

Index of Concepts

Design principles and hints appear in *underlined italics*. Procedure names appear in SMALL CAPS. Page numbers in **bold face** are in the Glossary. Page numbers that are greyed out are in a section that is [on-line].

A

abort, **475**, Ch. 9
absolute path name, 68, 72, **475**
abstraction, 22, **475**
 leaky, 30
accelerated aging, Ch. 8
access control list, **475**, Ch. 11
access time, 48
ACK (see acknowledgment)
acknowledgment, **475**, Ch. 7
ACL (see access control list)
ACQUIRE, 225, Ch. 9
action, 53, **475**, Ch. 9
action graph, Probsets
active fault, **475**, Ch. 8
ad hoc wireless network, 425, Probsets
adaptive
 routing, **475**, Ch. 7
 timer, Ch. 7
additive increase, Ch. 7
address
 destination, **482**
 in naming, 51, 122, **475**
 in networks, **495**, Ch. 7
 resolution protocol, **475**, Ch. 7
 source, **507**
 space, 51, **475**
 virtual, 206, 243, **511**
adopt sweeping simplifications, 40, 149, 160,
 Ch. 7, Ch. 8, Ch. 9, Ch. 10, Ch. 11
ADVANCE, 276
Advanced Encryption Standard (AES), Ch. 11
adversary, **476**, Ch. 11
advertise, 76, **476**, Ch. 7
alias, 72, **476**
 (see also indirect name)
alibi, 228
all-or-nothing atomicity, 89, **476**, Ch. 9
any-to-any connection, **476**, Ch. 7
application protocol, Ch. 7

arbiter failure, 229
archive, **476**, Ch. 9
 log, Ch. 9
ARP (see address resolution protocol)
assembly, 9
associative memory, 51
asynchronous, 55, 309, **476**, Ch. 7
at-least-once
 protocol assurance, **476**, Ch. 7
 RPC, 170
at-most-once
 protocol assurance, **476**, Ch. 7
 RPC, 170
atomic, **476**
 action, 89, 220, **476**, Ch. 9
 storage, 89, **476**, Ch. 9
atomicity, **476**, Ch. 9
 all-or-nothing, 89, **476**, Ch. 9
 before-or-after, 46, 89, **477**, Ch. 9
 log, Ch. 9
attachment point (see network attachment point)
authentication, **477**, Ch. 11
 key, Ch. 11
 logic, Ch. 11
 origin, **496**, Ch. 11
 tag, **477**, Ch. 11
authoritative name server, 179
authorization, **477**, Ch. 11
 matrix, Ch. 11
automatic rate adaptation, **477**, Ch. 7
availability, **477**, Ch. 8
avoid excessive generality, 16
avoid rarely used components, Ch. 8, Ch. 11
AWAIT, 276

B

backoff
 exponential, **486**, Ch. 7
 exponential random, **486**, Ch. 9
 random, 227

backup copy, **477**, Ch. 10
 backward error correction, **477**, Ch. 8
 bad-news diode, 38, **477**
 bandwidth, **477**, Ch. 7
 bang-bang protocol, Ch. 7
 base name, 67
 batch, 314, **477**
 bathtub curve, Ch. 8
be explicit, Ch. 8, Ch. 11
 before-or-after atomicity, 46, 89, **477**, Ch. 9
 Belady's anomaly, 337
 best effort, **478**, Ch. 7
 contract, Ch. 7
 big-endian numbering, 158
 BIND, 63
 binding, 27, 61, **478**
 stable, **507**
 user-dependent, 74, **511**
 bit error rate, **478**, Ch. 7
 bit stuffing, **478**, Ch. 7
 blast protocol, Ch. 7
 blind write, **478**, Ch. 9
 block, 245
 cipher, Ch. 11
 in UNIX, 93
 blocking read, Ch. 9
 bootstrapping, 223, **478**, Ch. 9
 bot, Ch. 11
 bottleneck, 300, **478**
 data rate, Ch. 7
 bounded buffer, 206
 broadcast, 77, **478**, Ch. 7
 buffer overrun attack, Ch. 11
 burn in, burn out, Ch. 8
 burst, **478**, Ch. 7
 bus, 80
 address, 81
 arbitration, 81
 Byzantine fault, **478**, Ch. 8

C

CA (see certificate authority)
 cache, 51, 332, **478**
 coherence, **479**, Ch. 10
 snoopy, **507**, Ch. 10
 capability, **479**, Ch. 11
 capacity, 302, 322, **479**
 careful storage, Ch. 8
 carrier sense multiple access, **485**, Ch. 7
 cascading change propagation, Ch. 11
 case-
 coercing, 128
 preserving, 128
 sensitive, 128
 CBC (see cipher-block chaining)
 cell, 46
 storage, **479**, Ch. 9
 certificate, **479**, Ch. 11
 authority, **479**, Ch. 11
 self-signed, Ch. 11
 certify, **479**, Ch. 11
 checkpoint, **479**, Ch. 9
 checksum, **479**, Ch. 7
 cipher, **479**, Ch. 11
 cipher-block chaining, Ch. 11
 ciphertext, **479**, Ch. 11
 circuit
 switch, **479**, Ch. 7
 virtual, **511**, Ch. 7
 cleartext, **479**, Ch. 11
 client, 155, **479**, Ch. 7
 client/service organization, 159, **479**
 clock algorithm, 344
 CLOSE, 88
 close-to-open consistency, 192, **479**
 closure, 68, **480**
 coding, Ch. 8
 coherence
 cache, **479**, Ch. 10
 read/write, 46, **502**
 collision
 Ethernet, **485**, Ch. 7
 hash, Ch. 11
 name, 124, **480**
 commit, **480**, Ch. 9
 two-phase, **510**, Ch. 9
 communication link, 59, **480**
 commutative cryptographic transformation,
 Ch. 11
 COMPARE, 75
 compartment, Ch. 11
 compensation, **480**, Ch. 10
complete mediation, Ch. 11
 complexity, 10, **480**
 Kolmogorov, 11
 component, 8

computationally secure, Ch. 11
 condition variable, 276, 463
 conditional failure rate function, Ch. 8
 confidentiality, 480, Ch. 11
 confinement, 480, Ch. 11
 conflict, Ch. 10
 confusion matrix, 372
 congestion, 480, Ch. 7
 collapse, 480, Ch. 7
 connection, 480, Ch. 7
 connectionless, 481, Ch. 7
 consensus, 481, Ch. 10
 the consensus problem, Ch. 10
 consistency, 481
 close-to-open, 192, 479
 eventual, Ch. 10
 external time, Ch. 9
 sequential, Ch. 9
 strict, 508, Ch. 10
 strong (see consistency, strict)
 consistent hashing, Probsets
 constituent, 9
 constraint, 481, Ch. 10
 context, 62, 481
 context reference, 63, 66, 481
 continuous operation, 481, Ch. 8
 control point, 481, Ch. 7
 convergent encryption, Probsets
 cookie, Ch. 11
 cooperative multitasking, 269
 cooperative scheduling, 269, 481
 copy-on-write, 326
 covert channel, 481, Ch. 11
 critical section, 220
 cross-layer cooperation, Ch. 7
 cryptographic
 hash function, 481, Ch. 11
 key, 481, Ch. 11
 transformation, 481, Ch. 11
 transformation, commutative, Ch. 11
 cryptography, 482, Ch. 11
 public key, 501, Ch. 11
 shared-secret, 506, Ch. 11
 CSMA/CD (see carrier sense multiple access)
 cursor, 88
 cursor stability, Ch. 10
 cut-through, 482, Ch. 7

D

dally, 314
 dangling reference, 130, 482
 data integrity
 in communications, 482, Ch. 7
 in security assurance, 482, Ch. 11
 in storage, Ch. 10
 data rate, 482, Ch. 7
 datagram, Ch. 7
 deadlock, 221, 482, Ch. 9
 decay, 46, 482, Ch. 8
 factor, Ch. 7
 set, 482, Ch. 8
 declassify, Ch. 11
decouple modules with indirection, 27, 106,
 123, 173, 243, 286, 325, Ch. 7
 decrypt, 482, Ch. 7, Ch. 11
 DECRYPT, Ch. 11
 default context reference, 66, 482
 defense in depth, Ch. 8, Ch. 11
 delay, Ch. 7
 processing, 500, Ch. 7
 propagation, 500, Ch. 7
 queuing, 501, Ch. 7
 transmission, 510, Ch. 7
 delayed authentication, Ch. 11
 delegation forwarding, 112
 demand
 algorithm, 339
 paging, 346, 482
 dependent outcome record, Ch. 9
design for iteration, 37, 228, Ch. 8, Ch. 11
design principles, 40, Inside front cover
 adopt sweeping simplifications, 40, 149,
 160, Ch. 7, Ch. 8, Ch. 9, Ch. 10, Ch. 11
 avoid excessive generality, 16
 avoid rarely used components, Ch. 8,
 Ch. 11
 be explicit, Ch. 8, Ch. 11
 complete mediation, Ch. 11
 decouple modules with indirection, 27, 106,
 123, 173, 243, 286, 325, Ch. 7
 design for iteration, 37, 228, Ch. 8, Ch. 11
 durability mantra, Ch. 10
 economy of mechanism, Ch. 11
 end-to-end argument, Ch. 7, Ch. 8, Ch. 9,
 Ch. 10, Ch. 11
 escalating complexity principle, 14

design principles, (cont'd)

- fail-safe defaults*, Ch. 11
- golden rule of atomicity*, Ch. 9
- incommensurate scaling rule*, 33, 316, Ch. 7
- keep digging principle*, 37, Ch. 8, Ch. 11
- law of diminishing returns*, 18, 305, Ch. 9
- least privilege principle*, Ch. 11
- minimize common mechanism*, Ch. 11
- minimize secrets*, Ch. 11
- one-writer principle*, 212
- open design principle*, Ch. 11
- principle of least astonishment*, 85, 89, 128, 205, Ch. 11
- robustness principle*, 29, Ch. 8
- safety margin principle*, 24, Ch. 8
- unyielding foundations rule*, 20, 38, 288
- destination, **482**, Ch. 7
 - address, **482**
- detectable error, **482**, Ch. 8
- dictionary attack, Ch. 11
- digital signature, **483**, Ch. 11
- dilemma of the two generals, **510**, Ch. 9
- diminishing returns, law of*, 18, 305, Ch. 9
- direct
 - mapping, 346
 - memory access, 83
- directory, 65, **483**
 - in UNIX, 97
- discipline
 - simple locking, **506**, Ch. 9
 - system-wide locking, Ch. 9
 - two-phase locking, **510**, Ch. 9
- discovery
 - of maximum transmission unit, **494**, Ch. 7
 - of names, 76
- discretionary access control, **483**, Ch. 11
- dispatcher, 262
- distance vector, Ch. 7
- divide-by-zero exception, 206
- DMA (see direct memory access)
- do action (see redo action)
- domain
 - name, 175
 - virtual memory, 230, **483**
- Domain Name System
 - design of, 175
 - eventual consistency in, Ch. 10
 - fault tolerance of, Ch. 8

- down time, **483**, Ch. 8
- dry run, Ch. 9
- duplex, **483**, Ch. 7
- duplicate suppression, **483**, Ch. 7
- durability, 46, **483**, Ch. 8
 - log, Ch. 9
- durability mantra*, Ch. 10
- durable storage, **483**, Ch. 8
- dynamic scope, 68, **483**

E

- earliest deadline first scheduling policy, 360, **484**
- early drop, **484**, Ch. 7
- echo request, Ch. 7
- economy of mechanism*, Ch. 11
- element, 9
- elevator algorithm, 361
- emergent property, 4, **484**
- emulation, 208, **484**
- encrypt, **484**, Ch. 7, Ch. 11
- ENCRYPT, Ch. 11
- encryption key, Ch. 11
- end-to-end, **484**
 - layer, **484**, Ch. 7
- end-to-end argument*, Ch. 7, Ch. 8, Ch. 9, Ch. 10, Ch. 11
- enforced modularity, 153, **484**
- ENUMERATE, 63
- enumerate (in naming), 63, **484**
- environment, **484**
 - of a system, 8
 - of an interpreter, 53
 - reference, 53
- erasure, **484**, Ch. 8
- ergodic, **484**, Ch. 8
- error, **484**, Ch. 8
 - containment, **485**, Ch. 8
 - correction, **485**, Ch. 7, Ch. 8
 - detection, **485**, Ch. 7, Ch. 8
- escalating complexity principle*, 14
- Ethernet, **485**, Ch. 7
- event variable, 460
- eventcount, 276, **485**
- eventual consistency, **485**, Ch. 10
- EWMA (see exponentially weighted moving average)
- exactly-once
 - protocol assurance, **485**, Ch. 7

RPC, 171
 exception, 57, 205, 235, **485**
 divide-by-zero, 205
 illegal instruction, 235
 illegal memory reference, 233
 indirect, 325
 memory reference, 231
 missing-page, 328, **494**
 permission error, 233
 TLB miss, 253
 explicit context reference, 66, **485**
 explicitness, **485**, Ch. 11
exploit brute force, 301
 exponential
 backoff, **486**, Ch. 7
 random backoff, **486**, Ch. 9
 exponentially weighted moving average, 355,
 Ch. 7
 export, 60, **486**
 external time consistency, Ch. 9

F

fail-
 fast, **486**, Ch. 8
 safe, **486**, Ch. 8
 secure, **486**, Ch. 8
 soft, **486**, Ch. 8
 stop, **486**, Ch. 8
 vote, **486**, Ch. 8
fail-safe defaults, Ch. 11
 failure, **486**, Ch. 8
 tolerance, **486**, Ch. 8
 false positive/negative, 371
 fast start, Ch. 7
 fate sharing, 153
 fault, **486**, Ch. 8
 avoidance, **486**, Ch. 8
 tolerance, **487**, Ch. 8
 tolerance design process, Ch. 8
 tolerance model, Ch. 8
 FCFS (see first-come, first-served)
 FIFO (see first-in, first-out)
 file, 87, **487**
 in UNIX, 95
 memory-mapped, 325
 pointer, 88
 fingerprint, **487**, Ch. 7
 first-come, first-served scheduling policy, 353, **487**

first-in, first-out page removal policy,
 336, **487**
 fixed
 timer, Ch. 7
 window, Ch. 7
 flooding, 441, Probsets
 flow control, **487**, Ch. 7
 follow-me forwarding, 112
 force, 320, **487**, Ch. 9
 forward
 error correction, **487**, Ch. 8
 secrecy, **487**, Ch. 11
 forwarder, Ch. 7
 forwarding table, **487**, Ch. 7
 fragile name, 121
 fragment, **487**
 frame, **487**, Ch. 7
 freshness, **487**, Ch. 11
 full-duplex, **488**, Ch. 7

G

garbage collection, 131
 gate (protected entry), 236, **488**
 generality, 15
 generated name, 124, **488**
 GET, 50
 global name, 75, **488**
golden rule of atomicity, Ch. 9
 granularity, 8, Ch. 9
 guaranteed delivery, Ch. 7

H

half-duplex, **488**, Ch. 7
 Hamming distance, **488**, Ch. 8
 hard-edged, Ch. 7
 hard error, Ch. 8
 hard link, 105
 hard real-time scheduling policy, 359, **488**
 hash function, 125, **488**
 hashed MAC, Ch. 11
 hazard function, Ch. 8
 header, **488**, Ch. 7
 heartbeat, Ch. 8
 hierarchy, 25, **488**
 in naming, 73
 in routing, **488**, Ch. 7
 high-water mark, Ch. 9

bints, 40*exploit brute force*, 301*instead of reducing latency, bide it*, 309*optimize for the common case*, 307, 334,

Ch. 9

separate mechanism from policy, 331, 349,

Ch. 11

hit ratio, 333

HMAC (see hashed MAC)

hop limit, 488, Ch. 7

hot swap, 488, Ch. 8

hyperlink, 133

I

I/O bottleneck, 316

ICMP (see Internet control message protocol)

idempotent, 170, 488, Ch. 7, Ch. 9

identifier, 127, 489

illegal instruction, 489

exception, 235

illegal memory reference exception, 233

IMS (see Information Management System)

in-memory database, Ch. 9

incommensurate scaling, 5, 489

incommensurate scaling rule, 33, 316, Ch. 7

incremental

backup, 489, Ch. 10

redundancy, Ch. 8

indirect

block, 95

name, 73, 104, 489

indirection, 27, 61, 489

exception, 325

infant mortality, Ch. 8

information flow control, Ch. 11

Information Management System, Ch. 9

inode, 95

install, 489, Ch. 9

instead of reducing latency, bide it, 309

instruction

reference, 53, 489

repertoire, 503

integrity (see data integrity)

intended load, 489, Ch. 7

interconnection, 8

interface, 8

interleaving, 310, 489

intermittent fault, 489, Ch. 8

International Organization for Standardization,
489, Ch. 7

Internet, Ch. 7

control message protocol, Ch. 7

protocol, Ch. 7

service provider, 139

interpreter, 53, 490

interrupt, 53, 235, 283, 490

invalidate, 490, Ch. 10

invisible hand, Ch. 7

IP (see Internet protocol)

ISO (see International Organization for
Standardization)

isochronous, 490, Ch. 7

isolation, 220

ISP (see Internet service provider)

iteration, 36

J

jitter 490, Ch. 7

job, 352, 490

journal storage, 490, Ch. 9

K

KDC (see key distribution center)

keep digging principle, 37, Ch. 8, Ch. 11

kernel, 238, 490

mode, 234, 490

key (see cryptographic key)

key distribution center, 490, Ch. 11

key-based cryptographic transformation, 490,
Ch. 11

Kolmogorov complexity, 11

L

latency, 49, 302, 490, Ch. 8

latent fault, 491, Ch. 8

law of diminishing returns, 18, 305, Ch. 9

layer

bypass, 79

end-to-end, 484, Ch. 7

link, 491, Ch. 7

network, 496, Ch. 7

layering, 24, 491

leaky abstraction, 30

least astonishment principle, 85, 89, 128, 205,
Ch. 11*least privilege principle*, Ch. 11

least-recently-used page removal policy, 338, **491**
 least significant component, 71
 lexical scope (see static scope)
 lightweight remote procedure call, 238, **442**
 limited change propagation, Ch. 11
 limited name space, 129, **491**
 link
 in communications, 59, **480**
 in naming, 73, **491**
 in UNIX, 99
 layer, **491**, Ch. 7
 soft (see indirect name)
 symbolic (see indirect name)
 list system, **491**, Ch. 11
 little-endian numbering, 158
 livelock, 222, **491**, Ch. 9
 locality of reference, 334, **491**
 spatial, 334, **507**
 temporal, 334, **509**
 location-addressed memory, 51
 lock, 218, **491**, Ch. 9
 compatibility mode, Ch. 9
 manager, Ch. 9
 point, **491**, Ch. 9
 set, **491**, Ch. 9
 lock-step protocol, **491**, Ch. 7
 locking discipline
 simple, **506**, Ch. 9
 system-wide, Ch. 9
 two-phase, **510**, Ch. 9
 log, **491**, Ch. 9
 archive, Ch. 9
 atomicity, Ch. 9
 durability, Ch. 9
 performance, Ch. 9
 record, Ch. 9
 redo, Ch. 9
 sequence number, Ch. 9
 undo, Ch. 9
 write-ahead, **512**, Ch. 9
 logical
 copy, **492**, Ch. 10
 locking, **492**, Ch. 9
 lost object, 130
 LRPC (see lightweight remote procedure call)
 LRU (see least-recently used)

M

MAC
 (see media access control address)
 (see message authentication code)
 magnetic disk memory, 49
 malware, Ch. 11
 Manchester code, **492**, Ch. 7
 margin, **492**, Ch. 8
 mark point, **492**, Ch. 9
 marshal/unmarshal, 157, **492**
 maskable error, **492**, Ch. 8
 masking, **492**, Ch. 8
 massive redundancy, Ch. 8
 master, **492**, Ch. 10
 maximum transmission unit, **492**, Ch. 7
 mean time
 between failures, **492**, Ch. 8
 to failure, **492**, Ch. 8
 to repair, **492**, Ch. 8
 media access control address, 126
 mediation, **492**, Ch. 11
 memory, 45
 associative, 51
 barrier, 47
 location-addressed, 51
 manager, 230, **493**
 manager, multilevel, 325
 manager, virtual, 206, 243, **512**
 -mapped file, 325
 -mapped I/O, 84, **493**
 random access, 50, **501**
 transactional, **510**, Ch. 9
 volatile/non-volatile, 45, **496**, **512**
 memory reference exception, 231
 memoryless, **493**, Ch. 8
 message, 59, **493**, Ch. 7
 authentication, **493**, Ch. 11
 authentication code, **493**, Ch. 11
 representation, 54
 message-sending protocol, Ch. 7
 message timing diagram, 155
 metadata, 91, 120, **493**
 microkernel, 240, **493**
minimize common mechanism, Ch. 11
minimize secrets, Ch. 11
 mirror, **493**, Ch. 10
 missing-page exception, 328, **494**

mobile host, Ch. 7
 modular sharing, 116, **493**
 modularity, 19
 enforced, 153, **484**
 soft, 153, **507**
 module, 9, **493**, Ch. 8
 monolithic kernel, 238, **494**
 most-recently-used page removal policy, 340, **494**
 most significant component, 72
 MRU (see most-recently-used)
 MTBF (see mean time between failures)
 MTTF (see mean time to failure)
 MTTR (see mean time to repair)
 MTU (see maximum transmission unit)
 MTU discovery, **494**, Ch. 7
 multihomed, **494**, Ch. 7
 multilevel
 memory, 324, **494**
 memory manager, 325
 multiple
 lookup, 73, **494**
 -reader, single-writer protocol, Ch. 9
 register set processor, 447
 multiplexing, **494**, Ch. 7
 multiplicative decrease, Ch. 7
 multipoint, **494**, Ch. 7
 multiprogramming, 256
 multitasking, 256
 Murphy's law, 86
 mutual exclusion, 220

N

N + 1 redundancy, **494**, Ch. 8
 N-modular redundancy, **494**, Ch. 8
 N-version programming, **494**, Ch. 8
 NAK (see negative acknowledgment)
 name, 44, **494**
 base, 67
 collision, 124
 conflict, 116, **494**
 discovery, 76
 fragile, 121
 generated, 124, **488**
 global, 75, **488**
 indirect, 73, 104, **489**
 lookup, multiple, 73, **494**
 opaque, 121, **496**
 overloaded, 120, **497**

 path, **498**
 pure, 120, **501**
 qualified, 67, **501**
 resolution, 62
 resolution, recursive, 71, **502**
 well-known, 77, **512**
 name-mapping algorithm, 62
 name space, 61, **495**
 limited, 129, **491**
 unique identifier, 64, **511**
 universal, 62, **511**
 unlimited, 129, **511**
 name-to-key binding, **495**, Ch. 11
 namespace (see name space)
 naming
 authority, 180
 hierarchy, 73, **495**
 network, 72, **495**
 scheme, 61, **495**
 NAT (see network address translation)
 negative acknowledgment, **495**, Ch. 7
 nested outcome record, Ch. 9
 network, **495**, Ch. 7
 address, **495**, Ch. 7
 address translation, Ch. 7
 attachment point, 65, **495**, Ch. 7
 layer, **495**, Ch. 7
 services access point, **496**
 Network File System, 184
 NFS (see Network File System)
 NMR (see N-modular redundancy)
 non-blocking read, Ch. 9
 non-discretionary access control, **495**, Ch. 11
 non-preemptive scheduling, 269, **495**
 non-volatile memory, 45, **495**
 nonce, **496**, Ch. 7
 not-found result, 64
 NSAP (see network services access point)

O

object, 9, 60, **496**
 object-based virtual memory, 465
 occasionally connected, Ch. 10
 offered load, 311, **496**, Ch. 7
 on-demand zero-filled page, 326
 one-time pad, Ch. 11
one-writer principle, 212
 opaque name, 121, **496**

OPEN, 88
open design principle, Ch. 11
 operating system, 78, 79, **496**
 OPT (see optimal page-removal policy)
 optimal page removal policy, 337, **496**
 optimistic concurrency control, **496**, Ch. 9
optimize for the common case, 307, 334, Ch. 9
 origin authenticity, **496**, Ch. 11
 orphan, 130
 OSI (see International Organization for Standardization)
 outcome record, Ch. 9
 overhead, 302
 overlay network, 425, Ch. 7, Probsets
 overload, 311, **496**
 overloaded name, 120, **496**
 overprovisioning, Ch. 7

P

pacing, Ch. 7
 packet, **496**, Ch. 7
 forwarding, **496**, Ch. 7
 forwarding network, Ch. 7
 switch, **496**, Ch. 7
 page, 245, **496**
 fault (see missing-page exception)
 map, 245, **496**
 on-demand zero-filled, 326
 table, 246, **496**
 page-map address register, 247, **496**
 page-removal policy, 329, **496**
 clock algorithm, 344
 direct mapping, 346
 first-in, first-out, 336, **487**
 least-recently used, 338, **491**
 most-recently used, 340, **494**
 optimal, 337, **496**
 random, 345
 pair-and-compare, **497**, Ch. 8
 pair-and-spare, **497**
 parallel transmission, **497**, Ch. 7
 partition, **497**, Ch. 8, Ch. 10
 password, **497**, Ch. 11
 patch, 17
 path, Ch. 7
 name, 75, **497**
 name, absolute 68, 72, **475**
 name, relative, 72, **503**
 search, 73, 75, **504**
 selection, **497**, Ch. 7
 vector, Ch. 7
 payload, **497**, Ch. 7
 peer-to-peer
 design, 164
 network, 425
 pending, **498**, Ch. 9
 performance log, Ch. 9
 permission error exception, 233
 persistent, 46, **498**
 fault, **498**, Ch. 8
 sender, **498**, Ch. 7
 pessimistic concurrency control, **498**, Ch. 9
 PGP (see protocol, pretty good privacy)
 phase encoding, **498**, Ch. 7
 phase-locked loop, Ch. 7
 physical
 address, 243, **498**
 copy, **498**, Ch. 10
 locking, **498**, Ch. 9
 piggybacking, **498**, Ch. 7
 pipeline, **498**, Ch. 7
 PKI (see public key infrastructure)
 plaintext, **498**, Ch. 11
 point-to-point, **499**, Ch. 7
 polling, 273, **499**
 port, **499**, Ch. 7
 precision (in information retrieval), 373
 preemptive scheduling, 269, **499**
 prepaging, 346
 PREPARED
 message, Ch. 9
 state, **499**
 presentation
 protocol, **499**, Ch. 7
 service, Ch. 7
 presented load (see offered load)
 preservation, Ch. 8
 presumed commit, Ch. 9
 preventive maintenance, **499**, Ch. 8
 pricing, Ch. 7
 primary
 copy, **499**, Ch. 10
 device, 331, **499**
 principal, **499**, Ch. 11
principle of escalating complexity, 14

principle of least astonishment, 85, 89, 128, 205, Ch. 11

principles (see *design principles*)

priority

- inversion, 358
- scheduling policy, 357, 499

privacy, 499, Ch. 11

private key, 499, Ch. 11

probe, Ch. 7

procedure calling convention, 150

process, 97, 248

processing delay, 500, Ch. 7

processor multiplexing, 256

producer and consumer problem, 211

program counter, 56, 500

progress, 500, Ch. 9

propagation delay, 500, Ch. 7

propagation of effects, 4, 500

protection, 500, Ch. 11

- group, 500, Ch. 11

protocol, 500, Ch. 7

- address resolution, 475, Ch. 7
- application, Ch. 7
- bang-bang, Ch. 7
- blast, Ch. 7
- bus arbitration, 81
- carrier sense multiple access, 485, Ch. 7
- challenge-response, Ch. 11
- Diffie-Hellman key agreement, Ch. 11
- Internet, Ch. 7
- internet control message, Ch. 7
- Kerberos, Ch. 11
- lock-step, 491, Ch. 7
- message-sending, Ch. 7
- multiplexing, Ch. 7
- Network File System, 184
- presentation, 499, Ch. 7
- pretty good privacy, Ch. 11
- ready/acknowledge, 501, Ch. 7
- real-time transport, Ch. 7
- reliable message stream, Ch. 7
- request/response, Ch. 7
- routing, Ch. 7
- secure shell, Ch. 11
- secure socket layer, Ch. 11
- security, 504, Ch. 11
- simple network time service, Ch. 7
- stream transport, Ch. 7

- transmission control, Ch. 7
- transport, 509, Ch. 7
- transport layer security, Ch. 11
- two-phase commit, 510, Ch. 9
- user datagram, Ch. 7

proxy, 7, 371

pseudocode representation, 54

pseudorandom number generator, Ch. 11

public key, 500, Ch. 11

- cryptography, 500, Ch. 11
- infrastructure, Ch. 11

publish/subscribe, 173, 500

pull, 172

pure name, 120, 500

purging, 500, Ch. 8

push, 172

PUT, 50

Q

quad component, Ch. 8

qualified name, 67, 501

quantum, 356

quench, 501, Ch. 7

query, 77

queuing delay, 501, Ch. 7

quorum, 501, Ch. 10

quota, 313

R

race condition, 215, 501

RAID, 52, 501

- RAID 1, Ch. 8
- RAID 4, Ch. 8
- RAID 5, Ch. 8

RAM (see random access memory)

random

- access memory, 50, 501
- backoff, 227
- backoff, exponential, 486, Ch. 9
- drop 501, Ch. 7
- early detection, 501, Ch. 7
- number generator, Ch. 11
- page-removal policy, 345
- pseudorandom number generator, Ch. 11

rate monotonic scheduling policy, 360, 501

raw storage, Ch. 8

RC4 cipher, Ch. 11

- READ, 45
 - read and set memory, 224, **501**
 - read-capture, Ch. 9
 - read/write coherence, 46, **501**
 - ready/acknowledge protocol, **501**, Ch. 7
 - real time, 359, **502**, Ch. 7
 - real-time
 - scheduling policy, 359, **502**
 - scheduling policy, hard, 359, **488**
 - scheduling policy, soft, 359, **506**
 - transport protocol, Ch. 7
 - reassembly, **502**, Ch. 7
 - recall (in information retrieval), 373
 - RECEIVE, 59
 - receive livelock, 350
 - reconciliation, **502**, Ch. 10
 - recovery, Ch. 8
 - recursive
 - name resolution, 71, **502**
 - replication, Ch. 8
 - RED (see random early detection)
 - redo
 - action, **502**, Ch. 9
 - log, Ch. 9
 - reduced instruction set computer, 55
 - redundancy, **502**, Ch. 8
 - redundant array of independent disks (see RAID)
 - reference, 60, **502**
 - count, 131
 - monitor, Ch. 11
 - string, 334, **502**
 - register renaming, Ch. 9
 - relative path name, 72, **502**
 - RELEASE, 225, Ch. 9
 - reliability, **502**, Ch. 8
 - reliable
 - delivery, **502**, Ch. 7
 - message stream protocol, Ch. 7
 - remote procedure call, 167, **502**
 - reorder buffer, Ch. 9
 - repair, **503**, Ch. 8
 - repertoire, 53, **503**
 - replica, **503**, Ch. 8
 - replicated state machine, **503**, Ch. 10
 - replication, **503**
 - recursive, Ch. 8
 - reply, 155
 - representations
 - bit order numbering, 158
 - confusion matrix, 372
 - message, 54
 - pseudocode, 54
 - timing diagram, 155
 - Venn diagram, 372
 - version history, Ch. 9
 - wait-for graph, 221
 - repudiate, **503**
 - request, 155, **503**
 - request/response protocol, Ch. 7
 - resolution, name, 62
 - resolve, **503**
 - RESOLVE, 63
 - response, 155, **503**
 - restartable atomic region, 451
 - revectoring, Ch. 8
 - reverse lookup, 64
 - revocation, Ch. 11
 - RISC (see reduced instruction set computer)
 - Rivest, Shamir, and Adleman cipher, Ch. 11
 - robustness principle*, 29, Ch. 8
 - roll-forward recovery, **503**, Ch. 9
 - rollback recovery, **503**, Ch. 9
 - root, 72, **503**
 - in UNIX, 102
 - round-robin scheduling policy, 262, 356, **503**
 - round-trip time, **503**, Ch. 7
 - estimation, Ch. 7
 - route, Ch. 7
 - router, **504**, Ch. 7
 - routing, Ch. 7
 - algorithm, **504**, Ch. 7
 - protocol, Ch. 7
 - RPC (see remote procedure call)
 - RSA (see Rivest, Shamir, and Adleman cipher)
 - RSM (see read and set memory)
 - RTP (see real-time transport protocol)
- ## S
- safety margin principle*, 24, Ch. 8
 - safety-net approach, Ch. 8, Ch. 11
 - scheduler, 348, **504**
 - scheduling policy
 - earliest deadline first, 360, **484**
 - first-come, first-served, 353, **487**

- scheduling policy (*Cont'd*)
 - hard real-time, 359, **488**
 - priority, 357, **499**
 - rate monotonic, 360, **501**
 - real-time, 359, **502**
 - round-robin, 262, 356, **503**
 - shortest-job-first, 354
 - soft real-time, 359, **506**
- scope, 75, **504**
 - dynamic, 68, **483**
 - lexical (see scope, static)
 - static, 68, **507**
- search, 73, **504**
 - in key word query, 75
 - in name discovery, 76
- search path, 73, 75, **504**
- second-system effect, 39
- secondary device, 331, **504**
- secrecy, **504**
- secure area, **504**
- secure channel, **504**, Ch. 11
- Secure Socket Layer, Ch. 11
- security, **504**, Ch. 11
 - protocol, **504**, Ch. 11
- seed, Ch. 11
- segment
 - of a message, **504**, Ch. 7
 - virtual memory, 68, 253, 285, **504**
- self-describing storage, 365
- self-pacing, **505**, Ch. 7
- semaphore, 276, 277, **505**
- separate mechanism from policy*, 331, 349, Ch. 11
- sequence coordination, 211, 273, **505**, Ch. 9
- sequencer, 276, **505**
- sequential consistency, Ch. 9
- serial transmission, **505**, Ch. 7
- serializability, Probsets
- serializable, **505**, Ch. 9
- server, 157, **505**
- service, 155, **505**, Ch. 7
 - time, 311, Ch. 7
- session service, Ch. 7
- set up, **505**, Ch. 7
- shadow copy, **505**, Ch. 9
- Shannon's capacity theorem, Ch. 7
- shared-secret
 - cryptography, **506**, Ch. 11
 - key, **506**, Ch. 11
- sharing, 60, **506**, Ch. 7
- shortcut (see indirect name)
- shortest-job-first scheduling policy, 354
- sign, **506**, Ch. 7, Ch. 11
- simple
 - locking discipline, **506**, Ch. 9
 - network time service protocol, Ch. 7
 - serialization, **506**, Ch. 9
- simplex, **506**, Ch. 7
- simplicity, 39
- single
 - acquire protocol, 220, **506**
 - event upset, **506**, Ch. 8
 - point of failure, Ch. 8
 - state machine, Ch. 10
- single-writer, multiple-reader protocol, Ch. 9
- Six sigma, Ch. 8
- slave, **506**, Ch. 10
- sliding window, **506**, Ch. 7
- slow start, Ch. 7
- snapshot isolation, Ch. 9
- snoopy cache, **506**, Ch. 10
- SNTP (see protocol, simple network time service)
- soft
 - error, Ch. 8
 - link (see indirect name)
 - modularity, 153, **506**
 - real-time scheduling policy, 359, **507**
 - state, 189, **506**
- source, **507**, Ch. 7
 - address, **507**
- spatial locality, 334, **507**
- speaks for, **507**, Ch. 11
- speculate, 314, **507**
- spin loop, 212, **507**
- SSH (see protocol, secure shell)
- SSL (see Secure Socket Layer)
- stability, 46, **507**
 - cursor, Ch. 10
- stable
 - binding, 64, **507**
 - storage, 45
- stack
 - algorithm, 341, **507**
 - discipline, 150
 - pointer, 56

starvation, 355, **507**
 static
 discipline, 29
 routing, **507**, Ch. 7
 scope, 68, **507**
 station, **507**, Ch. 7
 identifier Ch. 7
 stop and wait (see lock-step protocol)
 storage, 50, **508**
 atomic, **476**
 careful, Ch. 8
 cell, 46, **479**, Ch. 9
 durable, **483**, Ch. 8
 fail-fast, Ch. 8
 journal, **490**, Ch. 9
 leak, 130
 raw, Ch. 8
 stable, 45
 store and forward, **508**, Ch. 7
 stream, **508**, Ch. 7
 cipher, Ch. 11
 transport protocol, Ch. 7
 strict consistency, **508**, Ch. 10
 strong consistency (see strict consistency)
 stub, 167, **508**
 subassembly, 9
 submodule, 9
 subsystem, 9
 supermodule, **508**, Ch. 8
 supervisor call instruction, 236, **508**
 SVC (see supervisor call instruction)
 swapping, 347, **508**
 sweeping simplifications
 (see *adopt sweeping simplifications*)
 symbolic link (see indirect name)
 synonym, 72, **508**
 system, 8, **508**
 systemwide lock, Ch. 9

T

Taguchi method, Ch. 8
 tail drop, **508**, Ch. 7
 TCB (see trusted computing base)
 TCP (see transmission control protocol)
 TDM (see time-division multiplexing)
 tear down, **508**, Ch. 7
 temporal
 database, Ch. 10

 locality, 334, **508**
 tentatively committed, Ch. 9
 test and set memory (see read and set
 memory)
 thrashing, 335, **509**
 thread, 204, **509**
 manager, 205, **509**
 threat, **509**, Ch. 11
 insider, Ch. 11
 throughput, 303, 323, **509**
 ticket system, **509**, Ch. 11
 tiger team, Ch. 11
 time-division multiplexing, Ch. 7
 time-domain addressing, Ch. 10
 time-sharing, 256
 time-to-live, Ch. 10
 timed capability, Ch. 11
 timer
 adaptive, Ch. 7
 fixed, Ch. 7
 timing diagram, 155, 156
 TLB (see translation look-aside buffer)
 TLB miss exception, 253
 TLS (see Transport Layer Security)
 TMR (see triple-modular redundancy)
 tolerance, 23
 tolerated error, **509**, Ch. 8
 tombstone, **509**, Ch. 7
 tracing garbage collection, 131
 trade-off, 6
 binary classification, 7, 371
 tragedy of the commons, Ch. 7
 trailer, **509**, Ch. 7
 transaction, **509**, Ch. 9
 transactional memory, **509**, Ch. 9
 TRANSFER operation, Ch. 9
 transient fault, **509**, Ch. 8
 transit time, **509**, Ch. 7
 translation look-aside buffer, 253
 transmission
 control protocol, Ch. 7
 delay, **509**, Ch. 7
 parallel, **497**, Ch. 7
 serial, **505**, Ch. 7
 transport
 protocol, **509**, Ch. 7
 service, Ch. 7
 Transport Layer Security, Ch. 11

triple-modular redundancy, **510**, Ch. 8
 trusted
 computing base, **510**, Ch. 11
 intermediary, 163, **510**
 TTL (see time-to-live)
 tunnel (in networks), Ch. 7
 two generals dilemma, **510**, Ch. 9
 two-phase
 commit, **510**, Ch. 9
 locking discipline, **510**, Ch. 9

U

UDP (see user datagram protocol)
 UNBIND, 63
 undo
 action, **510**, Ch. 9
 log, Ch. 9
 Uniform Resource Locator, 133
 unique identifier name space, 64, **510**
 universal name space, 62, **510**
 universe of values, 62, **510**
 unlimited name space, 129, **510**
 untolerated error, **511**, Ch. 8
unyielding foundations rule, 20, 38, 288
 upcall, Ch. 7
 URL (see Uniform Resource Locator)
 useful work, 302
 user
 datagram protocol, Ch. 7
 -dependent binding, 74, **511**
 mode, 234, **511**
 utilization, 302, **511**

V

valid construction, **511**, Ch. 8
 validation (see valid construction)
 value, 62, **511**
 verify, Ch. 7, Ch. 11
 version history, **511**, Ch. 9
 virtual
 address, 206, 243, **511**
 address space, 206, 248

circuit, **511**, Ch. 7
 machine, 208, 290, **511**
 machine monitor, 208, 290, **511**
 memory, 206, 332
 memory manager, 206, 243, **511**
 memory, object-based, 465
 shared memory, 326
 virtualization, 201, **511**
 virus, Ch. 11
 volatile memory, 45, **511**
 voter, **511**, Ch. 8

W

wait-for graph, 221
 WAL (see write-ahead log)
 watchdog, Ch. 8
 waterbed effect, 6
 well-known
 name/address, 77, **511**
 port, Ch. 7
 window, **512**, Ch. 7
 fixed, Ch. 7
 of validity, Ch. 11
 sliding, **506**, Ch. 7
 wired down (page), 331
 witness, **512**, Ch. 7, Ch. 10, Ch. 11
 work factor, Ch. 11
 working
 directory, 67, **512**
 set, 335, **512**
 worm, Ch. 11
 WRITE, 45
 write-ahead log, **512**, Ch. 9
 write tearing, 47, **512**
 write-through, **512**

X

X Window System, 162

Y

yield (in manufacturing), Ch. 8
 YIELD (thread primitive), 257