

INDEX

Page references followed by t indicate material in tables.

- A3 Technologies, 158
- Aanza AutoID Group, 158
- Abstract Syntax Notation 1 (ASN.1), 140
- Accelitec, 158
- Accenture Corporation, 62, 199
- Access control applications, 45t
- Access security, in “smart” tags versus bar codes, 22
- Accountability, in supply chain management, 24
- Accusort Systems, Inc., 158
- AcelC Designs, Inc., 159
- Acheson Colloids Company, 159
- Acronyms list, 137–138
- Active RFID tags, 6–8
- Active tags, xiii, 139
 - read ranges of, 12
 - versus passive tags, 13
- Active transponder, 139
- Adams, Russ, 18
- Addressability, 139
- AeroScout, 159
- AgInfoLink, 159
- Air interface, 139
 - standards for, 89
- Airline passenger identity authentication, 70
- Airport applications, 57–58
- Alanco Technologies, Inc., 159, 199
- Alanco Technologies RFID tracking system, 77–78
 - validation of, 78–79
- Albertson’s, 41
- Alcatel, 28
- Alien Technology, 159–160
- Alignment, 140
- Alphanumeric, 140
- AMD, 28
- American Association of Motor Vehicle Administrators, 76
- American Standard Code for Information Interchange (ASCII), 140

- Ammunition shipments, DoD policy
 - related to, 124
- Amplitude modulation (AM), 140
- Amplitude shift keying (ASK), 140
- Analytica India, 160
- Ancillary return on investment (ROI), 52
- Animal tracking standards, 87
- Antenna nulls, 15
- Antennas, 140
 - sizes and types of, 14
- Antenna/tag coupling, 14
- Anticollision function, xiii
- Anticollision techniques, 10
 - in “smart” tags versus bar codes, 21–22
- Anti-dash, 140
- Anti-kidnaping measures, 64–65
- Applied Digital Solutions, Inc. (ADS), 64, 73, 108, 199
- ARC Advisory Group Emerging Practices Study, 55
- Argent Group, 160
- Assembly, RFID technology in, 48–49
- Asset management applications, 2
- Asset management programs, 55–56
- Association for Identification & Mobility (AIM), 199
- Association of American Railroads, 28
- Assyst, Inc., 160
- Asynchronous transmission, 140
- Authentication, 10
- Auto-ID Center, 29, 90, 112
- Auto-ID Labs, 90
- Automatic identification and data
 - capture (AIDC) systems, 16–20
 - technology standards for, 88–89
- Automatic identification manufacturers (AIM), 139
- Automatic identification technology, 18
- Automatic toll collection systems, 112
- AVANTE International Technology, Inc., 160
- Avicon, 161
- Awake, 140
- AXCESS, Inc., 161

- Backscatter modulation, 140
- Bandwidth, 141

- Banker, Steve, 52, 55
- Bar codes, 18–19
 - versus “smart” tags, 20–23
- Bar code/smart tag solutions, 20
- Bar code system characteristics, versus RFID system characteristics, 23t
- Bar code technology, in Wal-Mart, 116
- Batch reading, 140–141
- Battery-assisted tags, 7
- Baud, 141
- Baxter Healthcare, 161
- Benetton Clothing Co., 99
- Best Buy, 41
- Bibliotheca RFID Library Systems AG, 161
- Bielomatik Leuze GmbH + Co. KG, 161
- Binary Coded Decimal (BCD), 141
- Binary number system, 141
- Biometric equipment, 70
- Biometric identification system, fusion
 - with location determination system, 69
- Bi-phase coding, 141
- Bit, 141
- Bit error rate (BER), 141
- Bit rate, 141
- Block check character (BCC), 141
- Block code, 141
- Border and port of entry security
 - protection, 69–70
- Bosch, 28
- Brand protection, in supply chain
 - management, 24
- BT Syntegra, 162
- Bulk commodities, 141
 - DoD policy related to, 130
- Business applications, RFID technology
 - for, 44–46
- Byte, 141

- California Department of Corrections, 200
- Calipatria prison, validation of Alanco RFID system in, 78
- Camera monitoring, smart shelf
 - evaluation with, 99–100
- Capacity-channel, 142
- Capacity-data, 141

- Capacity utilization, 47
- CapTech Ventures, 162
- Cargo, DoD policy related to, 124
- Cargo tracking, 70
- Carrier, 142
- Carrier frequency, 142
- Case, 142
- Catalyst International, 162
- CCL Label, 162
- Channel, 142
- Channel decoding, 142
- Channel encoding, 142
- Character set, 142
- Chariot Solutions, 162–163
- Checkpoint, 27
- Checkpoint Systems, Inc., 38, 163
- Checksum, 142
- Chemsultants, 163
- China Elite Technology Company, Limited, 163
- Chip, 142
- Chipping, 142
- “Chipping of Goods” Initiative, 74–75
- Chip technology, 16
- Clocking information, 142
- Closed systems, 142
- CMS Consultants, 163–164
- CoBaLt Technology, 164
- Coca-Cola, 106
- Code 39 symbols, 18, 19
- Code plate, 142
- Cognizant Technology Solutions, 164
- Collision, 142
- Collision avoidance, 142
- “Combating Counterfeit Drugs” report, 61–62. *See also* FDA Compliance Policy Guide (CPG)
- Commercial RFID applications, 39–65
- Commercial RFID systems, 28
- Compatibility, 143
- Control, 164
- Concatenation, 143
- Concentrator, 143
- ConnecTerra, 38, 164
- Consumer choice, 103
- Consumer education, 103
- Consumer notice, 103
- Consumer privacy concerns, 100–102
- “Consumer profiling,” 98
- Consumers Against Supermarket Privacy Invasion and Numbering (CASPIAN), 98, 100
- Container Handling Cooperative Program, 28
- Container Security Initiative (CSI), 70
- Contention (clash), 143
- Continuous monitoring, 80
- Continuous reporting, 143
- Continuous wave modulation, 143
- Contract/solicitation requirements, DoD, 130
- Control characters, 143
- Controller (host), 5
- CopperEye, Ltd., 165
- Core processing functions, 35–36
- Corrections
 - Alanco RFID tracking system in, 77–78
 - electronic monitoring in, 80–81
 - future of RFID technology in, 82
 - Global Positioning Systems in, 81–82
 - RFID systems in, 113
 - RFID technology in, 76–82
- Corrections Corporation of America, 82
- Corruption, data, 143
- Cost of investment, 53
- Costs of labor, reduced, 53–54
- Cougaar Software, Inc., 165
- Counterfeiting detection, 74
- Covansys, 165
- Craig Lamb & Singletary, Inc., 165
- Crime fighting, RFID technology in, 74–76
- CVS drugstores, 63
- Das, Raghu, 3, 22, 23
- Data, 143
- Data brokers, 38
- Data collection, middleware in, 34
- Data encryption/decryption, 10–11
- Data field, 143
- Data field protection, 143
- Data identifier, 143
- Data management, 109–110
- Data Matrix bar code standard, 20
- Data rate, 14, 143
- Data routing, middleware in, 34–35

- Data Technology Group, Inc., 165–166
- Data transfer, 143
- DC Logistics, 166
- DDK International, Inc., 166
- Decentralized manufacturing process, 48–49
- Decryption, 10–11
- Defense Systems, Inc., 166
- Dell Computer, 49
- Demand planning and forecasting, 47
- Demodulation, 143
- Department of Defense (DoD), xi, 1, 112, 200. *See also* DoD entries
 - incorporation of RFID technology, xi
 - RFID policy overview, 121–135
- Department of Homeland Security (DHS), 68–70. *See also* Homeland security
 - NEXUS program of, 57
 - RFID use by, 113
- Department of State, 57
- Depp, Steven, 27
- Derived keys authentication, 10
- De-tuning, 144
- Device management, middleware in, 35
- DHS RFID technology program, xvi
- d’Hunt, Susy, 8
- Dipole antennas, 15, 144
- Directivity, antenna, 144
- Direct return on investment (ROI), 52
- Direct sequence spread, 144
- Dispersion, pulse, 144
- Distortion, 144
- Distribution
 - applications of, 44t
 - RFID technology in, 49–50
- Distribution Management Systems, Inc., 166
- DoD Logistics Automatic Identification Technology (LOG-AIT) Office, 123. *See also* Department of Defense (DoD)
- DoD mandate, xiv; 2, 29, 40–41, 89
 - EPC and, 95
 - strategic dimensions of, 41–43
- DoD policy guidelines, 41
- DoD purchase card transactions, 132
- DoD RFID definitions, 129
- DoD RFID status, 134–135
- DoD supply chain
 - business rules for active RFID technology in, 123–128
 - business rules for passive RFID technology in, 128–133
- Downlink, 144
- Driver’s License Modernization Act of 2002, 75
- Drivers’ licenses, RFID technology and, 75–76
- Drug counterfeiting, 60–61
- DYNASYS, 166
- EAN International, 90
- “Early movers,” 30
- ecVision, 167
- Edgeware, 36–37
- Effective aperture, 144
- Efficiency
 - antenna, 144
 - in supply chain management, 24
- Ekahau, 167
- Electromagnetic coupling, 144
- Electromagnetic field, 144–145
- Electromagnetic radiation, limiting
 - human exposure to, 84
- Electromagnetic spectrum, 145
 - licensing of, 83
- Electromagnetic waves, 145
- Electronic article surveillance (EAS), 27
- Electronic Data Interchange (EDI), 145
- Electronic Data Interchange
 - information, DoD policy related to, 131
- Electronic data transfer, 145
- Electronic Frontier Foundation (EFF), 98
- Electronic label, 145
- Electronic monitoring, in corrections, 80–81. *See also* Global Positioning Systems (GPS)
- Electronic Privacy Information Center (EPIC), 98
- Electronic Product Code (EPC), 105. *See also* EPC entries; Gen2 entries
 - labels, xi, 2
 - network, 90–92
- Emerson & Cuming, 167
- Employee monitoring, 73–74

- Encore Graphics, 167
- Encryption, 10–11
 - of data, 145
- Enterprise application adapters, 37
- Enterprise Information Systems, 167
- Enterprise IT networks, 112. *See also*
 - Information technology (IT)
- Enterprise IT systems, xiv, 33
- Enterprise software vendors, 38
- Environmental parameters, 145
- Environmental susceptibility/durability,
 - in “smart” tags versus bar codes, 22
- EPC architecture, 35–37. *See also*
 - Electronic Product Code (EPC)
- EPCglobal, 29, 51, 145, 168
 - “certification” initiative, 119
 - history of, 90
 - policy guidelines of, 102–103
 - RFID technology standards, xi, xvi, 88, 89–94
 - standards, xvi, 30, 105, 106
- EPCglobal US, 200
- EPC Integrator, 167–168
- EPC network system components,
 - published specifications for, 93–94
- EPC number, 92–93
- epcSolutions, Inc., 168
- EPC tag data specifications, 92–93
- EPC technology, 145
- Error, 145
- Error burst, 146
- Error control, 146
- Error correcting code (ECC), 146
- Error correcting mode, 146
- Error correcting protocol, 146
- Error correction, 146
- Error detection, 146
- Error management, 146
- Escort Memory Systems, 168
- Ethical issues, 80, 108–109
- Europe
 - implantable chips in, 65
 - regulatory bodies in, 84–85
 - spectrum allocations in, 86
- European Communications Committee (ECC), 84–85
- European Conference of Postal and Telecommunications Administrations (CEPT), 29, 84
- European Radiocommunications Office (ERO), 84
- European Telecommunications Standards Institute (ETSI), 85, 146
- European Union, 57
- Evidence handling, 72
- Exciter, 146
- eXI Systems, 168–169
- Extended Binary Coded Data Interchange Code (EBCDIC), 146
- Exterior container, 146
- ExxonMobil, 1, 28, 112
- E-Z Pass Interagency Group, 28
- Factory programming, 146
- Fairchild Company, 27
- Fair information practice principles, 101
- False activation, 146
- Far field, 146
- “Fast followers,” 30
- Fast Forward Technologies, 169
- FDA Compliance Policy Guide (CPG), 62–63. *See also* Food and Drug Administration (FDA)
- FDA counterfeit drug investigations, 60–61
- FDA Counterfeit Drug Task Force, 61
- Federal Highway Administration, 27
- Federal RFID projects, 57–58
- Federal Trade Commission workshop, 104
- Feder, Barnaby J., 64
- Field of view, 147
- Field programming, 147
- Field strength, 147
- File, 147
- FileTrail, Inc., 169
- Filler character, 147
- Fill rate, 47
- Finger scan, 70
- Fixed-position interrogators, 11
- FKI Logistex Baggage Handling Team, 169
- Flux density, 152
- Food and Drug Administration (FDA), 57. *See also* FDA entries
- Ford, Rollin, 119–120
- Forward link, 147
- Franwell, Inc., 169

- Frequency, 11–16, 147
 Frequency hopping, 15
 Frequency hopping spread spectrum (FHSS), 147
 Frequency hop rate, 147
 Frequency hop sequence, 147
 Frequency modulation (FM), 147
 Frequency shift keying (FSK), 147
 Frequency spectrum management, DoD policy related to, 127–128, 132–133
 Freyman, Robert, 27
 Full duplex (FDX), 147
- Garment labels, RFID chips embedded in, 99
 Gen2 (Generation 2) EPC standards, 94, 105
 Gen2 EPC tags, 119
 General Data Company, Inc., 169–170
 General Electric (GE), 27
 General Services Administration (GSA), 57
 GenuOne, 170
 Gillette Company, 29, 98
 smart shelf evaluation by, 99–100
 GlaxoSmithKline, 63
 Glenayre, 27
 Global Data Synchronization Network (GDSN), 106
 Global positioning systems (GPS), in corrections, 80–82. *See also* GPS/RFID location tracking system
 Global standards/regulations, growth of, 105–106
 Global Trade Identification Numbers (GTIN), 92
 GlobeRanger Corporation, 38, 170
 Governmental RFID applications, 39–65
 Governmental RFID regulation, 83–84
 GPS/RFID location tracking system, 73.
 See also Global positioning systems (GPS)
 “Gray market” distribution, 63
 Grocery store bar coding, 18–19
 GrowSafe Systems, Ltd., 170
- Hackensack University Medical Center, 65
 Half duplex (HDX), 148
- HAL Systems, Inc., 170–171
 Handshaking, 148
 Harmonics, 148
 Harrington, R. F., 27
 Harris, D. B., 26
 Harris, Gardiner, 60
 Harrison, Mark, 87
 Health records chips, 65
 Hewlett Packard (HP), 36
 Hexadecimal (hex), 148
 Hidden readers, 101
 High frequency (HF) band, 85
 High frequency RFID bands, 12
 Hitachi Europe, Ltd., 171
 HK Systems, 171
 Hodges, Steve, 87
 Homeland security. *See also* Department of Homeland Security (DHS)
 RFID applications, xv–xvi
 RFID deployment steps for, 70–71
 RFID technology in, 68–71
 Horizon Blue Cross Blue Shield of New Jersey (HBCBSNJ), 65
 Horizon Services Group, LLC, 171
 Hormel Foods, 106
 Hunt, V. Daniel, xxiii, 1, 33, 39, 67, 97, 137
- iAnywhere/XcelleNet, 171
 IconNicholson, 172
 Identec Solutions, Inc., 172
 Identification card standards, 87–88
 Identity management systems, 69
 ID filter, 148
 IDmicro, 172
 Illinois prison facility, Alanco RFID system at, 79
 Impact, 148
 Implantable microchip, subdermal, 64
 In2Connect Lt, 172
 Incorrect read, 148
 Individual tracking and profiling, 101
 Inductive antennas, 15
 Inductive coupling, 148
 Industrial and manufacturing RFID applications, xv
 Industrial applications, 45t
 Industrial RFID standards, 86–87
 Industrial-scientific-medical (ISM) bands, 85

- In-field reporting, 148
- Infocom Systems, 173
- Information
 - general, 148
 - theoretic, 148
- Information technology (IT). *See also*
 - Enterprise IT entries
 - integration of, 33–38
 - in RFID technology, 26
- Infrared identification technology, 18
- Infrastructure software vendors, 38
- Innovative Equipment, Ltd., 173
- Innovision Corp., 173
- Innovision Research & Technology plc, 173
- INSIDE Contactless, 173
- Institute of Applied Physics,
 - Department for Automation, 174
- Integral RFID, Inc., 174
- Intel, 28
- Intellareturn Corp., 174
- Interchangeability, 149
- Interface, 148
- Interference, 148
 - from other radio systems, 13
- Intermec Technologies Corp., 11, 38, 174
- Internal Revenue Service, 57
- International Business Machines (IBM), 18, 28, 171–172, 200
- International Paper, 174
- International shipping containers,
 - security of, xv–xvi, 69
- International Standards Organization (ISO), 29, 87–89, 106
- International standards organizations, 86–87
- “Internet of things,” 90
- Interoperability, 149
- Interrogation, 149
- Interrogation zone, 149
- Interrogators (readers), 5, 149
 - placement of, 11
- Intersymbol interference, 149
- In-use programming, 148
- Investment cost, 53
- iPico Identification, 175
- Irista (HK Systems-Irista), 175
- ISO/IEC JTC1 joint subcommittee, 87
- Isotropic source, 149
- “Item-level RFID technology” position
 - statement, 100–101
- Item management technologies,
 - standards for, 88–89
- Ito America Corp., 175
- Japan
 - regulatory body in, 84
 - spectrum allocations in, 86
- Johnson and Johnson, 63
- Juvenile detention facility, Alanco RFID
 - system in, 78–79
- KartKeeper, 175
- Kennedy Group, The, 193
- “Kill switch” alternative, 103
- Kiosk scanners, 70
- Koelle, Alfred, 27
- Kraft, 106
- Landt, Jeremy, 26
- Laudis Systems, 175–176
- Law enforcement applications, 113
 - RFID in, 71–76
- Leader Induction Technology, 176
- Legislation, RFID-related, 104
- Library system applications, 45t
- License plates, RFID technology and, 75
- Lifetime, 149
- Line-of-sight, in “smart” tags versus bar
 - codes, 21
- Liquids, effect on RFID systems, 13
- Location determination systems, 69
- LOGMARS program, 18
- Lorantec Systems, Inc., 176
- Los Alamos Scientific Laboratory, 27
- Low frequency (LF) band, 85
- Low frequency RFID bands, 12
- Lowry Computer Products, Inc, 176
- Lyngsoe Systems, 176
- MagTech Systems, Inc., 176
- Manchester coding, 149
- Manhattan Associates, Inc., 38, 177
- Mannings RFID, 177
- Manufactured goods, tracking, 102
- Manufacturers tag ID (MfrTagID), 149
- Manufacturing applications, 45t
 - RFID technology in, 48–49

- Markem Corp., 177
- Massive data aggregation, 101
- Materials science, in RFID technology, 26
- Matrics, Inc., 177
- Maximum permissible interference guidelines, 84
- Mean time between failures, 149
- Mean time to repair, 149
- Medical records, access to, 64
- Medications, copying of, 61
- Memory, 149
- Memory modules, 149
- Memory size/data storage, in “smart” tags versus bar codes, 20–21
- Metals, effect on RFID systems, 13
- Metro AG, xvi, 41, 89
- Mexican law enforcement, 64–65
- Microsoft Corporation, 38, 177
- Microwave band, 86
- Middleware. *See also* RFID middleware as part of an RFID system, 35–37e recent focus on, 34 state of development of, 38 vendors of, 38
- Mikron, 28
- Miles Technologies, 177–178
- Misread, 149
- M.I.T. Auto-ID Center, 29, 90
- Modulation, 150
- Modulation index, 150
- Monitoring applications, 45t
- Motorola Corporation, 28, 76–77
- MPI Label Systems, 178
- Multiple reading, 150
- Multiple RW, 10. *See also* Read/write (RW) memory in “smart” tags versus bar codes, 21–22
- Multiplexor (multiplexer), 150
- Mutual symmetrical authentication, 10
- National Strategy for Homeland Security, 69
- National identification system, 75–76
- National Institute of Justice (NIJ) study, 73
- National Service Center, 178
- National standards organizations, 87
- N. C. Cuthbert, 178
- NCR Corporation, 178
- Nestle, 106
- NEXUS program (DHS), 57
- 9/11 attacks, homeland security protection and, 69–70
- 1940s (WWII) technological developments, 26
- 1950s technological developments, 26
- 1960s technological developments, 27
- 1970s technological developments, 27
- 1980s technological developments, 28
- 1990s technological developments, 28–29. *See also* 2000s technological developments
- Noise, 150
- Noise immunity, 150
- Northern Apex-RFID, 179
- Null spots, 15
- OatSystems, 38
- Object Naming Service (ONS), 90
- ObjectStore, 179
- Octave Technology, Inc., 179
- Offenders, electronic monitoring of, 80
- Office of Human Research Protection, 80
- Ohio Department of Rehabilitation and Correction (ODRC), 79, 200
- Omnidirectional, 150
- On-off keying (OOK), 150
- Open systems, 150
- Open Tag Systems, 179
- Optical character recognition (OCR), 16–18
- ORACLE, 38, 179–180
- Orientation, 150 problems with, 15 sensitivity to, 150
- Orlando, Florida, Police Department, 73
- Out of field reporting, 151
- OxyContin, 63
- Packaging applications, 44–45t
- Packaging tagging/markings, DoD policy related to, 129–130
- Pallet (palletized unit load), 151
- Panther Industries, Inc., 180
- Paratek Microwave, Inc., 180
- Parelec, Inc., 180

- Parity, 151
- Passive chips, 65
- Passive RFID business rules, DoD, 128–129
- Passive RFID tags, 6–8
- Passive RFID technology, 122
- Passive tags, xiii. *See also* Passive RFID tags
 - read ranges of, 12
 - versus active tags, 13
- Passive transponder (tag), 151
- Passive UHF RFID tag specifications DoD, 130–131
- Paxar Americas, Inc., 181
- Payback period, 54
- Pedigree system, 62
- Penetration, 151
- PepsiCo, 106
- Personal tracking unit (PTU), 81
- Pfizer, 63
- Pharmaceutical industry
 - RFID technology and, 63–64
 - timeline for RFID adoption, 61–62
- Pharmaceuticals, tracking, 102
- Pharmaceutical supply chain, RFID and, 60–64. *See also* Supply chain management
- PharmaSeq, Inc., 181
- Phase IV Engineering, Inc., 181
- Phase modulation (PM), 151
- Phase shift keying (PSK), 151
- Philips, 27, 28
- Pittsfield Weaving Company, 181
- Plitek, 181
- Point of sale (POS) applications, 11, 45t
- Polar field diagram, 151
- Polarization, 151
- Polarization summary, 151–152
- Police efficiency, RFID technology to improve, 71–72
- Police officer safety, RFID technology to ensure, 72–74
- Police patrols
 - RFID monitoring of, 73–74
 - RFID use in, 72
- Portable interrogator devices, 11
- Port Authority of New York and New Jersey, 28
- Port concentrator, 152
- Power levels, 152
- Power Paper, 182
- Power source, 39
- Pre-1940s technological developments, 26
- Precisia, 182
- Precision Systems, 182
- Prescription Drug Marketing Act (PDMA) of 1987, 62
- Price, of “smart” tags versus bar codes, 22–23
- Printer solutions, smart label, 20
- Printronix, Inc., 182
- Prison function, automating, 79–80
- Prison inmates, implanting RFID chips in, 79–80
- Prison operations, RFID technology in, 82
- Privacy advocates, 98
 - consumer privacy concerns of, 100–102
- Privacy concerns/issues, 97–104
 - RFID industry response to, 102–103
- Privacy implications, 58
- Privacy protections, xvi, 97–98
- Process management, middleware in, 35
- Procter & Gamble, 29, 98
 - RFID tag testing by, 100
- Procurement processes, 47–48
- Product information maintenance, 110
- Product Markup Language (PML), 90
- Product recalls, 37
 - pharmaceutical industry, 64
- Product safety, in supply chain management, 24
- Profit projections, 46–47
- Programmability, 152
- Programmer, 152
- Programming, 152
- Projected lifetime, 152
- Property control, 72
- Property crime, RFID technology and, 74–75
- Protocol, 152
- Provia Software, 38, 182–183
- Proximity, 152
- Proximity sensor, 152
- PSC, Inc., 183
- Psion Teklogix, 183

- Puglia, Albert B., xxiii–xxiv, 1, 33, 39, 67, 97, 137
- Puglia, Mike, xxiv, 1, 33, 39, 67, 97, 137
- Pulse dispersion, 153
- Purdue Pharma, 63
- Quest Information Systems, 183
- R4 Global Services, 183
- Radcliffe, Inc., 184
- Radianse, Inc., 184
- Radio frequency electronics, in RFID technology, 25
- Radio frequency identification (RFID), 153. *See also* RFID entries defined, 1
- Radio frequency identification (RFID) technology, xi, 44–46
- acceptable uses of, 102
 - accuracy of, 107
 - advantages of, 116–117
 - applications of, xiv–xv, 1
 - benefits of, xiii
 - business case for, 51–56
 - business interest in, 67–68
 - capabilities of, 112
 - combining with other technologies, 69
 - commercial applications of, 112
 - convergence of technologies in, 25–26
 - in corrections, 76–82
 - costs of developing and deploying, 104–105
 - current interest in, 2
 - data management challenges related to, 109–110
 - early exploration of, 26
 - economic benefits of, 113–114
 - ethical issues related to, 108–109
 - explosion and early-adopter applications of, 27
 - functional capabilities of, xiv
 - future of, 29–31, 111–114
 - government use of, 57–60, 112–113
 - history and evolution of, 25–31
 - in homeland security, 68–71
 - immaturity and integration with legacy systems, 106–107
 - impediments to developing, xvi
 - implanted in humans, 64–65
 - improper use of, 100
 - industry and government interest in, 2–3
 - interest in, xi–xii
 - lack of knowledge, end-user confusion, and skepticism related to, 108
 - in law enforcement, 71–76
 - legislation and regulation related to, 104
 - mainstream, 28–29
 - milestones and adoption speed in, 26–29
 - overview of, 5–24
 - pharmaceutical supply chain and, 60–64
 - privacy issues in applying, 97–104
 - rights and responsibilities related to, 101–102
 - roll-out timeline for, 30–31
 - short-term benefits of, 53
 - spectrum allocations for, 85–86
 - in supply chain management, 23–24, 46–51
 - uncertainty concerning, 113
 - upstream/downstream supply chain extensions of, 43
 - widespread development of, xvii
 - widespread government use of, 60
- Radio frequency tag, 153
- Radio systems, interference from, 13
- Railroad cars, RFID-enabling, 28
- Range
- programming, 153
 - read, 153
- Rapidwerks LLC, 184
- Raytheon, 27
- RCA, 27
- Read, 153
- Readability, 153
- Reader interfaces, 36–37
- Reader interference, 107
- Reader/interrogator, 153
- Reader/writer, 153
- Read only (RO), 153
- Read-only tags, xiii, 8
- Read ranges, 12, 39
- in “smart” tags versus bar codes, 21
- Read rate, 153

- Read reliability, in “smart” tags versus bar codes, 22
- Read/write (RW), 153. *See also* Multiple RW
- Read/write RFID tags, in “smart” tags versus bar codes, 21
- Read/write tags, 8
- RealTime Technologies, Inc., 184
- Recalls, in supply chain management, 24
- Records, use, retention, and security of, 103
- RedPrairie Corporation, 38, 184
- Redundancy, 153
- Regional standards organizations, 87
- Regulation, RFID-related, 104
- Regulations, global, 105–106. *See also* RFID regulations
- Regulatory bodies, world, 84–85
- Replication, in “smart” tags versus bar codes, 22
- Reprogrammability, 153
- Response time, 47
- Retail and consumer packaging RFID applications, xv
- ReturnMe.com, LLC, 185
- Return on assets (ROA), 55–56
- Return on investment (ROI)
 - quantifying, 53–55
 - routes to, 56
 - types of, 52
- Returns/refunds, RFID technology in, 50
- RF Code, Inc., 185
- RFID adopters, categories of, 30. *See also* Radio frequency identification (RFID) entries
- RFID applications
 - commercial and governmental, 39–65
 - current commercial, 44–45t
 - development of, 41
 - federal, state, and municipal, 58–59t
 - innovative, 43
- RFID bands, low frequency and high frequency, 12
- RFID business rules, DoD, 124–128, 128–133
- RFID chips
 - embedded in garment labels, 99
 - implanting in prison inmates, 79–80
- RFID controllers, 11
- RFID DataCorp, 185
- RFID definitions, DoD, 129
- RFID Deployment Center, 185–186
- RFideaWorks Corp., 186–187
- RFID effectiveness, factors in, 39–40
- RFID-enabled license plates, 75
- RFID-enabled object tracing, 76
- RFID-enabled “smart gun,” 73
- RF IDentics, 185
- RFID equipment manufacturers, 38
- RFID field trials, 27
- RFID funding, DoD policy related to, 125–126, 132
- RFID growth, xiv
 - barriers to, 22–23
 - rates of, 41
- RFID hosts, xiii, 112
- RFID implants, effectiveness of, 80
- RFID, Inc., 186
- RFID industry
 - focus of, 40
 - response to privacy concerns, 102–103
 - revenues, 3
 - self-regulation by, 104
- RFID infrastructure, DoD policy related to, 125
- RFID interrogators, 9–11
- RFID inventions, 27
- RFID investment, return on, 52
- RFID ITV server management, DoD policy related to, 127
- RFID Journal*, 157
- RFID mandates, xi, 2
- RFID middleware, xiv, 33–38. *See also* Middleware
 - core functions of, 34–35
 - defined, 33
- RFID passport, 57
- RFID prohibited practices, 102
- RFID readers, xiii
 - scalability of, 107
- RFID regulations, 83–86
- RFID “smart” labels, 19–20
- RFID Solutions, LLC, 186
- RFID Sources Corporation, 186
- RFID standards, 86–95
 - industrial, 86–87
- RFID status, DoD, 134–135

- RFID system characteristics
 - at various frequencies, 17t
 - versus bar code system characteristics, 23t
- RFID systems, xii–xiii. *See also* RFID tag systems
 - building blocks of, 111–112
 - commercial, 26
 - core components of, 5–6
 - effect on warehousing processes, 53–54
 - effect of liquids and metals on, 13
 - interference from other radio systems, 13
 - middleware in, 35–37
- RFID Systems, Inc., 186
- RFID tag formats, DoD, 126–127
- RFID tag return, DoD policy related to, 126
- RFID tags, xii–xiii, 6–9, 99
 - cost of, 53, 104, 111–112
 - deactivating, 103
 - forms of, 9
 - hidden placement of, 100
 - labeling of products with, 100
 - price of, xiv, 16
 - size of, 16
 - volume and cost of, 42–43
- RFID tag systems, in law enforcement, 72
- RFID technology
 - development of, 43, 68
 - standards in, xiv
- RFID technology deployment, issues surrounding, 97–110
- RFID theory, development of, 27
- RFID users, openness and accountability of, 101–102
- RFID vendors, list of, 157–198. *See also* Vendors
- RFID Wizards Inc. ROI study, 53–54
- RFTag, 153
- Richardson, Robert, 27
- Rights and responsibilities framework, 101–102
- RightTag, Inc., 187
- Rittenback, Otto, 27
- Ross Correctional Facility, pilot RFID system in, 79
- RS232, 154
- RS422, 154
- RS485, 154
- RSI ID Technologies, 187
- Rush Tracking Systems, 187
- Safety guidelines, 83–84
- Saft America, 187
- SAMSys Technologies, 188
- SAP, 38
- Sara Lee, 106
- SATO America, Inc., 188
- Savant computer, 91
- Savant software application technology, 90
- Savant specification, 35
- Scanner, 154
- Scan Solutions, Inc., 188
- Scrambling, 154
- Screening, 154
- Secura Key, 188
- Security and access control RFID applications, xv
- Security applications, 45t
- Security management-related RFID applications, xv
- Seideman, Tony, 18, 19
- Sensing applications, 45t
- Sensor, 154
- Sensormatic, 27
- Sentinel Business Solutions, 188
- Separation, 154
- Serviant Corporation, 189
- Sex offenders, tracking and monitoring, 82
- Ship2Save.com, 189
- Shipping container, 154
- Short range device (SRD), 155
- Signal to noise & distortion, 154
- Signal to noise (S/N) ratio, 154
- Simply RFID, 189
- Sinusoidal carrier, 154
- SIRIT Technologies, 189
- SkandSoft Technologies, 189
- “Slow adopters,” 30
- “Smart & Secure Tradelanes” (SST) program, 70–71
- “Smart borders,” xv, 69
- SmartCode Corp., 190

- “Smart guns,” 72–73
- Smart label printer solution, 20
- “Smart” labels, 9, 16, 19–20
 - tests of, 28
- “Smart” shelves, 49–50, 72
 - system trials for, 98
- “Smart” tags, xiii, 8
 - versus bar codes, 20–23
- SoftLogistics LLC, 190
- Solzon Corp., 190
- Source decoding, 155
- Source encoding, 155
- Spectrum
 - electromagnetic, 155
 - signal, 155
- Spectrum allocations, RFID, 85–86
- Spectrum mask, 155
- Speedpass, 1, 28, 112
- Spread spectrum, 155
- Spurious emissions, 155
- Standards. *See also* RFID standards
 - AIDC and item management technologies, 88–89
 - animal tracking, 87
 - global, 105–106
 - guidelines for, 28–29
 - RFID identification card, 87–88
- Stockman, Harry, 26
- Storage capacity, 40
- Student tracking, 58
- Sun, 38
- Supplier implementation plan, DoD, 133–135
- Supply chain(s)
 - applications of, 2
 - benefit of RFID to, 117–118
 - item-level visibility of, 63
 - metrics for, 46–47
- Supply chain management. *See also* Pharmaceutical supply chain
 - processes of, 47–51
 - RFID technology in, 23–24, 46–51
- Surden, Harry, 98
- Surface acoustic wave (SAW) devices, 154
- Symbol Technologies, 190
- Synchronization, 155
- Synchronous transmission, 155
- Syscan, 190
- Sysgen, 191
- Sysgen Data Ltd., 191
- T3Ci, 191
- Tacit Solutions, Inc., 191
- Tag (transponder), 5, 155. *See also*
 - Active tags; Battery-assisted tags; EPC tag data specifications; Gen2 EPC tags; Passive tags; Read-only tags; Read/write tags; RFID tag entries; “Smart” tags; Unitized active tag orientation of, 107
- TagMaster, Inc., 191
- TagStone, 191–192
- TAGSYS, Inc., 192
- Tapemark, 192
- Target, xvi, 29, 41, 89
- Technology assessment, 101
- Technology Research Corporation, 1, 97, 111, 115, 137, 200
- Techprint, Inc., 192
- TEK Industries, Inc., 192
- Tesco, 41, 98, 99
- Texas Instruments Incorporated, 28, 193, 200
- Texas Instruments TIRIS system, 28
- Tharo Systems, Inc., 193
- The Kennedy Group, 193
- Thin Battery Technologies, 193–194
- ThingMagic, 194
- 3M, 157–158
- TIRIS system, 28
- Tolerance, 155
- Toll collection applications, 45t
- Tompkins Associates, 194
- Topflight Corporation, 194
- Toshiba TEC Corporation, 194
- Tower Semiconductor, 195
- Track-and-trace technology, 61
- Transceiver, 155
- Transmitter (exciter), 155
- Transponder, 155
- Transportation and distribution RFID applications, xv
- Transportation applications, 44t
- Transportation Worker Identification Credential, 70
- Traxus Technologies Inc., 53, 195

- TrenStar, 195
 Tri-Star Consulting, Inc., 195
 Trivalent Solutions, Inc., 195
 TSI PRISM RFID tracking system, 77, 78–79
 2000s technological developments, 29.
See also 1940s (WWII)
 technological developments
- Ultra high frequency (UHF) band, 85
 differences among countries, 105
 Uniform Code Council (UCC), 90
 Unilever, 106
 Unique product identification codes, 101
 United Kingdom
 “Chipping of Goods” Initiative, 74–75
 RFID deployment in, 71
 United States. *See also* American
 entries; Department entries; Federal
 entries; Governmental entries;
 National entries; U.S. entries
 regulatory body in, 84
 RFID technology development in,
 69–70
 spectrum allocations in, 86
 Unitized active tag, 156
 Unit pack, 156
 Universal Product Code (UPC), 18
 Uplink, 156
 UPM Rafsec, 196
 U.S. Customs Service, 70. *See also*
 United States
 U.S. Postal Service, 57
 U.S.-VISIT initiative, xvi, 70
 U.S.-VISIT “next generation travel
 documents” program, 57, 113
- Vector, 156
 Vendor Managed Technologies, Inc., 196
 Vendors, middleware, 38. *See also* RFID
 vendors
 VeriChip, 64–65, 79
 ethical issues related to, 108
 Verification, 156
 VeriSign, 196
 Vernon, F. L., 26
- Viagra, 63
 Vinding, J. P., 27
 Virginia driver’s license hearings, 75–76
 Visibility, in supply chain management,
 24
 ViVOTech, Inc., 196
 Vizional, 196
 Vogelman, J. H., 27
- Wackenhut Corrections Corporation, 82
 Wal-Mart, xi, 1, 29, 62
 domestic distribution center
 operations of, 118
 four-tiered distribution cycle of, 117
 incorporation of RFID technology,
 xi–xii
 RFID timeline of, 119
 smart shelf evaluation by, 98–99
 Wal-Mart mandate, xiv, 2, 29, 89, 116
 effect of, 40–41
 EPC and, 95
 strategic dimensions of, 41–43
 Wal-Mart RFID initiative, 115–120
 Warehousing processes, effect of RFID
 on, 53–54
 Wavechain Consulting, 197
 Wave Data Technologies, LLC, 197
 Wavelet Technologies, Inc., 197
 Weber Marking Systems, 197
 Wegmans Food Markets, 106
 Westinghouse, 27
 WhereNet, 55, 197
 Wild Mouse Software, Inc., 198
 Williams, David, 3, 39, 42
 Winer, Peter, 38
 Wireless electronic monitoring, 80–81
 Wireless encryption requirements, DoD,
 127, 132
 World regulatory bodies, 84–85
 Write, 156
 Write-once-read-many (WORM)
 memory, 8, 156
 Write rate, 156
- Zebra, 38
 Zeller., Tom, Jr., 64