Index

10G-EPON (10 Gbit/s Ethernet Passive Optical Network), 126–7
1G-EPON (see EPON)
2.5G, 144
2G (Second Generation), 143–5, 157, 176
3.9G, 145
3G (Third Generation), 104, 141–5, 147, 155, 174, 176
3GPP (3G Partnership Project), 25, 70, 82, 143–6
3GPP2, 162
4G (Fourth Generation), 24, 141–5, 153, 155, 157, 160–1, 174, 176
6LoWPAN (IPv6 based Low-power Wireless Personal Area Network), 283

A
AA, 96
AAA (Authentication, Authorization, and Accounting), 81, 95, 109, 110, 150, 158, 161, 233, 247–9
AAA client, 248–9
AAA server, 248–9
ABS (Advanced Base Stations), 158
AC (Access Categories), 173
Access Edge Sites (AES), 128
Access Network (AN), 89, 93, 167, 192, 211, 215–16, 301
Acknowledgement (ACK), 35–41
ACS (Access Call Server), 304–5
AD (Adaptation Functions), 304

Admission control, 91, 181–2, 190, 194–5, 202–3, 213–5, 269, 275
ADSL (Asymmetric Digital Subscriber Line), 5, 103, 105–11
ADSL modem, 110
ADSL router, 111
ADSL2, 108
ADSL2+, 108
AF (Application Function), 148, 196, 231
AG (Access Gateway), 302–3, 305
aGP (Adaptive Granting and Polling), 158
AH (Authentication Header), 310
Alternative operators, 137, 329
AM-FE (Access Management Functional Entity), 95
AMR (Adaptive Multi-Rate codec), 158, 262
AMS (Advanced Mobile Stations), 158
ANI (Application-Network Interface), 88, 91, 221, 255, 277, 307
ANI/SNI interworking function, 255
ANR (Automatic Neighbor Relation), 156
ANSI (American National Standardization Institute), 106
Anycast, 51, 310
AON (Active Optical Network), 118, 127
AP (Access Point), 168
API (Application Programming Interface), 221, 280
APN (Access Point Name), 173
Application interface provisioning function, 256
Application provider, 290
Application Server (AS), 152, 163
AR (Available Rate), 206, 208–9
A-RACF (Access-network Resource and Admission Control Function), 215
AR-FE (Access Relay Functional Entity), 96
ARP (Address Resolution Protocol), 43–4, 198
ARPANET, 17, 18
ARS (Available Rate Service), 206–8
AS number, 56, 65
ASF (Application Support Functions), 222, 228, 230, 279
AS-FE (Application Server Functional Entity), 230, 252
ASN (Access Service Network), 157, 158
ASN-GW (Access Service Network Gateway), 158
ATM (Asynchronous Transfer Mode), 19, 110, 145, 186
ATM-PON (ATM Passive Optical Network), 119, 120
AuC (Authentication Center), 148, 163
Autonomous System (AS), 56, 65, 80, 286
BM-SC (Broadcast Multicast Service Center), 173
BPON (Broadband Passive Optical Networks), 119–20
BPSK (Binary Phase Shift Keying), 142
BR (Bandwidth Request), 158
BRAS (Broadband Remote Access Server), 109–11
Bridge, 21
Broadband access, 2, 19, 71, 73, 103, 105, 135–7, 297–8, 328, 329
Broadband Internet, 70, 103
Broadband market, 136–7
Broadband services, 135–6
Broadband strategy, 105
Browser, 62
BS (Base Station), 146
BT (Burst Tolerance), 209
B-tag, 201
Business challenges, 327–9
Business models, 24, 225, 293–8
Business users, 136, 213
Business, 134, 157, 175, 177–8, 293, 327, 329–30
Busy-hour, 8

B
BCS (Breakout Call Server), 304–5
BE (Best-Effort in WiMAX), 158
Bearer, 148–9, 151–2, 173
Bellman-Ford, 55
Best-effort IPTV, 295, 297
Best-effort VoIP, 294, 297
Best-effort, 20, 22, 23, 39, 60, 69, 74, 85, 91, 97, 133, 182, 203
BGCF (Breakout Gateway Control Function), 163
BG-FE (Border Gateway Functional Entity), 215
BGP (Border Gateway Protocol), 57, 286, 307, 313
BGW (Border Gateway), 231
Bitstream access, 137
BitTorrent, 63, 65
Bluetooth, 283, 289, 292

C
Cable network, 105, 111–14, 211
CableLabs, 112–14, 162
CAC (Connection Admission Control), 200, 202, 216
Call Server, 302–4
CAP (Carrierless Amplitude Phase modulation), 107–8
CAPEX (Capital Expenditures), 229
Carrier aggregation, 153–4, 159, 317
Carrier ENUM, 98
Carrier Ethernet, 122, 128–9, 199
CBS (Committed Burst Size), 201
CD (Change/Direction), 206, 208
CD&LCF (Content Delivery and Location Control Functions), 272
CD&SF (Content Delivery and Storage Functions), 272–3
CDF (Content Delivery Functions), 91, 92, 232, 271–3, 275
Index

CDM (Code Division Multiplexing), 13
CDMA (Code Division Multiple Access), 13
Cdma2000, 146, 161, 176
CDN (Content Delivery Network), 295
CEA (Capabilities-Exchange-Answer), 238
Centralized P2P, 60
CER (Capabilities-Exchange-Request), 238
CES (Circuit Emulation Service), 131
CGN (Carrier-Grade NAT), 320
CGOE (Carrier Grade Open Environment), 307–12
CH (Charging information field), 208
CIDR (Classless Inter-Domain Routing), 44, 286
CIR (Committed Information Rate), 201
Circuit-switched networks, 7
Classful addressing, 44, 45
Classless addressing (see CIDR)
Client-server, 23, 58, 60, 62, 64, 85, 105
Cloud computing, 75, 257, 324–6, 330
CMTS (Cable Modem Termination System), 113
CO (Central Office), 117, 127
CoA (Care-of-Address), 95, 168, 318
Coaxial cable, 105
Community-based VPN, 287
Congestion avoidance, 38–9
Congestion control, 38–9, 42, 202
Congestion window (cwnd), 39
Congestion, 38
Constrained device, 290–1
Content provider, 270
Content, 297
Context-aware computing, 325–6
Control plane, 87, 88, 146, 175, 215
Converged Web services, 277
Conversational services, 23–4
Core Network (CN), 89, 93, 167, 192, 211, 213, 215–17
CoS (Class of Service), 199–200
COTS (Commercial-Of-The-Shelf), 307–9
CPE (Customer Premises Equipment), 95, 195, 202, 215
CPN (Customer Premises Network), 211
CPU (Central Processor Unit), 321, 323, 325
C-RACF (Core-network Resource and Admission Control Function), 215
Credential, 251
CR-LDP (Constraint-based Label Distribution Protocol), 194
CS (Circuit-Switching), 252, 253
CSCF (Call Session Control Function), 162, 171, 250
CSC-FE (see CSCF)
CSG (Closed Subscriber Group), 155
CSN (Connectivity Service Network), 157–8, 211
CTIF (Communication Telephony Integration Function), 231
Customer network, 93

D
DARPA (Defense Advanced Research Projects Agency), 17–18, 65
Datagram, 30, 36, 44
DCCP (Datagram Congestion Control Protocol), 315, 317
DECT (Digital Enhanced Cordless Telecommunications), 160
Demarcation points, 211–2
Device provider, 290
DHCP (Dynamic Host Configuration Protocol), 18, 46–48, 51, 59, 82, 94, 95, 111, 149, 158
Diameter architecture, 239
Diameter AVP (Attribute-Value Pair), 235–6, 239
Diameter messages, 237
Diameter nodes, 238
Diameter PDU (Protocol Data Unit), 234
Diameter protocol, 81, 95, 164, 233–40, 248, 263, 306
Diameter Proxy agent, 238
Diameter Redirect agent, 238
Diameter Relay agent, 238
Diameter routing algorithm, 239
Diameter routing table, 240
Diameter sessions, 238
Diameter Translation agent, 239
DiameterURI, 237
Differentiated Service (see DiffServ)
<table>
<thead>
<tr>
<th>Term</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DiffServ</td>
<td>182, 194, 202, 214, 216, 217</td>
</tr>
<tr>
<td>Digital dividend</td>
<td>176</td>
</tr>
<tr>
<td>Digital signals</td>
<td>5</td>
</tr>
<tr>
<td>Dijkstra algorithm</td>
<td>56</td>
</tr>
<tr>
<td>Direct tunnel</td>
<td>146</td>
</tr>
<tr>
<td>Distance vector</td>
<td>55–6</td>
</tr>
<tr>
<td>DMT (Discrete Multi-Tone)</td>
<td>106–8</td>
</tr>
<tr>
<td>DMT modulation</td>
<td>107</td>
</tr>
<tr>
<td>DNS (Domain Name System)</td>
<td>17, 18, 34, 43, 49–51, 59, 65, 81, 94, 97–9, 101, 163, 164, 191, 276, 319, 320</td>
</tr>
<tr>
<td>DOCSIS (Data-Over-Cable Service Interface Specifications)</td>
<td>112–14</td>
</tr>
<tr>
<td>DOCSIS 1.0</td>
<td>113</td>
</tr>
<tr>
<td>DOCSIS 1.1</td>
<td>113</td>
</tr>
<tr>
<td>DOCSIS 2.0</td>
<td>113</td>
</tr>
<tr>
<td>DOCSIS 3.0</td>
<td>113</td>
</tr>
<tr>
<td>Domain name</td>
<td>43, 49–50</td>
</tr>
<tr>
<td>DoS (Denial of Service)</td>
<td>42</td>
</tr>
<tr>
<td>DP (Delay Priority)</td>
<td>208</td>
</tr>
<tr>
<td>DPA (Disconnect-Peer-Answer)</td>
<td>238</td>
</tr>
<tr>
<td>DPR (Disconnect-Peer-Request)</td>
<td>238</td>
</tr>
<tr>
<td>DSCP (DiffServ Code Point)</td>
<td>215, 216</td>
</tr>
<tr>
<td>DSL (Digital Subscriber Line)</td>
<td>5, 70, 104–5, 108, 160, 211, 306</td>
</tr>
<tr>
<td>DSLAM (Digital Subscriber Line Access Multiplexer)</td>
<td>106–10, 305</td>
</tr>
<tr>
<td>DSMIPv6 (Dual-stack MIPv6)</td>
<td>150</td>
</tr>
<tr>
<td>DS-TE (DiffServ-enabled MPLS Traffic Engineering)</td>
<td>194, 216</td>
</tr>
<tr>
<td>DTLS (Datagram Transport Layer Security)</td>
<td>234, 238</td>
</tr>
<tr>
<td>DTMF (Dual-Tone Multi Frequency)</td>
<td>262</td>
</tr>
<tr>
<td>Dual-stack NGN</td>
<td>320</td>
</tr>
<tr>
<td>Duplicate ACK</td>
<td>40</td>
</tr>
<tr>
<td>DVB-T (Digital Video Broadcasting - Terrestrial)</td>
<td>104, 176, 294</td>
</tr>
<tr>
<td>DWA (Device-Watchdog-Answer)</td>
<td>238</td>
</tr>
<tr>
<td>DWDM (Dense WDM)</td>
<td>118, 119</td>
</tr>
<tr>
<td>DWR (Device-Watchdog-Request)</td>
<td>238</td>
</tr>
<tr>
<td>EDGE (Enhanced Data rates for Global Evolution)</td>
<td>144, 146</td>
</tr>
<tr>
<td>EEC (Ethernet Equipment slave Clock)</td>
<td>134</td>
</tr>
<tr>
<td>EFM (Ethernet in the First Mile)</td>
<td>119, 122</td>
</tr>
<tr>
<td>EFMA (Ethernet in the First Mile Alliance)</td>
<td>122</td>
</tr>
<tr>
<td>E-health</td>
<td>289</td>
</tr>
<tr>
<td>EIR (Excess Information Rate)</td>
<td>201</td>
</tr>
<tr>
<td>E-LAN (Ethernet LAN)</td>
<td>129, 132–3, 199</td>
</tr>
<tr>
<td>E-Line (Ethernet Line)</td>
<td>129, 130, 132–3, 199</td>
</tr>
<tr>
<td>E-mail (Electronic mail)</td>
<td>1, 20, 34, 36, 59, 60–1, 91, 97, 98, 133, 159</td>
</tr>
<tr>
<td>E-mail address</td>
<td>165, 242</td>
</tr>
<tr>
<td>E-MBMS (Evolved Multicast and Broadcast Multimedia System)</td>
<td>173</td>
</tr>
<tr>
<td>Emergency services</td>
<td>175, 297</td>
</tr>
<tr>
<td>Emergency telecommunications</td>
<td>90</td>
</tr>
<tr>
<td>Emulation (of PSTN/ISDN)</td>
<td>123, 125, 131, 301, 304–5</td>
</tr>
<tr>
<td>E-NNI (Ethernet Network-Network Interface)</td>
<td>199–201</td>
</tr>
<tr>
<td>eNodeB</td>
<td>148, 149, 152, 156, 173</td>
</tr>
<tr>
<td>ENUM, 50–1, 97–100, 163, 164</td>
<td></td>
</tr>
<tr>
<td>EPC (Evolved Packet Core)</td>
<td>146–9</td>
</tr>
<tr>
<td>E-PHB (Ethernet Per Hop Behavior)</td>
<td>202</td>
</tr>
<tr>
<td>EPL (Ethernet Private Line)</td>
<td>129</td>
</tr>
<tr>
<td>EP-LAN (Ethernet Private LAN)</td>
<td>129, 133</td>
</tr>
<tr>
<td>EPON (Ethernet Passive Optical Network)</td>
<td>119, 120, 121–3, 126, 127</td>
</tr>
<tr>
<td>EPS (Evolved Packet System)</td>
<td>148, 152, 173</td>
</tr>
<tr>
<td>ePTPS (extended real-time Polling Service)</td>
<td>173</td>
</tr>
<tr>
<td>ESP (Encapsulated Security Payload)</td>
<td>310</td>
</tr>
<tr>
<td>E-Tree (Ethernet Tree)</td>
<td>129, 132–3, 199</td>
</tr>
<tr>
<td>ETSI (European Telecommunication Standardization Institute)</td>
<td>80, 82</td>
</tr>
<tr>
<td>E-UNI (Ethernet User-Network Interface)</td>
<td>198–201</td>
</tr>
<tr>
<td>Euro DOCSIS</td>
<td>113</td>
</tr>
<tr>
<td>E-UTRA (Evolved UMTS Terrestrial Radio Access)</td>
<td>148</td>
</tr>
</tbody>
</table>
Index

E-UTRAN (Evolved UMTS Terrestrial Radio Access Network), 148, 150, 155, 156, 173
EVC (Ethernet Virtual Connection), 129, 133–4, 199, 200
EVPL (Ethernet Virtual Private Line), 129, 133
EVP-LAN (Ethernet Virtual Private LAN), 129, 133
EVP-Tree (Ethernet Virtual Private Tree), 129, 133
Ex-ante regulation, 135, 136, 178
Exchange (in PSTN), 4, 7, 301–2
Ex-post regulation, 135

F
FA (Flow Aggregate), 203–5
Fast recovery, 38, 41
Fast retransmit, 38, 41
FDD (Frequency Division Duplex), 153
FDM (Frequency Division Multiplexing), 13
FDMA (Frequency Division Multiple Access), 13, 144
Femtocell, 153, 155, 159–60
FG-NGN (Focus Group on Next Generation Networks), 75
FIE-FE (Flow-aware Information Exchange Functional Entity), 203, 205–6
FIFO (First In First Out), 204
FIG-FE (Flow-aware Information Gathering Functional Entity), 203, 205–6
FIM-FE (Flow-aware Information Management Functional Entity), 203, 205–6
Firewall, 163
Fixed broadband, 70, 105, 122, 159, 178, 329
Flow control, 38
Flow Label, 32, 203, 310
FMC (Fixed-Mobile Convergence), 71, 78, 155, 160–1, 229, 252, 253, 329
Foreign Agent, 95
Four-market model, 184
FQDN (Fully Qualified Domain Name), 237, 243, 276
Frequency bands, 142, 153–4, 173, 176
FSA (Flow-State-Aware), 203, 206–10, 215
FSA header, 207
FSD (Flow Sender Depth), 209
FTP (File Transfer Protocol), 18, 34, 36, 59, 60, 61–2, 81, 97, 186
FTTB (Fiber To The Building), 125
FTTC/FTTCab (Fiber To The Curb or Cabinet), 125
FTTCell (Fiber To The Cell), 125
FTTH (Fiber To The Home), 104, 115–19, 124
FTTO (Fiber To The Office), 125
Fully-fledged device, 290–1

G
G.DMT, 106
G.Lite, 106
Gaming, 152, 158
GAN (Generic Access Network), 160
Gateway Sites (GWS), 127
GBR (Guaranteed Bit Rate), 152
GCS (Gateway Call Server), 304–5
Generalized mobility, 78, 161
GERAN (GSM EDGE Radio Access Network), 149, 173
GGSN (Gateway GPRS Support Node), 144, 146
GIWF (Generic Inter-Working Function), 132
GMPLS (Generalized Multi-Protocol Label Switching), 128
GMSK (Gaussian Minimum Shift Keying), 144
GPI (Grant Polling Interval), 158
GPON (Gigabit-capable Passive Optical Networks), 119–21, 124, 125, 126
G-PON (see GPON)
GPRS (General Packet Radio System), 144, 145, 146, 161, 173
GPS (Global Positioning System), 134
GPU (Graphic Processor unit), 325
GR (Guaranteed Rate), 206, 208, 209
GRUU (Globally Routable User Agent URI), 165
GSM (Global System for Mobile communication), 141, 143, 144, 161, 163, 176
GTP (GPRS Tunneling Protocol), 150
GTP-C (GTP Control plane), 150
GTP-U (GTP User plane), 150

H
H.248, 305
H.323, 99
Handover, 143, 148, 149, 169
HCF (Handover Control Functions), 169, 171
HDTV (High Definition TV), 295
Header Checksum, 31
HeNB (Home eNodeB), 155
HFC (Hybrid Fiber-Coaxial), 114
HGWC-FE (Home Gateway Configuration Functional Entity), 96
Hierarchical routing, 55–6
HIP (Host Identity Protocol), 252, 319
HIT (Host Id Tags), 252
HLR (Home Location Register), 163
HM (Handover Management), 170–1
HNB (see HeNB)
Home Address, 95
Horizontal handover, 90, 166, 266
HSDPA (High Speed Downlink Packet Access), 145
HSPA (High Speed Packet Access), 174
HSS (Home Subscriber Server), 147, 148, 163, 164, 250, 268
HSUPA (High Speed Uplink Packet Access), 145
HTML (Hypertext Markup Language), 62
HTTP (Hypertext Transfer Protocol), 18, 59, 61, 62–3, 65, 97, 161, 186, 276, 280, 291
Hub, 21
Hybrid P2P, 60

I
IaaS (Infrastructure as a Service), 325
IAB (Internet Architecture Board), 65
IANA (Internet Assigned Numbers Authority), 46, 56, 65, 236
IBCF (Interconnection Border Control Function), 163
ICANN (Internet Corporation for Assigned Names and Numbers), 44, 46, 65
ICMP (Internet Control Message Protocol), 31
ICS (IMS Call Server), 304, 305
I-CSCF (Interrogating - Call Session Control Function), 162–5, 228, 252, 267–9
I-CSC-FE (see I-CSCF)
ICT (Information and Communication Technologies), 1, 17, 24, 25, 64, 69, 73, 178
Identifier, 251
Identity information, 251
Identity Management (IdM), 78, 91, 92, 250
IdSP (Identity Service Provider), 251–2
ID-WSF (Identity Web Services Framework), 252
IEEE (Institute of Electrical and Electronics Engineers), 25, 80, 82, 119, 121, 123, 143
IETF (Internet Engineering Task Force), 12, 17, 25, 29, 51, 65, 78, 79, 80–1, 182, 216, 240
IGMP (Internet Group Management Protocol), 273
IMAP4 (Internet Message Access Protocol-version 4), 61
IMEI (International Mobile Equipment Identity), 249
IMPU (IP Multimedia Public Identity), 165
IMS evolution to NGN, 303–4
IMS-based IPTV, 271, 275
IMS-based service creation environment, 330
IMSI (International Mobile Subscriber Identity), 97, 161, 167
IM-SSF (IP Multimedia Service Switching Function), 163
IMT spectrum, 177
IMT-2000 (International Mobile Telecommunications - 2000), 104, 141–2, 176
IMT-Advanced, 24, 141–3, 145, 152–3, 176
Incumbent operator, 73, 329
Infrastructure, 136–7
INNI (Internal Network-Network Interface), 93–4
Integrated Services (see IntServ)
Intelligent transportation system, 289
Inter-AN MM, 167
Inter-AS routing, 57
Inter-CN MM, 167
Interference, 142
Internet architecture, 29
Internet governance, 65–6
Internet services, 59
Internet TV (see best-effort IPTV)
Internet, 2, 16–7, 19, 23–4, 45–8, 51, 60, 69, 70, 72, 83, 85, 96, 145, 178, 182, 185, 321
Intra-AN MM, 167
Intra-AS routing, 57
IntServ, 182, 216–7
IoT (Internet of Things), 24, 285, 288–90, 295, 318
IoT ecosystem, 296
IoT services, 293
IP address, IP addressing, 35, 43–8, 51, 54, 58, 65, 96, 97, 149, 164, 168, 191–2, 199, 200, 203, 214, 243, 268
IP interconnection, 307
IP network, 52, 53, 56, 74, 95, 217, 306, 320
IP telephony, 241
IP-CAN (IP Connectivity Access Network), 149–50
IPDV (IP packet Delay Variation), 187
IPER (IP packet Error Ratio), 187
IPLR (IP packet Loss Ratio), 187
IPsec, 234, 249, 310, 322
IPTD (IP packet Transfer Delay), 186, 187
IPTV (IP Television), 23, 24, 34, 73, 74, 75, 77, 82, 83, 85, 91, 151, 159, 172, 173, 187, 195, 203, 210, 231–2, 257, 269–73, 278, 294
IPTV functional architecture, 270, 271, 273
IPTV over NGN, 276
IPTV p2p (peer-to-peer), 273, 274
IPTV services, 294–5, 330
IPv4-based NGN, 310, 320
IPv4-to-IPv4 tunneling, 320
IPv6 (Internet Protocol version 6), 18, 31, 33, 43, 44, 52, 79, 97, 149, 192, 194, 203, 209, 210, 214, 216, 217, 310, 312, 317, 320–1
IPv6 address, IPv6 addressing, 33, 51, 313, 314, 315, 316, 320
IPv6-based NGN, 310, 312–16, 318, 320
IRTF (Internet Research Task Force), 65
ISC (IMS Service Control), 164
ISDN (Integrated Services Digital Network), 5, 97, 121, 186, 301–4
ISIM (IM Service Identity Module), 97, 99
ISOC (Internet Society), 65
ISP (Internet Service Provider), 46, 73, 135
ISUP (ISDN User Part), 11, 163, 305
I-tag, 130, 201
ITF (IPTV Terminal Functions), 271, 275
ITU (International Telecommunication Union), 3, 24, 25, 51, 66, 69, 79, 80, 103, 119, 123, 141, 157, 162, 200, 301
ITU-D (ITU-Development), 3, 103, 105
ITU-R (ITU-Radiocommunications), 3, 103, 104–5, 141, 142, 143, 145, 152, 176
IVR (Interactive Voice Response), 231
IVVR (Interactive Voice and Video Response), 231

J
Jitter, 262, 266
JRG-NGN (Joint Rapporteur Group on Next Generation Networks), 75

L
LAN (Local Area Network), 22, 30, 122, 161, 200
Latency, 142, 143, 160, 262
LBS (Location-Based Services), 174, 326
LCS (Location Service), 174
Leased lines, 129, 137, 186, 211
Legacy Web services, 277
Legal interception of VoIP, 297
LER (Label Edge Router), 213, 215–6
LID (Location ID), 168
Link state, 55, 56
LINP (Logically Isolated Network Partitions), 321–4
LIPA (Local IP Access), 155
LLU (Local Loop Unbundling), 136, 137
LM (Location Management), 169, 170, 171
LMA (Local Mobility Anchor), 149
Local loop, 4, 7
LSP (Label Switching Path), 194, 213–7
LSR (Label Switching Router), 213
LTE (Long Term Evolution), 104, 143–6, 148–50, 152–6, 161, 173

M
MAC (Medium Access Control), 21, 30, 154, 198, 200
MAG (Mobile Access Gateway), 149
MAN (Metropolitan Area Network), 22, 30
Management plane, 87
Mash-up service, 291
MBMS (Multicast and Broadcast Multimedia System), 173–4
MBMS-GW (Multicast and Broadcast Multimedia System Gateway), 173
MBSFN (MBMS Single Frequency Network), 173
MCC (Multimedia Communication Centre), 231
MCDF (Multimedia Call Distribution Function), 231
MDF (Main Distribution Frame), 305
MDS (Managed Delivery Services), 224, 225, 226, 227, 228, 229
MDS AoS (Always on Service), 226, 227
MDS ODS (On-Demand Service), 226, 227
MDS PSS (Pre-Scheduled Service), 226, 227
MDU (Multi-Dwelling Unit), 125
Media clouds, 325
MEF (Metro Ethernet Forum), 122, 128, 129
MEN (Metro Ethernet Network), 128, 131, 132, 133, 134
Metadata, 273
Metro Ethernet, 22, 83, 128, 131, 133
MRFP (Multimedia Resource Function Processor), 163
MG (Media Gateway), 114
MGCF (Media Gateway Controller Function), 163
MIH (Media Independent Handovers), 170, 253
MIME (Multipurpose Internet Mail Extensions), 61
MIMO (Multiple Input Multiple Output), 142, 145, 153, 160
MLD (Multicast Listener Discovery), 273
MLM-FE (Mobility Location Management Functional Entity), 169
MM (Mobility Management), 165–71
MMCF (Mobility Management Control Function), 90, 94, 167–9, 190
MME (Mobility Management Entity), 147, 148, 149, 173
MMoP (Multimedia over IP), 277
MMS (Multimedia Messaging Service), 147, 175
MMSC (Multimedia Service Continuity), 253
Mobile backhaul, 131–3
Mobile broadband, 71–2, 82, 104, 141, 172, 175–8, 194, 329
Mobile IP (MIP), 95, 149, 158, 168, 170, 252–3, 319, 322
Mobile IPv4 (MIPv4) (see Mobile IP)
Mobile IPv6 (MIPv6), 150, 158, 252, 317, 322
Mobile operator, 134, 157
Mobile TV, 172, 175
Mobile VoIP, 294
Mobile WiMAX 1.0, 104, 156, 157, 161
Mobile WiMAX 2.0, 104, 143, 157–9, 160, 161
MOS (Mean Opinion Score), 189
MPCP (Multi-Point Control Protocol), 122, 127
MPEG (Moving Pictures Experts Group), 172, 266
MPEG-2, 172, 266
MPEG-4, 172, 266
MPLS (Multi-Protocol Label Switching), 83, 86, 110, 118, 182, 194, 200, 201, 202, 205, 213–17, 286
MPLS/BGP, 286
MPLS-TE (MPLS with Traffic Engineering), 216
MPM (Management for Performance Measurement), 190, 210, 213
MPM (Measurement of Performance Management), 194
MRC-FE (Media Resource Control Functional Entity), 230, 231
MRF (Multimedia Resource Function), 163
MRFC (Multimedia Resource Function Controller), 163
MRS (Maximum Rate Service), 206
MS (Mobile Station), 157
MSAG (Multi Service Access Gateway) (see MSAN)
MSAN (Multi Service Access Nodes), 305–6
MSISDN (Mobile Subscriber Integrated Services Digital Network number), 97, 161
MTP (Message Transfer Part), 11
MTU (Multi-Tenant Unit), 125
Multicast, 44, 52, 173, 190, 272, 273
Multicast-based IPTV, 273
Multihoming, 42–3, 312–17
Multistreaming, 42–3
MUP (Mobile User Part), 11
MVNO (Mobile Virtual Network Operator), 325
N
NaaS (Network as a Service), 325
NACF (Network Attachment Control Functions), 90–1, 94–6, 190, 192, 215, 248, 275, 284, 315
NAC-FE (Network Access Configuration Functional Entity), 94, 95
Name servers, 50
Napster, 63
NAPT (Network Address and Port Translation), (see NAT)
NAR (Naming-numbering and Address Resolution), 99
NAS (Non-Access Stratum), 147
NAT (Network Address Translation), 32, 46, 47, 91, 111, 163, 192
NAT-PT (Network Address Translation - Protocol Translation), 320
NCP (Network Control Program), 17
Network architecture, 59, 307
Network interface, 54
Network mobility, 166
Network operators, 72, 79, 135
Network providers, 24, 270, 290, 297, 328
Network virtualization, 321–4, 329
Next Header, 32, 209–10, 312–3
NGA (Next Generation Access), 127, 135, 306, 328
NGN (Next Generation Networks), 1, 23–5, 69–74, 75–80, 83, 85–6, 88, 92–5, 97–9, 125, 148, 161, 165, 167–8, 181–2, 185, 188–92, 197–203, 206,
NGN (Next Generation Networks)  
(continued)  
211–13, 215–17, 301–3, 306–8,  
324, 326, 327, 330  
NGN applications, 310  
NGN migration, 329–30  
NGN operator, 98, 268, 269  
NGN provider, 224, 290, 296, 328  
NGN standardization, 76, 81, 82  
NGN-GSI (Next Generation Network  
Global Standards Initiative), 76  
NG-PON (Next Generation Passive Optical  
Networks), 125  
NG-PON1, 123, 126  
NG-PON2, 123, 126  
NNI (Network-Network Interface), 88, 92,  
93, 94, 307  
NodeB, 145  
Nomadism, 166  
Non-real-time services, 23  
NOS (Network Operating System), 326  
NRA (National Regulatory Agency), 185  
nrtPS (non-real-time Polling Service), 158  
NSFNET, 18  
NTP (Network Time Protocol), 134  

O  
OAM (Operation and Maintenance), 198,  
199  
OASIS (Organization for the Advancement  
of Structured Information Standards),  
224  
OCF (Overload Control Function), 231  
ODN (Optical Distribution Network), 117,  
119, 124  
OFDMA (Orthogonal Frequency Division  
Multiple Access), 145, 159, 160  
OGSA (OMA Global Service Architecture),  
224  
OLT (Optical Line Termination), 117–23,  
126  
OMA (Open Mobile Alliance), 175, 224  
ONT (Optical Network Termination),  
117–23  
ONU (Optical Network Unit), 117–19, 121,  
126  
OpenFlow, 326–7  
OpenID, 252  
OPEX (Operational Expenditure), 189, 229  
OSA (Open Service Access), 163, 224  
OSE (Open Service Environment), 221–4,  
329  
OSI (Open System for Interconnection), 11,  
20, 21  
OSPF (Open Shortest Path First), 57, 194  
Outage, 143  

P  
PaaS (Platform as a Service), 325  
PacketCable 1.0 and 1.5, 114  
PacketCable 2.0, 115  
PacketCable multimedia, 114  
PacketCable, 113, 114  
PBB (Provider Backbone Bridges), 130, 201  
PBX (Public Branch eXchange), 302  
PCC (Policy and Charging Control), 148,  
190  
PCC-FE (Policy and Charging Control  
Functional Entity), 278  
PCEF (Policy and Charging Enforcement  
Function), 148, 150  
PCM (Pulse Code Modulation), 7, 8, 15,  
262  
PCR (Policy and Charging Rules  
Function), 148, 150, 196, 197  
P-CSCF (Proxy - Call Session Control  
Function), 162, 164, 228, 267–9  
P-CSC-FE (see P-CSCF)  
PD-FE (Policy Decision Functional Entity),  
190, 191, 192, 195, 196, 213, 214,  
215  
PDH (Plesiochronous Digital Hierarchy),  
14, 72, 73, 134, 186  
PEC (Packet-based Equipment Clock),  
134  
Peering-network trust model, 247  
Peer-to-Peer (P2P), 1, 18, 19, 59, 63, 64, 81,  
159, 175  
PE-FE (Policy Enforcement Functional  
Entity), 190, 191, 192, 195, 215  
Performance measurements, 211, 212  
Personal end-to-end VPN, 287
Personal mobility, 166
P-GRUU (Public - Globally Routable User
Agent URI), 165
P-GW (Packet Data Network Gateway),
148, 149, 150, 152
PHB (Per Hop Behavior), 202
PII (Personally Identifiable Identifiers), 251
PLMN (Public Land Mobile Network), 1, 6,
12, 23, 69, 70, 73, 75, 79, 83, 84, 96,
97, 98, 101, 129, 137, 181, 185, 261
PME-FE (Performance Measurement
Execution Functional Entity), 213
PMIPv6 (Proxy Mobile IPv6), 149, 150,
317
PMP-FE (Performance Measurement
Processing Functional Entity), 213
PMR-FE (Performance Measurement
Reporting Functional Entity), 213
PoA (Points of Attachment), 319
Point-to-multipoint fiber, 117–8, 123
Point-to-point fiber, 117–8, 123
Policy makers, 135
PON (Passive Optical Network), 118, 120,
123, 126, 160, 211
POP3 (Post Office Protocol-version 3), 61,
186
Port number, 34, 35, 43, 47, 58, 192, 203,
214, 317
Portability, 166
POTS (Plain Old Telephone Service), 106,
121, 125, 185, 261, 301
PP (Preference Priority), 206, 208
PPP (Point-to-Point Protocol), 95, 96,
110
PPPoE (PPP over Ethernet), 110–11
PRC (Primary Reference Clock), 134
Price-cap, 137
Private IP address, 47, 95
Provider bridges, 130, 201
PS (Packet-Switching), 252, 253
PSI (Public Service Identity), 165
PSTN (Public Switched Telephone
Network), 5–6, 8–9, 12, 14, 23, 51,
69–70, 73–5, 79, 82, 83, 84, 96, 97,
98, 101, 106, 125, 129, 137, 161, 181,
185, 261, 301–4
Public IP address, 47
Pull services, 174
Pure P2P, 60
Push services, 175
PVR (Personal Video Recorder), 271
PWC-FE (Proxy Web Control Functional
Entity), 279
Q
QAM (Quadrature Amplitude Modulation),
108, 142, 145
QCI (QoS Class Identifiers), 152
Q-in-Q network, 130, 201
QoE (Quality of Experience), 188
QoS (Quality of Service), 22, 23, 31, 32,
77–8, 91, 96, 129, 143, 149, 150,
151, 152, 158–9, 171, 172, 173,
181–4, 188–93, 195, 197–200,
202–4, 206–11, 213–17, 261–7, 310
QoS class, 187, 200, 268
QoS management, 183
QoS parameters, 187
QoS regulation, 185
QoS-enabled VoIP, 266–9, 294, 297, 330
Q-tag, 130
R
RACF (Resource and Admission Control
Function), 90, 91, 94, 189, 190–3,
195, 197, 200, 202, 206, 210,
213–17, 248, 269, 275
RADIUS (Remote Authentication Dial In
User Service), 95, 109–10, 158,
233–4, 248
RAN (Radio Access Network), 133–4, 144
RAN-CE (Radio Access Network Customer
Equipment), 131–3
RARP (Reverse Address Resolution
Protocol), 198
RCS (Routing Call Server), 304
Realm, 99, 240
Real-time services, 23
Receiver Report (RR), 265
Regulation of IPTV, 297
Index

Regulation, 135–7, 157, 178, 184, 293, 296–98, 329
Regulator, 135–7, 178, 329
Relays, 160
Reliability, 129, 188, 189, 315
Repeater, 21
Residential users, 136, 213
Resolver, 50
Resource records, 50
Retail markets, 136–7, 296
Retail pricing/prices, 135, 137
RFC (Request For Comment), 17
RFID (Radio-Frequency Identification), 285
RIP (Routing Information Protocol), 57, 194
RIR (Regional Internet Registry), 46
RLC (Radio Link Control), 154
RNC (Radio Network Controller), 143, 148
Roaming, 156
Router, 21, 45, 52, 55, 194
Routing algorithm, 53, 54, 55
Routing protocol, 54
Routing table, 53–5
Routing, 52
RSVP (Resource Reservation Protocol), 202, 216–7
RSVP-TE (Resource Reservation Protocol for MPLS Traffic Engineering), 194, 216–7
RTCP (RTP Control Protocol), 263, 265–6
RTCP header, 265
RTO (Retransmission timeout), 40
RTP (Real-time Transport Protocol), 172, 186, 241, 263–6
RTP header, 264
rtPS (real-time Polling Service), 158, 173
RTT (Round Trip Time), 39, 40, 123
RUAM (Remote User Access Module), 301–2

SAE (System Architecture Evolution), 82, 145–52, 163
SAML (Security Assertion Markup Language), 251, 252
SBC (Session Border Controller), 163, 215, 216, 250
SCCP (Signaling Connection Control Part), 11
SCF (Service Control Function), 91–2, 94–5, 170–1, 189, 190, 192, 195–7, 200, 202, 206, 210, 215, 217
SC-FDMA (Single Carrier FDMA), 145, 160
SCMF (Software Control Management Function), 231
SCP (Signal Control Point), 10
S-CSCF (Service - Call Session Control Function), 101, 162–5, 228, 252, 267–9
S-CSC-FE (see S-CSCF)
SCTP (Stream Control Transmission Protocol), 41–2, 81, 163, 313, 315–6
SDH (Synchronous Digital Hierarchy), 15–6, 119, 134, 186
SDN (Software Defined Networking), 324, 326–8, 330
SDP (Session Description Protocol), 241
SDTV (Standard TV), 270, 295
Security mechanisms, 247
Security, 78
Self-Organizing Network (SON), 156, 160
Sender Report (SR), 265
Service continuity, 166, 252
Service discontinuity, 166
Service mobility, 166
Service providers, 24, 72, 79, 225, 270, 297, 308, 328
Service stratum, 74, 85–8, 91–2, 94, 99, 148, 162, 170–1, 185, 190, 192, 200, 213, 278, 284, 306
SG (Signaling Gateway), 302–3, 305
SGSN (Serving GPRS Support Node), 144, 146
S-GW (Serving Gateway), 148–50, 152, 163

S
S1 interface, 149
S5/S8 interface, 148, 150
SAA-FE (Service Authentication Authorization Functional Entity), 171
SaaS (Software as a Service), 325
Index

S-HC-FE (Handover Control Functional Entity in the Service stratum), 171
Signaling network, 9, 302
Signaling protocol, 241, 263
Signaling, 4, 9, 24, 182, 203, 206, 210, 267
Significant market power, 298
SIGTRAN (Signaling Transmission), 12, 305
Simulation (of PSTN/ISDN), 125, 162, 301, 304–5
Single-network trust model, 247
SIP (Session Initiation Protocol), 12, 19, 24, 25, 64, 74, 79, 81, 82, 97, 99, 114, 115, 161, 162, 163, 164, 182, 233, 240–7, 263, 304, 305, 306
SIP Call ID, 241
SIP functions, 242
SIP Location service, 244
SIP messages, 241–2
SIP network elements, 243
SIP Proxy server, 244
SIP Redirect server, 244
SIP Registrar server, 244
SIP response codes, 242
SIP signaling, 244, 246
SIP User Agent Client (UAC), 244
SIP User Agent Server (UAS), 244
SIP User Agent, 244, 246
SIPA (Selected IP Traffic Offload), 156
SIPS URI, 243
SIPS, 242
SISO (Single Input Single Output), 142
Skype, 19, 63, 64
SLA (Service Level Agreement), 183, 185, 189, 190, 213
SLF (Subscriber Location Function), 163
SL-FE (Subscription Locator Functional Entity), 171, 251
Slow start threshold (ssthresh), 39
Slow start, 38–9
Smart grid, 289
Smart home, 289, 292
SMS (Short Message Service), 24, 175
SMTP (Simple Mail Transfer Protocol), 60–1, 186
SNI (Service-Network Interface), 88, 221, 255
SNMP (Simple Network Management Protocol), 34
SOA (Service Oriented Architecture), 223–4
SOAP (Simple Object Access Protocol), 277
Social networking, 326
Socket, 18, 35, 36, 43, 58
Soft Switch (see Call Server)
Software platform provider, 290
Solution providers, 308
SON (Service Overlay Network), 254–7
SON control function, 256
SON management function, 256
SON service composition function, 256
SONET (Synchronous Optical Networking), 15, 119, 134
Spectrum management, 175–6
Spectrum, 142, 154, 159, 160, 175–7
SRTP (Secure RTP), 249
SS7 (Signaling System No.7), 9–11, 25, 42, 240, 246
SSF (Service Support Functions), 222, 228, 230, 279
SSID (Service Set ID), 168
SSL (Secure Socket Layer), 326
SSP (Service Switching Point), 10
S-tag, 130, 201
Stateless IP/ICMP Translation Algorithm, 320
Storage cloud, 326
STP (Signal Transfer Point), 10
Structured P2P network, 59
SUP (Service User Profile), 271
Supernodes, 64
SUP-FE (Service User Profile Functional Entity), 171, 230, 251, 252
Switch, 21
Switching systems, 6, 13
SyncE (Synchronous Ethernet), 134
Synchronization, 134
TAA-FE (Transport Authentication and Authorization Functional Entity), 95–6
TCAP (Transaction Capabilities), 11
TCF (Transport Control Function), 228
TCP (Transmission Control Protocol), TCP/IP, 17, 21, 34–42, 58, 81, 182, 186, 209
TCP Reno, 41
TCP SACK (TCP Selective Acknowledgements), 41, 42, 315
TCP window, 38
TDD (Time Division Duplex), 153
TDM (Time Division Multiplexing), 13, 14, 83, 123, 131, 132, 133, 134, 306
TDMA (Time Division Multiple Access), 13, 120, 122, 144
TDM-PON (TDM Passive Optical Network), 118
TE (Traffic Engineering), 181, 203, 213, 216, 315
Technology providers, 308
tel URI, 99–100, 161, 165
Telecom operator, 24, 70, 73, 96, 135, 224, 293, 297, 328
Telecommunications, 69, 72, 175, 178, 182, 327
Telephone network, 7, 50
Telephone numbers 50–1, 98, 165
Telephony, 2, 4, 18, 24, 69, 73, 123, 161, 261
Terminal Equipment (TE), 211
Terminal mobility, 166
TF (Transport Function), 167, 170
TFTP (Trivial File Transfer Protocol), 34
T-GRUU (Temporary - Globally Routable User Agent URI), 165
TISPAN (Telecommunications and Internet converged Services and Protocols for Advanced Networking), 82, 162
TLD (Top Level Domain), 50, 65
TLM-FE (Transport Location Management Functional Entity), 95–6
TLS (Transport Layer Security), 234, 238, 249
TMG (Trunking Media Gateways), 302–4
ToS (Type of Service), 31, 191, 193, 216
TP (Type of FSA transmission mode), 208
Trackers, 65
Transit network, 211
Translators (IPv4 to IPv6), 320
Transmission systems, 4, 6, 12, 13
Transport stratum, 74, 78–9, 86–90, 92, 94, 99, 148, 168–9, 171, 185, 190–2, 200, 211, 213, 284, 306, 312, 315
TRC-FE (Transport Resource Control Functional Entity), 190, 192–5, 213–6
TRE-FE (Transport Resource Enforcement Functional Entity), 190–1
TTL (Time To Live), 31, 33
TUP (Telephone User Part), 11
TUP-FE (Transport User Profile Functional Entity), 96
TV (Television), TV broadcast, 3, 70, 71, 73, 83, 111, 172–3
Twisted pairs, 4, 70, 105, 106

U
UAM (User Access Module), 301–2
Ubiquitous networking, 329
UDDI (Universal Description, Discovery and Integration) protocol, 222
UDP (User Datagram Protocol), 17, 21, 32, 33–4, 36, 42, 58, 81, 172, 186, 209
UE (User Equipment), 148, 149
UGS (Unsolicited Grant Service), 158
UICC (Universal Integrated Circuit Card), 97
UID (User ID), 165, 167–8
UMA (Unlicensed Mobile Access), 160, 252
UMTS (Universal Mobile Telecommunication System), 82, 135, 143, 148, 169
UMTS/HSPA (Universal Mobile Telecommunication System/High Speed Packet Access), 71, 104, 146, 150, 156, 176
UNI (User-Network Interface), 88, 91, 187, 285, 307
UNI-C (User-Network Interface - Customer), 133
Unicast, 51, 190, 272
Unicast-based IPTV, 274–5
UNI-N (User-Network Interface - Network), 133
Universal service, 297
Unlicensed spectrum, 283
Unstructured P2P network, 60
URI (Uniform Resource Identifier), 97–8, 100, 161, 242
USBF (Unified Service Broker Function), 231
User plane, 87, 88, 92, 146, 175, 215
USN (Ubiquitous Sensor Network), 280–85, 289, 295
USN applications, 285
USN architecture, 283
UTRAN (UMTS Terrestrial Radio Access Network), 149, 155, 173

V
VCC (Voice Call Continuity), 253
VCI (Virtual Channel Identifier), 110
Vertical handover, 90, 167, 266, 315
Video streaming, 20, 91, 152, 172, 175, 294
Virtual corporate office, 287
Virtual home network, 257
VLAN (Virtual LAN), 130, 133–4, 198, 321–2
VLAN ID, 130, 198, 201
VMTN (Virtual MPLS Transport Network), 194
VNO (Virtual Network Operator), 325
VoD (Video on Demand), 271, 295, 297
VoIP (Voice over IP), 20, 23, 24, 25, 34, 73, 74, 75, 77, 79, 82, 85, 91, 99, 143, 146, 150, 151, 152, 158–9, 195, 203, 210, 244, 261–3, 267–8, 294
VoIP services, 294, 304
VPI (Virtual Path Identifier), 110
VPN (Virtual Private Network), 72, 73, 81, 91, 190, 198, 199, 200, 202, 249, 285–88, 321–2, 325
VPN functions, 286
VPN services, 285–88, 296
VRM (Virtual Resource Manager), 321
VSC (Voice Service Continuity), 253

W
W3C (World Wide Web Consortium), 66
WAN (Wide Area Network), 22, 30
WCDMA (Wideband Code Division Multiple Access), 145
WDM (Wavelength Division Multiplexing), 14, 118–9, 120, 124
WDM-PON (WDM Passive Optical Network), 118–9
Web services component, 277–80
Web services, 276–80, 291, 295, 330
Web-based streaming, 277
WFQ (Weighted Fair Queuing), 204
Wholesale markets, 136–7, 296
Wholesale pricing, 135–7
WiFi, 22, 83, 119, 146, 156, 161, 172–3, 178, 211, 289, 292
WiMAX, 22, 83, 133, 146, 156, 172–3
WirelessMAN-Advanced (see Mobile WiMAX 2.0)
WLAN (Wireless Local Area Network), 83, 121, 156, 168, 283
WMAN (Wireless Metropolitan Area Network), 83
WMF (Web Media Function), 277–80
WMGC-FE (Web Media Gateway Control Functional Entity), 280
WMRC-FE (Web Media Resources Control Functional Entity), 278
WMT-FE (Web Media Transform Functional Entity), 280
Working Party 5D, 143
WoT (Web-of-Things), 288, 290–1, 295, 318
WoT agent, 292
WoT broker, 290–2
WoT services, 291–3
WRC (World Radiocommunication Conference), 104, 176
WSCF (Web Service Control Function), 277–80
WSDL (Web Services Description Language), 222, 277
WSDM (Web Services Distributed Management), 222
WSGC-FE (Web Signaling Gateway Control Functional Entity), 278–80
WSN (Wireless Sensor Network), 282
WWW (World Wide Web), 1, 5, 18–9, 20, 24, 34, 36, 60, 62, 81, 85, 91, 97, 133, 150, 159, 175, 276–80, 288, 290–2

X
X2 interface, 148–9
xDSL (see DSL)

XG-PON (10-Gigabit capable Passive Optical Networks), 123–6
XLG-PON (40-Gigabit capable Passive Optical Networks), 123, 126
XML (Extensible Markup Language), 251, 277

Z
Zigbee, 283, 289, 292