

Index

A

- access control subsystems SNMPv3 engines, 48–49
- Accounting Server
 - aggregation, 211
 - basics, 208–210
 - correlation, 211
 - mediation, 210
 - reports, 212
- actions, 151–156
- AF (assured forwarding), PHBs, 162
- agents (SNMP), 11, 13, 36–37
- aggregate objects, 33–34. *See also* LSPs; VLANs; VPNs
- alarms, 35
- Alcatel, network management software, 28
- AS (autonomous system) network, 152
- ATM (Asynchronous Transfer Mode), 4
 - LANE, 19
 - linked overviews, 99–101
 - PNNI, 21
 - ports, 24
 - PVCs, 25–26
 - scalability on virtual circuits, 85–86
 - SPVCC, 20
 - VPI/VCI, 20, 23
- authentication
 - in different versions, 62
 - protocols, 52
 - Security Server, 218–219
 - SNMP message format, 49–51, 60–61

B

- best effort QoS (quality of service), 117, 161
- Borland JBuilder, 107

C

- Charlotte's Networks routers, stress testing, 90
- CIM (Common Information Model), 159–160
- Cisco network management software, 28
 - stress testing, 90
- CLI (command-line interface), 13
 - EMS compatibility, 30
 - Telnet, 32
- coarse granularity QoS (quality of service), 117–119
- COM (Component Object Model), 108
- command generator and responder SNMPv3 applications, 49
- Configuration Server
 - basics, 202–203
 - connection table updates, 204–205
 - creating network objects, 205
 - secure users, 203–204
 - server database tables, 206
 - software structure, 208
 - topology updates, 205–206
 - trace files, 204
- ContextID and ContextName objects (SNMP), 49, 51
- converged networks, 33–34
- COPS (Common Open Policy Service), 156–157
- CORBA specifications, OMG, 107–108
 - NMS middleware, 225
- CPE (customer premises equipment), SP networks, 24

cross-connects
 LERs, 74
 LSRs, 74
 MPLS, 111, 113, 263–264
 CTI (computer-telephone integration), 7

D

DEFVAL MIB object attribute, 40
 DEN (Directory-Enabled Networking), 158–160
 DES (Data Encryption Standard) keys, 49, 60
 DESCRIPTION MIB object attribute, 40
 DiffServ (Differentiated Services) QoS, 24, 117–119, 161
 attacks, 165
 MPLS, 164–165
 discovery, 34–35
 and mapping (NNM), 172–173
 Discovery Server, 220
 dispatchers, SNMPv3 engines, 48–49
 DMI (Desktop Management Interface), 32, 33

E

EF (expedited forwarding), PHBs, 162
 EGP (Exterior Gateway Protocol), 102
 EMS (element management systems), 13
 management system value pyramid, 28–31
 Telnet, 32
 VLANs, 9
 encryption, SNMPv3, 52, 53, 60
 EngineBoots objects (SNMP), 49, 51
 EngineID objects (SNMP), 49, 51
 EngineTime objects (SNMP), 49, 51
 enterprise networks
 categories of networks, 1
 components, 4–5
 data flows, 6
 deployment
 centralized, 6–7
 geographically distributed, 5
 disadvantages, 9
 features, 7
 intranets, 6
 lifecycles, 7
 migration toward IP networks, 69–70
 scalability issues, 89
 services provided, 2–3
 storage planning, 8
 unified messaging, 6
 entities (SNMP). *See* agents (SNMP)
 EROs (Explicit Route Objects), 111–112

Ethernet ports, 24
 events, 35

F

Fault Server
 basics, 197–200
 database tables, 200–201
 software structure, 201
 topology updates, 201–202
 faults, 35
 FCAPS areas, OSI model, 26–28, 78
 FTN MIB, 299–300
 NMS stovepipes, 140–141
 software layers, 95
 fine granularity QoS (quality of service), 117–118
 Foundry Networks routers, stress testing, 90
 FTN (FEC-To-NHLFE MIB)
 basics, 292–295
 example, 295–296
 mplsFTNTable setup, for LSP redirection, 296–298
 mplsFTNTTable setup, for tunnel redirection, 298

G

GET operations
 JDMK sample program, 248
 Visual C++ sample program, 240
 GetBulkRequest messages (SNMP), 44, 56–57, 62
 GETNEXT operations
 JDMK sample program, 248–249
 Visual C++ sample program, 240
 GetNextRequest messages (SNMP), 44, 55–56, 62
 GetRequest messages (SNMP), 44, 54–55, 60
 GetResponse messages (SNMP), 44, 86

H

Hewlett-Packard OpenView, 10, 28
 NNM
 backup and restore, 179
 basics, 168–169
 data warehousing, 178
 discovery and mapping, 172–173
 integration with other software, 187
 Java-based Web interface, 180–181
 mediation, 170–171
 MIBs, 183
 monitoring, 174
 MPLS support, 183
 notification processing, 176
 policy support, 184
 programmability, 187–188

Hewlett-Packard OpenView
 NNM (*continued*)
 reliability, 185
 reporting, 177
 host routing tables, 154

I

IDL (Interface Definition Language), 31
 management software, 108
 IGP (Interior Gateway Protocol), 102
 IIOP (Internet Inter-Orb Protocol), 107–108
 in-segments
 LERs, 74
 LSRs, 74
 MPLS, 111, 113, 261
 InetAddressType MIB object, 41
 information models
 CIM, 159–160
 DEN, 158–160
 InformRequest messages (SNMP), 44, 57–60
 interfaces (IP networks), 101
 interfaces *versus* ports, 24–25
 IntServ (Integrated Services) QoS, 117–118, 161
 IP networks
 layer 3, OSI model, 21–22
 linked overviews, 101–102
 managed objects, 101–102
 migration toward IP networks, 69–70
 MPLS routing protocols, 114
 QoS levels, 160–164
 routing table controls, 151–155
 SLAs, 160–161
 ipInReceives object, 39
 IS-IS (Intermediate System–Intermediate System) routing protocol, 73
 IP protocols, 102
 MPLS, 114
 traffic engineering, 116

J–K

Java RMI (Remote Method Invocation), 108
 JBuilder (Borland), 107
 JDMK (Java Development Management Kit) sample program
 extensions, 251–253
 GET operations, 248
 GETNEXT operations, 248–249
 SNMP manager, 245–247
 SNMP manager, synchronous, 249

versus Visual C++ SNMP sample program,
 249–251

Juniper routers, stress testing, 90

L

label operations (MPLS), 114–115
 encapsulation, 115–116
 LANE (ATM LAN Emulation), 19
 LANs (large area networks), 3
 layer 2, OSI model, 17–21
 VPNs
 scalability, 83–85
 layer 2.5, OSI model, 22–23
 layer 3, OSI model, 21–22
 VPN scalability, 85
 LEAP (Lightweight Flow Accounting Protocol), 299
 LERs (label edge routers)
 MIB scalability, 87–89
 MPLS nodes, 71–75
 stress testing networks, 90
 lexicographic ordering, MIBs, 43
 LSPs (label switched paths), 20, 21
 MIB scalability, 87–89
 MPLS
 components, 111–113
 DiffServ support, 164–165
 service-level network components, 300
 stress testing networks, 90
 LSRs (label switching routers)
 MIB scalability, 87–88
 MPLS nodes, 71–75
 stress testing networks, 90

M

MacAddress object, 39
 managers (SNMP), 36, 37–39
 MAX-ACCESS MIB object attribute, 40, 41
 MaxMessageSize objects (SNMP), 49–50, 54
 MD5 protocol, SNMP privacy settings, 49, 52, 60–61
 message subsystems SNMPv3 engines, 48–49
 MessageFlags objects (SNMP), 49–51, 53–55
 MessageID objects (SNMP), 49–50, 54
 MessageSecurity objects (SNMP), 49, 51, 54
 MessageVersion objects (SNMP), 49–50, 54
 MIBs (Management Information Bases), 2
 basics, 143, 288
 centralizing to match NE features, 146
 columns
 default values, 291–292
 tightly coupled intercolumn dependencies,
 289–290

- component of SNMP, 36, 39–40
 - Configuration Server support, 206–207
 - extensions, 66
 - FTN MIB
 - basics, 292–295
 - example, 295–296
 - mplsFTNTable setup, for LSP redirection, 296–298
 - mplsFTNTable setup, for tunnel redirection, 298
 - lexicographic ordering, 43
 - manipulating with scripts and software modules, 10–11
 - necessary for management, 10–12
 - NMS support features, 181–182
 - objects
 - attributes, 40–42
 - default values, 144–145
 - management, 11–12, 66, 182
 - semantic dependencies, 144
 - OIDs, 42–43
 - quality, 15–16
 - scalability, 86, 87–89, 291–292
 - scalable aggregated services, 175
 - sections, 64–65
 - versus* standard operating systems, 66–67
 - textual conventions, 39
 - thin software layers, 291–292
 - upgrades following MIB changes, 105–106
 - WALK operations, 241–242
- Microsoft SMS (Systems Management Server), 6, 16, 32
- Monitoring Server, 220–221
- MPLS (Multiprotocol Label Switching) networks, 1–2
- basics, 68–71
 - creating LSPs, 88
 - cross-connects, 111, 113, 263–264
 - deploying on NEs, 256–257
 - DiffServ, 164–165
 - EROs, 111–112
 - example, 258–261
 - in-segments, 111, 113, 261
 - interfaces, 257–258
 - label operations (MPLS), 114–115
 - encapsulation, 115–116
 - label stacks, 264–265
 - layer 2.5, OSI model, 22–23
 - LERs, 71–75
 - LSPs, 20, 21, 111–113
 - configuring through LSRs, 266–267
 - creating with LSR MIB, 267–273
 - examples, 258–266
 - standards, 284
 - and tunnels, 283
 - main components, 110–111
 - MIBs, 255–256
 - FTN MIB, 292–299
 - nextObjectIndex counter, 283–284
 - standards, 284
 - migration to IP networks, 69–70
 - nodes, 71
 - out-segments, 111, 113, 262–263
 - protocols, routing and signaling, 114
 - QoS, 116–119
 - resource blocks, 111–112
 - scalability, 119–122
 - traffic engineering, 116, 117, 119–122, 265
 - tunnel table objects, 120–122
 - mplsTunnelHopTable, 282
 - mplsTunnelResourceTable, 278–279
 - mplsTunnelResourceTable, configuring, 281–282
 - mplsTunnelTable, 273–278
 - mplsTunnelTable, configuring, 280–281
 - tunnels, 111–113, 119–122
 - creating, 283
 - standards, 284
- mplsFTNAddrType MIB object, attributes, 40–42
- mplsFTNTable object
 - setup for LSP redirection, 296–298
 - setup for tunnel redirection, 298
- mplsInSegmentTable object, 261
- mplsInterfaceConfTable object, 259–261
- mplsInterfacePerfTable object, 266
- mplsLabelStackTable object, 264–265
- mplsOuSegmentTable object, 262–263
- mplsTunnelHopTable object, 282
- mplsTunnelIncludeAffinity object, 145
- mplsTunnelIndexNext object, 87, 147
- mplsTunnelResourceTable object, 278–279
 - configuring, 281–282
- mplsTunnelTable object, 273–278
 - configuring, 280–281
- multiservice switches, 138
 - operational skill set requirements, 110
 - testing, 90
- N**
- NBI (Northbound Interface), 226
 - integration with OSS layers, 304–305
- NEs (network elements)
 - advantages and disadvantages, 90–91
 - basics, 67–68, 148–149

- NEs (network elements) *(continued)*
 - CLI compatibility, 30
 - configuring, 223–225
 - database backup and restore, 222–223
 - feature of enterprise networks, 7
 - manageability, 15–16
 - managing newly commissioned and legacy NEs, 11
 - shrink-wrapped solutions, 303–304
 - software distribution, 221–222
- nextObjectIndex object, 87, 283–284
- NICs (network interface cards), 7
- NMS (network management systems), 1–2
 - Accounting Server
 - aggregation, 211
 - basics, 208–210
 - correlation, 211
 - mediation, 210
 - reports, 212
 - advantages, 16–17
 - basics, 10–14
 - components, 230–231
 - boundaries, 191
 - business processes, 188–189
 - Configuration Server
 - basics, 202–203
 - connection table updates, 204–205
 - creating network objects, 205
 - MIB support, 206–207
 - secure users, 203–204
 - server database tables, 206
 - software structure, 208
 - topology updates, 205–206
 - trace files, 204
 - data and code combinations, 81–83
 - data model, 146–147
 - distributed clients and servers, 147–148
 - data warehousing, 177–178
 - database backup and restore, 178–179
 - and upgrade, 223
 - discovery, 34–35, 171–172
 - Discovery Server, 220
 - Fault Server
 - basics, 197–200
 - database tables, 200–201
 - software structure, 201
 - topology updates, 201–202
 - goals, 35
 - integration with other software, 185–187
 - Java
 - RMI, 179–180
 - trends towards Java-based NMS, 226–227
 - management system value pyramid, 28–32
 - EMS, 28–31
 - OSS, 28–29, 31–32
 - mapping, 171–172
 - MIBs, 181–182
 - middleware, 225
 - migration toward IP networks, 69–70
 - monitoring, 173–174
 - Monitoring Server, 220–221
 - MPLS support, 183
 - NBI, 226
 - notifications, 35
 - processing, 176
 - SNMPv3, 57–60
 - object creating using software abstraction, 301–302
 - operational skill set requirements, 108–110
 - OSI model
 - FCAPS areas, 26–28
 - layer 2, 17–21
 - layer 2.5, 22–23
 - layer 3, 21–22
 - Performance Server
 - aggregation, 213–214
 - basics, 212–213
 - correlation, 214
 - database tables, 216
 - reports, 214–215
 - SLA alerts, 215–216
 - topology updates, 216
 - policy-based (PBNM), 149–150
 - architectural elements, 150–151
 - COPS, 156–157
 - network processors, 157–158
 - policies, 155–156
 - policy support, 184
 - ports *versus* interfaces, 24–25
 - programmability, 187
 - reasons for using, 25–26
 - reliability, 184–185
 - reporting, 176–177
 - requirements for high-level support, 136–137
 - security, end-to-end, 302–303
 - Security Server
 - access applications, 217–218
 - basics, 217
 - permitted views, 219
 - privilege levels, 219
 - services management, 137–139
 - shrink-wrapped solutions, 303–304
 - software components, 193–197

- software development
 - basics, 103–104
 - class design, 107
 - CORBA-based, 107–108
 - data analysis, 104–105
 - deployment software, 135
 - GUIs, 107
 - insulating applications from low-level code, 108
 - object-oriented development, 106–107
 - UML, 106–107
 - upgrades following MIB changes, 105–106
 - software development skill sets
 - basics, 91–93
 - cross-functional cooperation, 133–136
 - distributed creative problem solving, 95–96
 - domain expertise, 97–98
 - linked overviews, ATM view, 99–101
 - linked overviews, basics, 98–99
 - minimal code changes, 103
 - short development cycles, 102–103
 - solution engineering, 125–129, 306–307
 - solution engineering, example, 131–133
 - solution engineering, expertise in general-purpose software, 129–130
 - solution engineering, thinking in chunks, 130–131
 - solution mindset, taking ownership, 96–97
 - software vendors, 28
 - stovepipe structure, 139–143
 - uses, 189–190
 - VLANs, 9
 - workflows, 188–189
 - XML data representation, 225
 - NNM (Network Node Manager) Hewlett-Packard
 - OpenView
 - backup and restore, 179
 - data warehousing, 178
 - discovery and mapping, 172–173
 - integration with other software, 187
 - Java-based Web interface, 180–181
 - MIBs, 183
 - monitoring, 174
 - MPLS support, 183
 - notification processing, 176
 - policy support, 184
 - programmability, 187–188
 - reliability, 185
 - reporting, 177
 - nodes (IP networks), 101
 - cross-connects, 111, 113
 - in-segments and out-segments, 111, 113
 - Nortel network management software, 28
 - notifications, 35
 - notification originator and receiver SNMPv3 applications, 49
 - processing, 176
 - SNMPv3, 57–60
- O**
- object attributes, MIBs, 40–42
 - OBJECT IDENTIFIER MIB object attribute, 40
 - object-oriented software development, 106–107
 - OIDs (object identifiers), MIBs, 42–43
 - OMG (Object Management Group)
 - CORBA specifications, 107–108
 - IDL, 108
 - OpenView (Hewlett-Packard), 10, 28. *See also* NNM
 - OSI model
 - FCAPS areas, 26–28, 78
 - FTN MIB, 299–300
 - NMS stovepipes, 140–141
 - software layers, 95
 - layer 2, 17–21
 - VPN scalability, 83–85
 - layer 2.5, 22–23
 - layer 3, 21–22
 - VPN scalability, 85
 - network management standards, 35
 - OSPF (Open Shortest Path First) routing protocol, 73
 - IP protocols, 102
 - MPLS, 114
 - traffic engineering, 116
 - OSS (Operational Support System)
 - integration with NBI, 304–305
 - management system value pyramid, 28–29, 31–32
 - and NBI, 226
 - out-segments
 - LSRs, 74
 - MPLS, 111, 113, 262–263
- P**
- PBNM (policy based network management), 149–150
 - architectural elements, 150–151
 - components, triggers and actions, 151–156
 - COPS, 156–157
 - network processors, 157–158
 - policies, 155–156
 - PDPs (policy server/decision points), 150, 156–157
 - PDUs (protocol data units), 43–44
 - inform fields, 59–60
 - trap fields, 58–59

- PEPs (policy enforcement points), 150, 156
 - PHB (per-hop-behavior), 118, 161–162, 164
 - PIBs (Policy Information Bases), 157
 - PNNI (Private Network-to-Network Interface), 21
 - ports *versus* interfaces, 24–25
 - privacy settings, SNMP message format, 49–51
 - protocols (IP networks), 102
 - proxy forwarder SNMPv3 applications, 49
 - PSTNs (Public Switched Telephone Networks), 5
 - PVCs (permanent virtual circuits)
 - ATM, 25–26
- Q**
- QA (quality assurance), role in network management, 305
 - QoS (quality of service)
 - interface level, 24
 - IP networks, 160–164
 - MPLS, 116–119
- R**
- RMI (Remote Method Invocation), 108
 - Routing Policy Specification Language, 153
 - RowStatus object, 39
 - RPCs (remote procedure calls), 82
 - management software development, 108
- S**
- SANs (storage area networks), 5
 - feature of enterprise networks, 7
 - incompatible management systems, 10
 - lifecycle stages, 8
 - scalability
 - ATM virtual circuits, 85–86
 - MIBs, 86, 87–89, 291–292
 - MPLS, 119–122
 - VPNs
 - layer 2, OSI model, 83–85
 - layer 3, OSI model, 85
 - Security Server
 - access applications, 217–218
 - authentication, 218–219
 - permitted views, 219
 - privilege levels, 219
 - security subsystems SNMPv3 engines, 48–49
 - serial link-based menu systems, 32, 33
 - SET operations, Visual C++ sample program, 241
 - SetRequest messages (SNMP), 44, 57
 - SHA (Secure Hash Algorithm) protocol, 49, 52, 60–61
 - SLA (service level agreements), 17, 21
 - alerts for Performance Server, 215–216
 - QoS, 160–161
- SMI (Structure of Management Information)
 - SPPI, 157
 - version 2, 39
 - SMS (Systems Management Server), Microsoft, 6, 16, 32
 - SNMP manager
 - JDMK sample program, 245–247
 - synchronous manager, 249
 - Visual C++ sample program, 233–236
 - SNMP (Simple Network Management Protocol), 1
 - agents, 11, 13, 36–37
 - applications
 - MIB browsers, 62–66
 - types, 49
 - configuring Windows NT/2000 platform, 231
 - de facto standard for network management, 35–36
 - disadvantages of using SNMP, 14–15
 - manageability of NEs, 15–16
 - managers, 11, 36, 37–39
 - message exchanges
 - basics, 53
 - GetBulkRequest, 44, 56–57
 - GetNextRequest, 44, 55–56
 - GetRequest, 44, 54–55
 - GetResponse, 44
 - InformRequest, 44, 57–60
 - SetRequest, 44, 57
 - Trap, 44, 57–60
 - message format
 - common data, 49–51
 - context, 49, 52–53
 - PDUs, 49, 53
 - PDUs, inform fields, 59–60
 - PDUs, trap fields, 58–59
 - security model data, authentication, 49–52, 60–62
 - security model data, general, 49, 51
 - security model data, privacy, 49–52, 60–61
 - MIBs, 36, 39–40
 - lexicographic ordering, 43
 - manipulating with scripts and software modules, 10–11
 - necessary for management, 10–12
 - object attributes, 40–42
 - object management, 11–12
 - OIDs, 42–43
 - quality, 15–16
 - versus* Microsoft SMS, 32
 - NMS discovery, 34–35
 - PDUs, 43–44

- problems, 61
 - sample program, JDMK
 - extensions, 251–253
 - GET operations, 248
 - GETNEXT operations, 248–249
 - SNMP manager, 245–247
 - SNMP manager, synchronous, 249
 - sample program, Visual C++, 236–238
 - batch files, combining, 243
 - extensions, 251–253
 - GET operations, 240
 - GETNEXT operations, 240
 - versus* JDMK, 249–251
 - MIB WALK operations, 241–242
 - Security violations, 243–245
 - SET operations, 241
 - setup, 231–232
 - SNMP manager, 233–236
 - TRAP operations, 242–243
 - SNMPv3 engine, 48–49
 - SNMPv3 security *versus* view-based access controls, 53
 - versions, 44, 61–62
 - SOAP (Simple Object Access Protocol), 225
 - SP (service provider) networks
 - categories of networks, 1
 - CPE, 24
 - migration toward IP networks, 69–70
 - reasons for using management, 25–26
 - SPPI (Structure of Policy Provisioning Information), 157
 - SPVCC (Switched Permanent Virtual Channel Connection), 20
 - STATUS MIB object attribute, 40
 - storage. *See also* SANs
 - enterprise network planning, 8
 - StorageType object, 39
 - subnets (IP networks), 101
 - SYNTAX MIB object attribute, 40, 41
- T**
- TCP/IP. *See* IP networks
 - TDM (time-division multiplexing), 20
 - Telelogic CM Synergy, 136
 - Telnet, 32
 - TestAndIncr object, 39
 - textual conventions, MIBs, 39
 - thin software layers
 - MIBs, 291–292
 - software solutions, 306
 - TLS (Transparent LAN Service), 132
- TOM (Telecommunications Operations Map), 31
 - traffic engineering, MPLS, 116, 117, 119–122
 - Trap messages (SNMP), 44, 57–60, 86
 - TRAP operations, Visual C++ sample program, 242–243
 - triggers, 151–155
 - TruthValue object, 39
 - tunnels, MPLS, 111–113, 119–122
- U**
- UML (Uniform Modeling Language), 106–107
 - UNIX platform, network management software, 28
 - UserName objects (SNMP), 49, 51
- V**
- VCI (Virtual Channel Identifiers), 20, 23
 - versions of SNMP, 44
 - Visual C++ sample program, 236–238
 - batch files, combining, 243
 - extensions, 251–253
 - GET operations, 240
 - GETNEXT operations, 240
 - versus* JDMK, 249–251
 - MIB WALK operations, 241–242
 - security violations, 243–245
 - SET operations, 241
 - setup, 231–232
 - SNMP manager, 233–236
 - TRAP operations, 242–243
 - VLANs (virtual LANs), 3, 8–9
 - aggregate objects, 33–34
 - feature of enterprise technology, 8–9
 - layer 2, OSI model, 17–21
 - multisite example, using SP ATM/MPLS cloud, 131–133
 - NMS discovery, 34
 - service-level network components, 300
 - VoIP (voice over IP), 3
 - VPI (Virtual Path Identifiers), 20, 23
 - VPLS (Virtual Private LAN Service), 131–133
 - VPNs (virtual private networks)
 - OSI layer 2 and 3 scalability, 83–85
 - service-level network components, 300
- W–Z**
- WALK operations, MIBs, 42, 241–242
 - WANs (wide area networks)
 - MPLS, 1
 - VoIP, 3
 - Web Services, 225
 - Windows NT/2000, network management software, 28
 - XML data representation, 225