

INDEX

A

AC (alternating current), 95

access

- access points. *See* access points
- unauthorized, 102
- VPNs, 106
- wireless medium, 85
 - DCF, 85–86
 - PCF, 86
- WPA, 104–106

Access Control Server (ACS), 151

access points

- automatic configuration, 207
- BSS, 77
- Cisco 7920 Wireless IP Phone, 30
- configuring, 172
 - data rates, 175
 - filtering, 176
 - firmware, 172
 - protection mechanisms, 176
 - RF channels, 174
 - SSIDs, 173
 - transmit power, 174
 - VLANs, 173
- density, calculating, 154
- inspecting, 203
- installing, 115, 157, 167–168
 - antenna alignment, 171
 - electrical power distribution, 171–172
- inter-access point interference, 161
- locations, determining, 156
- mounting, 130, 168–170
- passive monitoring, 101–102
- physical installations of, 199
- placement of, 153
 - documentation, 161–164
 - RF site surveys, 155–161
 - wireless capacity analysis, 153–155
- RF signals, 58
 - characteristics, 58–59
 - FCC rules, 62
 - gain, 59
 - modulation, 58

OFDM, 61

SNR, 60

spread spectrum, 60–61

- rogue, 115–118, 199
- self-healing functions, 209
- switches, 152
- transmit power, 160
- troubleshooting, 201
- verifying, 157
- wireless networks, 36–38

accounting, bandwidth, 180

ACK (acknowledgement) frames, 83

ACS (Access Control Server), 151

action plans, 196

active scanning, 82

Ad Hoc mode, 84–85

Adaptive Wireless Path Protocol, 43

addresses, assigning IP, 29

Admission Request (ARQ), 52

AES (Advanced Encryption Standard), 8, 43, 104–105

agents, call processing, 147

AID (association identifier), 82

AirMagnet Analyzer, 132

Alerting message (H.323), 52

algorithms, video, 49

aligning antennas, 171

alternating current (AC), 95

analysis

- calling patterns, 142
- ROI, 16–24
- security gaps, 200
- VoWLAN requirements, 123
 - applications, 124–125
 - budgets, 136
 - client devices, 133–134
 - coverage areas, 127–129
 - documenting, 138
 - environments, 130–132
 - existing systems, 134–135
 - identifying, 124
 - policies/preferences, 135–136
 - roaming, 129–130
 - schedules, 137
 - security, 132–133

- users*, 125–126
 - utilization*, 126–127
 - verifying*, 137–138
- wireless, 153–155
- antennas, aligning**, 171
- applications, VoWLAN requirements**, 124–125
- architecture**
 - reviewing, 198
 - single-site, 142
 - VoWLAN, 27–28
 - WANs
 - multisite with centralized call processing*, 142–146
 - multisite with distributed call processing*, 146–147
- ARQ (Admission Request)**, 52
- assessments, security**, 197, 201
- assigning IP addresses**, 29
- assisted site surveys**, 207
- association identifier (AID)**, 82
- association, testing**, 184
- attacks**, 15, 102–103
- attributes**
 - video, 48–50
 - voice, 47–48
- audio standards**, 52
- authentication**, 106–113
 - Cisco LEAP, 111–113, 151
 - IEEE 802.1X, 109–110
 - open system, 107–108
 - shared keys, 108
 - testing, 184
- automatic access point configuration**, 207

B

- backhaul nodes**, 41–42
- backups, ISDN**, 145
- bandwidth, accounting**, 180
- Bandwidth Change Request (BRQ)**, 52
- base range measurements**, 159
- basements, coverage areas**, 128
- Basic Service Set (BSS)**, 77
- batteries, tests**, 187

- beacons**
 - Ad Hoc mode, 84–85
 - downlink, measuring, 159
- benefits**
 - of mesh networks, 43
 - of VoWLAN solutions, 5–6
- BPSK (binary phase shift keying)**, 61
- brackets**, 168. *See also* mounting access points
- broadcasting, SSID**, 113–114
- BRQ (Bandwidth Change Request)**, 52
- BSS (Basic Service Set)**, 77
- budgets, VoWLAN requirements**, 136

C

- cables, mesh networks**, 42
- CAC (Call Admission Control)**, 147
- calculating access point density**, 154
- calibrating downlink beacon signals**, 159
- Call Admission Control (CAC)**, 147
- call flow (VoIP)**, 50
 - H.323, 51–53
 - SCCP, 53–56
 - SIP, 56–57
- call managers**
 - Cisco CallManager, 32–33. *See also* Cisco CallManager
 - Cisco CallManager Express, 33–34
 - installing, 177
 - device mobility*, 179–180
 - system parameters*, 178
 - VoWLAN, 28
- call Proceeding message (H.323)**, 52
- call processing agents**, 147
- calling**
 - patterns, analyzing, 142
 - search space, CallManager, 178
- cameras, Linksys Wireless-G Internet Video Camera**, 34–35
- capacity**
 - increases, 204
 - troubleshooting, 69–71
- capital costs, ROI**, 20–21
- Carrier Sense Multiple Access with Collision Avoidance**. *See* protocols, CSMA/CA

case studies

- applications, 125
- budgets, 136–137
- client devices, 134
- coverage areas, 129
- environments, 132
- existing systems, 135
- policies/preferences, 136
- requirements, validating, 138
- roaming, 130
- security, 133
- users, 126
- utilization, 126
- VoWLAN requirements, 124

CCK (Complementary Code Keying)**Transmitter Power, 174****ceiling tiles, mounting access points, 169-170****cells**

- BSS, 77
- radio, 77

centralized call processing, 142–146**centralized firmware updates, 207****channels**

- microwave over interference, 163
- RF. *See also* RF
 - access points, 174*
 - wireless LANs, 92*
- wireless medium access, 85
 - DCF, 85–86*
 - PCF, 86*

Characteristics of RF signals, 58–59**Cisco 1000 Series Lightweight Access Points, 40****Cisco 2000 Series Wireless LAN Controllers, 40****Cisco 4100 Series Wireless LAN Controllers, 40****Cisco 7920 Wireless IP Phone, 28–30****Cisco Aironet**

- 1100 Series, 38
- 1130AG Series, 38
- 1200 Series, 38
- 1230AG Series, 38
- 1300 Series Outdoor Access Point/Bridge, 37
- 350 Series, 38

Cisco CallManager, 32–33, 177

- clusters, 32
- device mobility, 179–180
- system parameters, 178

Cisco CallManager Express, 33–34**Cisco IP Softphone, 30–32****Cisco LEAP authentication, 111–113****CiscoWorks Wireless LAN Solution Engineer (WLSE), 207–210****client devices, 158**

- identifying, 158
- VoWLAN requirements, 133–134

clusters, Cisco CallManager, 32**collocation, 81****Complementary Code Keying (CCK)
Transmitter Power, 174****components**

- H.323, 51–53
- VoWLAN, 27–28

compression, video, 49**configuration**

- access points, 172, 207
 - antenna alignment, 171*
 - data rates, 175*
 - electrical power distribution, 171–172*
 - filtering, 176*
 - firmware, 172*
 - installing, 167–168*
 - mounting, 168–170*
 - protection mechanisms, 176*
 - RF channels, 174*
 - SSIDs, 173*
 - transmit power, 174*
 - VLANs, 173*
- ISDN backups, 145
- management, 191–192
 - firmware versions, 193*
 - new application requests, 193*
 - RF channel changes, 192*
 - security optimization, 194*
 - signal coverage, 193*
 - transmit power changes, 192*
- monitoring, 195
- radio cells (802.11), 80
- VLANs, 208
- VoWLAN verification, 183–187
- Wireless IP phones, 180
 - firmware, 180*
 - network settings, 181*
 - RF settings, 181–183*
- wireless LANs, 90
 - data rates, 93–94*

- data transfers*, 83
- fragmentation*, 97–98
- infrastructure mode*, 77–81
- power-save mode*, 94–95
- RF channels*, 92
- roaming*, 83–84
- RTS/CTS*, 95–97
- scanning*, 81–82
- SSIDs*, 90–91
- transmit power*, 93

Connect message (H.323), 52**connections**

- Ad Hoc mode, 84–85
- BSS, 77
- IP Phones, 80
- networks, 82
- troubleshooting, 206

connectors, access points, 167**coordination of facility access, 157****costs (ROI)**

- capital, 20–21
- determining, 16–24
- operational, 19
- payback periods, 23–24
- savings, 21–23

coverage

- expansion, 204
- monitoring, 194
- radio cells, 77
- signals, 193
- troubleshooting, 202, 206
- verifying, 203
- VoWLAN requirements, 127–129

customer service, 23**customizing thresholds, 208****D****data ISDN backups, 145****data rates**

- access points, 175
- RF settings, 181
- wireless LANs, 93–94

data transfers, 83**DCF (distributed coordination function), 85–86****defining VoWLAN requirements, 123****delivery traffic indication map (DTIM), 95****denial of service (DoS) attacks, 15, 102–103****density, calculating access pointed, 154****deployment**

- Cisco CallManager, 32–33
- Cisco CallManager Express, 33–34
- models, 142
 - multisite WAN*, 142–147
 - single-site architecture*, 142

design. See also configuration

- reviewing, 205

VoWLAN, 141

- access points*, 153
- deployment models*, 142
- documentation*, 161–164
- infrastructure*, 151
- multicasting*, 152
- multisite WAN*, 142–147
- QoS*, 153
- RF site surveys*, 155–161
- roaming*, 147–150
- security*, 150–151
- single-site architecture*, 142
- switches*, 152
- virtual LANs*, 151
- wireless capacity analysis*, 153–155

devices

- configuring, 199
- mobility, CallManager, 179–180
- pools, 178

diagrams, facilities, 156**direct sequence spread spectrum (DSSS), 61****distributed call processing, 146–147****distributed coordination function. See DCF****distribution**

- electrical, 171
- electrical power, 172

documentation

- site surveys, 161–164
- VoWLAN requirements, 138

DoS (denial of service) attacks, 15, 102–103**downlink beacons, measuring, 159****DSSS (direct sequence spread spectrum), 61****DTIM (delivery traffic indication map), 95****DTMF (dual-tone multi-frequency) tones, 51****dynamic grouping, 208****dynamic WEP keys, 111**

E

- EIRP (Effective Isotropic Radiated Power), 62, 159**
- electrical power distribution, 171–172**
- elevators, coverage areas, 127**
- encryption, 103–104**
 - AES, 8, 43, 104, 105
 - IEEE 802.11i, 106
 - TKIP, 105
 - VPNs, 106
 - WEP, 104–105
 - WPA, 106
- End Session message (H.323), 52**
- endpoints, VoIP call flow, 50**
- engineering functions, 203**
 - advanced problem resolution, 204
 - capacity increases, 204
 - coverage expansion, 204
 - design review, 205
 - firmware review, 204
 - technology upgrades, 205
- enterprises, VoWLANs, 9–10**
- environments, VoWLAN requirements, 130–132**
- existing security policies, reviewing, 197**
- existing systems, VoWLAN requirements, 134–135**

F

- facilities, RF site surveys, 156**
- fault status, 208**
- FCS (frame check sequence), 97**
- FHSS (frequency hopping spread spectrum), 61**
- filtering access points, 176**
- finding potential rogue access points, 117**
- firmware**
 - access points, 172
 - reviewing, 204
 - updates, 29
 - updating, 202, 207
 - versions, 193
 - wireless IP phones, 180
- follow-up tests, 186–187**
- fragmentation, 97–98**
- frame check sequence (FCS), 97**

- frames, ACK, 83**
- frequency hopping spread spectrum (FHSS), 61**

G

- G.711 codecs, 142**
- gain, RF signals, 59**
- gatekeepers, 51, 147**
- gateways**
 - H.323, 51
 - MGCP, 142
 - PSTN, 179
 - VoWLAN, 28
- grouping, dynamic, 208**

H

- H.45, 53**
- H.323, 51–53**
- hardware**
 - access points, 167
 - troubleshooting, 202
- healthcare, VoWLANs, 8–9**
- help desks, planning, 205–207**
- hidden nodes, troubleshooting, 96**
- history of VoWLANs, 6–8**
- HSRP (Hot Standby Router Protocol), 147**

I

- identifying, 158**
 - VoWLAN requirements, 124
- IDS (intrusion detection system), 209**
- IEEE (Institute of Electrical and Electronics Engineers), 7**
 - 802.11 standards, 86
 - 802.11i, 104–105
 - 802.1X authentication, 109–110
 - physical layer standards, 86
 - 802.11a, 86
 - 802.11b, 87
 - 802.11g, 88–89
 - 802.11n, 89
 - radio cell configurations, 80

implementing security assessments, 197, 201**infrastructure**

- design, 151
 - multicasting, 152*
 - QoS, 153*
 - switches, 152*
 - virtual LANs, 151*
- wireless LANs, 77–81
 - data transfers, 83*
 - roaming, 83–84*
 - scanning, 81–82*
- wireless networks, 36
 - access points, 36–38*
 - mesh networks, 41, 44*
 - switched networks, 39–41*

initial analysis, determining ROI, 17–19**inline PoE via power patches, 171****inspecting access points, 203****installation**

- access points, 115, 157, 167–168
 - antenna alignment, 171*
 - electrical power distribution, 171–172*
 - mounting, 168–170*
- CallManager, 177
 - device mobility, 179–180*
 - system parameters, 178*
- control policies, 196
- VoWLAN, 16–24

Institute of Electrical and Electronics Engineers.

See IEEE

integrated inline PoE, 171**Integrated Services Digital Network. *See* ISDN****inter-access point interference, 161****interfaces, security, 209****interference**

- inter-access point, 161
- ISI, 71
- microwave ovens, 163
- multipath, 71–72
- troubleshooting, 66–69

Internet Phone Software, 6**Internet Protocol. *See* IP****intersymbol interference (ISI), 71****interviewing users, 198–199****intrusion detection system (IDS), 209****IP (Internet Protocol)**

- addresses, 29
- Cisco IP Softphone, 30–32

IP Phone

- Cisco 7920 Wireless, 28–30
- Cisco CallManager, 32–33
- Cisco CallManager Express, 33–34
- Cisco IP Softphone, 30–32
- configuring, 180
 - firmware, 180*
 - network settings, 181*
 - RF settings, 181–183*
- packets, 80
- RF signals, 58
 - characteristics, 58–59*
 - FCC rules, 62*
 - gain, 59*
 - modulation, 58*
 - OFDM, 61*
 - SNR, 60*
 - spread spectrum, 60–61*
- voice attributes, 47–48
- VoIP call flow, 50
 - H.323, 51–53*
 - SCCP, 53–56*
 - SIP, 56–57*

ISDN (integrated Services Digital Network), 145**ISI (intersymbol interference), 71**

K

- keys, dynamic WEP, 111

L**languages, CallManager, 179****LANs (local area networks), virtual, 151****latency, troubleshooting, 66****Layer 2, roaming, 148****Layer 3, roaming, 148****layouts, access points, 167****LEAP authentication, 151****Linksys Wireless-G Internet Video Camera, 34–35****loads, testing, 186**

local area networks (LANs), virtual, 151
locations
 CallManager, 178
 determining access points, 156
lossy compression, 49

M

maintenance, 201–203
 access points, 201
 firmware, 202
 hardware, 202
 performance, 201
 signals, 202
management
 configuration, 191–192
firmware versions, 193
new application requests, 193
RF channel changes, 192
security optimization, 194
signal coverage, 193
transmit power changes, 192
 systems, 114–115
manufacturing, VoWLANs, 12
MCSs (media convergence servers), 32
measurements
 base range, 159
 downlink beacons, 159
media convergence servers (MCSs), 32
Media Gateway Control Protocol (MGCP), 142
mesh networks, 41, 44
messages
 H.323, 51
 SCCP, 53–56
 SIP, 56–57
Metageek, 69
metallic-based paint, 118
methodology, documentation, 161
MGCP (Media Gateway Control Protocol), 142
microwave ovens, 162
 interference, 163
 testing, 68
mixed-mode operations (802.11b/g), 88
mobile phones
 Cisco 7920 Wireless IP Phone, 28–30
 Cisco IP Softphone, 30–32
 VoWLAN architecture, 27–28

mobility, CallManager, 179–180
models (deployment), 142
 multisite WAN, 142–147
 single-site architecture, 142
modes
 Ad Hoc, 84–85
 infrastructure, 77–81
data transfers, 83
roaming, 83–84
scanning, 81–82
 power-save, 94–95
modification
 RF channels, 192
 transmit power, 160, 192
modulation, RF signals, 58
monitoring
 networks, 194
configuration, 195
coverage, 194
performance, 194
security policies, 195–197
 passive, 101–102
 performance, 203
 policies, 196
 RF, 209
 security policies, 209
mounting access points, 130, 168–170
Moving Picture Experts Group. See MPEG
MPEG (Moving Picture Experts Group), 49
multicasting, 152
multipath interference, troubleshooting, 71–72
multiple SSIDs
 mesh networks, 43
 support, 208
multipoint control units, H.323, 51
multisite WANs
 centralized call processing, 142–146
 distributed call processing, 146–147
mutual authentication, 111

N

NAV (network allocation vector), 85
NEC (National Electric Code), 169

networks

- connecting, 82
 - design, 151
 - multicasting*, 152
 - QoS*, 153
 - switches*, 152
 - virtual LANs*, 151
 - monitoring, 194
 - configuration*, 195
 - coverage*, 194
 - performance*, 194
 - security policies*, 195–197
 - VPNs, 104. *See also* VPNs
 - WANs, 28
 - wireless
 - access points*, 36–38
 - infrastructures*, 36
 - mesh networks*, 41, 44
 - switched networks*, 39–41
 - wireless IP phones, 181
- nodes, troubleshooting, 96**

O

- OFDM (Orthogonal Frequency Division Multiplexing), 61, 86**
- open system authentication, 107–108**
- operational costs, ROI, 19**
- operational support tools, reviewing, 198**
- optimization**
 - reliability, 144
 - security, 113, 194
 - uplink signal strength, 158
- Orthogonal Frequency Division Multiplexing (OFDM), 61, 86**
- overlapping 802.11 RF channels, 92**

P

- packets, routing, 78**
- painting walls, 118**
- parameters**
 - CallManager, 178
 - wireless LANs, 90
 - data rates*, 93–94

- fragmentation*, 97–98
- power-save mode*, 94–95
- RF channels*, 92
- RTS/CTS*, 95–97
- SSIDs*, 90–91
- transmit power*, 93

- partitions, CallManager, 178**
- passive monitoring, 101–102**
- passive scanning, 82**
- passwords, selecting, 114**
- paths**
 - Adaptive Wireless Path Protocol, 43
 - mesh networks, 42
- patterns, calling, 142**
- payback periods, ROI, 23–24**
- PCF (point coordination function), 85–86**
- PCM (Pulse Code Modulation), 48**
- penetration tests, 200**
- performance**
 - monitoring, 194, 203
 - troubleshooting, 201, 206
- phase shift keying (PSK), 58**
- phone calls, testing, 184, 186**
- physical installations of access points, 199**
- physical layer IEEE 802.11 standards, 86**
 - 802.11a, 86
 - 802.11b, 87
 - 802.11g, 88–89
 - 802.11n, 89
- placement of access points, 153**
 - RF site surveys, 155–161
 - wireless capacity analysis, 153–155
- planning help desks, 205–207**
- PoE (Power-over-Ethernet), 172, 196**
- point coordination function. *See* PCF**
- policies**
 - installation control, 196
 - monitoring, 196
 - security
 - assessments*, 197, 201
 - monitoring*, 195–197, 209
 - testing, 196
 - VoWLAN requirements, 135–136
- power**
 - CCK, 174
 - distribution, 171–172
 - transmit, 174. *See also* transmit power

Power-over-Ethernet. *See* PoE
power-save mode, 94–95
preferences, VoWLAN requirements, 135–136
productivity, 23
propagating signals, 118–119
protection mechanisms, 176
protocols
 Adaptive Wireless Path, 43
 CSMA/CA, 85
 HSRP, 147
 MGCP, 142
 RTP, 50
 SCCP, 29, 53–56
 SIP, 56–57, 147
 SNMP, 114
 TFTP, 180
 TKIP, 8, 104, 105
PSK (phase shift keying), 58
PSTN (Public Switched Telephone Network),
 28, 179
Pulse Code Modulation (PCM), 48

Q

QAM (quadrature amplitude modulation), 58
QoS (Quality of Service), 153
quadrature amplitude modulation. *See* QAM
qualitative benefits, VoWLAN ROI, 22–23
Quality of Service. *See* QoS
quantitative benefits, VoWLAN ROI, 21

R

radio cells, 77
radio frequency. *See* RF
radio redundancy, 43
ranges
 Cisco 7920 Wireless IP Phone, 30
 radio cells, 77
RAS (Registration, Admission, and Status), 51
RCF (Registration Confirmation), 52
Real-Time Transport Protocol (RTP), 50
reception, signal propagation, 118
reducing signal transmissions, 118

redundancy
 IP WAN links, 144
 SIP, 147
regions, CallManager, 178
registration, 184
Registration Confirmation (RCF), 52
Registration Reject (RRJ), 52
Registration Request (RRQ), 51
Registration, Admission, and Status. *See* RAS
Release Complete message (H.323), 52
reliability, optimizing, 144
replacing systems, 5–6
request-to-send/clear-to-send (RTS/CTS),
 88, 95–97
requirements
 documentation, 161
 NEC, 169
 VoWLAN
 analysis steps, 123
 applications, 124–125
 budgets, 136
 call processing agents, 147
 client devices, 133–134
 coverage areas, 127–129
 documenting, 138
 environments, 130–132
 existing systems, 134–135
 identifying, 124
 policies/preferences, 135–136
 roaming, 129–130
 schedules, 137
 security, 132–133
 users, 125–126
 utilization, 126–127
 verifying, 137–138
restrooms, coverage areas, 127
results, test, 162
retail, VoWLANs, 11
return on investment (ROI), 16–24
reviewing
 design, 205
 existing security policies, 197
 firmware, 204
 operational support tools, 198
 system architecture, 198

RF (radio frequency), 191

- channels
 - access points, 174*
 - wireless LANs, 92*
- interference, 66–69
- modifying, 192
- monitoring, 209
- signals, 58
 - characteristics, 58–59*
 - coverage, 63*
 - FCC rules, 62*
 - gain, 59*
 - modulation, 58*
 - OFDM, 61*
 - SNR, 60*
 - spread spectrum, 60–61*
- site surveys, 155–161, 167
- spectrum analyzers, 69
- wireless IP phones, 181–183

roaming

- design, 147–150
- infrastructure wireless LANs, 83–84
- IP Phone, 28
- VoWLAN requirements, 129–130
- Wi-Fi, 148

rogue access points, 115–118, 199**ROI (return on investment), determining, 16–24****role of VoWLAN solutions, 5–6****route groups, CallManager, 178****routing, packets, 78****RRJ (Registration Reject), 52****RRQ (Registration Request), 51****RTP (Real-Time Transport Protocol), 50****RTS/CTS (request-to-send/clear-to-send), 88, 95–97****S****safety, 23****savings, ROI, 21–23****scanning infrastructure wireless LANs, 81–82****SCCP (Skinny Client Control Protocol), 29, 53–56****schedules, VoWLAN requirements, 137****scope, testing, 161****security, 15**

- AES, 8, 43, 104–105
- Cisco 7920 Wireless IP Phone, 29
- design, 150–151
- gaps, 200
- IDS, 209
- interfaces, 209
- mesh networks, 43
- optimizing, 194
- policies, 195–197, 209
- RF settings, 182
- training, 196
- VoWLAN, 15–16, 101
 - access point installation, 115*
 - authentication, 106–113*
 - DoS attacks, 102–103*
 - encryption, 103–104*
 - IEEE 802.11i, 106*
 - optimizing, 113*
 - passive monitoring, 101–102*
 - requirements, 132–133*
 - rogue access points, 115–118*
 - signal propagation, 118–119*
 - SSID broadcasting, 113–114*
 - systems management, 114–115*
 - TKIP, 105*
 - unauthorized access, 102*
 - VPNs, 106*
 - WEP, 104–105*
 - WPA, 106*

selecting passwords, 114**self-healing functions, 209****servers**

- ACS, 151
- MCSs, 32

Service Set Identifiers. See SSIDs**Session Initiation Protocol (SIP), 147****settings. See also configuration**

- access points, 172
 - data rates, 175*
 - filtering, 176*
 - firmware, 172*
 - protection mechanisms, 176*
 - RF channels, 174*
 - SSIDs, 173*
 - transmit power, 174*
 - VLANs, 173*

- networks, wireless IP Phones, 181
- RF, 181–183
- Setup message (H.323), 52**
- shared key authentication, 108**
- signal-to-noise ratio (SNR), 158**
- signals**
 - access points, 167. *See also* access points
 - AirMagnet Analyzer, 132
 - capacity, 69–71
 - coverage areas, 127–129, 193, 202, 206
 - interference, 66–69
 - latency, 66
 - multipath interference, 71–72
 - propagation, 118–119
 - RF, 58
 - characteristics, 58–59*
 - FCC rules, 62*
 - gain, 59*
 - modulation, 58*
 - OFDM, 61*
 - SNR, 60*
 - spread spectrum, 60–61*
 - roaming, 129–130
 - testing, 119, 159
 - troubleshooting, 62–65
 - uplink, 158
 - video attributes, 48–50
 - voice attributes, 47–48
 - VoIP
 - call flow, 50*
 - H.323, 51–53*
 - SCCP, 53–56*
 - SIP, 56–57*
- signatures, RF interference sources, 67**
- Simple Network Management Protocol. *See* SNMP**
- single-site architecture, 142**
- SIP (Session Initiation Protocol), 56–57, 147**
- site surveys, 29**
 - access points, 167
 - assisted, 207
 - documentation, 161–164
 - RF, 155–161
- Skinny Client Control Protocol (SCCP), 29**
- small offices and homes, 13**
- SNMP (Simple Network Management Protocol), 114**
- SNR (signal-to-noise ratio), 60, 158**
- solutions, role of VoWLAN, 5–6**
- specifications, Linksys Wireless-G Internet Video Camera, 34**
- spectrum analyzers, 69**
- spread spectrum, 60–61**
- SRST (Survivable Remote Site Telephony), 144, 146**
- SSIDs (Service Set Identifiers), 102, 173**
 - access points, 173
 - broadcasting, 113–114
 - mesh networks, 43
 - multiple, 208
 - RF settings, 182
 - wireless LANs, 90–91
- stairwells, coverage areas, 127**
- status, fault, 208**
- subscriber setup, CallManager, 179**
- support, VLAN, 29**
- Survivable Remote Site Telephony (SRST), 144–146**
- switched networks, wireless, 39–41**
- switches, 152**
- systems**
 - architecture, 198. *See also* architecture management, 114–115
 - parameters, CallManager, 178
 - schedules, 179
 - status, troubleshooting, 206

T

- Task Group R, 66**
- technology upgrades, 205**
- Temporal Key Integrity Protocol. *See* TKIP**
- TerminalCapabilitySet message (H.323), 52**
- terminals, H.323, 51**
- test teams, 161**
- testing**
 - association, 184
 - authentication, 184
 - batteries, 187
 - follow-up, 186–187
 - loads, 186
 - microwave oven interference, 68
 - penetration, 200

- phone calls, 184–186
- policies, 196
- registration, 184
- results, 162
- scope, 161
- security, 197, 201
- signals, 119, 159
- tools, 162
- VoWLAN, 183–187
- TFTP (Trivial File Transfer Protocol), 180**
- thresholds, customizing, 208**
- TIM (traffic indication map), 94**
- TKIP (Temporal Key Integrity Protocol), 8, 104–105**
- tones, DTMF, 51**
- tools, testing, 162**
- traffic indication map (TIM), 94**
- training, security, 196**
- transfers, data, 83**
- transmissions, signal propagation, 118**
- transmit power**
 - access points, 174
 - Cisco 7920 Wireless IP Phone, 30
 - modifying, 160, 192
 - RF settings, 181
 - wireless LANs, 93
- Trivial File Transfer Protocol (TFTP), 180**
- troubleshooting. *See also* testing**
 - batteries, 187
 - connections, 206
 - help desks, 205–207
 - hidden nodes, 96
 - maintenance, 201–203
 - access points, 201*
 - firmware, 202*
 - hardware, 202*
 - performance, 201, 206
 - security, 197, 201
 - signals, 62–65, 202
 - capacity, 69–71*
 - coverage, 206*
 - interference, 66–69*
 - latency, 66*
 - multipath interference, 71–72*
 - system status, 206
- types of scanning, 81–82**

U

- unauthorized access, 102**
- universities, VoWLANs, 10**
- updating firmware, 29, 202, 207**
- upgrading technology, 205**
- uplink signal strength, optimizing, 158**
- user-based authentication, 111**
- users**
 - interviewing, 198–199
 - VoWLAN requirements, 125–126
- utility rooms, coverage areas, 128**
- utilization**
 - VoWLAN requirements, 126–127
 - Wi-Fi video, 49

V

- validation, VoWLAN requirements, 137–138**
- verification**
 - access points, 157
 - coverage, 203
 - VoWLAN, 137–138, 183–187
 - wireless device configuration, 199
- versions, firmware, 193**
- video**
 - attributes, 48–50
 - cameras, 34–35
- virtual LANs. *See* VLANs**
- Virtual Private Networks. *See* VPNs**
- visual inspection of facilities, 156**
- VLANs (virtual LANs)**
 - access points, 173
 - configuring, 208
 - support, 29
- Vocaltec, Inc. 6**
- voice**
 - attributes, 47–48
 - gateways, 28
 - ISDN backups, 145
- VoIP (Voice over Internet Protocol), 6**
 - call flow, 50
 - H.323, 51–53*
 - SCCP, 53–56*
 - SIP, 56–57*

call managers, 28
voice attributes, 47–48

VoWLAN

access points, 153
 documentation, 161–164
 RF site surveys, 155–161
 wireless capacity analysis, 153–155
architecture, 27–28
Cisco IP Softphone, 30–32
configuration management, 191–192
 firmware versions, 193
 new application requests, 193
 RF channel changes, 192
 security optimization, 194
 signal coverage, 193
 transmit power changes, 192
deployment models, 142
 multisite WAN, 142–147
 single-site architecture, 142
design, 141
engineering functions, 203
 advanced problem resolution, 204
 capacity increases, 204
 coverage expansion, 204
 design review, 205
 firmware review, 204
 technology upgrades, 205
enterprises, 9–10
healthcare, 8–9
history of, 6–8
infrastructure, 151
 multicasting, 152
 QoS, 153
 switches, 152
 virtual LANs, 151
manufacturing, 12
requirements
 analysis steps, 123
 applications, 124–125
 budgets, 136
 client devices, 133–134
 coverage areas, 127–129
 documenting, 138
 environments, 130–132
 existing systems, 134–135
 identifying, 124
 policies/preferences, 135–136

roaming, 129–130
schedules, 137
security, 132–133
users, 125–126
utilization, 126–127
verifying, 137–138

retail, 11

roaming, 147–150

ROI, determining, 16–24

security, 15–16, 101, 150–151

access point installation, 115

AES, 105

assessments, 197, 201

authentication, 106–113

DoS attacks, 102–103

encryption, 103–104

IEEE 802.11i, 106

optimizing, 113

passive monitoring, 101–102

rogue access points, 115–118

signal propagation, 118–119

SSID broadcasting, 113–114

systems management, 114–115

TKIP, 105

unauthorized access, 102

VPNs, 106

WEP, 104–105

WPA, 106

small offices and homes, 13

solutions, 5–6

universities, 10

verifying, 183–187

warehouses, 12

VPNs (Virtual Private Networks), 104–106

W

walls, painting, 118

WANs (wide area networks), 28

 centralized call processing, 142–146

 distributed call processing, 146–147

warehouses, VoWLANs, 12, 111

WEP (Wired Equivalent Privacy), 104–105, 111

wide area networks. See WANs

Wi-Fi

- roaming, 148
- video, 49

Wi-Fi Protected Access. See WPA**Wi-Fi Protected Access 2 (WPA2), 43****Wired Equivalent Privacy. See WEP****wireless adapters, Cisco 7920 Wireless IP Phone, 30****wireless capacity analysis, 153–155****wireless devices, verifying, 199****wireless IP Phones, 28**

- configuring, 180
 - firmware, 180*
 - network settings, 181*
 - RF settings, 181–183*
- packets, 80

wireless LANs. See WLANs**wireless network infrastructures, 36**

- access points, 36–38
- mesh networks, 41, 44
- switched networks, 39–41

Wi-Spy, 69**WLANs (wireless LANs), 7–8**

- adapters, 28
- Ad Hoc mode, 84–85
- capacity, 69–71
- configuring, 90
 - data rates, 93–94*
 - fragmentation, 97–98*
 - power-save mode, 94–95*
 - RF channels, 92*
 - RTS/CTS, 95–97*
 - SSIDs, 90–91*
 - transmit power, 93*
- IEEE 802.11 standards, 86
 - 802.11a, 86*
 - 802.11b, 87*
 - 802.11g, 88–89*
 - 802.11n, 89*
- infrastructure, 77–81
 - data transfers, 83*
 - roaming, 83–84*
 - scanning, 81–82*
- interference, 66–69
- latency, 66
- Linksys Wireless-G Internet Video Camera, 34–35

- multipath interference, 71–72

- troubleshooting, 62–65

- wireless medium access, 85

 - DCF, 85–86*

 - PCF, 86*

WLSE (CiscoWorks Wireless LAN Solution Engineer), 207–210**WPA (Wi-Fi Protected Access), 104–106****WPA2 (Wi-Fi Protected Access 2), 43**