

# Index

## • Symbols and Numerics •

$\lambda$  (lambda) wavelength symbol, 369  
2-D bar code, 35

## • A •

- ACCU-SORT Systems, Inc., 336, 353–354  
active RFID  
  battery, 20, 38  
  capacity for holding data, 33  
  cost, 33, 38  
  described, 20  
  interference, 33, 40  
  modification of data, 33  
  range, 43  
  security, 33  
  tag size, 38, 40  
actual versus predicted traffic rate (APTR), 262–263, 267  
actuator, 41  
advanced shipping notification (ASN), 62  
AEN (ambient electromagnetic noise), testing, 119–120, 121, 126–130, 143, 145  
age lot management, 296–297  
AIAG (Automotive Industry Action Group), 361  
AIM (Association for Automatic Identification and Mobility), 164  
air interface protocol  
  anticollision technology, 100  
  EPC standard, 40  
  frequency, 49, 100  
  ISO standards, 40, 358, 360–361  
  reading speed, relation to, 72  
  space domain, 100  
airline industry, using RFID in, 115  
AIT (Automatic Identification Technology) Office, 16, 18. *See also* DoD (Department of Defense)  
Albertsons, 17, 215  
Alien Technology readers  
  company overview, 335–336  
  configuration software, 194  
  customer support, 336  
  Ethernet connectivity, 193  
  illustrated, 21  
  metal object, performance with, 191  
  paper object, performance with, 191  
  range, 187  
  Web site, 335  
Alien Technology tags, 90, 94, 336  
ALOHA protocol, 93, 101, 363, 371  
AM (amplitude modulation), 363  
ambient electromagnetic noise (AEN), testing, 119–120, 121, 126–130, 143, 145  
analysis coordinator, 355  
anechoic chamber, 142, 143, 145, 186  
antenna  
  activation, 79, 80  
  angle, 90–91, 105  
  broadcast, 20, 78, 79–80  
  canting, 105, 352  
  capacitive element, 91  
  connecting, 203, 235  
  conveyor setup, 108–109, 353  
  cost, 350  
  detection field, 79  
  dipole, 85, 92  
  directivity, 98  
  gain, 99, 197, 198, 364  
  HF, 85, 89, 111  
  inductive element, 91  
  installing, 201, 203  
  length, 91  
  LF, 85, 89  
  monitoring, 250, 261, 265  
  multiplexing, 179, 200  
  multiturn planar coil, 111  
  orientation, 91, 92, 178, 235, 353  
  patch, 370  
  patterning test, 154–155  
  pilot system, 230  
  placement, 104, 105, 107–110, 186, 235

## antenna

- PLCM, 105
- polarization, 91, 99, 131, 365, 369
- programmability, 200–201
- propagation pattern, 132
- rack, 105, 151–152, 201–202, 254
- radiation efficiency, 99
- reception, 79–80
- resonance frequency, 85–86
- Rx, 96
- sequencing, 179
- shape, 85, 91, 94–95
- size, 89, 91
- tag, 79, 85, 86, 89, 90–92
- tuning, 91
- Tx, 96
- UHF, 89
- application analysis, 23
- Applied Wireless Identifications (AWID), Inc, 185, 190–191, 193, 336–337
- APTR (actual versus predicted traffic rate), 262–263, 267
- AR-400 reader, 111, 192, 339
- Ascential Software, 210, 214
- ASIC (application-specific integrated circuit), 364
- ASN (advanced shipping notification), 62
- Association for Automatic Identification and Mobility (AIM), 164
- asynchronous data, 364
- ATTV (average tag traffic volume), monitoring, 259–261, 266
- Auto-ID (automatic identification), 10, 31–34, 41–43. *See also specific technology*
- Auto-ID Lab @Adelaide Web site, 346–347
- Auto-ID Labs (MIT), 10, 44, 50, 346, 352–353
- Automatic Identification Technology (AIT) Office, 16, 18. *See also DoD (Department of Defense)*
- Automotive Industry Action Group (AIAG), 361
- average tag traffic volume (ATTV), monitoring, 259–261, 266
- Avery Dennison Strip tag, 95
- AWID (Applied Wireless Identifications), Inc, 185, 190–191, 193, 336–337
- Aztec bar code symbology, 36

## • B •

- back link, 99
- back up
  - outsourcing, 329
  - remote location, data from, 63
- backscatter, 20, 79, 90, 92, 364
- bandwidth, 364
- bar code
  - capacity for holding data, 33, 34, 36
  - cost, 33, 35, 36
  - interference, 33, 35, 36, 130
  - life span, 35
  - linear, 34, 42
  - matrix symbol, 36–37, 42
  - modification of data, 33, 34
  - printer, RFID-enabled, 174, 238
  - range, 33, 35
  - Reed-Solomon erasure and error correction, 35
  - RFID as replacement for, 10, 16, 45
  - RFID compared, 13, 33, 34–37, 71
  - scanning, 35, 45, 71
  - security, 33, 34, 35, 36
  - stacked, 35–36
  - standard, 33, 35, 36
  - symbology, 35, 36, 42
  - 2-D, 35
  - UPC, 10, 44–47
- baud, 364
- BEA WebLogic Application Server, 214
- bend radius, 364
- bidirectional system, 364
- binary counting scheme, 364
- binary tree anticollision technology, 101
- bit rate, 364
- BizTalk Server integration broker, 214
- Bluetooth wireless technology, 120, 364
- budget, 59
- bus (parallel device), 365
- bus portal, 106
- business case
  - assumption base, 277
  - benefit analysis, 38, 58, 274–275, 281–284, 303
  - cost statement, 278
  - denial, dealing with, 290
  - driver analysis, 277, 278–279



CSMA/CD (Carrier Sense, Multiple Access with Collision Detection), 365  
 customer return process, automating, 299  
 cyclic redundancy check (CRC), 365, 366  
 Cyclotron, 142, 150, 188–189

## • D •

dashboard, RFID control, 355  
 Data Matrix bar code symbology, 36–37, 42  
 dB (Decibel), 366  
 DB2 data integration tool, 214  
 Department of Defense. *See* DoD  
 Department of Homeland Security, 113  
 deployment  
   impact on organization, 24, 56–63, 247, 279–280  
   implementation model, 24  
   implementation road map, 285–286  
   integrating RFID data into existing system, 27–28  
   location, specifying in RFP, 324  
   middleware, 213–217  
   model, 24  
   production system, 27–28, 231–232, 355–356  
   scope, 227, 276–277  
   tag, 25  
   timeline, establishing, 277, 283, 285–286  
 dielectric effect, 162, 164, 366  
 digital signal processor (DSP) chip, 95, 96–98, 196  
 diode, 366  
 distance. *See* range  
 diversion, 12, 15, 113–114, 282  
 DNS (Domain Name Service), 62  
 dock door  
   interrogation zone, 104–105, 133–135, 137, 230, 353  
   tag, testing in dock door simulation, 168–169  
 DoD (Department of Defense)  
   AIT Office, 16, 18  
   container tagging, 38, 44  
   EPC support, 47–48  
   frequency, 68  
   payment cycle, 18  
   supplier RFID policy, 17  
 Domain Name Service (DNS), 62

doorway portal, 106  
 DSP (digital signal processor) chip, 95, 96–98, 196  
 dust mote network, 29

## • E •

EAI (enterprise application integration), 215  
 EAN International, 52, 357–358  
 EAS (electronic article surveillance), 366–367  
 EBCDIC (Extended Binary Coded Decimal Interchange Code), 367  
 edge (network periphery), 366  
 EDI (Electronic Data Interchange), 62  
 EEPROM (Electrically Erasable Programmable Read-Only Memory), 366  
 effective radiated power (ERP), 366  
 eGate Integrator integration broker, 214  
 EIRP (effective isotropic radiated power), 366  
 electronic article surveillance (EAS), 366–367  
 Electronic Data Interchange (EDI), 62  
 electronic product code. *See* EPC  
 EMI (electromagnetic interference), 366  
 encryption, 32  
 Engels, Daniel (MIT Auto-ID Labs RFID expert), 352–353  
 enterprise application integration (EAI), 215  
 enterprise resource planning (ERP), 207, 367  
 EPC (electronic product code)  
   air interface protocol, EPC standard, 40  
   ASN, integrating with, 62  
   cost, 47  
   data structure, 46, 48  
   data transmission technology, integration with, 62  
   defined, 367  
   DoD support, 47–48  
   Generation protocol, 48–49, 51–52  
   header, 46  
   industry support, 47, 48, 52  
   ISO standard, 51  
   Manager Number, 46, 239

- network, global, 48
  - numbering scheme, 10, 238–240
  - object class, 46
  - OID data, 51
  - RFID, relation to, 10
  - security, 39, 47
  - serial number, 47
  - tag class, 39, 50
  - UPC versus, 10, 44–47
  - Wal-Mart, 11, 50
  - EPCglobal
    - Manager Number assignment, 239
    - mandate, 52, 358
    - registry, 64
    - Software Action Group, 209
    - UCC, relation to, 44, 52
    - Web site, 344
    - working groups, 53
  - ERP (effective radiated power), 366
  - ERP (enterprise resource planning), 207, 367
  - Ethernet
    - gigabit, 368
    - PoE, 185, 192, 195
    - reader, 193, 194, 256
  - ETSI (European Telecommunications Standards Institute), 40, 367
  - evanescent wave, 367
  - Exchange Integrator integration broker, 214
  - executive support. *See* business case
  - Extended Binary Coded Decimal Interchange Code (EBCDIC), 367
- F ●**
- Faraday Effect, 367
  - Faraday's Law of Electromagnetic Induction, 111
  - far-field communication, 367
  - FAST Tag RFID system, 336
  - FCC (Federal Communications Commission)
    - compliance, 185, 199–200, 354
    - frequency licensing, 65, 121, 122
    - RFID standards, 40
    - vendor certification, 354
    - Web site, 68
  - FDA (Food and Drug Administration), 68
  - FDMA (Frequency Division Multiple Access), 100
  - FEC (Forward Error Correction), 367
  - Federal Communications Commission. *See* FCC
  - Federal Trade Commission (FTC), 53
  - Fennig, Chris (ODIN technologies RFID expert), 349–350
  - FFCA (Full Faraday Cycle Analysis), 24–25, 122, 126, 136, 321
  - Five Forces model, 304–305
  - flip-chip, 90, 241
  - Fluidic Self-Assembly (FSA), 90, 335
  - FM (frequency modulation), 368
  - Food and Drug Administration (FDA), 68
  - food industry, using RFID in, 12, 115–116
  - Forrester Research, 206, 217
  - Forward Error Correction (FEC), 367
  - forward link, 99, 352
  - FOX IV Technologies, 337
  - FRC (frequency response characterization), 171–173
  - frequency. *See also* HF (high frequency); LF (low frequency); UHF (ultrahigh frequency)
    - agile, 196, 339, 367
    - air interface protocol, 49, 100
    - antenna resonance, 85–86
    - Australia, 67
    - carrier, 365
    - China, 68
    - common, 65–66
    - DoD, 68
    - domain, 100
    - electromagnetic wave
      - measurement, as, 83
    - Europe, 40, 67
    - FDA, 68
    - FRC, 171–173
    - hopping, 120, 124, 161, 172, 368
    - interrogation zone, 20
    - ISM band, 120, 121, 156, 368
    - Japan, 67
    - licensing, 65, 121, 122
    - material tagged, matching to, 66, 69, 172
    - microwave, 65, 68, 369
    - passive RFID, 66
    - penetration, 370

frequency (*continued*)

- pharmaceutical industry, 68–69
- range, relation to, 66, 70
- SA, 122, 125, 131, 199, 349
- shelf interrogation zone, 110–111
- spectrum, 22, 40, 65, 83, 89
- standards, 40
- tag tuning, 74, 91
- United States, 40, 64, 67–68
- Wal-Mart, 68
- wavelength, relation to, 66
- wideband communication, 74
- Frequency Division Multiple Access (FDMA), 100
- frequency modulation (FM), 368
- frequency response characterization (FRC), 171–173
- friendliness pyramid, 164–166
- FSA (Fluidic Self-Assembly), 90, 335
- FTC (Federal Trade Commission), 53
- Full Faraday Cycle Analysis (FFCA), 24–25, 122, 126, 136, 321
- full-duplex, 368

## • G •

- Gauss's Law, 90
- Generation protocol, EPC, 48–49, 51–52
- ghost read, 98, 232, 353
- GHz (gigahertz), 83
- GLOBAL registry, 359
- Global Tag (GTAG) initiative, 358
- Global Trade Identification Number (GTIN), 368
- GlobeRanger middleware, 209, 217
- GPS (Global Positioning System), integrating RFID with, 39
- Grand Central middleware, 215
- ground plane plate, 131, 133
- GTAG (Global Tag) initiative, 358
- GTIN (Global Trade Identification Number), 368

## • H •

- halving process, 300
- hazardous material safety, 42, 114
- HDMA (Healthcare Distribution and Manufacturers Association), 64

- Hertz (Hz), 83
- HF (high frequency)
  - antenna, 85, 89, 111
  - induction field, 84
  - pharmaceutical industry, use in, 68–69
  - power level, 67
  - range, 66
  - shelf interrogation zone, 110, 111
  - spectrum, 40, 65, 89, 368
- highway toll system, using RFID in, 13–14, 106
- Hitachi mu-chip, 93
- homologation, 298–299
- HTTP (Hypertext Transfer Protocol) reader interface, 256
- human body, effect on signal, 164
- human intervention reduction provided by RFID, 11, 13–14, 57–58
- hysteresis, 353
- Hz (Hertz), 83

## • I •

- IBM middleware, 210, 214, 217
- IC (integrated circuit), 369. *See also* chip identification card ISO/IEC standards, 359–360
- IDTechEx Web site, 345
- IEC (International Electrotechnical Commission), 359–361
- impedance, 91, 93, 368
- Impinj (firm), 337–338
- inductance, 84–85, 111, 368, 370
- Industrial, Scientific, and Medical (ISM) frequency band, 120, 121, 156, 368
- ink, conductive, 90
- integrated circuit (IC), 369. *See also* chip integrating RFID data into existing system, 27–28
- Integration Platform integration broker, 214
- interference
  - active RFID, 33, 40
  - AEN, 119–120, 121, 126–130, 143, 145
  - bar code, 33, 35, 36, 130
  - cause, locating, 129–130
  - contact memory button, 37
  - EMI, 366
  - monitoring, 250
  - movement, caused by, 42

- noise, 84, 370  
 object in interrogation zone, caused by,  
   25, 28, 40, 73–74, 86  
 passive RFID, 33, 40  
 planning, taking into account when, 32  
 range, effect on, 71  
 shielding, 130  
 Intermec Technologies Corporation, 338  
 International Electrotechnical Commission  
 (IEC), 359–361  
 International Organization for  
 Standardization. *See* ISO  
 interrogation zone  
   boundary, 353  
   bus portal, 106  
   car portal, 106  
   conveyor, 108–109  
   defined, 369  
   dock door, 104–105, 133–135, 137, 230, 353  
   doorway portal, 106  
   frequency, 20  
   interference caused by object in, 25, 28,  
     40, 73–74, 86  
   luggage portal, 106, 107  
   over-designing, avoiding, 107, 350  
   overlapping interrogation patterns, 235  
   path loss, testing for, 204  
   pilot system, 230  
   planning, 107, 121, 130–131  
   security portal, 106  
   shelf setup, 110–112  
   shrink-wrap station, 109–110, 230  
   site, changing to accommodate, 60  
   speed of item movement through, 71–73  
 in-transit visibility (ITV), 9  
 inverse square law, 71, 85  
 ISM (Industrial, Scientific, and Medical)  
   frequency band, 120, 121, 156, 368  
 ISO (International Organization for  
 Standardization)  
   air interface protocol standards, 40, 358,  
     360–361  
   bar code standards, 35, 36  
   EPC standard, 51  
   identification card standards, 359–360  
   item management standards, 360  
   JTC1/SC31, 360–361  
   PDF standard, 36  
   tag conformance standards, 170  
   Web site, 361  
 ITV (in-transit visibility), 9  
 I2 tag, 94
- **J** •
- JTC1/SC31 (Joint Technical Committee 1,  
 Subcommittee 31), 360–361
- **K** •
- King, Patrick (Michelin Tire Corporation  
 RFID expert), 353  
 Kowalke, Steve (ACCU-SORT Systems RFID  
 expert), 353–354
- **L** •
- labeling reduction brought by RFID,  
 293–294  
 lambda ( $\lambda$ ) wavelength symbol, 369  
 LASL (Los Alamos Scientific  
 Laboratories), 82  
 law enforcement, using RFID in, 113  
 Law of Electromagnetic Induction, 111  
 LF (low frequency)  
   antenna, 85, 89  
   induction field, 84  
   range, 66  
   spectrum, 40, 65, 89, 369  
 life span  
   bar code, 35  
   contact memory button, 37  
   tag, 32, 40  
 line of sight, 32, 33, 159  
 link margin, 167  
 liquid, effect on signal, 66, 69, 163, 165, 350  
 Los Alamos Scientific Laboratories  
 (LASL), 82  
 low frequency. *See* LF  
 luggage portal, 106, 107

## • M •

- MacDonald, Kevin (Sun Microsystems RFID expert), 354–355
- magneto-optical effect, 367
- maintenance, 185–186, 302, 316
- Manchester encoding, 369
- mandate, 16–18
- Manhattan Associates middleware, 209, 217
- Marconi Corporation, 84
- MARKEM Corporation, 339
- Massachusetts Institute of Technology (MIT) Auto-ID Labs, 10, 44, 50, 346, 352–353
- material. *See also specific material*
  - dispersion, 369
  - tagging hazardous, 42, 114
- Matrics. *See* Symbol Technologies readers; Symbol Technologies tag
- MaxiCode bar code symbology, 36
- McCollum, Duncan (CSC RFID expert), 351
- mean time between failure (MTBF), 263–265, 267
- meat, tracking using RFID, 115–116
- megahertz (MHz), 22
- memory
  - contact memory button, 33, 37, 42
  - DSP chip, 97
  - EEPROM, 366
  - tag, 38, 52, 92
- MEMS (micro-electro-mechanical systems), 41
- Mesa Code bar code symbology, 36
- mesh network, integrating reader in, 29
- Met Labs, 140
- metal, effect on signal, 163, 164, 165, 191, 350–351
- MHz (megahertz), 22
- Michelin Tire Corporation, 114, 294, 353
- micro-electro-mechanical systems (MEMS), 41
- Microsoft middleware, 210, 214
- Microsoft Project 2003 For Dummies* (Stevenson), 222
- microwave, 65, 68, 369
- middleware
  - application integration provided by, 81, 207
  - application server, 214
  - choosing appropriate, 213–216
  - content packaging, 208
  - cost, 301
  - data management, 81, 207, 214
  - described, 61, 80
  - filtering, 206, 211–212, 216
  - integration broker, 214
  - location, 211–212
  - monitoring, importance to, 256
  - need, prioritizing, 215–216
  - network architecture, 210–216
  - partner integration provided by, 81, 207
  - process management, 207–208
  - pure play solution, 209
  - reader management, 81, 206–207
  - RFP, stating middleware requirement in, 322
  - routing, 216
  - scalability, 208
  - tier structure, 211–213
  - track-and-trace functionality, 216
  - vendor overview, 208–210
- MIT (Massachusetts Institute of Technology) Auto-ID Labs, 10, 44, 50, 346, 352–353
- modification of data
  - bar code, 33, 34
  - contact memory button, 33, 37
  - tag, 33, 39
- modulation, 93, 95–96, 363, 370
- monitoring
  - antenna, 250, 261, 265
  - APTR, 262–263, 267
  - ATTV, 259–261, 266
  - background process, 254
  - custom monitoring system, building, 267
  - error detection, self-healing after, 268
  - expanding system, when, 265
  - frequency count, 258
  - goal-oriented, 257
  - interference, for, 250
  - intrusive/nonintrusive, 255–256, 257

load, 257  
 middleware, importance to, 256  
 MTBF, 263–265, 267  
 need for, 250–251  
 operator feedback, 252–254  
 outsourcing, 267, 313, 322–323, 329  
 plotting reader transmission, 257  
 power failure, for, 250  
 predicting future behavior based on  
   monitoring data, 255  
 RECR, 262, 266  
 RETR, 261, 266  
 RFP, stating monitoring requirement in,  
   322–323  
 software, using third-party, 267  
 statistical approach, 255–257, 258,  
   265–268  
 status of reader, 250, 251–254, 256,  
   260–261  
 support, importance to, 236  
 system behavior, 251, 255  
 tag count, 257, 259, 260  
 tag detection, 250, 255  
 tag state change, 260  
 tag type, for new, 250  
 time interval, breaking data into,  
   257–259, 260  
 movement  
   AEN roving capture, 127–129  
   interference caused by, 42  
   range, effect on, 69  
   reader, triggering using motion  
     detector, 178  
   tracking high volume moving stock, 43  
 Moxa PT devices, 193  
 MTBF (mean time between failure),  
   263–265, 267  
 mu-chip, 93  
 multi-pathing, 131, 162–163

## • N •

NDA (nondisclosure agreement), 325  
 Nelson, Mark (Savi Technology RFID  
   expert), 355

network analyzer, 93  
 NFC (near-field communication), 69, 370  
 noise, 84, 370  
 Nokia Web site, 42  
 numbering scheme, 10, 238–240

## • O •

OATSystems middleware, 209, 214, 217  
 Object Identification (OID) EPC data, 51  
 ODIN technologies  
   antenna rack, 105  
   company background, 340  
   Cyclotron, 142, 150, 188–189  
   testing lab, 140  
   Trifecta software, 156–157, 161–162, 173  
   Web site, 105  
 OID (Object Identification) EPC data, 51  
 OMRON electronics, 187, 194, 196, 199,  
   340–341  
 Oracle middleware, 210, 214, 216, 217  
 oscilloscope, 142  
 outsourcing  
   advantages/disadvantages, 308–309  
   back up, 329  
   choosing provider, 318, 325–326  
   cost, 312, 313, 316–317, 327  
   deployment location, specifying, 324  
   goal, as means of achieving, 310–312  
   monitoring, 267, 313, 322–323, 329  
   NDA, 325  
   need for, evaluating, 309–314  
   negotiating with provider, 331  
   planning, 314–315  
   problem severity level, mandating  
     response appropriate to, 329–330  
   reference, checking, 325, 327  
   resource analysis, performing when  
     considering, 314–316  
   RFP, 318–325, 327  
   risk, 308–309, 313, 317  
   security, 322  
   service, penalizing bad, 329  
   service-level benchmark, setting, 329  
   site assessment, 321

- outsourcing (*continued*)
    - SLA, 323, 327–331
    - staff, evaluating internal when
      - considering, 315, 317–318
    - statement of work, 315
    - switching provider, 309, 313
    - technical support, 323–324
    - testing, 140, 321
    - timeline considerations, 307, 310, 311–312, 314–315, 318
  - overhead, transmission stream, 370
- *p* ●
- packet, data, 370
  - paper object, reader performance with, 191
  - Parallel Integrated Chip Assembly (PICA), 90
  - passive RFID
    - capacity for holding data, 33, 89
    - cost, 33
    - described, 20
    - frequency, 66
    - interference, 33, 40
    - modification of data, 33
    - power source, 79, 84–85, 89, 90–93, 137
    - range, 40
    - security, 33
    - tag size, 38, 40
  - path loss contour mapping (PLCM), 105, 131–137
  - Paxar bar code printer, 238
  - PDF (portable data file) standard, 36
  - peer-to-peer network, 81
  - Pelican equipment case, 149
  - PeopleSoft middleware, 216
  - phantom read, 98, 353, 370
  - pharmaceutical industry, using RFID in
    - counterfeiting, 12, 15, 64, 113
    - diversion, 12, 15, 113–114
    - frequency, 68–69
    - inventory tracking, 12
    - security, 12, 15, 113–114
  - photon, 370
  - PICA (Parallel Integrated Chip Assembly), 90
  - pilot system
    - accountability, 225
    - antenna, 230
    - baseline, 230
    - business case, 228, 232, 355–356
    - debriefing, 221, 230, 231–232
    - deliverable tracker, 224–225
    - gating, 231
    - goal, 227
    - interrogation zone, 230
    - issue tracker, 225–226
    - phasing, 229–231
    - planning, 26, 59, 222–226
    - procurement, 223
    - production system, moving to, 231–232, 355–356
    - project manager, 225–226, 228
    - result, measuring, 229
    - risk mitigation, 229
    - scalability, 228
    - scope, 227
    - security, 229
    - site, 223
    - specification document, 228
    - stand-alone, 229
    - team roster, 226
    - testing, 26–27, 59
    - timeline, 222, 223, 225
    - training, 223
    - user involvement, 228
  - ping command, checking reader status
    - using, 252
  - planning
    - application analysis, 23
    - Auto-ID strategy, 32, 41–43
    - cost, 24, 32
    - data transmission technology, 61–62
    - importance of, 22
    - interference, taking into account, 32
    - interrogation zone, 107, 121, 130–131
    - network, 61, 62–64
    - outsourcing, 314–315
    - pilot system, 26, 59, 222–226
    - policy, 23
    - site assessment, 120–126
    - tag deployment, 25
    - time needed for, 23
    - timeline, 24
  - plastic, effect on signal, 164
  - PLCM (path loss contour mapping), 105, 131–137
  - PoE (Power over Ethernet), 185, 192, 195

polarization  
 antenna, 91, 99, 131, 365, 369  
 defined, 370  
 portable data file (PDF) standard, 36  
 print-and-apply station, 151, 158  
 printer, RFID-enabled, 174, 238  
 Printronix bar code printer, 238  
 privacy, 53–54  
 product age management, 296–297  
 Product Center data integration tool, 214  
 product recall, using RFID in, 114  
 project manager, 225–226, 228, 272,  
 354–355  
 protocol defined, 371  
 Provia Software, 209–210  
 PT (protocol translation), 193  
 pure play solution, 209

• **Q** •

QuickMBA Web site, 305  
 quiet zone, 371

• **R** •

radiation field, 84, 85  
 radio frequency (RF) site assessment,  
 120–126  
 Rafsec Folded Dipole CCT tag, 95  
 range  
 accuracy, effect on, 69  
 active RFID, 43  
 Alien Technology readers, 187  
 bar code, 33, 35  
 frequency, relation to, 66, 70  
 interference, effect on, 71  
 inverse-square relationship, 71  
 movement, effect on, 69  
 passive RFID, 40  
 sensitivity of reader, relation to, 70  
 signal power, relation to, 70–71  
 Symbol Technologies readers, 187  
 tag size, relation to, 40, 98  
 testing, 154–155, 171, 186–187  
 read error change rates (RECR), 262,  
 266–267  
 read errors to total reads (RETR), 261, 266

reader. *See also* antenna; middleware;  
*specific brand*  
 absolute best value measurement, 72–73  
 accuracy, comparing readers for, 72  
 accuracy, effect of distance on, 69  
 acquisition mode, 178, 179, 191–192, 197  
 agile, 196  
 back link, 99  
 choosing appropriate, 182–186  
 command language, 256, 257  
 configuration class, 236–238  
 configuration file, 238, 329  
 configuration software, 183, 194–195  
 coordinating multiple readers, 178  
 cost, 29, 183, 184–186, 301, 337  
 cross talk, 177–178  
 current oscillation, 96–97  
 data export software, 183–184  
 DSP chip, 95, 96–98, 196  
 duplicate read, 206  
 EPC information server, 61  
 Ethernet, 193, 194, 256  
 FCC compliance, 185, 199–200  
 feedback, 245–246, 252–254  
 filtering software, 61  
 fixed-location, 182  
 frequency count, monitoring, 258  
 ghost read, 98, 232, 353  
 grid computing, integrating in, 29  
 hand-held, 182, 199, 236  
 installing, 185, 201–204  
 intelligent, 29  
 interface, 61, 78, 256  
 load, monitoring, 257  
 luggage portal, 106  
 maintenance, 185–186  
 middleware management function, 81,  
 206–207  
 mobile, 182, 199, 236  
 motion detector, triggering using, 178  
 network connectivity, 183, 192–195, 234,  
 252, 256  
 number of readers in use, limiting, 232  
 overlapping interrogation patterns, 235  
 pallet read, full, 178–179  
 PCMCIA slot, 193  
 phantom read, 98, 353, 370

reader (*continued*)

- ping command, checking status
  - using, 252
- placement, 186, 202
- polling, 104
- power output flexibility, 198–199
- powering up, 203–204
- protocol support, 187, 196
- rack, 105, 151–152, 201–202, 254
- RECR, monitoring, 262, 266
- response from tag, listening for, 20, 104
- RETR, monitoring, 261, 266
- scan period, 197
- sensitivity, relation to range, 70
- sensor capability, 29
- shelf reader, 111
- signal transmission, 20
- simultaneous reading, 14, 40, 72–73, 246
- speed, 71–72, 178, 188–189
- splatter, 199–200
- starting manually, 244–245
- status, monitoring, 250, 251–254, 256, 260–261
- support, importance of monitoring
  - to, 236
- talking first anticollision protocol, 72
- TCP/IP, 256
- technical support, 186
- testing lab reader setup, 149–150
- testing reader performance, 155, 183, 186–192
- time to last tag in field measurement, 72–73
- training, 244–246
- transmission, plotting, 257
- troubleshooting, 245
- tunability, evaluating, 177, 184, 195–201
- upgrading, 184, 185
- UPS, 236
- wakeup, 178
- wireless, 195

- real-time information capture, 12, 14–15, 58, 97
- recall of product, using RFID in, 114
- receiving antenna (Rx), 96
- RECR (read error change rates), 262, 266–267
- rectified product segregation, 298
- RedPrairie middleware, 209–210

- Reed-Solomon bar code erasure and error correction, 35
- refraction, 162, 371
- refractive index, 371
- REG (RFID Expert Group), 164
- repeater, 371
- request for proposal (RFP), 318–325, 327
- RETR (read errors to total reads), 261, 266
- return link, 352
- return on investment. *See* ROI
- return process, automating, 299
- RF Code middleware, 209, 217
- RF (radio frequency) site assessment, 120–126
- RFID Alliance Lab, 140
- RFID Exchange Web site, 345–346
- RFID Expert Group (REG), 164
- RFID Gazette Web site, 347
- RFID Journal Online Web site, 344
- RFID Solutions Online Web site, 345
- RFID Update Web site, 346
- RFID@WINMEC Web site, 347
- RFP (request for proposal), 318–325, 327
- Rice Virtual Lab Web site, 268
- Rohde and Swartz Spectrum Analyzer, 199
- ROI (return on investment)
  - business case, stating in, 274–275, 283, 287
  - cost, tallying, 300–302
  - expansion tool, as, 303–304
  - halving process, 300
  - money saved, identifying, 292–300
- RS connectivity protocols, 192–193
- Rule of Three and Four, 306
- Rx (receiving antenna), 96



- SA (Spectrum Analyzer), 122, 125, 131, 199, 349
- SAMSys readers
  - company overview, 341
  - configuration software, 194
  - Ethernet connectivity, 193
  - paper object, performance with, 191
  - protocol support, 187, 196
  - tunability, 197
- SAP middleware, 209, 214, 216, 217

- Savant middleware, 61, 80, 209, 256, 260  
Savi Technology, 48, 209, 217, 355, 362  
SAW (Surface Acoustic Wave), 371  
SCM (supply-chain management), 207  
Secure Tradelanes (SST), 362  
security  
  active RFID, 33  
  bar code, 33, 34, 35, 36  
  contact memory button, 33, 37, 42  
  counterfeiting reduction, 12, 15, 64, 113, 281–282  
  EAS, 366–367  
  encryption, 32  
  EPC, 39, 47  
  high-value stock, 43  
  inventory tracking, 12, 15  
  outsourcing, 322  
  passive RFID, 33  
  pharmaceutical industry, 12, 15, 113–114  
  pilot system, 229  
  portal, 106  
  RFP, stating security requirement in, 322  
  serialized data, 12  
  shrinkage, 15  
  testing system with outside partner, 28  
SeeBeyond middleware, 214, 215  
semi-passive RFID, 39, 43  
sensor, 29, 41  
serial number encoding, 239  
serialized data, inventory tracking, 11, 12–13, 43  
service level agreement (SLA), 323, 327–331  
shelf interrogation zone, 110–112  
shipping  
  accuracy improvement brought by RFID, 294–296, 299  
  ASN, 62  
  container tagging, 38, 44, 113, 361–362  
  item processing, simultaneous, 14  
  pallet versus flat-loaded case, 59  
shrink-wrap station interrogation zone, 109–110, 230  
signal. *See also* frequency; interference;  
  range  
  absorption, 162, 163–164  
  analog, 363  
  attenuation, 71, 142, 164, 167–168, 353  
  backscatter, 20, 79, 90, 92, 364  
  cardboard, transparency to, 163, 166  
  detuning, 163, 164  
  generator, 131  
  human body, effect on, 164  
  liquid, effect on, 66, 69, 163, 165, 350  
  loss, 162, 369  
  metal, effect on, 163, 164, 165, 191, 350–351  
  modulation, 93, 95–96, 363, 370  
  multi-pathing, 131, 162–163  
  obstruction, effect on, 25, 28  
  packaging material transparency to, 163, 165–166  
  plastic, effect on, 164  
  PLCM, 105, 131–137  
  power level, choosing appropriate, 350  
  power, relation to range, 70–71  
  propagation effect, 162–163, 164  
  radiation field, 84, 85  
  reader, transmission by, 20  
  reflection, 162, 164  
  refraction, 162, 371  
  repeater, 371  
  splatter, 199–200  
  standing wave, 162  
  tag power derivation from, 39  
  tag, transmission by, 20  
Simple Network Management Protocol (SNMP), checking reader status using, 252, 261  
simplex, 371  
site  
  AEN, testing, 119–120, 121, 126–130, 143, 145  
  interrogation zone, 60  
  outsourcing site assessment, 321  
  pilot system, 223  
  planning site assessment, 120–126  
  RF assessment, 120–126  
  RFID impact on, 60–61  
  RFP, stating site assessment requirement in, 321  
  ski resort, using RFID in, 112–113  
SKU (stock-keeping unit) testing, 25, 140, 150, 155–157, 191  
SLA (service level agreement), 323, 327–331  
slap and ship. *See* tag and ship  
Slashdot Web site, 347–348

slide-ware, 208  
 smart card, close coupling, 365  
 smart shelf, 110  
 SNMP (Simple Network Management Protocol), checking reader status using, 252, 261  
 Software Action Group, 209  
 space domain anticollision technology, 100  
 Spectrum Analyzer (SA), 122, 125, 131, 199, 349  
 splatter, 199–200  
 SQL Server, 214  
 Squiggle tag, 94  
 SR-400 reader, 192  
 SST (Secure Tradelanes), 362  
 standing wave, 162  
 steering committee, 272, 273  
 stock-keeping unit (SKU) testing, 25, 140, 150, 155–157, 191  
 strategic thinking, 290–291  
 Sun Microsystems, 210, 217, 354–355  
 supply-chain management (SCM), 207  
 Surface Acoustic Wave (SAW), 371  
 Symbol Technologies readers  
   acquisition mode, 191–192  
   agile, 339  
   AR-400, 111, 192, 339  
   configuration software, 194  
   Ethernet connectivity, 193  
   illustrated, 21  
   installation, 185  
   inventory mode, 192  
   luggage portal, 106  
   metal object, performance with, 191  
   paper object, performance with, 191  
   protocol support, 196  
   range, 187  
   scan period, 197  
   SR-400, 192  
 Symbol Technologies tag, 21, 90, 101  
 synchronization, data, 64  
 synchronous communication, 371

## • T •

tag. *See also specific brand*  
 antenna, 79, 85, 86, 89, 90–92  
 application testing, 168–171  
 applying, 174–177, 240–241, 242  
 APTR, monitoring, 262–263, 267  
 ATTV, monitoring, 259–261, 266  
 bending, 241  
 capacity for holding data, 33, 39, 89  
 characterization testing, 157–158  
 chip, 20, 79, 89–90, 92–94, 243  
 choosing appropriate, 166–168, 350  
 class, 39, 50  
 conveyor, testing on, 168  
 cost, 22, 40, 159, 302, 336  
 count, monitoring, 257, 259, 260  
 deployment, 25  
 detection, monitoring, 250, 255  
 dock door, simulating when testing, 168–169  
 encoding, 174–175, 238–239  
 encrypting data on, 32  
 energy used by, 20  
 ISO conformance standards, 170  
 I2 tag, 94  
 level, establishing, 277  
 life span, 32, 40  
 linear, 242–243  
 link margin, 167  
 memory, 38, 52, 92  
 microprocessor, 20  
 modifying data on, 33, 39  
 orientation, 91, 92, 161, 241–243  
 placement, 25, 160–161, 242  
 planning, 25  
 polling, 104  
 power source, active tag, 20, 38  
 power source, passive tag, 79, 84–85, 89, 90–93, 137  
 Rafsec Folded Dipole CCT tag, 95  
 reader compatibility with future tag protocol, 196  
 response to reader, 20, 78

- signal transmission by, 20
- size, 38, 40, 92, 98
- Squiggle tag, 94
- state change, monitoring, 260
- substrate, 89, 90
- time to last tag in field measurement, 72–73
- TPI, 169, 190
- tuning, 74, 91
- type, monitoring or new, 250
- type, standardizing, 232
- type, testing for appropriate, 166–168
- WORM, 49, 51, 372
- tag and ship, 9, 174–175
- tag performance index (TPI), 169, 190
- talking first anticollision protocol, 72
- Target Corporation, 17, 215
- TCP/IP (Transmission Control Protocol/Internet Protocol), reader support, 256
- team
  - analysis coordinator, 355
  - assembling, 271–273
  - business case presentation, team-level, 288
  - meeting, 275
  - project manager, 225–226, 228, 272, 354–355
  - steering committee, 272, 273
  - structure, 272, 273
  - technology expert, 272
  - training, 275–276
- Team Tag-IT, 354
- technical support, 186, 323–324
- testing
  - AEN, 119–120, 121, 126–130, 143, 145
  - anechoic chamber, 142, 143, 145, 186
  - antenna patterning, 154–155
  - application testing, 149, 160, 168–171
  - baseline, 59, 190
  - characterization test, tag, 157–158
  - conveyor, locating in relation to testing lab, 150
  - conveyor, testing tag on, 168
  - dock door simulation, tag testing, 168–169
  - equipment used, casing for travel protection, 149
  - FRC, 171–173
  - grid, testing lab floor, 146–147
  - laying out testing lab, 145–148
  - location of testing lab, choosing appropriate, 143–145
  - network connectivity, testing lab, 144, 146
  - office setting testing lab, 144
  - outsourcing, 140, 321
  - path loss, testing interrogation zone for, 204
  - pilot system, 26–27, 59
  - placement of tag, 160–161
  - print-and-apply station, 151
  - procedure, developing, 153–158, 160–161
  - range, 154–155, 171, 186–187
  - reader performance, 155, 183, 186–192
  - reader, setting up in testing lab, 149–150
  - RFP, stating testing requirement in, 321
  - scientific, 149, 160
  - SKU testing, 25, 140, 150, 155–157, 191
  - tag type, 166–168
  - variable, control/dependent, 190
  - warehouse setting testing lab, 144
- Texas Instruments, 341–342, 354
- ThingMagic (firm), 186, 187, 196, 342
- thinking, strategic, 290–291
- Three and Four, Rule of, 306
- TIBCO Software middleware, 210, 214, 215, 217
- time domain anticollision technology, 100–101
- time to last tag in field measurement, 72–73
- tiny sensor network, 29
- toll system, highway, 13–14, 106
- TPI (tag performance index), 169, 190
- training, 161, 223, 244–247, 275–276, 301
- transceiver, 78, 371
- Transmission Control Protocol/Internet Protocol (TCP/IP), reader support, 256
- transponder, 37, 78, 79, 372

TREAD (Transportation Recall Enhancement & Accountability Documentation) Act, 291  
 tree walking anticollision technology, 93, 101  
 Trifecta software, 156–157, 161–162, 173  
 2-D bar code, 35  
 Tx (transmitting antenna), 96  
 Tyco/ThingMagic readers, 186, 187, 196

## • U •

UCC (Uniform Code Council), 44, 52, 209, 357–358  
 UCCnet organization, 64, 358–359  
 UCLA (University of California at Los Angeles) RFID@WINMEC Web site, 347  
 UHF (ultrahigh frequency)  
   antenna, 85–86, 89  
   dock door interrogation zone, 104  
   frequency hopping, 124  
   induction field, 85  
   power level, 67  
   range, 66  
   shelf interrogation zone, 110  
   spectrum, 22, 40, 65, 89, 372  
   supplier mandate, 64, 68  
 UID (unique identifier), 371  
 ultrahigh frequency. *See* UHF  
 Uniform Code Council (UCC), 44, 52, 209, 357–358  
 University of California at Los Angeles (UCLA) RFID@WINMEC Web site, 347  
 University of Kansas RFID Alliance Lab, 140  
 UPC (Universal Product Code), 10, 44–47  
 UPS (uninterruptible power supply), 236  
 user feedback committee, 355

## • V •

validation (work product review), 275  
 vapor ware, 208  
 Venture Research, Inc., 105  
 verification tunnel, 236  
 VeriSign DNS system, 62  
 version control, 222–223

## • W •

Wal-Mart  
   EPC, 11, 50  
   frequency, 68  
   inventory tracking, 10, 11  
   middleware, 215  
   speed requirement, 188  
   supplier RFID requirement, 16  
   synchronization, data, 64  
   verification tunnel, 236  
 warehouse management systems (WMS), 207  
 warranty verification, using RFID in, 114  
 wavelength, 66, 371  
 WebLogic Application Server, 214  
 webMethod middleware, 210, 214, 217  
 WebSphere  
   Application Server, 214  
   Business Integrator integration broker, 214  
 White, Joe (Symbol Technologies RFID expert), 350–351  
 wideband communication, 74  
 WMS (warehouse management systems), 207  
 WORM (write once, read many) tag, 49, 51, 372  
 W3C (World Wide Web Consortium), 52

## • Z •

Zebra bar code printer, 238