



## Numerics

---

- 3DES encryption, 311
- 802.1x port authentication, 114
  - communications, 115–121
  - configuring on Catalyst 6000 switches, 123–125
  - functionality, 122

## A

---

- AAA (authentication, authorization and accounting)
  - accounting, 469, 479
    - method lists, applying, 481–482
    - method lists, configuring, 479–481
  - applying access lists, 486–488
  - authentication, 470
    - configuring, 471
    - local database, configuring, 471
    - method list, configuring, 471–474
  - authorization, 469, 475
    - method lists, applying, 477–479
    - method lists, configuring, 475–476
  - auth-proxy, 541–542, 544
  - command authorization, configuring, 549–552
  - debug commands, 670
  - downloading routes, 486–488
  - lock and key, configuring, 548–549
  - method lists, 469
  - network components, 470
  - PPP
    - authentication and authorization, 482–485
    - timeouts, configuring, 488–489
  - providing preshared keys for IPsec, 537, 539
  - RADIUS, 515, 519–520, 522–530
    - accounting, 531–533
    - communications architecture, 516
    - packet format, 517–518
    - password encryption, 518–519
    - router support, 521–531
  - resolving common problems, 671–677
  - show commands, 670
- TACACS+
  - accounting, 508–512
  - authentication, 498
  - authorization, 499–507
  - communications architecture, 494
  - daemon functionality, 493–494
  - header architecture, 495–497
  - packet encryption, 497
  - VPDN, 544, 546–547
  - x-auth in ISAKMP, 539–541
- acceptable usage policies, defining, 16
- access control. *See also* CBAC
  - PIX, 72
  - switches, 75
- access lists. *See* ACLs
- access policies, defining, 16–17
- Access-Accept messages (RADIUS), 519
- accessing firewalls, vulnerabilities, 140
- Access-Reject messages (RADIUS), 519
- accountability policies, defining, 16
- accounting, 479
  - method lists
    - applying, 481–482
    - configuring, 479–481
- RADIUS, 515, 531–532
  - IETF Accounting AV pairs, 532–533
  - TACACS+, 508–512
- ACEs (Access Control Elements), 567
- ACKs, ZL ACKs, 248
- ACLs (access control lists), 153. *See also* turbo ACLs
  - applying to IP fragments, 583–584, 587–588
    - overlapping fragment attacks, 589
    - tiny fragment attacks, 588
  - applying with AAA, 486–488
  - blocking ICMP packets, 573–575
  - blocking known offenders, 575
  - blocking spoofed IP addresses, 575
  - extended, 569, 571
  - functionality, 567–568, 573
  - impact on performance, 590
  - implicit deny all entry, 571
  - logging facility, 573
  - NetFlow switching, 594–595
  - restricting traffic, 572–573
  - standard, 568

- thwarting attacks
  - DoS attacks, 580–582
  - fraggle attacks, 578–579
  - smurf attacks, 576–578
  - SYN floods, 579–580
- top-down processing, 571
- active routers (HSRP), 43
- addressing, NAT
  - debugs, 626–627
  - order of operations, 625–626
  - PIX Firewall capabilities, 155
  - resolving common problems, 629–633
  - show commands, 627–629
- advanced PIX Firewall features
  - alias, 159
    - configuring, 185–188
    - DNS doctoring, 161–162
  - DNS guards, 165
  - flood guards, 162
  - frag guards, 163–164
  - fragment handling, 174–175
  - mail guards, 164
  - multicast support, 172
  - multimedia support, 166
  - protocol fixup, 168–169
  - spoof detection, 168
  - sysopt commands, 169–172
  - traffic filtering, 165
  - URPF, 168
- Advertisement Interval field (VRRP packets), 53
- aggressive mode (IKE) exchanges, 278
  - using preshared key authentication, 302–306
- AH (Authentication Header), 317
  - integrity checking, 312–313
- Alarm messages (POP), 432
- alarms
  - corresponding severity levels, 447–448
  - false positives, 449
  - signatures, customizing, 463–465
- alias feature (PIX Firewall), 159
  - configuring, 185–188
  - DNS doctoring, 161–162
  - frag guards, 164
- applets (Java), blocking, 203
- appliance sensors
  - event logging, 439–441
  - IP session logging, 441
- application layer inspection, Cisco IOS
  - Firewall, 202
- application layer VPNs, 219
- applying
  - ACLs
    - overlapping fragment attacks, 589
    - tiny fragment attacks, 588
    - to ICMP packets, 573–575
    - to IP fragments, 583–584, 587–588
    - to known IP addresses, 575
    - to spoofed IP addresses, 575
      - with AAA, 486–488
  - method lists, 474, 477–482
  - route filters, 82
  - URPF, 90
- area filters, 101
- ARP spoofing, 113
- ASA (Adaptive Security Algorithm), 147
  - ISN, generating random sequence, 148
  - stateful inspection, 152
  - TCP connection establishment, 148–150
  - TCP traffic filtering, 148
  - UDP session establishment, 150
- assessing threats to security, 6–8
- assigning privilege levels to users, 549–552
- associations, 114
- asymmetric routing, 89, 143
- atomic signatures, 420
- attacks
  - cessation of operation
    - Land.c, 414–415
    - ping of death, 413–414
  - classifying with NBAR and PDLM, 607–608
  - Code Red worm, 608–610
  - DDoS, rate limiting with CAR, 619
  - defending against with service provider
    - security, 557–558
  - DoS, 7, 401, 405
    - CBAC prevention mechanisms, 204–206
    - cessation of normal OS operation, 405
    - DDoS, 407–413
    - rate-limiting, 616–618
    - resource exhaustion, 405
    - TCP SYN floods, 405–407
    - thwarting with ACLs, 580–582
  - false positives, 449
  - fraggle, thwarting with ACLs, 578–579

- LAN floods, preventing, 110–111
  - MAC address floods, 107–109
  - network access, 401
    - buffer overflows, 415–416
    - data access, 402
    - privilege escalation, 417–418
    - system access, 402
  - overlapping fragment, 175
  - perpetrators
    - experienced hackers, 404
    - inexperienced hackers, 403
    - trusted users, 403
    - untrusted users, 403
  - smurf, thwarting with ACLs, 576–578
  - SYN floods, thwarting with ACLs, 579–580
  - tiny fragment, 174–175
  - tracing with service provider security, 560–562
  - attributes payload, 318
  - auditing network security policies, 12
  - authentication, 470
    - configuring AAA, 471
    - cut-through proxy, 158–159
      - configuring on PIX, 188–191
    - EAP, 115, 118
    - IKE
      - digital signatures, 308–309
      - encrypted nonces, 310
      - preshared key, 307
    - local database, configuring, 471
    - login banners, 69, 78
    - method lists
      - applying, 474
      - configuring, 471–474
    - OSPF, 98
    - password management, 59–60
    - policies, defining, 17
    - port authentication, 802.1x, 114–125
    - PPP, 482–485
    - RADIUS, 515, 519
    - router authentication, MD5-HMAC, 84–87
    - TACACS+, 498
    - x-auth in ISAKMP, 539–541
  - Authentication Data field
    - HSRP packets, 46
    - VRRP packets, 54
  - Authentication Type field (VRRP packets), 52
  - authorization, 475
    - configuring PPP timeouts with AAA, 488–489
    - method lists
      - applying, 477–479
      - configuring, 475–476
    - PPP, 482, 484–485
    - privilege escalation, 402
    - RADIUS, 515, 520–530
      - IETF attribute support on Cisco routers, 521–531
      - vendor-specific attribute support on Cisco routers, 530–531
    - TACACS+, 499–507
  - auth-proxy, 541–542, 544. *See also* lock and key
  - troubleshooting, 676–677
  - availability statements, defining, 18
- 
- ## B
- 
- backscatter traceback, 560–562
  - backup devices
    - HSRP, 42
      - active routers, 43
      - Failover protocol, 49
      - failure detection, 43
      - functionality, 47, 49
      - implementations, 46–47
      - packet format, 44–46
      - versus VRRP, 49
    - routing-enabled redundancy, 39–40
      - dynamic, 41
      - static routes, 40
    - VRRP, 50
      - failure detection, 51
      - master router selection, 50
      - packet format, 51–54
  - backup mode (VRRP), 50
  - bandwidth management, CAR, 613–614
    - compound interest measurement, 615–616
    - token buckets, 614
  - banners, 69, 78
  - bastion hosts, 29
  - BGP (Border Gateway Protocol), 92
    - disabling version negotiation, 94
    - EBGP multihop, 94
    - incoming route filtering, 92–93

- network advertisements, 93
- outgoing route filtering, 93
- peer authentication, 92
- restricting communications, 94
- Biotech Inc., network security design and implementation case study, 12–13
  - asset identification, 13
  - defining security policies, 15–20
  - risk analysis, 14–15
  - threat identification, 13–14
- black hole filtering, 87–88
- block size, 311
- bottlenecks, firewall-induced, 138
- bound checking buffer overflow attacks, 416
- broadcast floods, preventing, 110–111
- buffer overflow attacks, 415–416
- burst parameters of CAR, 614
- bypassing NAT, 663

## C

- cabling, selecting, 38
- CAM overflow, preventing, 107–109
- capturing core dumps, 70, 78
- CAR (Committed Access Rate), 613–614
  - compound interest measurement, 615–616
  - dropping malicious traffic, 616–618
  - rate-limiting traffic
    - DDoS attacks, 619
    - DoS attacks, 616–618
    - suspected malicious traffic, 618
  - token buckets, 614
- case studies
  - implementing CBAC on routers with NAT, 207–210, 212
  - network security design and implementation, 12–13
    - asset identification, 13
    - defining security policies, 15–20
    - risk analysis, 14–15
    - threat identification, 13–14
  - zoning with Cisco PIX Firewalls, 30–31
- Catalyst 6000 series switches
  - configuring as sensors, 435, 458–461
  - port security, 107–109
  - private VLANs, 111–112
    - ARP spoofing, 113
    - configuring, 113
    - ports, 112
    - sticky ARP, 113
- categories of IDS signatures, 444–445
- categorizing VPNs
  - based on business functionality, 220
  - based on encryption, 217–218
  - based on OSI model layer
    - application layer VPNs, 219
    - data link layer VPNs, 219
    - network layer VPNs, 219
- CBAC (context-based access control), 199
  - DoS attack prevention mechanisms, 204–206
  - functionality of, 200–201
  - implementing on routers with NAT, 207–212
  - stateful packet filtering, 200–201
  - threshold values, 204–205
  - timeouts, 204–205
- CBC (Cipher Block Chaining), 311
- CEF (Cisco Express Forwarding), enabling, 67
- centralized administrative tools, 139
- cessation-of-operation attacks, 405
  - Land.c, 414–415
  - ping of death, 413–414
- challenges of implementing service provider security, 563
- characteristics of firewalls, 137
- Checksum field
  - RFC 1701 GRE header, 225
  - VRRP packets, 53
- CIDS configuration GUI (CSPM IDS console), 434
- circuit-level firewalls, 141
- Cisco 7200/7500 series routers, turbo ACLs, 590–593
- Cisco IDS
  - shunning, 575
  - troubleshooting, 666–670
- Cisco IOS command authorization, 549–552
- Cisco IOS Firewall
  - features of, 201
    - application layer inspection, 202
    - DoS attack prevention, 204–206
    - fragment handling, 206–207
    - invalid command filtering, 203

- Java blocking, 203
  - transport layer inspection, 202
- Cisco PIX Firewall
  - access control, 72
  - ACLs, 153
  - advanced features
    - alias, 159–162
    - DNS guards, 165
    - flood guards, 162
    - frag guards, 163–164
    - fragment handling, 174–175
    - mail guards, 164
    - multicast support, 172
    - multimedia support, 166
    - protocol fixup, 168–169
    - spoof detection, 168
    - sysopt commands, 169–172
    - traffic filtering, 165
    - URPF, 168
  - alias feature, configuring, 185–188
  - ASA, 147
    - generating random ISN sequence, 148
    - stateful inspection, 152
    - TCP traffic filtering, 148–150
    - UDP session establishment, 150
  - configuration management, 71
  - configuring
    - as sensors, 454–457
    - with three interfaces, 176–181
  - connectivity, troubleshooting, 645–647
  - cut-through proxy authentication, 158–159, 188–191
  - debugs, 635–637
  - events logging, 74, 442–443
  - failover feature, 156–158, 181–184
  - logging capabilities, 153–154
  - NAT, 155
  - object groups, scaling configurations, 191–195
  - password management, 73–74
  - recommended timeout values, 637
  - redundancy, 155
  - resolving common problems, 643–645
  - routing capabilities, 155
  - security zones, 152–153
  - sensor implementaion, 448
  - show commands, 638–643
  - SSH, 73
  - troubleshooting, 633–634
- Cisco Secure Intrusion Detection
  - categories of signatures, 444–445
  - management console. *See also* CSPM IDS
    - Console, UNIX director
      - CIDS console, 433
      - CSPM IDS, 433
      - interaction with sensor, 427–428
      - placement, 426
      - UNIX director, 430–432
  - sensors, configuring
    - configd daemon, 437
    - fileXferd daemon, 437
    - inline processing, 427
    - interaction with management console, 427–428
    - loggerd daemon, 437
    - logging intrusions, 439–443
    - managed daemon, 437
    - packetd daemon, 437
    - passive monitoring, 427
    - placement, 426
    - postofficed daemon, 436–437
    - responses to intrusions, 438
    - sapd daemon, 437
    - shunning feature, 444
    - signature engines, 446–447
    - TCP reset mechanism, 443
    - types of, 435
  - signatures, customizing, 463–465
- class maps, NBAR classification, 603–605
- classifying
  - NBAR packets, 599–600
    - class maps, 603–605
    - packet dropping, 605–606
    - packet marking, 605–606
    - recognizable protocols, 600–603
  - network attacks
    - based on mode of attack, 401–402
    - based on perpetrator, 402–404
    - with PDLM and NBAR, 607–608
- Code Red worm, 608–610

- command authorization
  - configuring, 549–552
  - versus EXEC authentication, 551
- Command messages (POP), 432
- commands
  - debug icmp trace, 635–637
  - debug ip inspect tcp, 651
  - debug ip nat, 626–627
  - debug ip packet, 626
  - maximum-prefix, 97
  - scheduler allocate, 67
  - show conn detail, 639–640
  - show crypto engine connection active, 659
  - show crypto isakmp sa, 659–660
  - show interface, 640–643
  - show ip inspect all, 648–649
  - show ip nat translations, 628
  - show xlate detail, 637–639
  - sysopt, 169–172
- communications architecture, RADIUS, 516
- community ports, 112
- components
  - of AAA, 470
  - of IKE, 276
    - aggressive mode, 302–306
    - main mode, 278–293, 296–302
    - quick mode, 279
  - of service provider security, 563
- composite signatures, 420
- compound interest measurement, 615–616
- compulsory tunneling, 245
  - setup process, 251–270
- computer technology purchasing guidelines,
  - defining, 16
- concentrators, 275
- configd daemon
  - IDS Sensor, 437
  - UNIX director, 431
- configuration management, 54–55
  - PIX, 71
  - switches, 75
- configuring
  - 802.1x on Catalyst 6000 switches, 123–125
  - accounting, method lists, 479–482
  - authentication, 147
    - local database, 471
    - method lists, 471–474
  - authorization, method lists, 475–479
  - Catalyst 6000 IDS as sensors, 458–461
  - CEF, 67
  - firewalls, 139
  - HTTP, 66
  - IP permit lists, 109–110
  - IPsec
    - combined remote-access/LAN-to-LAN implementation, 369–373
    - one-to-many router, 355–360
    - over GRE, 360–365
    - over L2TP using voluntary tunneling, 373–379
    - remote-access implementations, 366–368
    - router-to-router using digital signatures, 338–349
    - router-to-router using preshared key authentication, 325–338
    - router-to-router using RSA encrypted nonces, 349–354
    - TED, 379–391
  - NTP, 68
  - OSPF
    - loopbacks as router ID, 101
    - route filtering, 101
    - stub areas, 99–100
    - timers, 101
  - PIX Firewall
    - alias feature, 185–188
    - as sensors, 454–457
    - cut-through proxy authentication, 188–191
    - failover to secondary device, 181–184
      - with 3 interfaces, 176–181
  - PPP timeouts with AAA, 488–489
  - private VLANs, 113
  - proxy authentication, 541–544
  - route dampening, 96
  - routers as sensors, 449–454
  - scheduler, 67
  - SNMP, 64–66
  - turbo ACLs, 591–593
  - UNIX director, shunning, 462–463
  - URPF, 89
  - VPDN, 544–547
- congestion, firewall-induced, 138

- connecting
    - IPX sites with GRE, 235–239
    - multiple sites with GRE, 230–235
  - connectivity, Cisco PIX, troubleshooting, 645–647
  - control connection establishment, L2TP, 246
  - controlling
    - LAN floods, 110–111
    - PIX access, 72
    - router access, 55
      - TTY, 58
      - vtty, 55–57
    - switch access, 75
  - convergence, 83
  - cookies, 280
  - core dumps, 70, 78
  - Count IP Addr field (VRRP packets), 52
  - couple hello messages, 43
  - courtesy ARP, 113
  - crackers versus hackers, 400
  - creating
    - DMZs, 26–30
    - security policies, 8–9
  - CSPM IDS Console
    - internal architecture, 433
      - CIDS configuration GUI, 434
      - cvtnrlog.exe, 434
      - EDI, 434
      - EVI, 434
      - nr.postofficed daemon, 433
      - nr.smid daemon, 434
      - Sensor CA, 433
    - versus UNIX director, 429
  - customizing signatures, 463–465
  - cut-through proxy authentication, 158–159
    - configuring on PIX Firewall, 188–191
  - cvtnrlog.exe (CSPM IDS console), 434
- ## D
- 
- daemons
    - CIDS console, 433–435
    - Cisco IDS sensor, 436–438
    - UNIX director, 431–432
  - damages due to successful attacks, estimating, 8
  - data access attacks, 402
  - data link layer VPNs, 219
  - data-link layer, L2TP, 243
    - compulsory tunneling, 245, 251–270
    - control connection establishment, 246
    - header format, 248–250
    - session establishment, 247–248
    - setup process, 246
    - tunnel layers, 244
    - voluntary tunneling, 245
  - DDoS attacks, 407
    - rate limiting with CAR, 619
    - Stacheldraht, 411–413
    - TFN, 409–411
    - Trinoo, 408
  - debug icmp trace command, 635–637
  - debug ip inspect tcp command, 651
  - debug ip nat command, 626–627
  - debug ip packet command, 626
  - debugs
    - IPsec, 654–658
    - PIX, 635–637
  - default timeout values, PIX, 637
  - defining
    - network security policies, 15–20
    - security zones, 25–26
      - DMZs, 26–31
  - deliberate inside attackers, 403
  - denial of service, 7
  - DES encryption, 311
  - designing secure networks, 11
    - case study, 12–20
    - security zones, 25–26
      - case study, 30–31
      - DMZs, 26–27, 29–30
  - Destination Address field (VRRP packets), 51
  - detecting
    - Code Red worm, 610
    - intrusions, 418–419
  - devices
    - AAA network components, 470
    - authentication
      - digital signatures, 308–309
      - encrypted nonces, 310
      - preshared keys, 307
    - Catalyst 6000 IDSM, configuring as sensor, 458–461



- physical security, 36
  - environmental factors, 39
  - media, 38
  - network topographical design, 36
  - placement, 37–38
  - power supply, 38
  - redundant locations, 36
- PIX, 71
  - access control, 72
  - configuration management, 71
  - connectivity problems, troubleshooting, 645–647
  - debugs, 635–637
  - events logging, 74
  - password management, 73–74
  - recommended timeout values, 637
  - resolving common problems, 643–645
  - show commands, 638–643
  - SSH, 73
  - troubleshooting, 633–634
- redundancy
  - dynamic, 41
  - HSRP, 42–49
  - routing-enabled, 39–40
  - VRRP, 49–54
- routers
  - CEF, 67
  - configuration management, 54–55
  - configuring as sensor, 449–454
  - controlling access, 55–58
  - core dumps, 70
  - disabling unnecessary services, 61–63
  - events logging, 61
  - HTTP, 66
  - login banners, 69
  - loopback interfaces, 63
  - Nagle protocol, 70
  - NTP, 68
  - password management, 59–60
  - scheduler, 67
  - sensor implementation, 448
  - SNMP, 64–66
  - SSH, 58
  - traffic processing, 585
- switches
  - configuration management, 75
  - controlling access, 75
  - core dumps, 78
  - events logging, 76
  - IP permit lists, configuring, 109–110
  - login banners, 78
  - NTP, 77
  - port security, 107–109
  - VLANs, 105
    - basic security rules, 105–106
- Diffie-Hellman algorithm, 284–285
- DiffServ, marking packets, 605–607
- digital signatures, 308–309
- directed broadcast control, 87
- dirty DMZs, 28–29
- disabling
  - BGP version negotiation, 94
  - directed broadcast control, 87
- disabling unnecessary services, 61–63
- DMZs, 26–30
  - placement
    - between firewall and public network, 27
    - between stacked firewalls, 30
    - outside the firewall, 28–29
- DNS guards (PIX Firewall), 165
- DoS attacks, 401, 405
  - CBAC prevention mechanisms, 204–206
  - cessation of normal OS operation, 405
  - DDoS, 407
    - Stacheldraht, 411, 413
    - TFN, 409–411
    - Trinoo, 408
  - preventing on Cisco IOS Firewalls, 204–206
  - rate-limiting, 616–618
  - resource exhaustion, 405
  - TCP SYN floods, 405–407
  - thwarting with ACLs, 580–582
- DPD (Dead Peer Discovery), 323
- dropped packets
  - NBAR, 605–606
  - rate limiting, 616
- DSCP (Differentiated Services Code Point), marking packets, 605–607
- DTP (Dynamic Trunking Protocol), 106
- dynamic network redundancy, 41
- Dynamic Trunking Protocol (DTP), 106

## E

- EAP (Extensible Authentication Protocol), 115
  - as 802.1x communications mechanism, 118
  - messages, 117–118
  - packet fields, 116
- EAPOL (EAP over LANs), 119
- ease of firewall configuration, 139
- EBGP multihop, 94
- EDI (Event Database Interface), CSPM IDS
  - console, 434
- elements
  - of security policies, 9–10, 15–20
  - of service provider security, 563
- enable secrets, 59
- enabling
  - CEF, 67
  - Nagel protocol, 70
- encapsulation
  - EAPOL, 121
  - GRE, 223
    - connecting IPX sites, 235–239
    - connecting multiple sites, 230–235
    - implementations, 224
    - non-IP traffic, 227
    - RFC 1701 implementation, 223–225
    - RFC 2784 implementation, 226–227
    - tunneling between private networks, 227–230
- IPsec
  - AH, 317
  - ESP, 316
    - transport mode, 314
    - tunnel mode, 314–316
- encryption
  - IPsec, 311
  - nonces, 310
  - public/private key pairs, 307
  - VPNs, 218
- end devices, 7
- environmental considerations of physical security
  - design, 39
- Error messages (POP), 432
- ESP (Encapsulating Security Payload), 316
  - integrity checking, 312–313

- event logging, 439–442
  - in appliance sensors, 439–441
  - on IDSM, 441
- eventd daemon (UNIX director), 432
- events logging, 61
  - switches, 76
- EVI (Event Viewing System), CSPM IDS
  - console, 434
- extended ACLs, 569–571
- extended authentication. *See* x-auth
- extranet VPNs, 220

## F

- failover (PIX), 155–158
  - to secondary device, 181–184
- Failover protocol (HSRP), 49
- failure detection (HSRP), 43
- false positives, 449
- features of Cisco IOS Firewall, 201
  - application layer inspection, 202
  - DoS attack prevention, 204–206
  - fragment handling, 206–207
  - invalid command filtering, 203
  - Java blocking, 203
  - transport layer inspection, 202
- fields
  - of EAP packets, 116
  - of EAPOL frames, 121
  - of HSRP packets, 45–46
  - of VRRP packets, 52–54
- fileXferd daemon (IDS Sensor), 431, 437
- fileXferd daemon (UNIX director), 431
- filtering. *See also* protocol filtering
  - incoming BGP routes, 92–93
  - IP fragments, 583–588
    - overlapping fragment attacks, 589
    - tiny fragment attacks, 588
  - MAC addresses on specific ports, 107–109
  - outgoing BGP routes, 93
  - RFC 1918 address space, 582
  - traffic with IP permit lists, 109–110
  - with ACLs
    - blocking ICMP packets, 573–575
    - blocking known offenders, 575
    - blocking spoofed IP addresses, 575

- extended, 569–571
  - functionality, 567–568, 573
  - implicit deny all entry, 571
  - NetFlow switching, 594–595
  - standard, 568
  - top-down processing, 571
- firewalls
- bastion hosts, 29
  - characteristics, 137
  - circuit-level, 141
  - Cisco IOS Firewall
    - application layer inspection, 202
    - CBAC, 199–201
    - debug commands, 650–651
    - DoS attack prevention, 204–206
    - features, 201
    - fragment handling, 206–207
    - invalid command filtering, 203
    - Java blocking, 203
    - order of operations, 648
    - show commands, 648–649
    - resolving common problems, 651–652
    - transport layer inspection, 202
    - troubleshooting, 647
  - Cisco PIX Firewall
    - ACLs, 153
    - advanced traffic filtering, 165
    - alias feature, 159, 161–162, 185–188
    - ASA, 147–150
    - configuring with three interfaces, 176–181
    - connectivity problems, troubleshooting, 645–647
    - creating zones, 30–31
    - cut-through proxy authentication, 158–159, 188–191
    - debugs, 635–637
    - DNS guards, 165
    - event logging, 442–443
    - failover feature, 156–158
    - failover to secondary device, 181, 183–184
    - flood guards, 162
    - frag guards, 163–164
    - fragment handling, 174–175
    - IP session logging, 443
    - logging capabilities, 153–154
    - mail guards, 164
    - multicast support, 172
    - multimedia support, 166
    - NAT, 155
    - protocol fixup, 168–169
    - redundancy, 155
    - resolving common problems, 643–645
    - routing capabilities, 155
    - scaling configurations, 191–195
    - security zones, 152–153
    - sensor implementation, 448
    - show commands, 638–643
    - spoof detection, 168
    - stateful inspection, 152
    - sysopt commands, 169–172
    - troubleshooting, 633–634
    - URPF, 168
  - device security, 140
  - ease of configuration, 139
  - interaction with IPsec, 393
  - layering, 144
  - nonstateful packet filters, 141
  - notification ability, 138
  - personal, 142
  - positioning, 143–144
  - proxy servers, 141
  - stateful packet filters, 142
  - three-legged, creating DMZs, 27
  - traffic processing speed, 138
- Flags field (RFC 1701 GRE header), 224
- flapping routes, dampening, 95
- floating static routes, 40
- flood guards (PIX Firewall), 162
- flooded CAM tables, preventing, 107–109
- frag guards (PIX Firewall), 163–164
- fraggle attacks, thwarting with ACLs, 578–579
- fragment handling
  - Cisco IOS Firewalls, 206–207
  - PIX Firewall, 174–175
- fully meshed networks, dynamic redundancy, 41
- functionality
  - of CBAC, 200–201
  - of HSRP, 47–49

## G

- Garfinkel, S., 8
- getadmin exploits, 417–418
- goal of network security, 5
- gratuitous ARP, 113
- GRE (Generic Routing Encapsulation), 223
  - connecting IPX sites, 235–239
  - connecting multiple sites, 230–235
  - implementations, 224
  - non-IP traffic encapsulation, 227
  - RFC 1701 implementation, 224–226
  - RFC 2784 implementation, 226–227
  - tunneling between private networks, 227–230
- Group field (HSRP), 46
- guard feature (PIX Firewall)
  - DNS guards, 165
  - flood guards, 162
  - frag guards, 163–164
  - mail guards, 164

## H

- hackers, 400
  - experienced, 404
  - Metnick, Kevin, 421–422
  - professional, 404
  - script kiddies, 403
  - versus crackers, 400
- half-open SYN attacks, 405, 407
- hard coding BGP version information, 94
- hash payload (IKE main mode message), 290
- hashing, 312–313
  - MD5-HMAC, 84–87
- headers
  - L2TP, format, 248–250
  - TACACS+, 495–497
- Heartbeat messages (POP), 432
- Hellotime field (HSRP), 45
- heuristic/holistic classification, NBAR, 600
- high-availability IPsec over GRE, 360–365
- high-severity alarms, 448
- HMAC (Message Authentication Codes using Hashing), integrity checking, 312–313
- holdtime (HSRP active routers), 43
- Holdtime field (HSRP), 45

- home gateways, VPDN configuration, 544–547
- Honey Pots, 558
- host intrusion detection, 425
- HSRP (Hot Standby Router Protocol), 42
  - active routers, 43
  - Failover protocol, 49
  - failure detection, 43
  - functionality, 47–49
  - implementations, 46–47
  - packet format, 44–46
  - versus VRRP, 49

## I

- ICMP (Internet Control Message Protocol)
  - floods, rate limiting with CAR, 617
  - maintaining path integrity, 91
  - packet filtering, 573–575
- identifying resources to protect, 6
- identity payload
  - EAP messages, 117
  - IKE main mode message, 290
- IDSM
  - event logging, 441–442
  - IP session logging, 442
  - sensor implementation, 448
- IDSs
  - Catalyst 6000 IDSM
    - configuring as sensors, 458–461
  - Cisco Secure IDS
    - categories of signatures, 444–445
    - management console, 426–433
    - sensors, 426–428, 435–444
    - signature engines, 446–447
  - PIX Firewall, configuring as sensors, 454–457
  - resolving common problems, 666–670
  - routers, configuring as sensors, 449–454
  - signature-based, 419
  - statistical anomaly-based, 419
- IEEE 802.1x port authentication, 114
  - communications, 115–21
  - configuring on Catalyst 6000 switches, 123–125
  - functionality, 122
- IETF Accounting AV pairs (RADIUS), 532–533
- IETF attributes supported on Cisco routers, 521–531

- IKE (Internet Key Exchange), 276
  - aggressive mode using preshared key authentication, 302–306
  - Diffie-Hellman algorithm, 284–285
  - digital signature authentication, 308–309
  - encrypted nonces, 310
  - main mode, 278
    - using digital signature authentication, 298–302
    - using preshared key authentication, 280–297
  - preshared key authentication, 307
  - quick mode, 279
  - SA, 279, 284
- implementations
  - of GRE, 224
    - RFC 1701, 224–226
    - RFC 2784, 226–227
  - of HSRP, 46–47
- implementing
  - CBAC on routers with NAT, 207–210, 212
  - network security policies, 10–20
  - service provider security, 563
- implicit deny all entry (ACLs), 571
- improving network security policies, 12
- incoming BGP routes, filtering, 92–93
- incoming call establishment
  - L2TP, 247
- ingress filtering, 82
- inside global addresses, 628
- inside local addresses, 628
- integrity checking, 312–313
- intranet VPNs, 220
- intrusion detection, 418
  - motivation for, 399–400
  - responses, 438
    - event logging, 439–442
    - IP session logging, 441–443
    - shunning, 443
    - TCP reset, 443
- invalid command filtering, Cisco IOS Firewall, 203
- invalid IP addresses, blocking with ACLs, 581–582
- IOS Firewalls
  - CBAC, 199
    - functionality of, 200–201
    - stateful packet filtering, 200–201
  - debug commands, 650–651
  - order of operations, 648
  - resolving common problems, 651–652
  - show commands, 648–649
  - troubleshooting, 647
- IP Address field (VRRP packets), 53
- IP addressing, NAT, 129
  - security benefits, 130
  - vulnerabilities, 131
- IP fragments
  - filtering, 583–584, 587–588
  - overlapping fragment attacks, 589
  - tiny fragment attacks, 588
- IP log messages (POP), 432
- IP permit lists, configuring, 109–110
- IP session logging, 441–443
  - in appliance sensors, 441
  - on IDSM, 442
  - on PIX Firewall, 443
  - on router-based sensors, 443
- IP source routing, maintaining path integrity, 91
- IPsec
  - AH, 317
  - combined LAN-to-LAN/remote access
    - configuration, 369–373
  - components, 276
  - compulsory tunneling, 266–270
  - debugs, 654–658
  - DPD, 323
  - encryption mechanisms, 311
  - ESP, 316
  - high-availability configuration over GRE, 360–365
  - IKE, 276
    - aggressive mode, 302–306
    - digital signature authentication, 308–309
    - encrypted nonces, 310
    - main mode, 278–302
    - preshared key authentication, 307
    - quick mode, 279
  - integrity checking, 312–313
  - interaction
    - with firewalls, 393
    - with NAT, 391–393
  - LAN-to-LAN implementations, 274
  - MTU issues, troubleshooting, 664–666
  - one-to-many router configuration, 355–360
  - order of operations, 653–654

over L2TP using voluntary tunneling, 373–379  
 preshared keys, obtaining from AAA, 537–539  
 remote-access client implementation, 366–368, 275, 317–318  
   extended authentication, 318–320  
   mode configuration, 321  
   NAT transparency, 321  
 router-to-router  
   using digital signatures, 338–349  
   using preshared key authentication, 325–338  
   using RSA encrypted nonces, 349–354  
 show commands, 658–660  
 TED, configuring, 379, 381–391  
 transport mode, 314  
 troubleshooting common problems, 661–666  
 tunnel mode, 314–316  
 VPNs, order of events, 653–654  
 IPv4 GRE, 223  
   RFC 1701 implementation, 223–225  
   RFC 2784 implementation, 226–227  
 IPX sites, connecting with GRE, 235–239  
 ISAKMP, 277  
   x-auth, 541  
   x-auth for remote-access clients, 539–540  
 ISN (Initial Sequence Number), generating random sequences, 148  
 isolated ports, 112  
 ISPs, net police filters, 82

## J-K

Java blocking (Cisco IOS Firewall), 203  
 Key field (RFC 1701 GRE header), 225  
 key-exchange process (IKE), 276  
   aggressive mode exchange with preshared key authentication, 302–306  
   main mode exchange, 278  
     with digital signature authentication, 298–302  
     with preshared key authentication, 280–297  
   quick mode exchange, 279  
 known offenders, blocking, 575

## L

L2TP (Layer 2 Tunneling Protocol), 243  
   compusory tunnels, 245  
     setup process, 251–270  
   control connection establishment, 246  
   header format, 248–250  
   session establishment, 247–248  
   setup process, 246  
   three-way message exchange, 246  
   tunnel layers, 244  
   voluntary tunnels, 245  
 LAN switching  
   basic security rules, 105–106  
   flood attacks, preventing, 110–111  
   IP permit lists, configuring, 109–110  
   port authentication, 114  
     communications, 121  
     IEEE 802.1x, 114–125  
   port security, 107–109  
 Land.c attacks, 414–415  
 LAN-to-LAN IPsec implementations, 274  
   combining with remote-access configuration, 369–373  
 layering firewalls, 144  
 Length field (L2TP header), 250  
 likelihood of attack, assessing, 7–8  
 Livingston Enterprises, Inc., RADIUS, 515  
 lock and key, configuring, 548–549  
 loggerd daemon, 431  
   IDS Sensor, 437  
   UNIX director, 431  
 logging  
   ACLs, 573  
   BGP neighbor status changes, 97  
   events, 61  
   intrusions  
     event logs, 439–442  
     IP session logs, 441–443  
   PIX events, 74  
   switches, 76  
   syslog messages on PIX, 153–154  
 login banners, 69  
   switches, 78  
 loopbacks, 63  
   configuring as router ID (OSPF), 101  
 low-severity alarms, 447

## M

- MAC addresses, restricting on specific ports, 107–109
- mail guards (PIX Firewall), 164
- main mode (IKE) exchanges, 278
  - using digital signature authentication, 298–302
  - using preshared key authentication, 280–298
    - ISAKMP message payloads, 281–284
    - PFS, 291–292
- maintaining
  - path integrity, 91
  - routing table stability, 94
    - maximum-prefix command, 97
    - route dampening, 95–96
- maintenance policies, defining, 18
- malicious attacks, false positives, 449
- malicious traffic, dropping with CAR, 616–618
- managed daemon (IDS Sensor), 437
- management console (Cisco Secure IDS)
  - CSPM IDS console, 433
    - CIDS configuration GUI, 434
    - cvtnrlog.exe, 434
    - EDI (Event Database Interface), 434
    - EVI, 434
    - nr.postofficed daemon, 433
    - nr.smid daemon, 434
    - Sensor CA, 433
  - interaction with sensor, 427–428
  - placement, 426
  - UNIX director, 430
    - configd daemon, 431
    - eventd daemon, 432
    - fileXferd daemon, 431
    - loggerd daemon, 431
    - POP, 432
    - postofficed daemon, 430
    - sapd daemon, 431
    - shunning, 462–463
    - smid daemon, 431
- management protocols
  - HTTP, 66
  - SNMP, 64–66
- managing NBAR classified traffic, 606–607
- marking packets, NBAR, 605–606
- master routers, 50
- masters (Trinoo), 408

- MD-5 challenge messages (EAP), 117
- MD5-HMAC, 84–87
- medium-severity alarms, 448
- messages, TLS, 118
- method lists, 469
  - applying, 474–482
  - configuring, 471–474
    - for AAA accounting, 479–481
    - for AAA authorization, 476
- Metnick, Kevin, attack on Tsutomu Shimomura's computers, 421–422
- misconfiguration
  - of access lists, troubleshooting, 662
  - of firewalls, 139
- mode configuration (remote access IPsec), 321
- motivation
  - for IDSs, 399–400
  - for service provider security, 557
    - ability to track source of attacks, 560–562
    - defense against attacks, 557–558
- multicast support, PIX Firewall, 172
- multimedia support, PIX Firewall, 166
- multiple sites, connecting with GRE, 230–235

## N

- Nagle protocol, enabling, 70
- NAK messages (EAP), 117
- NAT (Network Address Translation), 129
  - bypassing, 663
  - common problems, troubleshooting, 629–633
  - debugs, 626–627
  - interaction with IPsec, 391–393
  - order of operations, 625–626
  - PIX Firewall capabilities, 155
  - security benefits, 130
  - show commands, 627–629
  - transparency (remote access IPsec), 321
  - vulnerabilities, 131
- NBAR (Network-Based Application Recognition), 599–600
  - class maps, 603–605
  - classifying attacks with PDLM, 607–608
  - detection of Code Red worm, 608–610
  - dropping packets, 605–606

- effect on performance, 608
  - marking packets, 605–606
  - non-TCP-based recognizable protocols, 602–603
  - non-UDP-based recognizable protocols, 602–603
  - TCP-based recognizable protocols, 600–602
  - UDP-based recognizable protocols, 600–602
  - negotiation (IKE)
    - aggressive mode exchanges using preshared key authentication, 302–306
    - main mode exchanges
      - ISAKMP message payloads, 281–284
      - PFS, 291–292
      - using digital signature authentication, 298–302
      - using preshared key authentication, 280–298
  - neighbor database filters, 101
  - neighbor status (BGP), logging changes in, 97
  - net police filters, 82
  - NetFlow switching, ACL enhancements, 594–595
  - network access attacks, 401–402
  - network advertisements, BGP, 93
  - network attacks, 401
    - cessation-of-operation
      - Land.c, 414–415
      - ping of death, 413–414
    - DoS, 401, 405
      - cessation of normal OS operation, 405
      - DDoS, 407–413
      - resource exhaustion, 405
      - TCP SYN floods, 405–407
  - network access, 401
    - buffer overflows, 415–416
    - data access, 402
    - privilege escalation, 417–418
    - system access, 402
  - network flows, 594
  - network intrusion detection, 425
  - network layer VPNs, 219
  - network security policies
    - auditing, 12
    - creating, 8–9
    - defining, 15–20
    - design issues, 11
    - elements of, 9–10
    - implementing, 10–11
  - nonbroadcast neighbor configuration, OSPF, 98–99
  - nonces, 285
  - nonencrypted VPNs, 218
  - noninitial fragment inspection (Cisco IOS Firewall), 206
  - non-IP traffic encapsulation, 227
  - nonstateful packet filters, 141
  - non-TCP-based protocols recognized by NBAR, 602–603
  - non-UDP-based protocols recognized by NBAR, 602–603
  - notification ability of firewalls, 138
  - notification messages (EAP), 117
  - notify payload (DPD), 323
  - Nr field (L2TP header), 250
  - nr.postofficed daemon (CSPM IDS console), 433
  - nr.smid daemon (CSPM IDS console), 434
  - Ns field (L2TP header), 250
  - NTP (Network Time Protocol)
    - configuring, 68
    - switch implementations, 77
  - null route filtering, 87
- 
- ## O
- 
- Oakley, 277
  - object groups, scaling PIX configurations, 191–195
  - Offset field (L2TP header), 250–251
  - one-time password messages (EAP), 117
  - one-to-many router IPsec configuration, 355–360
  - OSPF (Open Shortest Path First)
    - configuring loopbacks as router ID, 101
    - nonbroadcast neighbor configuration, 98–99
    - route filtering, 101
    - router authentication, 98
    - stub areas, configuring, 99–100
    - timers, configuring, 101
  - outgoing BGP routes, filtering, 93
  - outgoing call establishment, L2TP, 247–248
  - out-of-sequence fragments, stateful inspection of
    - with Cisco IOS Firewall, 207
  - outside global addresses, 628



- outside local addresses, 628
- overlapping fragment attacks, 175, 589
- Overload NAT, 129

## P

---

- packet filters
  - nonstateful, 141
  - stateful, 142
- packetd daemon (IDS Sensor), 437
- packets
  - classifying with NBAR, 599–603
    - class maps, 603–605
  - dropping, 605–606
  - EAP, fields, 116
  - HSRP, 44–46
  - ICMP, blocking with ACLs, 573, 575
  - marking with NBAR, 605–606
  - network flows, 594
  - RADIUS, 517–518
  - TACACS+, encryption, 497
  - VRRP, 51–54
- PAE (Port Access Entity), 115
- passive monitoring, 427
- passwords
  - authentication, 470
  - encryption with RADIUS, 518–519
  - PIX, managing, 73–74
- PAT (Port Address Translation), 129
- path integrity, maintaining, 91
- PDLM (Protocol Description Language Module),
  - classifying attacks with NBAR, 607–608
- peer authentication (BGP), 92
- performance, effect of NBAR on, 608
- permissive security policies, 9
- perpetrators of network attacks
  - experienced hackers, 404
  - inexperienced hackers, 403
  - trusted users, 403
  - untrusted users, 403
- personal firewalls, 142
- PFS (Perfect Forward Secrecy), 291–292
- physical security, 36
  - environmental factors, 39
  - network topographical design, 36
  - power supply, 38
  - redundant locations, 36
  - selecting secure locations, 37–38
- ping of death attacks, 413–414
- PIX Firewall, 71
  - access control, 72
  - ACLs, 153
  - advanced features
    - DNS guards, 165
    - flood guards, 162
    - frag guards, 163–164
    - fragment handling, 174–175
    - mail guards, 164
    - multicast support, 172
    - multimedia support, 166
    - protocol fixup, 168–169
    - spoof detection, 168
    - sysopt commands, 169–172
    - traffic filtering, 165
    - URPF, 168
  - alias feature, configuring, 159–162, 185–188
  - ASA, 147
    - generating random ISN sequence, 148
    - stateful inspection, 152
    - TCP traffic filtering, 148–150
    - UDP session establishment, 150
  - configuration management, 71
  - configuring
    - as sensors, 454–457
    - with three interfaces, 176–181
  - connectivity, troubleshooting, 645–647
  - cut-through proxy authentication, 158–159, 188–191
  - debugs, 635–637
  - events logging, 74, 442–443
  - failover, 156–158
    - to secondary devices, 181–184
  - logging capabilities, 153–154
  - NAT, 155
  - object groups, scaling configurations, 191–195
  - password management, 73–74
  - recommended timeout values, 637
  - redundancy, 155
  - resolving common problems, 643–645
  - routing capabilities, 155
  - security zones, 152–153
  - sensor implementation, 448
  - show commands, 638–643

- SSH, 73
- troubleshooting, 633–634
- zones, creating, 30–31
- placement
  - of DMZs
    - between firewall and public network, 27
    - between stacked firewalls, 30
    - outside the firewall, 28–29
  - of firewalls, 143
- policies, 5
  - auditing, 12
  - creating, 8–9
  - defining, 15–20
  - design issues, 11
  - elements of, 9–10
  - implementing, 10–11
- policing, managing NBAR classified traffic, 607
- policy routing, dropping/marking NBAR classified traffic, 606
- POP (Post Office Protocol), Cisco Secure IDS communications, 432
- ports
  - authentication, 802.1x, 114
  - communications, 115–121
  - configuring on Catalyst 6000 switches, 123–125
  - functionality, 122
  - on private VLANs, 112
  - security, 107–109
- positioning firewalls, 143–144
- postofficed daemon
  - IDS Sensor, 436–437
  - UNIX director, 430
- power supplies, designing physical security, 38
- PPP (Point-to-Point Protocol)
  - AAA authentication and authorization, 482–485
  - L2TP, 243
    - compusory tunnels, 245, 251–270
    - control connection establishment, 246
    - header format, 248–250
    - session establishment, 247–248
    - setup process, 246
    - tunnel layers, 244
    - voluntary tunnels, 245
  - timeouts, configuring with AAA, 488–489
- prefix lists, filtering incoming BGP routes, 92–93
- preshared key authentication, 307
  - authenticating ISAKMP in IPsec implementations, 537–539
- preventing flood attacks, 110–111
- Priority field
  - HSRP, 46
  - L2TP header, 250
  - VRRP packets, 52
- private networks
  - route filtering, 81
    - address spaces, 82
    - applying, 82
    - ingress filtering, 82
    - net police filters, 82
  - tunneling between with GRE, 227–230
  - VPDN, 544–547
- private VLANs, 111–112
  - ARP spoofing, 113
  - configuring, 113
  - ports, 112
  - sticky ARP, 113
- privilege levels
  - assigning to users, 549–552
  - escalating, 402, 417
    - getadmin exploits, 418
    - unicode exploits, 418
- processing, order of operations
  - ACLs, 571
  - IPsec, 653–654
  - NAT, 625–626
- professional hackers, Metnick, Kevin, 421–422
- promiscuous ports, 112
- Protocol Description Language Module. *See* PDLM
- Protocol field (VRRP packets), 51
- protocol filtering, controlling LAN floods, 110–111
- protocol fixup, PIX Firewall, 168–169
- Protocol Type field (RFC 1701 GRE header), 225
- proxy authentication, configuring, 541–544
- proxy servers, 129
  - firewalls, 141
- public/private key pairs, 307

## Q

- QoS (quality of service)
  - CAR, 613–614
    - compound interest measurement, 615–616
    - dropping malicious traffic, 616–618
    - token buckets, 614
  - NBAR, 599–600
    - classifying attacks with PDLM, 607–608
    - detection of Code Red worm, 608–610
    - effect on performance, 608
    - marking/dropping packets, 605–606
    - recognizable protocols, 600–603
- qualitative risk assessment, 8
- quick mode (IKE), 279
  - timeout negotiation, 293

## R

- RADIUS, 515
  - accounting, 531–532
    - IETF Accounting AV pairs, 532–533
  - authentication, 519
  - authorization, 520–530
    - IETF attributes, 521–531
    - vendor-specific attributes, 530–531
  - communications architecture, 516
  - packet format, 517–518
  - password encryption, 518–519
- rate limiting
  - CAR, 613–614
    - compound interest measurement, 615–616
    - dropped packets, 616
    - dropping malicious traffic, 616–618
    - token buckets, 614
  - DoS attacks, 616–618
  - suspicious traffic, 618
- recommended PIX timeout values, 637
- redundancy
  - HSRP, 42
    - active routers, 43
    - Failover protocol, 49
    - failure detection, 43
    - functionality, 47–49

- implementations, 46–47
    - packet format, 44–46
    - versus VRRP, 49
  - physical security, 36
  - PIX Firewall capabilities, 155–158
  - routing-enabled, 39–40
    - dynamic, 41
    - static routes, 40
  - VRRP, 50
    - failure detection, 51
    - master router selection, 50
    - packet format, 51–54
- remote-access clients, x-auth, 539–541
- remote-access IPsec, 275, 317–318, 366–368
  - combining with LAN-to-LAN configuration, 369–373
  - extended authentication, 318–320
  - mode configuration, 321
  - NAT transparency, 321
- resolving common issues
  - AAA-related problems, 671–677
  - IDS-related problems, 666–670
  - IOS-related Firewall problems, 651–652
  - IPsec-related problems, 661–666
  - NAT-related problems, 629–633
- resource exhaustion DoS attacks, 405
  - DDoS
    - Stacheldraht, 411–413
    - TFN, 409–411
    - Trinoo, 407–408
  - simple DoS attacks. TCP SYN floods, 406–407
- responses to intrusions (IDS Sensor), 438
  - event logging, 439–442
  - IP session logging, 441–443
  - shunning, 444
  - TCP reset, 443
- restricting
  - BGP communications, 94
  - MAC addresses on specific ports, 107–109
  - traffic
    - with ACLs, 572–573
    - with IP Permit lists, 109–110
- restrictive security policies, 9
- RFC 1701 GRE implementation, 224–226

- RFC 1918 addressing
  - address space, filtering, 582
  - NAT, 129–130
  - vulnerabilities of, 131
- RFC 2409, IKE, 277
- RFC 2784 GRE implementation, 226–227
- RFC 2890 GRE implementation, 226
- risk assessment, likelihood of attacks, 7–8
- route dampening, 95–96
- route filtering, 81
  - address spaces, 82
  - applying, 82
  - ingress filtering, 82
  - net police filters, 82
  - OSPF, 101
- Router and PIX Firewall sensors, 435
- router-based sensors
  - event logging, 442–443
  - IP session logging, 443
- routers
  - CBAC implementation case study, 207–212
  - CEF, enabling, 67
  - configuration management, 54–55
  - configuring as sensors, 449–454
  - controlling access, 55
    - TTY, 58
    - vtty, 55–57
  - core dumps, 70
  - disabling unnecessary services, 61–63
  - events logging, 61
  - HTTP, configuring, 66
  - login banners, 69
  - loopback interfaces, 63
  - Nagle protocol, 70
  - NTP, configuring, 68
  - password management, 59–60
  - scheduler, configuring, 67
  - securing access, 58
  - sensor implementation, 448
  - sinkholes, 558
  - SNMP, configuring, 64–66
  - standby mode, 42
  - traffic processing, 585
- routing
  - asymmetric, 89
  - black hole filtering, 87–88
  - convergence, 83

- directed broadcast control, 87
- maintaining path integrity
  - ICMP redirects, 91
  - IP source routing, 91
- PIX Firewall capabilities, 155
- route authentication, 83
  - clear-text passwords, 84–87
  - MD5-HMAC, 84–87
  - OSPF, 98
- static routes, 83
- URPF, 88
  - applying, 90
  - configuring, 89
- Routing field (RFC 1701 GRE header), 226
- routing protocols
  - BGP, 92
    - disabling version notification, 94
    - EBGP multihop, 94
    - incoming route filtering, 92–93
    - logging neighbor status changes, 97
    - network advertisements, 93
    - outgoing route filtering, 93
    - peer authentication, 92
    - restricting BGP communications, 94
  - OSPF
    - configuring loopbacks as router ID, 101
    - nonbroadcast neighbor configuration, 98–99
    - route filtering, 101
    - router authentication, 98
    - stub areas, 99–100
    - timers, configuring, 101
- routing tables, maintaining stability, 94
  - maximum-prefix command, 97
  - route dampening, 95–96
- routing-enabled redundancy, 39–40
  - dynamic, 41
  - static routes, 40

---

## S

- SA (security association), 279
- sapd daemon, 431
  - IDS Sensor, 437
  - UNIX director, 431

- scaling PIX configurations, 191–195
- scheduler, configuring, 67
- script kiddies, 403
- security policies, 5
  - auditing, 12
  - creating, 8–9
  - defining, 15–20
  - design issues, 11
  - elements of, 9–10
  - incident reporting, 18
  - implementing, 10–11
- security zones
  - defining, 25–26
  - DMZs, 26–30
    - case study, 30–31
    - placement, 28–30
  - PIX, 152–153
- selecting
  - secure locations for devices, 37–38
  - secure media, 38
  - VRRP master routers, 50
- Sensor CA (CSPM IDS console), 433
- sensors
  - Catalyst 6000 IDS, configuring as, 458–461
  - Cisco Secure IDS
    - configd daemon, 437
    - fileXferd daemon, 437
    - inline processing, 427
    - interaction with management console, 427–428
    - loggerd daemon, 437
    - managed daemon, 437
    - packetd daemon, 437
    - passive monitoring, 427
    - placement, 426
    - postofficed daemon, 436–437
    - sapd daemon, 437
    - types of, 435
  - PIX Firewall, configuring as, 454–457
  - responses to intrusions, 438
    - event logging, 439–442
    - IP session logging, 441–443
    - shunning, 444
    - TCP reset, 443
  - routers, configuring as, 449–454
  - signature engines, 446–447
  - signatures, corresponding alarms and severity levels, 447–448
- Sequence field (L2TP header), 250
- Sequence Number field (RFC 1701 GRE header), 225
- service provider security
  - backscatter traceback, 560–562
  - components of, 563
  - implementing, 563
  - motivation for, 557
    - ability to track source of attacks, 560–562
    - defense against attacks, 557–558
  - sinkhole routers, 558
- session establishment, L2TP, 247–248
- Session ID field (L2TP header), 250
- setup process, L2TP, 246
  - compulsory tunnels, 251–266
    - with IPsec, 266–270
- severity levels of alarms, 447–448
- Shimomura, Tsotomu, 421–422
- show conn detail command, 639–640
- show crypto engine connection active command, 659
- show crypto isakmp sa command, 659–660
- show interface command, 640–643
- show ip inspect all command, 648–649
- show ip nat translations command, 628
- show xlate detail command, 637–639
- shunning, 443, 575
  - configuring on UNIX director, 462–463
  - managed daemon (Cisco IDS sensor), 437
- signature engines, 446–447
- signature-based IDSs, 419
- signatures, 419, 463–465
  - corresponding alarms and severity levels, 447–448
  - IDS signature categories, 444–445
- simple-text password authentication (VRRP), 53
- sinkhole routers, 558
- SIS (state information structure), 200–201
- site to site IPsec VPNs, 274
- SKEME, 276
- smashing the stack, 416
- smid daemon, 431
- smid daemon (UNIX director), 431

- smurf attacks, thwarting with ACLs, 576, 578
- SNMP (Simple Network Management Protocol),
  - configuring, 64–66
- son-of-IKE initiative, 277
- Source Address field (VRRP packets), 51
- source of attacks, tracking with service provider
  - security, 560–562
- Spafford, G., 8
- speak state (HSRP routers), 43
- spoof detection, PIX Firewall, 168
- spoofed IP addresses
  - blocking, 575
  - source IP addresses, 88–89
- SSH (secure shell), 58
  - PIX implementation, 73
- Stacheldraht attack, 411–413
- standalone IDS 4200 series sensors, 435
- standard ACLs, 568
- standards, IEEE 802.1x
  - configuring on Catalyst 6000 switches, 123–125
  - functionality, 122
  - port authentication, 114–121
- standby groups (HSRP), 43
- standby mode (HSRP), 42
- state information, 147
  - SIS, 200–201
- stateful inspection, 152
  - packet filters, 142
  - TCP packets, 148
- static routes, 83
  - routing-enabled redundancy, 40
- statistical anomaly-based IDSs, 419
- sticky ARP, 113
- stub areas, configuring, 99–100
- subport classification, NBAR, 600
- suplicants (IEE 802.1x), 114
  - communications with authenticator, 119–121
- suspicious content, rate-limiting, 618
- switches
  - access control, 75
  - Catalyst 6000 private VLANs, 111–112
    - ARP spoofing, 113
    - configuring, 113
    - ports, 112
    - IEEE 802.1x, configuration, 123–125
    - sticky ARP, 113

- configuration management, 75
  - core dumps, 78
  - events logging, 76
  - login banners, 78
  - NTP, 77
- switching
  - basic security rules, 105–106
  - IP permit lists, configuring, 109–110
  - LAN floods, controlling, 110–111
  - port authentication, 114
    - communications, 115–121
    - functionality, 122
  - port security, 107–109
- SYN floods
  - rate limiting with CAR, 617
  - thwarting with ACLs, 579–580
- synchronization, NTP
  - configuring, 68
  - switch implementations, 77
- syslog messages, PIX, 153–154
- sysopt commands, 169–172
- system access attacks, 402

## T

- TACACS+ (Terminal Access Controller Access Control Server plus)
  - accounting, 508–512
  - authentication, 498
  - authorization, 499–507
  - communications architecture, 494
  - daemon functionality, 493–494
  - header architecture, 495–497
  - packet encryption, 497
- TCP (Transmission Control Protocol)
  - connection establishment through PIX, 148–150
  - ISN, generating with ASA, 148
  - NBAR recognized protocols, 600–602
  - packet filtering with ASA, 148
- TCP port 179, restricting BGP communications, 94
- TCP reset, 443
- TCP SYN floods, 405–407
  - preventing with Cisco IOS Firewalls, 206
- TED (Tunnel Endpoint Discovery), configuring, 379–391

- TFN (tribal flood network) attack, 409–411
- TFN2K attack, 411
- threats, assessing, 6–7
- three-legged firewalls, creating DMZs, 27
- three-message exchange, L2TP, 246
- threshold values, CBAC, 204–205
- thwarting attacks with ACLs
  - DoS attacks, 580–582
  - fraggle attacks, 578–579
  - smurf attacks, 576–578
  - SYN floods, 579–580
- timeout negotiation, 293
- timeout values
  - CBAC, 204–205
  - PIX, 637
- timers, OSPF configuration, 101
- tiny fragment attacks, 174–175, 588
- TLS (Transport-Layer Security) messages, 118
- token buckets, 614–616
- top-down processing (ACLs), 571
- topographical designs, physical security, 36
- ToS (type of service), marking packets, 605–607
- traffic. *See also* traffic filters
  - classifying with NBAR, 599–600
    - recognizable protocols, 600–603
  - controlling with CAR, 613–614
    - compound interest measurement, 615–616
    - dropping malicious traffic, 616–618
    - token buckets, 614
  - network flows, 594
  - policing, 607
- traffic filters
  - ACLs, 572–573
    - blocking IMP packets, 573–575
    - blocking known offenders, 575
    - blocking spoofed IP addresses, 575
    - extended, 569–571
    - functionality, 567–568, 573
    - impact on performance, 590
    - implicit deny all entry, 571
    - logging facility, 573
    - standard, 568
    - thwarting DoS attacks, 580–582
    - thwarting fraggle attacks, 578–579
    - thwarting smurf attacks, 576–578
    - thwarting SYN floods, 579–580
    - top-down processing, 571
    - black hole filtering, 87–88
    - PIX Firewall, 165
  - transform payloads, IKE SA timeout negotiation, 284
  - transport layer inspection, Cisco IOS Firewall, 202
  - transport mode (IPsec) encapsulation, 314
  - Trinoo DDoS attack, 408
- troubleshooting
  - AAA, 670–677
  - IDS problems, 666–670
  - IOS Firewalls, 647–648
    - common problems, 651–652
    - debug commands, 650–651
    - show commands, 648–649
  - IPsec problems, 661–666
  - NAT, 629–633
  - PIX, 633–634, 643–645
    - common problems, 643–645
    - connectivity, 645–647
- trunking, VLAN security, 106
- Tsutomu Shimomura, 421–422
- TTL field (VRRP packets), 51
- TTY lines, 55
  - controlling router access, 58
- Tunnel ID field (L2TP header), 250
- tunnel mode (IPsec) encapsulation, 314–316
- tunneling
  - IPsec, IKE negotiation
    - aggressive mode exchange process, 302–306
    - main mode exchange process, 280–302
  - L2TP, 243
    - compulsory tunnels, 245, 251–270
    - control connection establishment, 246
    - header format, 248–250
    - session establishment, 247–248
    - setup process, 246
    - tunnel layers, 244
    - voluntary tunnels, 245
  - voluntary, 373–379
    - with GRE between private networks, 227–230
- turbo ACLs, 590–591
  - configuring, 591–593
- Type field
  - L2TP header, 250
  - VRRP packets, 52

## U

- UDP (User Datagram Protocol)
  - transmission through PIX, 150
  - NBAR recognized protocols, 600–602
- unauthorized access, restricting with ACLs, 572–573
- Unicast Reverse Path Forwarding. *See* URPF
- unicode exploits, 418
- unintentional inside attackers, 403
- UNIX director
  - configuring routers as sensors, 449–454
  - internal architecture, 430
    - configd daemon, 431
    - eventd daemon, 432
    - fileXferd daemon, 431
    - loggerd daemon, 431
    - POP, 432
    - postofficed daemon, 430
    - sapd daemon, 431
    - smid daemon, 431
  - shunning configuration, 462–463
  - versus CSPM IDS Console, 429
- unstable routing tables, controlling, 94
  - maximum-prefix command, 97
  - route dampening, 95–96
- URPF (Unicast Reverse Path Forwarding), 88–89
  - applying, 90
  - configuring, 89
  - PIX Firewall, 168

## V-W

- vendor-specific attributes supported on Cisco routers, 530–531
- Version field
  - L2TP header, 250
  - VRRP packets, 52
- Virtual IP Address field (HSRP), 46
- virtual reassembly, 163
- Virtual Router Redundancy Protocol. *See* VRRP
- virtual routers, 42
- Virtual Rtr ID field (VRRP packets), 52
- viruses, Code Red worm, 608–610
- VLANs, 105
  - basic security rules, 105–106
  - versus private VLANs, 111
- voluntary tunneling, 245, 373–379
- VPDN (Virtual Private Dialup Networking), 544–547
- VPNs
  - application layer, 219
  - data link layer, 219
  - encrypted, 218
  - extranet, 220
  - high-availability IPsec over GRE, 360–365
  - intranet, 220
  - IPsec, 653–654
    - debugs, 654–658
    - show commands, 658–660
  - misconfigured access lists, troubleshooting, 662
  - network layer, 219
  - nonencrypted, 218
  - one-to-many router IPsec, 355–360
  - remote-access IPsec implementations, 366–368
  - router-to-router IPsec
    - using digital signatures, 338–349
    - using preshared key authentication, 325–338
    - using RSA encrypted nonces, 349–354
- VRRP (Virtual Router Redundancy Protocol)
  - failure detection, 51
  - master router selection, 50
  - packet format, 51–54
  - versus HSRP, 50
- vty router access, 55
  - controlling, 55–57
- vulnerabilities
  - assessing, 6–7
  - of NAT, 131
  - of underlying firewall operating systems, 140



## X-Y-Z

---

- x-auth (extended authentication), 318–320, 539–541
  - for remote-access clients, 539–540
  - VPN users, 541
- x bits field (L2TP header), 250
  
- ZLB ACKs, 248
- zoning secure networks, 25–26
  - case study, 30–31
  - DMZs, 26–30