



Index

- 128 byte inode structure (Unix), 15
- abstraction
 - array-based virtualization, 84
 - physical storage, 1, 63–64
 - logical black address mapping, 64–68
 - metadata integrity, 68–69
- access
 - applications, 13–14
 - conventional file systems, 137–139
 - distributed file systems, 139
 - file ownership, 18
- access control lists (ACLs), 171
- ACLs (access control lists), 171
- addresses, logical block address (LBA)
 - mapping, 64–68
- administration. *See* management
- aggregation
 - blocks, 33–37
 - storage ports, 44–46
- allocation
 - blocks, 27
 - heterogeneous assets, 123
- APIs (application programming interfaces)
 - Fabric Application Interface Standard (FAIS), 101–106
 - server-based, 77, 79
- appliances, 109
 - black box virtualization, 109
 - distribution for, 117–118
 - functionality of, 109
 - black box virtualization, 109
 - high availability for, 114, 117
 - in-band virtualization, 110–113
 - mass distribution for, 117–118
 - out-of-band virtualization, 113
- application programming interfaces. *See* APIs
- application specific integrated circuits (ASICs), 100
- application-aware storage
 - virtualization, 7, 159, 161
- applications
 - access, 13–14
 - array-based point-in-time copy (snapshots), 88
- data
 - as files, 15–16
 - locations, 19
- fabric-based virtualization, 99
- formatting, 14
- heterogeneous assets, 124
- hierarchical storage management, 131–134
- in-band virtualization, 112
- logical volume manager (LVM), 71–75
- modification of, 14
- naming conventions, 17–18
- ownership, 18
- paths to storage, 43–44
- performance, 172
- read/write permission attributes, 18
- sizes, 19
- systematic organization of files, 19

- applications (*cont.*)
 - hierarchies, 20
 - integrity, 22
 - master tables, 21
 - parsing, 20
 - strategies, 22–23
 - time stamping, 18
 - virtualization-aware applications, 161–162
- architecture
- appliances
 - black box virtualization, 109
 - high availability for, 114, 117
 - in-band virtualization, 110–113
 - mass distribution for, 117–118
 - out-of-band virtualization, 113
- array-based data replication, 84, 87
- array-based point-in-time copy (snapshots), 88
- array-based virtualization, 81–83
- distributed modular array virtualization, 89–91
- fabric-based virtualization
 - Fabric Application Interface Standard (FAIS), 101–106
 - sentient SANs, 95–98
 - switched-based virtualization techniques, 99
- interconnections
 - Fibre Channel SAN, 48–54
 - Internet SCSI (iSCSI), 55–58
 - small computers system interface (SCSI), 46–48
 - SCSI Architectural Model (SAM-2), 30
- archiving, 168
- array-based data replication, 84, 87
- array-based point-in-time copy (snapshots), 88
- array-based virtualization, 9, 81–83
- arrays, 7
 - disk-to-disk to tape (D2D2T), 147–149
 - distributed modular array virtualization, 89–91
 - storage, 46
- As CreateOrModifyStoragePool() method, 157
- ASICs (application specific integrated circuits), 100
- assets
 - array-based virtualization, 83
 - fabric-based virtualization, 99
 - heterogeneous, 122–125
 - heterogeneous mirroring, 126–127
 - interoperability, 8
 - resizing, 124
- assignment of logical unit numbers (LUNs), 29
- asynchronous array-based replication, 85. *See also* array-based data replication
- attributes, 5
 - files (NTFS), 16
 - read/write permission, 18
- automation, 7, 155
 - application-aware storage virtualization, 159–161
 - logical unit number (LUN) management, 29
 - policy-based storage management, 155–159
 - virtualization-aware applications, 161–162
- availability
 - for appliances, 114, 117
 - paths to storage, 44
 - switch-based virtualization techniques, 99
- backups, 1, 145–152
 - conventional tape backups, 145–146
 - disk-to-disk-to tape (D2D2T), 147–149
- benefits of virtualization, 190
- black box virtualization, 109

- blocks, 26
 - LBA mapping, 64–68
 - small computers system interface (SCSI) protocol, 27–28
 - aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
 - sizes (file systems), 19
- cabling (interconnections)
 - Fibre Channel SAN, 48–54
 - Internet SCSI (iSCSI), 55–58
 - small computers system interface (SCSI), 46–48
- capacity
 - blocks, 26
 - logical unit numbers (LUNs), 29
 - volume management, 25–26
- CDB (Command Descriptor Block), 31–32
- characters, naming conventions for, 17–18
- check disk (chkdsk) utility, 22
- Chin, Howie, 48
- chkdsk (check disk) utility, 22
- CIFS (common Internet file system), 139
- CIM (common information model), 1, 156, 171
- class of storage, 7
- clients
 - Internet Storage Name Server (iSNS), 57
 - logical units (LUs), 28–30
- clustering, 1
- Command Descriptor Block (CDB), 31–32
- commands, small computers system interface (SCSI), 30. *See also* SCSI
- common information model (CIM), 1, 156, 171
- common Internet file system (CIFS), 139
- communication
 - array-based virtualization, 83
 - sentient SANs, 95–98
- Compaq ENSA document (2000), 165
- components
 - paths to storage, 43–44
 - SANs, 167
- configuration of applications, 14
- connections
 - E_Port, 53
 - in-band virtualization, 110
 - interconnections, 46
 - Fibre Channel SAN, 48–54
 - Internet SCSI (iSCSI), 55–58
 - plumbing, 59
 - small computers system interface (SCSI), 46–48
 - paths to storage, 43–44
 - ports, 44–46
 - sentient SANs, 95–98
- context switching, 30
- controlling application access, 13–14
- control path processor (CPP), 101
- controllers (RAID), 36–37
- conventional file system overview, 137–139
- conventional tape backups, 145–146
- corruption, point-in-time data snapshots, 129–131
- costs
 - of appliances, 118
 - overview of, 3
- CPP (control path processor), 101
- cross-pollination, 5
- customization of applications, 14
- cut-through switching, 50
- D2D (disk-to-disk) data replication, 84
- D2D2T (disk-to-disk to tape), 145–149

- daisy-chaining (SCSI), 47
- data as files, 15–16
- data lifecycle management, 73, 131–134
- data path controller (DPC), 101
- data replication, 84, 87, 127–128
- delivery
 - of global storage solutions, 183–184
 - overview of, 4
- dense wave division multiplexing (DWDM), 51
- dependencies, 165–168
- Desktop Management Task Force (DMTF), 156
- devices, 109. *See also* appliances interconnections.
 - See* interconnections
 - sentient SANs, 95–98
 - virtual device 1 (VDEV1), 104
- directories, 20
- directors, switch-based virtualization techniques, 99
- disk-to-disk (D2D) data replication, 84
- disk-to-disk to tape (D2D2T), 145–149
- disks
 - array-based data replication, 84, 87
 - array-based point-in-time copy (snapshots), 88
 - array-based virtualization, 81–83
 - blocks, 26
 - distributed modular array virtualization, 89–91
 - out-of-band virtualization, 114
 - small computers system interface (SCSI) protocol, 27–28
 - block aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
 - virtual tape
 - conventional tape backups, 145–146
 - disk-to-disk-to tape (D2D2T), 147–149
 - volume management, 25–26
- distributed file systems, 139
- distributed modular array virtualization, 89–91
- distribution for appliances, 117–118
- DLLs (dynamic link libraries), 14
- DMTF (Desktop Management Task Force), 156
- DNS (domain name service)
- DPC (data path controller), 101
- dual pathing (LVM), 73
- DWDM (dense wave division multiplexing), 51
- dynamic link libraries (DLLs), 14
- emerging technologies, 165–168, 192–194
- emulation, tape, 150–152
- enabling
 - storage services, 121–122
 - storage utilities, 169–173
- ENSA (Enterprise Network Storage Architecture), 4
- ethernets, in-band virtualization, 112
- Evaluator Group, The, 184
- executable files. *See* applications
- expansion port (E_Port)
 - connection, 53
- external small computers system interface (SCSI) storage devices, 47
- E_Port (expansion port)
 - connections, 53
- Fabric Application Interface Standard (FAIS), 50, 101–106
- fabric shortest path first (FSPF) protocol, 97
- fabric switches, 52

- fabric-based virtualization, 95
 - Fabric Application Interface Standard (FAIS), 101–106
 - sentient SANs, 95–98
 - switch-based virtualization techniques, 99
- FAIS (Fabric Application Interface Standard), 50, 101–106
- FC-SONET (Fibre Channel over SONET), 51
- FCID (Fibre Channel Identification), 66
- FCIP (Fibre Channel over IP), 51
- Fibre Channel, 1, 167
 - fabric-based virtualization, 106
 - HBA, 29
 - in-band virtualization, 110–113
 - out-of-band virtualization, 113
- Fibre Channel Identification (FCID), 66
- Fibre Channel over IP (FCIP), 51
- Fibre Channel over SONET (FC-SONET), 51
- file system check (fsck) utility, 22
- file systems
 - block sizes, 19
 - blocks, 26
 - metadata structures, 15–16
 - parsing, 20
 - small computers system interface (SCSI) protocol, 27–28
 - block aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
 - systematic organization of, 19
 - hierarchies, 20
 - integrity, 22
 - master tables, 21
 - parsing, 20
 - strategies, 22–23
- virtualized SAN, 137, 140, 142
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - volume management, 25–26
- files. *See also* applications
 - data as, 15–16
 - data locations, 19
 - file systems. *See* file systems
 - naming conventions, 17–18
 - ownership, 18
 - read/write permission attributes, 18
 - sizes, 19
 - systematic organization of, 19
 - hierarchies, 20
 - integrity, 22
 - master tables, 21
 - parsing, 20
 - strategies, 22–23
 - time stamping, 18
- formatting applications, 14
- fsck (file system check) utility, 22
- FSPF (fabric shortest path first) protocol, 97
- functionality of appliances, 109
 - black box virtualization, 109
 - high availability for, 114, 117
 - in-band virtualization, 110–113
 - mass distribution for, 117–118
 - out-of-band virtualization, 113
- global storage solutions, delivery of, 183–184
- hardware
 - appliances
 - black box virtualization, 109
 - high availability for, 114, 117
 - in-band virtualization, 110–113
 - mass distribution for, 117–118
 - out-of-band virtualization, 113
 - paths to storage, 43–44

- HBA (host bus adapter), 29, 43
 - automation, 158
 - plumbing, 59
- heterogeneous assets, pooling of, 122–125
- heterogeneous data replication, 127–128
- heterogeneous mirroring, 126–127
- hierarchies
 - file systems, 20
 - hierarchies, 131–134
- high availability
 - for appliances, 114, 117
 - dual-pathing, 1
- host bus adapter (HBA), 29, 43
 - automation, 158
 - plumbing, 59
- host-based virtualization, 9
- hosts
 - LVM, 71–73, 75
 - storage metadata servers, 75
- I/O (input/output)
 - Microsoft Multipath I/Os, 79
 - storage metadata integrity, 69
- IDE (integrated drive electronics), 45
- IETF (Internet Engineering Task Force), 2, 156
- IFCP (Internet Fibre Channel Protocol), 51
- ILM (Information Lifecycle Management), 5, 131–134
- implementation, overview of, 2
- in-band
 - methods, 9
 - virtualization, 110–113, 171
- INCITS (InterNational Committee for Information Technology Standards), 2
- Information Lifecycle Management (ILM), 5, 131–134
- Information Units (IU), 32
- inheritance, 5
- initiators, 28
- input/output (I/O)
 - Microsoft Multipath I/Os, 79
 - storage metadata integrity, 69
- integrated drive electronics (IDE), 45
- integration
 - automation, 155
 - application-aware storage virtualization, 159–161
 - policy-based storage management, 155–159
 - virtualization-aware applications, 161–162
 - server-based APIs, 77–79
 - switch-based virtualization techniques, 99
- integrity
 - file systems, 22
 - metadata, 68–69
- interconnections, 46
 - Fibre Channel SAN, 48–54
 - Internet SCSI (iSCSI), 55–58
 - paths to storage, 43–44
 - plumbing, 59
 - small computers system interface (SCSI), 46–48
- interfaces
 - API. *See* API
 - Fabric Application Interface Standard (FAIS), 101–106
 - interconnections, 46
 - Fibre Channel SAN, 48–54
 - Internet SCSI (iSCSI), 55–58
 - small computers system interface (SCSI), 46–48
 - server-based APIs, 77–79
 - storage ports, 44–46
 - virtual disk service (VDS), 77
- InterNational Committee for Information Technology Standards (INCITS), 2
- Internet Engineering Task Force (IETF), 2, 156

- Internet Fibre Channel Protocol (IFCP), 51
- Internet SCSI (iSCSI), 55–56, 58
- Internet Storage Name Server (iSNS), 57, 171
- interoperability, 4, 8, 83, 166
- interswitch links (ISLs), 51, 54
- iSCSI (Internet SCSI), 55–58
- ISLs (interswitch links), 51, 54
- iSNS (Internet Storage Name Server), 57, 171
- IU (Information Units), 32
- JBOD
 - logical block addresses (LBAs), 65
 - logical volume manager (LVM), 73
- Johnson, Gary, 183
- Kuo, Benjamin F., 192
- LAN-based tape backups, 145
- layers
 - array-based virtualization, 84
 - automation, 155
 - application-aware storage virtualization, 159–161
 - policy-based storage management, 155–159
 - virtualization-aware applications, 161–162
 - blocks, 26
 - logical volume manager (LVM), 71–75
 - small computers system interface (SCSI) protocol, 27–28
 - block aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
 - volume management, 25–26
- LBA (logical block address) mapping, 64–68
- limitations of logical volume managers (LVMs), 75
- links
 - array-based data replication, 86
 - load-sharing, 172
- load-sharing links, 172
- locations, file data, 19
- logical abstraction, 1, 7. *See also* abstraction
- logical block address (LBA) mapping, 64–68
- logical unit numbers. *See* LUNs
- logical units (LUs), 28–30
- logical volume management, 26
- logical volume manager (LVM), 71–75
- long-term data protection
 - conventional tape backups, 145–146
 - disk-to-disk-to tape (D2D2T), 147–149
 - virtual tape, 145–152
- LUNs (logical unit numbers), 28–29
 - array-based virtualization, 81–83
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - heterogeneous assets (pooling), 122–125
 - in-band virtualization, 111
 - logical block address (LBA) mapping, 64
 - logical volume manager (LVM), 73
 - masking, 30
 - out-of-band virtualization, 114
- LUs (logical units), 28–30
- LVM (logical volume manager), 71–75
- management, 9
 - appliances
 - black box virtualization, 109
 - high availability for, 114, 117
 - in-band virtualization, 110–113
 - mass distribution for, 117–118

- management (*cont.*)
 - out-of-band virtualization, 113
 - application access, 13–14
 - array-based virtualization, 83
 - automation, 155
 - application-aware storage virtualization, 159–161
 - policy-based storage management, 155–159
 - virtualization-aware applications, 161–162
 - backups. *See* backups
 - blocks, 26
 - data as files, 15–16
 - files
 - data locations, 19
 - hierarchies, 20
 - integrity, 22
 - master tables, 21
 - ownership, 18
 - parsing, 20
 - read/write permission attributes, 18
 - sizes, 19
 - strategies, 22–23
 - systematic organization of, 19
 - time stamping, 18
 - logical volume manager (LVM), 71–75
 - naming conventions, 17–18
 - overview of, 3
 - SANs, 166
 - small computers system interface (SCSI) protocol, 27–28
 - block aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
 - services
 - enabling, 121–122
 - heterogeneous data replication, 127–128
 - heterogeneous mirroring, 126–127
 - hierarchical storage management, 131–134
 - point-in-time data snapshots, 129–131
 - pooling heterogeneous assets, 122–125
 - mapping
 - logical block address (LBA), 64–68
 - logical unit numbers (LUNs), 30
 - volume management, 25
 - masking logical unit numbers (LUNs), 30
 - mass distribution for appliances, 117–118
 - Massiglia, Paul, 186
 - master tables, 21
 - metadata, 15–16
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - files
 - data locations, 19
 - ownership, 18
 - sizes, 19
 - in-band virtualization, 110–113
 - integrity, 68–69
 - naming conventions, 17–18
 - out-of-band virtualization, 113
 - read/write permission attributes, 18
 - storage servers, 75
 - time stamping, 18
 - volume management, 26
 - Microsoft
 - Multipath I/O, 79
 - virtual disk service (VDS), 77
 - migration, hierarchical storage management, 131–134
 - mirroring, 168
 - heterogeneous, 126–127
 - RAID. *See* RAID
 - virtual tape, 150
 - modification of applications, 14
 - monitoring virtual devices, 105

- moving
 - blocks to disks, 38–39
 - storage virtualization (up the stack), 187–188
- multi-protocol support, 168
- multilateral partnerships, 5
- multipath I/O, 79
- multiple physical disks, 7

- naming conventions, 17–18
- NAS (network-attached storage), 1, 89–91, 169
- network file system (NFS), 139
- network interface cards (NICs), 43
- network-attached storage (NAS), 1
- network-based virtualization, 9
- networks
 - appliances
 - black box virtualization, 109
 - high availability for, 114, 117
 - in-band virtualization, 110–113
 - mass distribution for, 117–118
 - out-of-band virtualization, 113
 - paths to storage, 43–44
 - ports, 44–46
 - virtualization solutions, 184–185
- NFS (network file system), 139
- NICs (network interface cards), 43

- operating systems
 - array-based point-in-time copy (snapshots), 88
 - logical volume manager (LVM), 71–75
 - Windows
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - NTFS file attributes, 16
 - virtualization-aware
 - applications, 161
- optimization of sentient SANs, 95–98
- options (appliances), 109
 - black box virtualization, 109
 - high availability for, 114, 117
 - in-band virtualization, 110–113
 - mass distribution for, 117–118
 - out-of-band virtualization, 113
- Orenstein, Gary, 190
- out-of-band method, 9
- out-of-band virtualization, 113, 171
- ownership of files, 18

- parallel small computers system
 - interface (SCSI)
 - interconnections, 46–48
- parsing file systems, 20
- partitioning out-of-band virtualization, 114
- partnerships, vendors, 5
- paths
 - control path processor (CPP), 101
 - data path controller (DPC), 101
 - FAIS. *See* FAIS
 - logical volume manager (LVM), 73
 - Microsoft Multipath input/output (I/O), 79
 - out-of-band virtualization, 113
 - redundancy, 52
 - to storage, 43–44
- PDU (Protocol Data Unit), 32
- Peer to Peer Remote Copy (PPRC), 84
- performance, 167
 - application-aware storage virtualization, 161
 - applications, 172
 - fabric-based virtualization, 95
 - Fabric Application Interface Standard (FAIS), 101–106
 - sentient SANs, 95–98
 - switch-based virtualization techniques, 99
 - hierarchical storage management, 134
 - interconnections, 59
 - overview of, 4
 - small computers system interface (SCSI) interconnections, 47
 - servers, 172

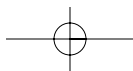
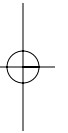
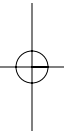
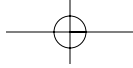
- permissions, read/write permission
 - attributes, 18
- physical disks. *See* disks
- physical separation, in-band
 - virtualization, 113
- physical storage
 - abstraction, 63–64
 - in-band virtualization, 111
 - logical block address mapping, 64–68
 - metadata integrity, 68–69
- physical storage devices, 63
- plumbing, 59
- point-in-time data snapshots, 1, 129–131
- policy-based automation, 7
- policy-based storage management, 155–159
- pooling, 172
 - heterogeneous assets, 122–125
 - in-band virtualization, 112
- ports, 44, 46, 59, 73. *See also* interconnections
- PPRC (Peer to Peer Remote Copy), 84
- primary arrays, 85. *See also* array-based data replication
- protection (long-term data)
 - conventional tape backups, 145–146
 - disk-to-disk-to tape (D2D2T), 147–149
 - virtual tape, 145–152
- Protocol Data Unit (PDU), 32
- protocols
 - fabric shortest path first (FSPF), 97
 - Fibre Channel SAN, 48, 50–54
 - Internet SCSI (iSCSI), 55–58
 - multi-protocol support, 168
 - plumbing, 59
 - small computers system interface (SCSI), 27–28
 - block aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - interconnections, 46–48
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
 - service location protocol (SLP), 50, 57
 - web-based enterprise management (WBEM), 156
- RAID (Redundant Arrays of Inexpensive Disks), 3
 - array-based virtualization, 81, 83
 - automation, 158
 - controllers, 36–37
 - hierarchical storage management, 132
 - logical block addresses (LBAs), 66
 - RAID 0, 33–34
 - RAID 1, 34
 - RAID 5, 35
 - virtual tape, 150
- RAID 0+1, 35
- read/write permission attributes, 18
- records, 14. *See also* applications
- recovery point objective (RPO), 87
- recovery time objective (RTO), 87
- redundancy
 - in-band virtualization, 116
 - paths, 52
 - RAID. *See* RAID
- Redundant Arrays of Inexpensive Disks. *See* RAID
- registered state change notification (RSCN), 50, 96
- reliability, 4, 59
- removable storage media, 145–152
 - conventional tape backups, 145–146
 - disk-to-disk-to tape (D2D2T), 147–149
- replication, 168
 - array-based, 84, 87
 - heterogeneous, 127–128
- resizing assets, 124

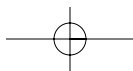
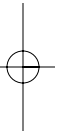
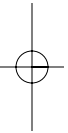
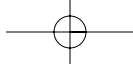
- restrictions
 - file ownership, 18
 - logical unit numbers (LUNs), 30
- RPO (recovery point objective), 87
- RSCN (registered state change notification), 50, 96
- RTO (recovery time objective), 87
- SAM-2 (SCSI Architectural Model), 30
- SANs (System Administration, Networking and Security Institute)
 - automation, 158
 - backups, 146
 - fabric-based virtualization, 95
 - Fabric Application Interface Standard (FAIS), 101–106
 - sentient SANs, 95–98
 - switch-based virtualization techniques, 99
 - in-band virtualization, 112
 - management, 166
 - optimization of sentient SANs, 95–98
 - out-of-band virtualization, 113
 - security, 167
 - virtualization-aware
 - applications, 161
 - virtualized file systems, 137–142
 - conventional file system overview, 137–139
 - distributed file system overview, 139
- SAN ArchitectCarlson Companies, 183
- SATA (serial ATA), 45
- Schulz, Greg, 184
- SCSI (small computers system interface) protocol, 27–28
 - block aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - in-band virtualization, 112
 - Internet SCSI (iSCSI)
 - interconnections, 55–58
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
 - SCSI Architectural Model (SAM-2), 30
 - SDKs (software development kits), 77
 - security, 18, 167
 - security identifier (SID), 18
 - Sentient SANs, optimization of, 95–98
 - separation in-band
 - virtualization, 113
 - serial ATA (SATA), 45
 - server-based APIs, 77–79
 - servers
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - heterogeneous assets, 122–125
 - in-band virtualization, 112
 - Internet Storage Name Server (iSNS), 57, 171
 - logical units (LUs), 28–30
 - logical volume manager (LVM), 71–75
 - out-of-band virtualization, 113
 - performance, 172
 - ports, 44, 46
 - small computers system interface (SCSI), 47
 - SNS (simple name server), 96
 - storage metadata, 75
 - virtualization solutions, 184–185
 - service location protocol (SLP), 50, 57
 - services, 121
 - dependencies, 165–166, 168
 - storage
 - enabling, 121–122
 - heterogeneous data replication, 127–128
 - heterogeneous mirroring, 126–127
 - hierarchical storage management, 131–132, 134

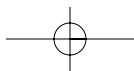
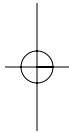
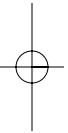
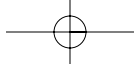
- services (*cont.*)
 - point-in-time data snapshots, 129–131
 - pooling heterogeneous assets, 122–125
- shared tape access, 1
- sharing virtualized SAN file systems, 140–142
 - conventional file systems, 137–139
 - distributed file systems, 139
- SID (security identifier), 18
- simple name server (SNS), 49, 96
- sizes
 - blocks, 26
 - files, 19
- sizing assets, 124
- SLP (service location protocol), 50, 57
- small computers system interface (SCSI) protocol, 27–28
 - block aggregation, 33–37
 - Command Descriptor Block (CDB), 31–32
 - logical units (LUs), 28–30
 - moving blocks to disks, 38–39
 - SCSI Architectural Model (SAM-2), 30
- SMI-S (SNIA Storage Management Interface Specification), 6, 79, 156
- snapshots, 88, 168
 - point-in-time data snapshots, 129–131
 - volume snapshot service (VSS), 78
- SNIA (Storage Networking Industry Association), 2, 156
- SNIA Storage Management Interface Specification (SMI-S), 6, 79, 156
- SNS (simple name server), 49, 96
- software development kits (SDKs), 77
- SRDF (Symmetrix Remote Data Facility), 84
- stacks, moving storage virtualization up, 187–188
- stonefly, 58
- storage metadata. *See* metadata
- Storage Networking Industry Association (SNIA), 2, 156
- storage virtualization
 - automation, 155
 - application-aware storage virtualization, 159–161
 - policy-based storage management, 155–159
 - virtualization-aware applications, 161–162
- categories of, 6–10
- delivery of global solutions, 183–184
- over distance, 1
- in-band virtualization, 112
- metadata
 - integrity, 68–69
 - servers, 75
- moving (up the stack), 187–188
- out-of-band virtualization, 113
- overview of, 1–6
- paths to, 43–44
- physical
 - abstraction, 63–64
 - logical block address mapping, 64–68
 - metadata integrity, 68–69
- ports, 44–46
- services
 - enabling, 121–122
 - heterogeneous data replication, 127–128
 - heterogeneous mirroring, 126–127
 - hierarchical storage management, 131–134
 - point-in-time data snapshots, 129–131
 - pooling heterogeneous assets, 122–125
 - utility, 169–173
 - virtualization solutions, 184–185
- store-and-forward switching, 51

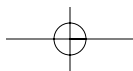
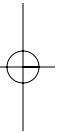
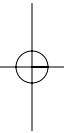
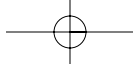
- strategies, 8, 22–23
- switching
 - context, 30
 - cut-through, 50
 - fabric-based virtualization, 95
 - Fabric Application Interface Standard (FAIS), 101–106
 - sentient SANs, 95–98
 - switch-based virtualization techniques, 99
 - out-of-band virtualization, 113
 - store-and-forward, 51
- Symmetrix Remote Data Facility (SRDF), 84
- synchronous array-based replication, 85. *See also* array-based data replication
- System Administration, Networking and Security Institute. *See* SANS
- systematic organization of files, 19
 - hierarchies, 20
 - integrity, 22
 - master tables, 21
 - parsing, 20
 - strategies, 22–23
- tables, master, 21
- targets, 28
 - array-based data replication, 84, 87
 - array-based point-in-time copy (snapshots), 88
 - array-based virtualization, 81–83
 - distributed modular array virtualization, 89–91
 - in-band virtualization, 110
- TCP offload engines (TOEs), 55
- time stamping, 18
- TOEs (TCP offload engines), 55
- transactions
 - array-based data replication, 84, 87
 - hierarchical storage management, 131–134
 - paths to storage, 44
 - sentient SANs, 95–98
- transport protocols, plumbing, 59
- trees, 20
- trends, 190
- Troika Networks, 192
- troubleshooting
 - interconnections, 59
 - small computers system interface (SCSI), 47
- trunking, 54
- UFS (Unix File System), 15
- unix
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - naming conventions, 17
- Unix File System (UFS), 15
- utilities
 - chkdsk, 22
 - fsck, 22
 - overview of, 5
- VDEV 1 (virtual device 1), 104
- VDS (virtual disk service), 77
- vendors (partnerships), 5
- VERITAS Software Corporation, 186
- virtual device 1 (VDEV1), 104
- virtual devices, monitoring, 105
- virtual disk service (VDS), 77
- Virtual LUNs (VLUNs), 64
- virtual storage
 - logical block address mapping, 64–68
 - physical abstraction, 63–64
- virtual tape, 145, 150, 152
 - conventional tape backups, 145–146
 - disk-to-disk-to tape (D2D2T), 147–149
- virtual tape library (VTL), 185
- virtual tape systems (VTS), 185
- virtualization of data, 190
- virtualization-aware applications, 161–162

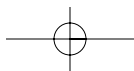
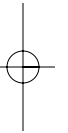
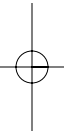
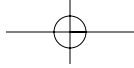
- virtualized SAN file systems, 137–142
 - conventional file system overview, 137–139
 - distributed file system overview, 139
- viruses, 129–131
- VLUNs (virtual LUNs), 64
- volume management, 25–26
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - logical volume manager (LVM), 71–75
- VSS (volume snapshot service), 78
- VTL (virtual tape library), 185
- VTs (virtual tape systems), 185
- WAFS (wide area file services), 185
- WBEM (web-based enterprise management) protocol, 156
- wide area file services (WAFS), 185
- windows
 - conventional file system overview, 137–139
 - distributed file system overview, 139
 - NTFS file attributes, 16
 - virtualization-aware applications, 161
- WWN (World Wide Name), 96

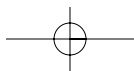
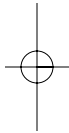
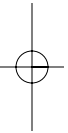
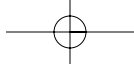


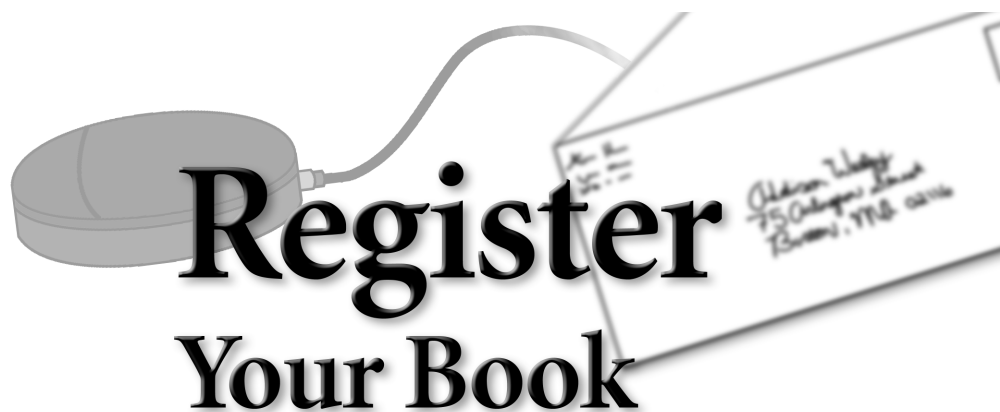












Register Your Book

at www.awprofessional.com/register

You may be eligible to receive:

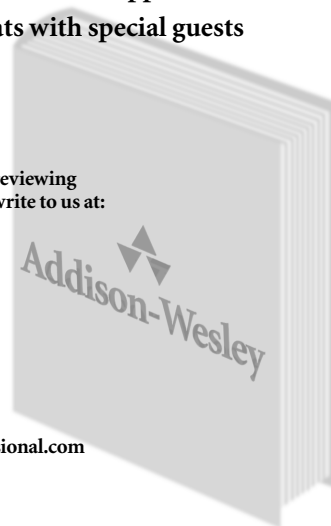
- Advance notice of forthcoming editions of the book
- Related book recommendations
- Chapter excerpts and supplements of forthcoming titles
- Information about special contests and promotions throughout the year
- Notices and reminders about author appearances, tradeshows, and online chats with special guests



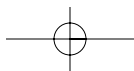
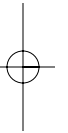
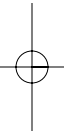
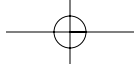
Contact us

If you are interested in writing a book or reviewing manuscripts prior to publication, please write to us at:

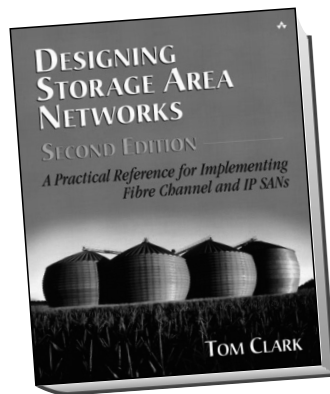
Editorial Department
Addison-Wesley Professional
75 Arlington Street, Suite 300
Boston, MA 02116 USA
Email: AWPro@aw.com



Visit us on the Web: <http://www.awprofessional.com>



Also Available from Addison-Wesley and Tom Clark



Designing Storage Area Networks, Second Edition A Practical Reference for Implementing Fibre Channel and IP SANs

BY TOM CLARK

Written for network developers, IT consultants, administrators, and managers, this updated and greatly expanded edition of the best-selling *Designing Storage Area Networks* goes far beyond a straight description of technical specifications and standards. The text offers practical guidelines for using diverse SAN technologies to solve existing networking problems in large-scale corporate networks. With this book you will learn how the technologies work and how to organize their components into an effective, scalable design. In doing so, you will discover today's best methods for managing storage area networks, including new troubleshooting techniques.

ISBN 0-321-13650-0, © 2003, 592 pages

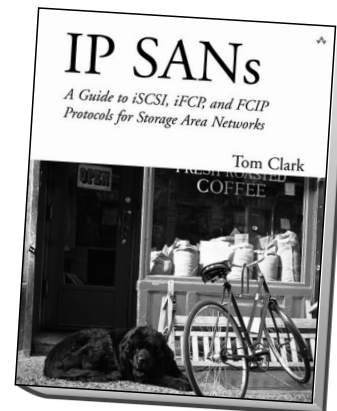
IP SANs

A Guide to iSCSI, iFCP, and FCIP Protocols for Storage Area Networks

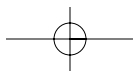
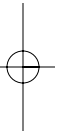
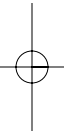
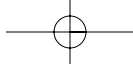
BY TOM CLARK

IP storage and networking have traditionally resided in two distinct worlds. Networking professionals from an Internet Protocol (IP) internetworking background are usually not familiar with storage issues, and storage administrators may be unfamiliar with IP internetworking. With IP storage networking, network professionals dealing with storage area networks (SANs) now have an integrated option for improved data storage. *IP SANs* explains these new IP technologies that enable SANs to keep up with today's networking needs, detailing the various storage solutions that are created when both disciplines are combined.

ISBN 0-201-75277-8, © 2001, 320 pages



Visit us online for more books and more information, and to read sample chapters:
<http://www.awprofessional.com>



Wouldn't it be great
if the world's leading technical
publishers joined forces to deliver
their best tech books in a common
digital reference platform?

They have. Introducing
InformIT Online Books
powered by Safari.

■ **Specific answers to specific questions.**

InformIT Online Books' powerful search engine gives you relevance-ranked results in a matter of seconds.

■ **Immediate results.**

With InformIT Online Books, you can select the book you want and view the chapter or section you need immediately.

■ **Cut, paste and annotate.**

Paste code to save time and eliminate typographical errors. Make notes on the material you find useful and choose whether or not to share them with your work group.

■ **Customized for your enterprise.**

Customize a library for you, your department or your entire organization. You only pay for what you need.

Get your first 14 days FREE!

For a limited time, InformIT Online Books is offering its members a 10 book subscription risk-free for 14 days. Visit <http://www.informit.com/online-books> for details.

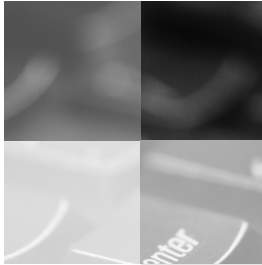
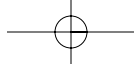


POWERED BY
Safari
TECH BOOKS ONLINE

informIT
Online Books

informit.com/onlinebooks





informIT

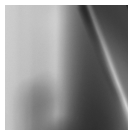
www.informit.com

YOUR GUIDE TO IT REFERENCE



Articles

Keep your edge with thousands of free articles, in-depth features, interviews, and IT reference recommendations – all written by experts you know and trust.



Online Books

Answers in an instant from **InformIT Online Book's** 600+ fully searchable on line books. For a limited time, you can get your first 14 days **free**.

POWERED BY
Safari
TECH BOOKS ONLINE



Catalog

Review online sample chapters, author biographies and customer rankings and choose exactly the right book from a selection of over 5,000 titles.

