 83
 - IP. *See* IP routing
 - between VLANs, 567–568, 567–568
 - routing by rumor, 379
 - routing domains, 898
 - Routing Information Field (RIF), 897
 - Routing Information Protocol. *See* RIP (Routing Information Protocol)
 - routing loops, 380–382, 381
 - routing metrics
 - defined, 898
 - EIGRP, 425
 - IGRP, 392
 - routing tables, 23
 - routing protocols, 22. *See also specific protocols by name*
 - CLI prompts for, 184
 - defined, 898
 - routing tables, 22–23, 22
 - defined, 898
 - EIGRP, 425
 - RIP, 387–389
 - RPs (Route Processors), 898
 - RS (router solicitation) requests
 - DHCPv6 servers, 748
 - ICMPv6 servers, 750
 - IPv6 autoconfiguration, 746, 747
 - RSPs (Route/Switch processors), 898
 - RSTP (Rapid Spanning Tree Protocol)
 - benefits, 513–514
 - Catalyst switch configuration, 525–526

- RTO (Retransmission Time Out)
 field, 440
- RTP (Reliable Transport Protocol), 421
- RTS (Request To Send) signal
 CSMA/CD, 708
 defined, 898
- running-config file, 177
 for configuration, 213, 275
 for interface status, 207
 for IP access lists, 640–642
 for passwords, 199–200
 for PPP, 796
- RXBOOT component, 253
-
- S**
- S reference points, 899
- S1 Catalyst switch configuration,
 517–518
- S2 Catalyst switch configuration,
 518–519
- SA (Source Address) field, 36
- sampling rates, 899
- SAP (Service Access Point), 899
- SAP (Service Advertising Protocol), 899
- saving configurations, 212–213, 237
- scalability
 RIPv1 vs. RIPv2, 391
 VLANs, 555–558, 556–557
- SCR (sustainable cell rate), 899
- scrolling command lines, 188
- SDH (Synchronous Digital
 Hierarchy), 899
- SDLC (Synchronous Data Link
 Control), 899
- SDM (Security Device Manager), 175,
 223–224
 access lists
 creating, 643–647, 643–646
 firewalls, 647–654, 648–650,
 653–654
 backups and restores, 280–283,
 280–283
 configuring, 225–232, 226–230, 241
 connectivity, 306, 306
 downloading, 224
 flash memory management,
 270–274, 271–274
 Frame Relay configuration,
 822–825, 823–824
 NAT configuration, 684–687,
 685–686
 PPP authentication, 813–818,
 813–816
 PPPoE configuration, 818–822,
 819–822
 Telnet protocol, 299–300, 299–300
 VPN configuration, 828–836,
 828–835
 wireless network configuration,
 721–728, 722–728
 secondary command, 207
 secret command, 194
 Secure Shell (SSH), 198–199
 security, 610
 access lists. *See* access lists
 Catalyst switch configuration,
 521–522
 devices for, 610–611, 611
 firewalls, 614–615, 647–654,
 648–650, 653–654
 forward/filter decisions, 503–504
 IPsec, 827
 threats, 611–613
 VLANs, 555
 wireless networks, 718–721
 Security Device Manager. *See* SDM
 (Security Device Manager)
 seed routers, 899

954 segment format – show interface command

- segment format
 - TCP, 75–77, 75
 - UDP, 78–79, 78
- segmentation, 6–8, 6
- Seq field in EIGRP, 440
- Sequence number field
 - ESP, 827
 - TCP header, 76
- Sequenced Packet Exchange (SPX), 902
- sequencing
 - defined, 899
 - TCP, 76
- serial interface commands, 209–212, 209–210
- Serial Line Internet Protocol (SLIP), 900
- serial transmissions
 - defined, 899
 - WANs, 785–786
- Serial Tunnel (STUN) technology, 904
- Serial WAN Connection Wizard,
 - 814, 814
- server mode in VTP, 564
- servers, 899
- Service Access Point (SAP), 899
- Service Advertising Protocol (SAP), 899
- service password-encryption command,
 - 200–201, 791
- Service Profile Identifiers (SPIDs), 902
- Service Set Identifiers (SSIDs), 713,
 - 719–720
- Session layer
 - defined, 899
 - OSI reference model, 16
- sessions
 - PPP, 790
 - Telnet, closing, 298–299
- set-based routers, 899
- setup command, 178
- setup modes
 - defined, 899
 - router, 178–179, 184
- SFD (Start Frame Delimiter)/Synch
 - field, 36
- SFs (Super Frames), 900
- shared keys, 720
- shared trees, 900
- shielded twisted pair (STP) wiring, 904
- shortened expressions in IPv6, 743–744
- Shortest Path First (SPF) algorithm
 - defined, 902
 - OSPF, 448–449
- shortest-path-first protocols,
 - 378–379, 900
- show access-list command, 640–641
- show cdp command, 284
- show cdp entry * command, 287–288
- show cdp interface command, 289
- show cdp neighbors command,
 - 284–285
- show cdp neighbors detail command,
 - 286–289, 796
- show cdp traffic command, 289
- show commands, do for, 203–204
- show controllers command, 222–223,
 - 222–223, 346
- show file command, 267, 269–270, 278
- show flash command, 257, 263–264, 269
- show frame command, 808
- show frame map command, 810–811
- show frame-relay lmi command, 809
- show frame-relay map command,
 - 802, 812
- show frame-relay pvc command, 805,
 - 809–810
- show history command, 188–189
- show hosts command, 301, 304
- show interface command
 - Catalyst switches, 528
 - Frame Relay, 810
 - interface status, 207
 - PPP, 792–793, 796
 - verifying configurations, 216–220

- show interface fastethernet
 - command, 217
- show interface serial command, 219
- show interface trunk command, 566
- show ip access-list command, 640
- show ip arp command, 152
- show ip eigrp command, 438, 440–441
- show ip eigrp topology command, 420
- show ip interface command, 220–221, 395, 640–642
- show ip interface brief command, 221
- show ip nat statistics command, 677, 683
- show ip nat translation command, 676, 682–683
- show ip ospf command, 458–459, 467–470
- show ip ospf database command, 459
- show ip ospf interface command, 460, 466, 471–472
- show ip ospf neighbor command, OSPF, 461
- show ip protocols command, 394–395, 461–462
- show ip route command, 330
 - default routes, 376
 - EIGRP, 438–439
 - OSPF, 457–458
 - RIP routes, 388–389
 - routing tables, 345, 349
 - static routes, 365–372
- show ipv6 ospf neighbor command, 764
- show ipv6 protocols command, 761, 764
- show ipv6 rip command, 761
- show ipv6 route command, 757–758, 760, 764
- show mac access-group command, 640, 642
- show mac address-table command, 502, 528
- show parser command, 537–538
- show processes command, 310–311
- show protocols command, 221
- show running-config command
 - Catalyst switches, 528
 - configuration, 213, 275
 - documentation, 292–294
 - interface status, 207
 - IP access lists, 640–642
 - passwords, 201
 - PPP, 796
- show sessions command, 297–298, 302
- show spanning-tree command, 509–510, 525, 530–533
- show startup-config command, 213–214, 275
- show terminal command, 188–189
- show users command, 299
- show version command, 189, 256–257
- show vlan command, 569–570, 583
- show vlan privileged command, 587
- show vtp password command, 581–582
- show vtp status command, 581–582, 584–585
- shutdown command, 206–207
- Signal Quality Error (SQE)
 - messages, 902
- signaling packets, 900
- silicon switching, 900
- Silicon Switching Engine (SSE), 903
- Simple Mail Transfer Protocol (SMTP)
 - defined, 900
 - function, 72
- Simple Network Management Protocol (SNMP)
 - defined, 901
 - function, 72–73
- simplex modes, 16, 900
- simplified management, subnetting
 - for, 113
- Site to Site VPN screen, 828, 828

- site-to-site VPNs, 825, 828, 828
- 6to4 tunneling, 754–755, 755
- sliding window method, 900
- SLIP (Serial Line Internet Protocol), 900
- Small Office/Home Office (SOHO)
 - cable, 780
 - defined, 901
- smart-serial cable, 785
- SmartPorts, 535, 535, 538, 538
- SMDS (Switched Multimegabit Data Service), 900
- SMTP (Simple Mail Transfer Protocol)
 - defined, 900
 - function, 72
- SNA (System Network Architecture), 900
- SNAP (Subnetwork Architecture Protocol), 900
- snapshot routing, 901
- SNMP (Simple Network Management Protocol)
 - defined, 901
 - function, 72–73
- sockets, 901
- software addresses, 84, 901
- SOHO (Small Office/Home Office)
 - cable, 780
 - defined, 901
- SONET (Synchronous Optical Network), 901
- Source Address (SA) field, 36
- Source IP address field, 85
- Source port field
 - TCP segment, 76
 - UDP segment, 78
- source ports in TCP, 80–81
- Source-Route Bridging (SRB), 902
- Source-Route Translational Bridging (SR/TLB), 903
- Source-Route Transparent Bridging (SRT), 903
- Source Service Access Points (SSAPs), 903
- source trees, 901
- SPAN (Switched Port Analyzer), 901
- spanning explorer packets, 901
- spanning-tree algorithm (STA), 506, 902
- spanning-tree backbonefast command, 524–525
- spanning-tree bpduguard command, 523–524
- spanning-tree mode command, 525
- spanning-tree portfast command, 512–513, 522–523
- Spanning-Tree Protocol. *See* STP (Spanning Tree Protocol)
- spanning-tree uplinkfast command, 524
- spanning-tree vlan command, 509
- spanning trees, 901
- spans, 901
- special purpose addresses
 - IP, 96
 - IPv6, 745
- specific configuration modes, 184
- SPF (Shortest Path First) algorithm
 - defined, 902
 - OSPF, 448–449
- SPIDs (Service Profile Identifiers), 902
- split horizon protocols
 - defined, 902
 - IP routing, 382
- split-MAC architecture, 715–716, 715
- spoofing, 612, 902
- spoolers, 902
- SPs (switch processors), 901
- SPX (Sequenced Packet Exchange), 902
- SQE (Signal Quality Error)
 - messages, 902
- SR/TLB (Source-Route Translational Bridging), 903

- SRB (Source-Route Bridging), 902
- SRT (Source-Route Transparent Bridging), 903
- SRTT field, 440
- SSAPs (Source Service Access Points), 903
- SSE (Silicon Switching Engine), 903
- SSH (Secure Shell), 198–199
- SSIDs (Service Set Identifiers), 713, 719–720
- STA (spanning-tree algorithm), 506, 902
- Stacheldraht attacks, 612
- standard access lists
 - IP, 619–624, 622–624, 657, 903
 - IPX, 903
- star topology, 903
- Start Frame Delimiter (SFD)/Synch field, 36
- startup-config file, 212–213
 - deleting, 277
 - displaying, 213–214, 275
 - password recovery, 258
 - router boot sequence, 254
- startup ranges, 903
- state transitions
 - defined, 903
 - Physical layer, 30
- Stateful IOS Firewall inspection engine, 614
- static NAT, 671, 674–675
- Static NAT-PT, 756
- static routing, 328, 363–364
 - 871W router, 372
 - Corp router, 364–366
 - default ADs, 378
 - defined, 903
 - hands-on lab, 404–405
 - R1 router, 366–368
 - R2 router, 368–370
 - R3 router, 370–372, 370–371
- static VLANs
 - characteristics, 558–559
 - defined, 903
- statistical multiplexing, 903
- status
 - interface, 207
 - virtual circuits, 803
- sticky command, 504, 522
- STM-1 (Synchronous Transport Module Level 1), 904
- store-and-forward switching method, 904
- STP (shielded twisted pair) wiring, 904
- STP (Spanning Tree Protocol), 505–506, 506
 - BackboneFast, 513
 - Catalyst switches. *See* Catalyst switch configuration
 - Cisco Network Assistant, 534–541, 535, 538–541
 - convergence, 511–512, 511
 - defined, 902, 904
 - EtherChannel, 514
 - exam essentials, 542
 - operations, 507–508
 - port states, 510–511
 - PortFast, 512–513
 - review questions, 543–549
 - root bridge selection, 508–510, 532–534
 - RSTP, 513–514
 - summary, 541
 - terminology, 506–507
 - UplinkFast, 513
 - written labs, 542, 550
- straight-through cable
 - defined, 904
 - Ethernet networking, 39, 39
- stub areas, 904
- stub networks, 904

958 STUN (Serial Tunnel) technology – switchport trunk command

- STUN (Serial Tunnel) technology, 904
 - subarea nodes, 904
 - subareas, 904
 - subchannels, 904
 - subcommands, 184
 - subinterfaces
 - CLI prompts for, 183
 - defined, 904
 - Frame Relay, 806–808, 840–841, 840
 - VLANs, 575
 - subnet addresses, 904
 - subnet masks
 - defined, 904
 - need for, 115–116
 - VLSMs, 137–138
 - subnet-zero command, 113, 142
 - subnets and subnetting, 112–113
 - CIDR, 116–118
 - Class A addresses, 134–136
 - Class B addresses, 127–133
 - Class C networks, 118–127, 120, 122
 - creating, 114–115
 - defined, 904–905
 - exam essentials, 158
 - ip subnet-zero, 113
 - review questions, 161–167
 - subnet masks for, 115–116
 - summarization, 147–150, 147, 149
 - summary, 157–158
 - VLANs, 575
 - written labs, 158–160, 168–169
 - Subnetwork Architecture Protocol (SNAP), 900
 - subscribers to group addresses, 101
 - successor routes, 421
 - summarization
 - defined, 905
 - EIGRP, 423–424, 424
 - process, 147–150, 147, 149
 - summary-address eigrp command, 475
 - summary route configuration, 474–476, 475–476
 - Super Frames (SFs), 900
 - sustainable cell rate (SCR), 899
 - SVCs (switched virtual circuits)
 - defined, 905
 - Frame Relay, 801
 - switch blocks, 905
 - switch fabrics, 905
 - switch ports
 - access lists, 634–636
 - VLANs, 570–571
 - switch processors (SPs), 901
 - switched LANs, 905
 - Switched Multimegabit Data Service (SMDS), 900
 - Switched Port Analyzer (SPAN), 901
 - switched virtual circuits (SVCs)
 - defined, 905
 - Frame Relay, 801
 - switches, 10, 10
 - vs. bridges, 8
 - Catalyst. *See* Catalyst
 - switch configuration
 - Data Link layer, 25–26, 26
 - defined, 905
 - vs. hubs, 26
 - layer 2. *See* layer 2 switching
 - for network segmentation, 6, 6
 - switchport command, 570–571
 - switchport access command, 571–572
 - switchport mode command, 571–572
 - switchport nonegotiate command, 527, 572
 - switchport port-security command, 503–504
 - switchport port-security aging command, 536
 - switchport port-security mac-address command, 521
 - switchport trunk command, 566

switchport trunk allowed command, 573
 switchport trunk encapsulation
 command, 572
 switchport trunk native command, 574
 switchport voice vlan command, 587
 symmetrical DSL, 782
 syn packet acknowledgments, 82
 Synchronous Data Link Control
 (SDLC), 899
 Synchronous Digital Hierarchy
 (SDH), 899
 Synchronous Optical Network
 (SONET), 901
 synchronous transmissions, 905
 Synchronous Transport Module Level 1
 (STM-1), 904
 syslog protocol, 905
 system LED, 516–517, 516
 System Network Architecture
 (SNA), 900

T

T-connectors, 38
 T reference points, 905
 T1 WANs, 905
 T3 WANs, 905
 Tab command, 187
 tables for VLSMs, 140–144, 141,
 143, 145
 TACACS+ (Terminal Access Controller
 Access Control System), 905
 tagged traffic, 905
 TAs (terminal adapters), 906
 TCP (Transmission Control Protocol),
 75–77
 defined, 906
 destination ports, 81–82
 key concepts, 79
 port numbers, 80–82, 80
 segment format, 75–77, 75
 source ports, 80–81
 syn packet acknowledgments, 82
 TCP/IP (Transmission Control
 Protocol/Internet Protocol)
 defined, 906
 and DoD model, 68–70, 69–70
 exam essentials, 102
 host-to-host layer protocols
 TCP, 75–77, 75
 UDP, 77–79, 78
 Internet layer protocols, 83
 ARP, 90–92, 90
 ICMP, 87–90, 87, 89
 IP, 84–87, 84, 86
 RARP, 91, 92
 IP addresses. *See* IP addresses
 process/application layer protocols,
 70–74
 review questions, 104–109
 summary, 101
 written labs, 102–103, 110
 TCP SYN flood attacks, 612
 TDM (Time Division
 Multiplexing), 906
 TE (terminal equipment) devices
 defined, 906
 TE1, 906
 TE2, 906
 telco abbreviation, 906
 telephony, VLANs, 586–588
 telnet command, 214–215
 Telnet protocol, 71, 295–296, 316
 closing sessions, 298–299
 for configuration information,
 214–215
 connections, 297
 defined, 906
 IP access lists, 625–626
 with multiple devices, 297

960 10Base2 technology – Transmission Power Control (TPC)

- passwords, 197–198, 295–296
 - for router connections, 174
 - SDM for, 299–300, 299–300
 - users, 297–298
- 10Base2 technology, 38
- 10Base5 technology, 38
- 10BaseT technology, 38, 852
- Teredo, 755
- Terminal Access Controller Access Control System (TACACS+), 905
- terminal adapters (TAs), 906
- terminal emulation
 - defined, 906
 - Telnet, 71
- terminal equipment (TE) devices
 - defined, 906
 - TE1, 906
 - TE2, 906
- terminal history size command, 189
- terminal monitor command, 395
- testing NAT, 677–679, 678–679
- TFN (Tribe Flood Network)
 - attacks, 612
- TFTP (Trivial File Transfer Protocol), 71
 - copying with, 264–265, 275–276
 - defined, 906
- TFTP hosts, 906
- tftp-server command, 266
- thicknet, 38, 906
- thin protocols, 77
- thinnet, 38, 906
- this network or segment address, 96
- thrashing of MAC tables, 505
- threats, security, 611–613
- three-layer hierarchical model, 46–49, 47
- three-way handshakes, 17, 906
- time-based access lists, 615, 637–638
- Time Division Multiplexing (TDM), 906
- time-range command, 637–638
- Time To Live (TTL)
 - defined, 907
 - IP header, 85
- timers
 - CDP for, 283–284
 - RIP, 383
- token buses, 907
- token passing access method, 907
- Token Ring Interface Processor (TRIP), 907
- Token Ring technology, 907
- tokens, 907
- toll networks
 - defined, 907
 - WANs, 775
- topology
 - databases, 446, 907
 - documenting, 292–294, 292, 294
 - EIGRP tables, 420, 425
- Topology View screen, 540, 540
- Total length field, 85
- TPC (Transmission Power Control), 710
- traceroute command
 - defined, 907
 - ICMP, 88, 152, 215
 - for network connectivity, 307–308
- traffic flow, ESP for, 827
- traffic information, CDP for, 289
- transferring files, 71–72
- transforms, IPSec, 826–827
- translation timeout in NAT, 678
- Transmission Control Protocol.
 - See* TCP (Transmission Control Protocol)
- Transmission Control Protocol/Internet Protocol. *See* TCP/IP (Transmission Control Protocol/Internet Protocol)
- Transmission Power Control (TPC), 710

- transparent bridging
 - defined, 907
 - operation, 25
 - transparent mode in VTP, 565
 - Transport layer, 16–17
 - acknowledgments, 21, 21
 - connection-oriented communication, 17–20, 18–19
 - defined, 907
 - flow control, 17
 - port numbers, 45, 45
 - windowing, 20–21, 20
 - traps
 - defined, 907
 - SNMP, 73
 - Tribe Flood Network (TFN) attacks, 612
 - TRIP (Token Ring Interface Processor), 907
 - Trivial File Transfer Protocol (TFTP), 71
 - copying with, 264–265, 275–276
 - defined, 907
 - Trojan horse attacks, 613
 - troubleshooting
 - connectivity, 308–310
 - debug ip rip for, 397–398
 - Frame Relay, 811–813, 812
 - IP addresses, 150–157, 150, 153–157
 - NAT, 677–679, 678–679
 - OSPF, 471–473, 472–474
 - show ip protocols for, 394–395
 - VTP, 583–586
 - trunk command, 571–572
 - trunk links
 - defined, 907
 - VLANs, 560–561, 561
 - trunk ports, 512, 571–574
 - Trunk Up-Down (TUD)
 - protocol, 907
 - trust exploitation attacks, 613
 - trusted networks, 611
 - TTL (Time to Live)
 - defined, 907
 - IP header, 85
 - TUD (Trunk Up-Down) protocol, 907
 - tunneling, 35
 - defined, 908
 - IPv6 migration, 754–755, 755
 - quality of service in, 832–836, 832–835
 - 2.4GHz wireless, 708–709, 708, 711–712
 - 1242AP router configuration, 361–362
 - 2500 routers configuration, 259–260
 - 2600 routers
 - bringing up, 177–179
 - configuration, 259
 - interfaces and connections, 174, 174
 - 2800 routers
 - bringing up, 175–177
 - interfaces and connections, 174–175, 174
 - Type field in Ethernet frames, 36
 - Type of Service field, 85
-
- ## U
- U reference points, 908
 - UDP (User Datagram Protocol), 77–78
 - defined, 908
 - key concepts, 79
 - port numbers, 80–82, 80
 - segment format, 78–79, 78
 - undebg all command, 309
 - unicasts, 100
 - defined, 908
 - IPv6, 742, 744
 - unidirectional shared trees, 908
 - unified wireless solution, 712–714, 713
 - AWPP, 718
 - MESH and LWAPP, 716–717, 717–718

security, 718–721
 split-MAC architecture, 715–716, 715
 UNII (Unlicensed National Information Infrastructure), 706, 706,
 709–710, 710
 unique local addresses, 745
 universal bit, 35
 unnumbered frames, 908
 unreliable protocols, 77
 unshielded twisted-pair (UTP)
 defined, 908
 Ethernet, 37, 41, 42
 untrusted networks, 611
 updates with holddown timers, 382
 upgrading IOS, 265–266,
 268–270, 314
 UplinkFast feature, 513, 524
 Urgent pointer field, 76
 URLs in IFS, 267
 use-tacacs command, 194
 User Datagram Protocol (UDP),
 77–78
 defined, 908
 key concepts, 79
 port numbers, 80–82, 80
 segment format, 78–79, 78
 user EXEC mode, 184
 user mode, 180–181
 username command, 225–226,
 791, 818
 usernames
 FTP, 71
 PPP, 791
 SDM, 226–227
 WANs, 818
 users, Telnet, 297–298
 UTP (unshielded twisted-pair) wiring
 defined, 908
 Ethernet, 37, 41, 42

V

V.24 standard, 788
 V.35 standard, 788
 valid host IDs
 Class A addresses, 97
 Class B addresses, 98
 Class C addresses, 98
 variable bit rate (VBR) class, 908
 variable-length subnet masks. *See* VLSMs
 (variable-length subnet masks)
 variance command, 442
 VBR (variable bit rate) class, 908
 VCCs (virtual channel connections), 908
 VDSL (Very High Data Rate Digital
 Subscriber Line), 784
 verifying
 configurations
 Catalyst switches, 528–534
 EIGRP, 438–443
 IOS, 214–223, 222–223
 IP routing, 373–374, 393–398
 NAT, 676
 OSPF, 457–462
 OSPFv3, 763–766
 PPP encapsulation, 792–793,
 792–793
 RIP routing tables, 387–389
 RIPng, 760–763
 router, 275, 373–374
 flash memory, 263–264
 Versatile Interface Processor (VIP), 908
 version 2 command, 391
 Version field, 85
 Very High Data Rate Digital Subscriber
 Line (VDSL), 784
 viewing configurations, 213–214
 violation command, 522, 536
 VIP (Versatile Interface Processor), 908
 VIP (Virtual IP) function, 908

- virtual channel connections (VCCs), 908
- virtual circuits
 - defined, 908
 - Frame Relay, 801
 - port numbers, 80
 - TCP, 75
- Virtual IP (VIP) function, 908
- virtual LANs. *See* VLANs (virtual LANs)
- virtual private networks (VPNs),
 - 825–826
 - configuration, 828–836, 828–835
 - defined, 909
 - IPSec for, 826–836
 - quality of service across tunnels,
 - 832–836, 832–835
- virtual rings, 908
- vlan command, 568–569, 585
- VLAN IDs, 909
- VLAN Management Policy Server (VMPS) service, 559, 909
- VLAN Trunk Protocol. *See* VTP (VLAN Trunk Protocol)
- VLANs (virtual LANs), 552
 - broadcast control, 554
 - configuration, 568–570
 - inter-VLAN routing, 575–580, 576–578, 580, 588–597
 - switch port assignments, 570–571
 - trunk ports, 571–574
 - voice, 586–588
 - defined, 909
 - dynamic, 559
 - exam essentials, 598
 - flexibility and scalability, 555–558, 556–557
 - frame tagging, 561–562
 - identifying, 559–563, 561
 - ISL for, 562
 - membership, 558–559
 - operation, 552–554, 553
 - review questions, 600–606
 - routing between, 567–568, 567–568
 - security, 555
 - static, 558–559
 - summary, 597–598
 - trunk links, 560–561, 561
 - VTP for. *See* VTP (VLAN Trunk Protocol)
 - written lab, 599, 607
- VLSMs (variable-length subnet masks),
 - 137–138, 137
 - benefits, 139
 - defined, 909
 - designing, 138–139, 138
 - EIGRP, 418–419, 423–424, 423–424
 - implementing, 139–144, 141–147
 - RIPv1 vs. RIPv2, 391–392
- VMPS (VLAN Management Policy Server) service, 559, 909
- voice configuration, 586–588
- voice traversal with firewalls, 614
- VPN Connection Information screen, 829, 829
- VPNs (virtual private networks),
 - 825–826
 - configuration, 828–836, 828–835
 - defined, 909
 - IPSec for, 826–836
 - quality of service across tunnels,
 - 832–836, 832–835
- VTP (VLAN Trunk Protocol), 563–564
 - configuration, 580–583
 - defined, 909
 - importance, 565
 - modes of operation, 564–565, 564
 - pruning, 565–566
 - troubleshooting, 583–586
 - vtp domain command, 581
 - vtp mode client command, 582

vtp mode server command, 581, 585
 vtp password command, 581–582
 VTP transparent mode, 565, 909
 VTY
 access lists for, 625–626
 passwords for, 295
 vty command, 195

W

WAN Wizard, 353–358, 353–358
 WANs (wide area networks), 774–775
 cabling, 779–782, 780–781,
 785–786, 786
 connection types, 775–776, 776
 defined, 909
 DSL, 782–785, 782, 784
 DTE and DCE for, 786, 786
 exam essentials, 836–837
 Frame Relay. *See* Frame Relay
 hands-on lab, 838–841, 849
 HDLC for, 787, 787
 PPP for, 788–789, 788
 authentication, 790–794,
 813–818, 813–816
 configuration, 791–792
 debugging, 793–796, 794–795
 encapsulation, 792–795, 792–794
 LCP options, 789
 sessions, 790
 PPPoE for, 796–797, 818–822,
 819–822
 review questions, 842–848
 summary, 836
 support, 777–779
 terminology, 775
 written lab, 837
 WCS (Wireless Control System),
 713–714
 well-known port numbers, 80

WEP (Wired Equivalency Protocol),
 719–720
 Wi-Fi Alliance, 706
 Wi-Fi Protected Access (WPA), 720
 wildcards
 for access lists, 620–622
 for default routes, 374
 defined, 909
 OSPF, 450–453, 452
 Window field, 76
 windowing
 defined, 909
 Transport layer, 20–21, 20
 Windows Registry, hexadecimal
 addresses in, 93
 WINS (Windows Internet Name
 Service), 909
 WinSock interface, 909
 Wired Equivalency Protocol (WEP),
 719–720
 Wireless Control System (WCS),
 713–714
 Wireless Express Security screen,
 724, 724
 Wireless Interfaces screen, 725–726,
 725–726
 wireless networks, 704
 802.11 standards, 706–712,
 708–710, 712
 AWPP, 718
 configuration, 721–728, 722–728
 exam essentials, 729
 MESH and LWAPP, 716–717,
 717–718
 overview, 704–706, 706
 review questions, 731–736
 security, 718–721
 split-MAC architecture, 715–716,
 715
 summary, 729

- unified solution, 712–714, 713
- written labs, 730, 737
- Wireless Security settings, 727, 727
- workgroup layer, 48
- workgroup layers, 909
- workgroup switching, 909
- WPA (Wi-Fi Protected Access), 720
- written labs
 - access lists, 655–656, 667
 - EIGRP and OSPF, 477–478, 491
 - internetworking, 50–55, 53, 62–66
 - IOS, 234, 249
 - IP routing, 402–403, 415
 - IPv6 protocol, 767, 772
 - layer 2 switching and STP, 542, 550
 - management, 313, 325
 - NAT, 688–689, 701
 - subnetting, 158–160, 168–169
 - TCP/IP, 102–103, 110

- VLANs, 599, 607
- WANs, 837
- wireless networks, 730, 737

X

- X.25 standard
 - defined, 910
 - for Frame Relay, 798
- X Window system
 - defined, 910
 - purpose, 72

Z

- ZIP (Zone Information Protocol), 910
- ZIP storms, 910
- zones, 910