

INDEX

Numerics

- 3DES (Tripe Data Encryption Standard), 141
- 8-bit samples, 41

A

- ABRDIAL button, 136
- abbreviated dial numbers, 136
- access control lists (ACLs), 187
- accounting, 158
- accounts, CCO, 45
- ACD (Automatic Call Distribution), 235
- ACF (admission control) messages, 163
- ACLs (access control lists), 187
- AD (Active Directory), 100
- Adaptive Differentiated PCM (ADPCM), 43
- additional switch ports (IP Phones), 121
- addresses, signaling, 6, 15–17
- administration, call, 158
- admission confirm (ACF) messages, 163
- admission reject (ARJ) messages, 163
- admission request (ARQ) messages, 163
- ADPCM (Adaptive Differentiated PCM), 43
- Advanced Encryption Standard (AES), 141
- Advanced Integration Module (AIM), 146
- AF (Assured Forwarding), 190
- agents
 - call, 18, 165–167
 - UAs, 169
- AIM (Advanced Integration Module), 146
- a-Law, 41
- aliasing, 37
- AMI (alternate mark inversion), 77
- amplitudes, 39
- analog. *See also* interfaces
 - converting
 - calculating bandwidth, 49–54*
 - case study, 54–58*
 - compressing, 42–49*
 - sampling, 36–42*
 - interfaces, 70
- announcements, 135
- Annunciator, 135



applications

Conference Connection, 231

MeetingPlace, 232, 234

ARJ (admission reject) messages, 163

ARQ (admission request) messages, 163

Assured Forwarding (AF), 190

audio, MeetingPlace, 231

auto answer feature (IP Phone), 136

Automatic Call Distribution (ACD), 235

AutoQoS, configuring, 217

auxiliary VLANs (IP Phones), 123

availability, downtime, 64

avoidance, congestion, 185

B

B8ZS (bipolar 8-zero substitution), 78

BackboneFast, 67

Backup and Restore System (BARS), 100

Backward Explicit Congestion Notification (BECN), 213

bandwidth

analog

calculating, 49–54

sampling, 37

analog compression, 42–49

calculators, 45

compressing, 214–217

QoS, 180–181

selecting, 54–58

tracking, 158

Barge feature (CCM), 139

BARS (Backup and Restore System), 100

Basic Rate Interface (BRI), 80

Bc (committed burst), 208

B-channels, 79

Be (Excess Burst), 209

bearer channels, 79

BECN (Backward Explicit Congestion Notification), 213

Best-Effort QoS, 183

BHCAs (Busy Hour Call Attempts), 110

bipolar 8-zero substitution (B8ZS), 78

bipolar violations, 77

bits

CLP, 193

DE, 193, 212

framing, 76

BRI (Basic Rate Interface), 80

bridges, root, 67

broadcast storms, 67

buckets (token), 209

buffers, look ahead, 43–44

Busy Hour Call Attempts (BHCAs), 110

busy hour traffic, 50

busy signals, 17, 72

buttons, line/speed dial, 124

byte-by-byte scheduling, 196

bytes, ToS, 188

C

CA (certificate authority), 140

cadence (ring), 13

CAIM (Compression Advanced Integration Module), 215

calculations

bandwidth, 49–54

Erlangs, 50

trunks, 51

calculators

Erlang B, 50

Voice Bandwidth, 45

call administration, 158

call agents, 18, 165, 167

Call Back feature (CCM), 139

call centers, 235

IPCC Enterprise, 237

IPCC Express, 236–237

call detail records (CDRs), 101

call forwarding, 137

Call Join feature (IP Phone), 137

call legs, 85–86

call minutes, 50

Call Park (IP Phone), 138

call progress tones, 72

call setup (CCM), 99

call types (H.323), 162–164

caller-ID, 73

Calling Search Spaces (CSS), 113

calls, 110

capacitors, 14

CAPF (Certificate Authority Proxy Function), 140

CAS (Channel Associated Signaling), 79

case studies

bandwidth selection, 54–58

CCM, 148–152

conference calls, 238–241

gateways, 172

migration from PBXs, 89–92

QoS, 218–221

voice network design, 23–29

Catalyst switches

inline power from (IP Phones), 118

queuing, 201

categories

of compression, 214

of QoS, 182



- CB-WFQ (Class-Based Weighted Fair Queuing), 199**
- CCM (Cisco CallManager), 18, 157, 227–231**
 - case study, 148–152
 - CME routers, 145–147
 - conference call support, 231–234
 - CoS configuration, 112–117
 - deploying, 104–112
 - grouping, 102
 - IP Phone
 - features, 134–139*
 - replacement, 117–134*
 - security, 139–141
 - switches, 97–102
 - Unity integration, 230
 - video voice calls, 141–144
- CCO (Cisco Connection Online) accounts, 45**
- CCS (Common Channel Signaling), 79**
- CDP (Cisco Discovery Protocol), 117**
- CDRs (call detail records), 101**
- Cell Loss Priority (CLP) bits, 193**
- central office (CO), 4**
- centralized call processing CCM design models, 106**
- CER (Cisco Emergency Responder), 116**
- certificate authority (CA), 140**
- Certificate Authority Proxy Function (CAPF), 140**
- certificates, 140**
- Channel Associated Signaling (CAS), 79**
- channels, 79**
- CID (context ID), 216**
- CIR (Committed Information Rate), 208**
- circuits, ringing, 14**
- Cisco 7902G IP phones, 125**
- Cisco 7905G IP Phones, 126**
- Cisco 7910G+SW IP Phone, 127**
- Cisco 7912G IP phones, 126**
- Cisco 7920 IP Phone, 132**
- Cisco 7936 IP Phone, 133**
- Cisco 7940G IP Phone, 127**
- Cisco 7960G IP Phone, 127**
- Cisco 7970G IP Phone, 129**
- Cisco 7971G-GE IP Phone, 129**
- Cisco CallManager (CCM), 18, 157, 227–231**
 - case study, 148–152
 - CME routers, 145–147
 - conference call support, 231–234
 - CoS configuration, 112–117
 - deploying, 104–112
 - grouping, 102

- IP Phone
 - features, 134–139*
 - replacement, 117–134*
 - security, 139–141
 - switches, 97–102
 - Unity integration, 230
 - video voice calls, 141–144
- Cisco CallManager Administration web interface, 99**
- Cisco CallManager Express (CME), 145–147**
- Cisco Catalyst 6500 multilayer switches, redundancy, 65**
- Cisco Connection Online (CCO) accounts, 45**
- Cisco Discovery Protocol (CDP), 117**
- Cisco Emergency Responder (CER), 116**
- Cisco IP Communicator, 131**
- Cisco IP Contact Center (IPCC) Enterprise Edition, 237**
- Cisco IP Contact Center (IPCC) Express Edition, 236–237**
- Cisco IP SoftPhone, 130**
- Cisco IP/VC 3540 MCUs, 144**
- Cisco proprietary inline power, 120**
- Cisco Unity, 229**
 - CCM integration, 230
 - PBX integration, 231
- Cisco Unity Express (CUE), 146**
- class of service (CoS)**
 - configuring, 112–117
 - marking, 191
 - remarking, 193
- Class-Based Weighted Fair Queuing (CB-WFQ), 199**
- classification, 183, 187**
- clients**
 - SCCP, 98
 - UACs, 169
- CLP (Cell Loss Priority) bits, 193**
- clusters, 101**
 - CCMs
 - deploying, 104–112*
 - grouping, 102*
 - gatekeepers, 164
- CME (Cisco CallManager Express), 145–147**
- CO (central office), 4**
- codebooks, 43**
- CODECs (coder decoders), 43, 120**
- coding, line, 77**
- collaboration, MeetingPlace, 231**
- co-location, 88**
- commands, ping, 111**
- committed burst (Bc), 208**
- Committed Information Rate (CIR), 208**
- Common Channel Signaling (CCS), 79**



components

- fault tolerance, 65
- H.323, 160
- MGCP, 166
- telephony
 - key systems, 10*
 - overview of networks, 4–7*
 - PBX, 9–10*
 - PSTN, 7*
 - signaling, 11–23*
- VoIP networks, 18
- compression, 186**
 - analog conversion, 42–49
 - bandwidth, 214–217
 - RTP header, 215
- Compression Advanced Integration Module (CAIM), 215**
- Computer Telephony Integration (CTI), 235**
- conditioners (traffic), 185, 207**
- conference call support (CCM), 231–234**
- conference calls**
 - case study, 238–241
 - video voice calls, 144
- conference calls (IP Phones), 134**
- Conference Connection application, 231**
- configuration**
 - auto answer (IP Phone), 136

- CCM, 99
 - case study, 148–152*
 - CME routers, 145–147*
 - CoS, 112–117*
 - IP Phone features, 134–139*
 - IP Phone replacement, 117–134*
 - security, 139–141*
 - video voice calls, 141–144*
- FXS ports, 72–74
- MeetingPlace, 232–234
- MGCP call setup, 165
- QoS, 181, 217–221
- ring patterns, 72
- SIP call setup, 170
- T1 interfaces, 77
- conforming traffic, 209**
- congestion**
 - avoidance, 185
 - management, 183, 194–207
- Conjugate Structure Algebraic Code Excited Linear Predication (CS-ACELP), 43**
- connections**
 - Conference Connection application, 231
 - routers
 - to digital circuits, 74–86*
 - to phone lines, 70–74*
 - trunks, 124
- connectors, RJ-45, 119**

context ID (CID), 216

convergence, 67

networks, 20

PBXs before, 68

conversion (analog)

calculating bandwidth, 49–54

case study, 54–58

compressing, 42–49

sampling, 36–42

copying databases, 101

CoS (class of service)

configuring, 112–117

marking, 191

remarking, 193

CS-ACELP (conjugate structure Algebraic Code Excited Linear Prediction), 43

CSSs (Calling Search Space), 113

CTI (Computer Technology Integration), 235

CUE (Cisco Unity Express), 146

customizing redundancy, 102

D

Data Connection (DC) Directory, 100

databases, copying, 101

DC (Data Connection) Directory, 100

D-channel, 79

DE (Discard Eligible) bits, 193

Default PHB, 189

defining logarithmic scales, 41

delay, 179

round trip, 111

serialization, 186

deploying CCMs, 104–112

design. *See also* configuration

CCM

centralized call processing models, 106

distributed call processing models, 109

single-site models, 105

networks, 23–29

redundancy, 102

determining GoS, 51

devices

edge, 6

redundancy, 65

dial peers, 85

dial plans, 98

dialing

pulse, 15

touch tone, 16

types, 74

difference signals, 43

Differentiated Service Code Point (DSCP), 188

DiffServ (Differentiated Services), 183

digital circuits, connecting, 74–86



digital signal processors (DSPs),
19, 106

digitizing voice, 37. *See also* conversion

direct gateway-to-gateway calls
(H.323), 162

Direct Transfer feature (IP Phone),
137

DirTrfr softkey, 137

disaster recovery, 100

Discard Eligible (DE) bits, 193, 212

distributed call processing CCM
design models, 109

downtime, availability, 64

drops, 179

DSCP (Differentiated Service Code
Point), 188

DSPs (digital signal processors),
19, 106

DTMF (dual tone multifrequency), 16

dual token buckets, 210

dual tone multifrequency (DTMF), 16

dual-rate policing, 211

E

E1, multiframes, 82

ECN (Explicit Congestion
Notification), 205

edge devices, 6

EF (Expedited Forwarding), 189

efficiency (link), 186

encoding waveforms, 42–49

encryption, CCM security, 141

endpoints
MGCP, 166
RTP streams, 157

Erlangs, calculating, 50

errors, quantization, 40

ESF (Extended Super Frame), 77

Ethernet switches, 19

events, MGCP gateways, 167

exceeding traffic, 209

Excess Burst (Be), 209

exchange area networks, 8

Executive CCSs, 114

existing phone systems, optimizing
reliability, 63–67

Expedited Forwarding (EF), 189

Explicit Congestion Notification
(ECN), 205

Extended Super Frame (ESF), 77

Extensible Markup Language.
See XML

external power supplies (IP Phones),
118

F**Fair Queuing (FQ), 196****Fast Link Pulse (FLP), 120****fault tolerance**

components, 65

MGCP, 168

FECN (Forward Explicit Congestion Notification), 213**FIFO (first-in, first-out) queuing strategies, 183, 195****FLP (Fast Link Pulse), 120****Foreign Exchange Office (FXO) ports, 73****Foreign Exchange Station (FXS) ports, 71****Forward Explicit Congestion Notification (FECN), 213****forwarding calls, 137****FQ (Fair Queuing), 196****Frame Relay**

PVC, 84

shaping, 212

frames, multiframe, 82**framing bits, 76****frequencies**

analog, 39

DTMF, 16

of rings, 72

FXO (Foreign Exchange Office) ports, 73**FXS (Foreign Exchange Station) ports, 71****G****gatekeepers, 19, 110, 161****gateways, 70**

case study, 172

gateway-to-gateway calls (H.323), 162

PIMG, 230

protocols, 157–159

*H.323, 159–164**MGCP, 165–168**SIP, 168–171*

registration, 158

resolution, 158

glare, 12**global synchronization, 203****GoS (grade of service), 49–51****ground start signaling, 13, 72****Group Call Pickup feature (IP Phone), 138****grouping CCMs, 102**



H

H.323 gateway protocol, 159–164

- call types, 162–164
- component, 160
- gatekeepers, 161
- terminals, 161

Hard QoS, 183

hardware queues, 194. *See also* queuing

HDB3 (High Density Binary 3), 78

header compression, 214

High Density Binary 3 (HDB3), 78

home use of VoIP, 87–88

HSRP (Hot Standby Router Protocol), 66, 164

HTML (Hypertext Markup Language), 122

hybrid phone switches, 11

I

identity verification, 140

iDivert (Immediate Divert) softkey, 137

IEEE 802.1Q trunks, 124

IEEE 802.3af standard, 120

IETF (Internet Engineering Task Force), 189

Immediate Divert (iDivert) softkey, 137

information signaling, 6, 17–23

inline power (IP Phones), 118

Integrated Services (IntServ), 183

Integrated Services Digital Network. *See* ISDN

integration

CCM and Unity, 230

CTI, 235

legacy voice mail, 228

PBX and Unity, 231

integrity (CCM security), 140

Interactive Voice Response (IVR), 235

interfaces

analog, 70

BRI, 80

Conference Connection, 231

PRI, 80

T1, 77

Internal partitions, 113

International partitions, 113

Internet Engineering Task Force (IETF), 189

Internet Protocol, 18, 188

Internetwork Operating System (IOS), 72

interoffice trunks, 6

IntServ (Integrated Services), 183

INVITE messages, 169

IOS (Internetwork Operating System), 72

IP (Internet Protocol), 18, 188

IP Phones, 18

Cisco 7902G, 125

Cisco 7905G, 126

Cisco 7910G+SW, 127

Cisco 7912G, 126

Cisco 7920, 132

Cisco 7936, 133

Cisco 7940G, 127

Cisco 7960G, 127

Cisco 7970G, 129

Cisco 7971G-GE, 129

Cisco IP Communicator, 131

Cisco IP SoftPhone, 130

features, 134–139

replacing, 117–134

IP/VC 3540 MCUs, 144

IPCC (Cisco IP Contact Center)

Enterprise Edition, 237

IPCC (Cisco IP Contact Center)

Express Edition, 236–237

ISDN (Integrated Services Digital Network), 71, 79

BRI, 80

PRI, 80

IVR (Interactive Voice Response), 235

J–L

jitter, 179

keepalive messages, 102

key systems, 10

languages (gateway protocols), 157–159, 172

H.323, 159–164

MGCP, 165–168

SIP, 168–171

latency, 179. *See also* delay

LCD (liquid crystal display) screens, 122

LCF (location confirm), 164

LDCELP (Low-Delay Conjugate Excited Linear Predication), 44

leasing, 88

legacy voice-mail integration, 228

LFI (Link Fragmentation and Interleaving), 186, 216

line buttons, 124

line coding, 77

linear quantization, 40

link efficiency, 186

Link Fragmentation and Interleaving (LFI), 186, 216

liquid crystal display (LCD) screens, 122



LLQ (Low Latency Queuing), 200
Lobby CCSs, 114
local loops, 5–6
local networks, 8
Local partitions, 113
Locally Significant Certificates (LSCs), 140
location confirm (LCF), 164
location request (LRQ), 164
logarithmic quantization, 41
Long Distance partitions, 113
long-haul networks, 8
look ahead buffers, 43–44
loop start signaling, 12, 72
loops, local, 5–6
Low Latency Queuing (LLQ), 200
Low-Delay Conjugate Excited Linear Predication (LDCELP), 44
LRQ (location request), 164
LSCs (Locally Significant Certificates), 140

M

maintenance, remote site (SRST), 106
Malicious Call Identification (MCID), 138
management, congestion, 183, 194–207
MANs (metropolitan-area networks), 112
mark probability denominators, 204
marking, 183
 BECN, 213
 CoS, 191
 FECN, 213
 traffic, 187
MCID (Malicious Call Identification), 138
MCS (Media Convergence Servers), 100, 229
MCUs (Multipoint Control Units), 19, 143, 161
Mean Opinion Score (MOS), 48
mean time between failures (MTBF), 64
mean time to repair (MTTR), 64
media encryption, 141
Media Gateway Control Protocol. See MGCP
MeetingPlace application, 232, 234
messages
 ACF, 163
 ARJ, 163
 ARQ, 163
 Cisco Unity, 229
 INVITE, 169
 keepalive, 102
 TCP connect, 102
 unified messaging, 227–231

metropolitan-area networks (MANs), 112

MGCP (Media Gateway Control Protocol), 156, 165–168

components, 166

fault tolerance, 168

midspans, inline power from, 119

migration

case study, 89–92

reliability, 63–67

routers

connecting digital circuits, 74–86

connecting phone lines, 70–74

trunks, 68–70

minimum thresholds, 204

m-Law, 41

models

redundancy, 103

WAN, 110

modulation

PAM, 39

PCM, 43

MOH (music on hold), 135

MOS (Mean Opinion Score), 48

MTBF (mean time between failures), 64

MTTR (mean time to repair), 64

multiframes, 82

Multilevel Precedence (IP Phone), 138

Multipoint Control Units (MCUs), 19, 143, 161

music on hold (MOH), 135

N

NBAR (Network Based Application Recognition), 187

Network Module (NM), 146

networks

convergence, 20

home use of VoIP, 87–88

PSTN, 7

signaling, 11–23

telephony, 4–10

types of, 8

voice, 23–29

NM (Network Module), 146

number of required trunks, calculating, 51

numbers

of rings, 74

sequences, 197

Nyquist Theorem, 38, 76



O–P

- one-stop messaging, 229**
- optimizing reliability, 63–67**
- oversampling, 37**
- oversubscriptions, WAN, 161**

- packets**
 - drops, 179
 - tail dropped, 185
- PAM (pulse amplitude modulation), 39**
- parking calls (IP Phone), 138**
- partitions (CCM), 113**
- party lines, 72**
- patterns, ring, 13, 72**
- payload compression, 214**
- PBX-IP Media Gateway (PIMG), 230**
- PBX (private branch exchange), 9–10**
 - migrating from
 - case study, 89–92*
 - connecting routers to digital circuits, 74–86*
 - connecting routers to phone lines, 70–74*
 - optimizing reliability, 63–67*
 - replacing trunks, 68–70*
 - Unity integration, 23
- PCM (pulse code modulation), 43, 121**
- Per Hop Behaviors (PHBs), 189**
- Perceptual Evaluation of Speech Quality (PESQ), 49**
- Perceptual Speech Quality Measurement (PSQM), 49**
- permanent virtual circuit (PVC), 84**
- PESQ (Perceptual Evaluation of Speech Quality), 49**
- PHBs (Per Hop Behaviors), 189**
- phone lines, connecting, 70–74**
- phone switches, 5–6**
- PIMG (PBX-IP Media Gateway), 230**
- ping command, 111**
- plans, dial, 98**
- PoE (Power over Ethernet), 119**
- policing, 185, 207, 211**
- PortFast, 67**
- ports. *See also* connections**
 - FXO, 73
 - FXS, 71
 - switches, 121
- power, inline (IP Phones), 118**
- Power over Ethernet (PoE), 119**
- PQ (Priority Queuing), 198**
- Preemption (IP Phone), 138**
- prerecorded announcements, 135**
- PRI (Primary Rate Interface), 80**
- prioritizing, voice (QoS), 186–193**
- Priority Queuing (PQ), 198**

Privacy feature (CCM), 139, 141
private branch exchange. *See* PBX
profiles, RED, 204
protocols, 18
 CDP, 117
 gateways, 157–159
 case study, 172
 H.323, 159–164
 MGCP, 165–168
 SIP, 168–171
 HSRP, 66, 164
 MGCP, 156, 165–168
 components, 166
 fault tolerance, 168
 RTP, 98, 157, 215
 SAP, 169
 SCCP, 98, 169
 signaling, 68
 SIP, 156, 168–171
 SMDI, 228
 STP, 67
 VRRP, 66
PSQM (Perceptual Speech Quality Measurement), 49
PSTN (public switched telephone network), 7
publishers, 101
pulse amplitude modulation (PAM), 39
pulse code modulation (PCM), 43, 121

pulse dialing, 15
PVC (permanent virtual circuit), 84

Q

Q.931 signaling protocol, 80
QoS (quality of service), 180
 AutoQoS, 217
 bandwidth, 180–181
 case study, 218–221
 configuring, 181
 congestion management, 194–207
 traffic
 compressing bandwidth, 214–217
 setting speed limits on, 207–214
 voice, 186–193
quality of service. *See* QoS
quantization, 39
queuing, 194–207
 Catalyst-based, 201
 CB-WFQ, 199
 FIFO strategies, 183, 195
 FQ, 196
 LLQ, 200
 PQ, 198
 WFQ, 196



R

random early detection (RED), 203

RAS (Registration, Admission, and Status), 160

Real-Time Transport Protocol (RTP), 98, 157, 215

records

bandwidth, 158

CDRs, 101

RED (random early detection), 203

redundancy

CCMs, 102

devices, 65

VRRP, 66

Registered Jack (RJ), 4

registration, gateways, 158

Registration, Admission, and Status (RAS), 160

reliability, optimizing, 63–67

remarking, CoS, 193

remote site (SRST), maintenance, 106

replacing

IP Phones, 117–134

switches with CCM, 97–102

trunks, 68–70

replication, 101

requirements for telephony systems, 24

residential gateways, 167

resolution, gateways, 158

resources, transcoding, 135

ring backs, 17, 72

ring cadence, 13

ring frequency, 72

ring patterns, 72

Ring wires, 4

rings, number of, 74

RJ (Registered Jack), 4

RJ-45 connectors, 119

root bridges, 67

round trip delays, 111

routers

CME, 145–147

digital circuits, 74–86

phone lines, 70–74

RTP (Real-Time Transport Protocol), 98, 157, 215

run-time data, 102

S

sampling, 36–42

SAP (Session Announcement Protocol), 169

SCCP (Skinny Client Control Protocol), 98, 141, 169

scheduling, byte-by-byte, 196

scrambling SCCP, 141

screens (LCD), 122

- Secure Real-Time Transport Protocol (SRTP), 141**
- security, CCM, 139–141**
- selection**
 - of bandwidth, 54–58
 - IP Phone features, 134–139
- sequence numbers, 197**
- serialization, delay, 186**
- servers**
 - CCM
 - case study, 148–152*
 - CME routers, 145–147*
 - CoS configuration, 112–117*
 - deploying, 104–112*
 - grouping, 102*
 - IP Phone features, 134–139*
 - IP Phone replacement, 117–134*
 - security, 139–141*
 - video voice calls, 141–144*
 - Cisco Unity, 229
 - gateways
 - case study, 172*
 - H.323, 159–164*
 - MGCP, 165–168*
 - protocols, 157–159*
 - SIP, 168–171*
 - MCS, 100
 - subscriber, 101
 - UASs, 169
- services, voice mail, 227–231**
- Session Announcement Protocol (SAP), 169**
- session initiation protocol, 156, 168–171**
- SF (Super Frame), 77**
- shaping, 185, 207, 212**
- signaling**
 - CAS, 79
 - CSS, 79
 - protocols, 68
 - types of, 6, 11–23, 72
- Signaling System 7 (SS7), 88**
- signal-to-noise (S/N) ratios, 41**
- Simplified Messaging Desk Interface (SMDI) protocol, 228**
- single token buckets, 210**
- single-site CCM design models, 105**
- SIP (session initiation protocol), 156, 168–171**
- sizing windows, 202**
- Skinny Client Control Protocol (SCCP), 98, 141, 169**
- slow start (TCP), 203**
- SMDI (Simplified Messaging Desk Interface) protocol, 228**
- SMDR (Station Message Detail Recorder), 50**
- Soft QoS, 183**
- softkeys (IP Phones), 124**
- Spanning Tree Protocol (STP), 67**
- speakers, frequency response, 39**



- speed dial buttons, 124, 136
- speed limits, setting on traffic, 207–214
- SRST (Survivable Remote Site Telephony), 106, 168
- SRTP (Secure Real-Time Transport Protocol), 141
- SS7 (Signaling System 7), 88
- Station Message Detail Recorder (SMDR), 50
- stations, connecting to, 71
- STP (Spanning Tree Protocol), 67
- streams, RTP, 157
- subscriber servers, 101
- Super Frame (SF), 77
- supervisory signaling, 12–15
- Survivable Remote Site Telephony (SRST), 106, 168
- sweet spots, sampling, 38
- switchback (MGCP), 168
- switches, 118, 201
 - CCM, 97–102
 - Ethernet, 19
 - hybrid phone, 11
 - phone, 5–6
 - ports, 121
 - redundancy, 65
- switchover (MGCP), 168
- synchronization, 203

T

- T1 interfaces, configuring, 77
- tail dropped packets, 185
- TCP (Transmission Control Protocol)
 - connect messages, 102
 - slow start, 203
 - synchronization, 203
- TDM (time-division multiplexing), 75
- telephones, replacing old with IP Phones, 117
- telephony
 - networks
 - key systems, 10*
 - overview of, 4–7*
 - PBX, 9–10*
 - PSTN, 7*
 - signaling, 11–23*
 - voice network designs, 23–29
- terminals, H.323, 161
- tertiary CCMs, 102
- thresholds, minimum, 204
- time-division multiplexing (TDM), 75
- Tip wires, 4
- token buckets, 209
- tones, call progress, 72
- ToS (type of service), 188
- touch tone dialing, 16

tracking, 110

- bandwidth, 158
- calls, 110

traffic

- bandwidth, 214–217
- busy hour, 50
- conditioners, 185, 207
- conforming, 209
- exceeding, 209
- marking, 187
- QoS, 181
- speed limits, 207–214
- violating, 211

traffic engineering, 49**trained ears, 48****transcoding resources, 135****Transmission Control Protocol.**

See TCP

Triple Data Encryption Standard (3DES), 141**troubleshooting**

- MTBF, 64
- MTTR, 64
- quantization, 40

trunks, 6, 124

- calculating, 51
- interoffice, 6
- replacing, 68–70

trust boundaries, 193**type of service (ToS), 188****types**

- of calls (H.323), 162–164
- of compression, 45
- of dialing, 15, 74
- of networks, 8
- of PHB, 189
- of signaling, 6, 11–23, 72

U–V

UACs (user agent clients), 169**UAs (user agents), 169****UASs (user agent servers), 169****undersampling, 37****unified messaging, 227–231****Unity (Cisco), 229**

- CCM integration, 230

- PBX integration, 231

UplinkFast, 67**User agent clients (UACs), 169****User agent servers (UASs), 169****user agents (UAs), 169****VAD (voice activity detection), 44****verification, identity, 140**



video

- CCM, 141–144
- MeetingPlace, 231
- violating traffic, 211**
- Virtual Router Redundancy Protocol (VRRP), 66**
- VLANs, auxiliary (IP Phones), 123**
- voice**
 - network design, 23–29
 - QoS, 186–193
- voice activity detection (VAD), 44**
- Voice Bandwidth Calculator, 45**
- voice intelligence, 39**
- voice mail services, 227–231**
- voice-enabled Ethernet switches, 19**
- Vonage, 87**
- VRRP (Virtual Router Redundancy Protocol), 66**

WFQ (Weighted Fair Queuing), 196

wide-area network. *See* WAN

windows, sizing, 202

wiring, telephony networks, 4

WRED (weighted random early detection), 185

WRED (Weighted RED), 175, 205

WRR (Weighted Round Robin), 201

XML (Extensible Markup Language), IP Phone support, 122

W–X

WAN (wide-area network)

- call processing model, 110
- oversubscriptions, 161
- waveforms, encoding, 42–49**
- web collaboration, MeetingPlace, 231**
- Weighted Fair Queuing (WFQ), 196**
- Weighted RED (WRED), 175, 205**
- Weighted Round Robin (WRR), 201**