

INDEX

- 5C content protection, *see* DTCP
- ACM (Admission Control Mechanism), 450–451, also *see* QoE
- ACAP (Advanced Common Application Platform), *see* CableLabs
- ADSL (Asymmetric Digital Subscriber Line)
- ADSL2, 30
 - ADSL2+, 30
 - ADSL Reach Extended 30
 - Technical Overview 27–30
- AES (Advanced Encryption Standard), 44
- AON (Active optical networks), 26
- ARIB (Association of Radio Industries and Businesses), 9, 246
- ATIS (Alliance for Telecommunications Industry Standard), 15–16, 468
- ATSC (Advanced Television Systems Committee)
- ATSC-T (ATSC Terrestrial), 216
 - DASE (Digital Television Application Software Environment), 245
 - Overview, 8
 - VSB (Vestigial sideband), 217
- ATM (Asynchronous Transfer Mode), 25, 31, 57
- AVC (Advanced Video Coding), *see* H.264/AVC
- AVS (Audio Video Standard), 80
- B-frames (Bi-directional Frames), 69, 77, 453
- Blu-ray, 372–373
- BPI+ (Baseline Privacy Plus), 44
- Broadband TV, *see* IPTV
- BSF (Broadband Services Forum), 15
- CableLabs
- ACAP, 245–246
 - CableCARD, 255–256
 - CableHome, 189–193
 - DOCSIS, *see* DOCSIS
 - OCAP (OpenCable Applications Platform), 241–245

- CableLabs (*continued*)
 - OCUR (OpenCable Unidirectional Receiver), 279
 - OpenCable, 221
 - OpenCable common download specification, 473
- Callers ID for TVs, *see* IPTV application types
- CA (Conditional Access) systems
 - Algorithms, 259
 - Downloadable CAS, 264–265
 - ECMs (Entitlement Control Messages), 252, 254
 - EMMs (Entitlement Management Messages), 251, 254
 - Hardware centric, 250–257
 - Hybrid approach, 263
 - Smart cards, 254–255
 - Software centric, 257–263
 - Removable security modules, 255–257
- CBR (Constant Bit Rate), 71, 438
- CEA (Consumer Electronics Association)
 - Home networking protocols, 328
 - IPTV “Principles” Initiative, 18
 - TV Web browsing standard, 401
- Channel Changing
 - Different mechanisms, 163–166
 - Improving rates, 166–169
 - Sources of delays, 159–163
 - Testing program, 462–464
- CIF (Coral Interoperability Framework), 278–279
- CMTS (Cable Modem Termination System)
 - CableHome deployment, 191
 - Communication with hybrid IP
 - Cable set-top boxes, 222
 - Modular CMTS (M-CMTS), 37
- COFDM (Coded Orthogonal Frequency Division Multiplexing), 28, 217–218
- Compression
 - Audio, 205–208
 - Drawbacks, 65–66
 - MPEG, 66–79
 - Spatial, 68
 - Temporal, 69
 - VC-1, 79–80
 - Video, 67–70
- CRC (Cyclic Redundancy Check), 114
- CRM (Customer Relationship Management), 121, 122
- CSMA/CD (Carrier sense multiple access with collision detection), 292–293
- DCAS, *see* CA systems
- DCT (Discrete Cosine Transform), 68, 76
- Decoding
 - Audio, 205–208
 - Video, 205
- DHCP (Dynamic Host Configuration Protocol)
 - DOCSIS 3.0 Deployments, 42
 - IP Address Management, 436
 - RG IP address assignment, 180–181
 - UPnP deployments, 318–321
- Diffserv (Differentiated Services), 179, 328, 440–441
- Digital certificates, 238, 261–262
- Digital signatures, 238, 261
- Digital TV
 - Benefits, 9–10
 - History, 6
 - Introduction, 1
- DisplayPort, 375–377
- DLNA (Digital Living Network Alliance)
 - Guidelines, 315
 - Technical architecture, 316–324
 - UPnP (Universal Plug and Play), 316–322
 - UPnP AV (UPnP for Audio Video streaming devices), 322–324
- DOCSIS (Data Over Cable Service Interface Specifications)
 - Channel Bonding, 41
 - DOCSIS 3.0, 37–45
 - DOCSIS over Satellite, 47–48
 - Evolution, 36–37
 - IGMPv3 support, 144
- DRM (Digital Rights Management),
 - About, 265–268
 - Analog watermarking, 276
 - Copy protection, 271–276
 - Digital Watermarks, 268–269
 - DLNA deployments, 322
- DSA (Differentiated Services Architecture), 439–441
- DSCP (Differentiated Services Code Point), 179, 440
- DSL (Digital Subscriber Line), 26–27

- DSL Forum
 - Introduction, 13–14
 - TR-069, 186–187, 188, 471
 - TR-126, 468
- DSLAM (Digital Subscriber Line Access Multiplexer)
 - Enabled for IGMP snooping, 154
 - Implementing proxy functionality, 167
 - Overview, 29
- DSM-CC (Digital Storage Media-Command and Control), 237, 419
- DTCP (Digital Transmission Content Protection), 272, 274
- DVB (Digital Video Broadcasting)
 - DVB-ASI (DVB-Asynchronous Serial Interface), 344
 - DVB-C (DVB-Cable), 221
 - DVB-CI (DVB-Common Interface), 255
 - DVB-HTML (DVB-HyperText Markup Language), 239
 - DVB-IPI (DVB Technical Module Ad Hoc Group on IP Infrastructure), 17–18, 169, 394
 - DVB-J (DVB-Java), 235–239
 - DVB-RCS (DVB Return Channel via Satellite), 47
 - DVB-S (DVB-Satellite), 218
 - DVB-S2 (DVB-Satellite-Second Generation), 218–219
 - DVB-T (DVB -Terrestrial), 216
 - H.264/AVC implementation, 75
 - MultiCrypt, 263
 - Multi-protocol encapsulation, 238
 - Overview, 8–9
 - SI (Service Information) tables, 87–88, 171
 - SimulCrypt, 263
- DVI (Digital Visual Interface), 373–374
- DVRs (Digital Video Recorders) *see* IP set-top boxes
- ECMs *see* CA systems
- EMMs *see* CA systems
- Encoding
 - Advantages & disadvantages, 65–66
 - Affect on QoE, 443–444
 - HDTV encoders, 371
 - Real time encoders, 119–120
- Encryption,
 - Defined, 252
 - DRM functionality, 269
 - IPSec (IP security), 258–259
 - Software centric CA system functionality, 258
- EPG (Electronic Program Guide)
 - Defined, 388–389
 - Technical architecture, 389–396
- Error correction, 114
- Ethernet, *see* GigE
- ETSI (European Telecommunications Standards Institute) 14, 169
- EuroDOCSIS, 45–46
- EV-DO (Evolution-Data Optimized), 53
- FCC (Federal Communications Commission) 6, 7, 264, 275
- FEC (Forward error correction), 449–450, *also see* QoE
- Fiber Access Networks, *see* FTTx
- Firewall, 183, 193
- Flow control, 114
- FSAN (Full Service Access Network) group, 25
- FTTx
 - FTTA (Fiber to the apartment), 22
 - FTTC (Fiber to the curb), 22
 - FTTH (Fiber to the home), 22
 - FTTN (Fiber to the neighbourhood), 21
 - FTTRO (Fiber to the regional office), 21
- G.983, *see* PON
- GENA (General Event Notification Architecture), 321
- GigE (Gigabit Ethernet),
 - Ethernet technical architecture, 288–293
 - Introduction, 35
 - Technical characteristics, 293
- Globally Executable MHP (GEM), 240–241
- GOP (Group of pictures)
 - GOP's length affect on QoE, 444
 - Introduction, 70

- H.264/AVC
 - Benefits, 75
 - Network abstraction layer, 83
 - Profiles, 78
 - Technical architecture, 76–78
 - Video coding layer, 83
- HANA (High-Definition Audio-Video Alliance)
 - About, 324
 - IEEE 1394, 324–327
- HDCP (High-Bandwidth Digital Content Protection), 274, 275
- HD-DVD, 373
- HDMI (High-Definition Multimedia Interface), 374–375
- HDTV (High definition TV)
 - Classifications, 367–369
 - Over IP, 369–370
 - Technical architecture, 370–380
- Headend, 5
- HFC (Hybrid Fiber Coaxial)
 - Features 32, 34
 - IPTV Topology, 34–35
- HGI (Home Gateway Initiative), 187–189
- Home network overview, 5
- HomePlug AV
 - Home powerline networking
 - characteristics, 298–301
 - Specification overview, 302–305
- HPNA (HomePNA)
 - HomePNA 3.1 technical characteristics, 309–311
 - Introduction to phoneline networking, 307–309
- HSDPA (High-Speed Downlink Packet Access), 53
- IEC (International Engineering Consortium), 67
- IEEE 802.11n, 294–298
- IEEE 802.1q, *see* VLANs
- IEEE 802.16, *see* WiMAX
- IEEE 802.16e, *see* WiMAX
- IEEE 802.3, *see* GigE
- IEEE 1394, *see* HANA
- I-Frames (Intra Frames), 69, 162, 167–168, 453
- IGMP (Internet Group Membership Protocol)
 - Devices, 130
 - Proxy functionality, 155, 167
 - Snooping, 61, 153–155
 - Version 1, 132–133
 - Version 2, 134–139
 - Version 3, 140–147
- IMS (Integrated Multimedia Subsystem), 50
- Interactive IPTV applications
 - About iTV (interactive TV), 387
 - Deployment, 419–420
 - Evolution, 382–387
 - IPTV application types, 387–416
 - Video centric IPTV application types, 417–419
- Internet TV 3–4, 53–56
- IP (Internet Protocol)
 - Addressing, 107, 109–111
 - IP as a backbone technology, 57–58
 - IPv4 video packets, 107, 108
 - IPv6, 107, 111–113, 155–158
- IPDR (Internet Protocol Detail Record Organization), 16, 44
- IP set-top boxes
 - Buffer size, 168
 - Characteristics, 200–201
 - DVRs and storage, 212–215, 405
 - Future trends, 197, 199
 - Hardware architecture, 201–212
 - HDTV enabled, 372–377
 - History, 195–196
 - Hybrid cable, 220–222
 - Hybrid satellite, 47, 218–220
 - Hybrid terrestrial, 216–218
 - Overview, 193–195
- IPTV (Internet Protocol Television)
 - Architecture overview 4–5
 - Benefits 1, 2
 - Definition 2
 - Growth drivers 10–12
 - Market data 12–13
 - Standardization 13–18
- IPTVCDs (IPTV Consumer Devices) 5, 124
- IPTVCM (IPTV communications model)
 - Data link layer, 113–114
 - Defined, 64
 - Encoding layer, 82–83
 - HomePNA 3.1 compliance, 310
 - IP layer, 106–113
 - Overview, 81–82

- Packetizing layer, 83–84
- Physical layer, 114–115
- RTP (Optional) layer, 88–95
- Transport layer, 95–106
- TS (Transport Stream) construction layer, 85–88
- IPTV middleware
 - IPTVCD software, 232–247
 - Server overview, 122–123
- IPTV network management
 - Day-to-day operational tasks, 436–437
 - Implementing business continuity plans, 478–481
 - Network management system
 - functionality, 424–426
 - Management work flows, 428–431, 432
 - Managing IP addresses, 436
 - Managing QoE, 441–468
 - Managing QoS, 437–441
 - Managing service availability, 434–435
 - Remote management of IPTVCDs, 469–471
 - Scheduling software updates, 471–473
 - Testing and monitoring, 431, 433–434
 - Troubleshooting, 473–478
- IPTV Security
 - CA systems, 250–265
 - DRM systems, 265–282
 - Intranet protection, 282–283
 - Overview, 121–122, 249–250
 - Protecting IP–VoD content, 364
- IRD (Integrated Receiver Devices), 119
- ISDB (Integrated Services Digital Broadcasting–Terrestrial)
 - BCAS, 256–257
 - ISDB–C, 219
 - ISDB–S, 219
 - ISDB–T, 217
- ISMA (Internet Streaming Media Alliance)
 - Channel changing initiative, 173
 - DRM industry initiative, 281–282
 - Hyperlinked video specification, 402
 - Overview 16
- ISO (International Organization Standardization), 67
- ITU (International Telecommunication Union)
 - HomePNA standardization, 309
 - ITU–T FG IPTV, 2, 15, 16
 - ITU–T J.144, 457
 - IPTV QoS and QoE metric, 455
- KDC (Key distribution center), 193
- LCD (Liquid crystal display), 379–380
- MAC (Media Access Control)
 - Ethernet implementation, 292
 - HomePlug AV implementation, 303–304
 - IEEE 802.11n implementation, 296
 - Introduction, 113
 - MAC based VLANs
 - MoCA implementation, 313
 - UPA–DHS implementation, 306–307
- MDI (Media Delivery Index), 457, and also *see* QoE
- Media Servers, 224
- Metadata
 - EPG metadata management, 389–391
 - Industry initiatives, 391–394
 - VoD metadata management, 346
- Metro Ethernet, 58–59
- MHP (Multimedia Home Platform)
 - Association with MHP, 239–240
 - GEM, 240–241
 - History, 233–234
 - Overview, 233
 - Technical architecture, 235–239
- MIB (Management Information Base), 192, 427
- MIMO (Multiple–input multiple–output), 297
- MoCA (Multimedia over Coax Alliance)
 - Inside the MoCA IPTVCM layers, 313–314
 - Specification characteristics, 311–313
- Modulators 35
- MOS (Mean Opinion Score), 455–456 and also *see* QoE
- MPEG (Moving Picture Experts Group)
 - About MPEG Compression, 66–67
 - Blocks and macroblocks, 68, 77
 - Elementary streams, 82–83
 - Frame types, 69–70
 - Overview 14
 - Packetized Elementary Streams, *see* PES packets
 - Slices, 69
 - Transport Streams, *see* TS packets

- MPEG-1, 67
- MPEG-2
 - Audio, 206-207
 - Decoding, 205-208
 - Overview, 67-72
 - Profiles and levels, 71
- MPEG-4, 72-79
- MPEG-4 Part 10, *see* H.264/AVC
- MPEG-7, 391-392
- MPEG-21, 67, 277
- MPLS (Multi Protocol Label Switching), 57-58, 441
- MPQM (Moving Picture Quality Metric), 456-457 and also *see* QoE
- Multicasting
 - Any source multicast, 141
 - Distribution shared trees, 149-150
 - Distribution source trees, 147-149
 - DOCSIS 3.0 Deployments 42
 - Groups and Addressing, 131-132
 - Introduction, 127-129
 - IPTV Multicasting 129-130
 - MLD (Multicast Listener Discovery), 156-158
 - PIM (Protocol Independent Multicast), 150-152
 - Protocols, 132-147
 - RPF (Reverse Path Forwarding), 152-153
 - Source specific multicast-141
- Municipal wireless networks, 51-53

- NAL (Network Abstraction Layer) units
 - Introduction, 83
 - RTP integration, 91
- NAT (Network Address Translation), 181
- NCTA (National Cable and Television Association), 264
- NTP (Network Time Protocol), 123
- NTSC (National Television System Committee), 6

- OBSS (Operational and Business Support System), 120-121
- OFDM (Orthogonal Frequency Division Multiplexing), 28, 49, 313, 303, 327
- OLT (Optical line termination) 22
- ONT (Optical network terminal), 22, 23
- Open IPTV Forum 14

- OSGi (Open Services Gateway Initiative), 186

- PDP (Plasma display panel), 378-379
- PES (Packetized Elementary Stream) packets, 83-86
- P-frames (Predictive frames), 69, 453
- PKI (Public Key Infrastructure), 260-261, 262, 270
- PON (Passive optical network)
 - BPON (Broadband PON), 24-25
 - EPON (Ethernet PON), 25
 - GPON (Gigabit PON), 25-26
 - Overview, 22-23
- PPPoE (Point-to-point protocol over Ethernet), 180, 359
- PSI (Program specific information) tables, 87-88, 169
- PSNR (Peak signal-to-noise ratio), 456 and *see* QoE
- PVCs (Private Virtual Circuits), 178, 179, 180

- QAM (Quadrature amplitude Modulation), 222, 314
- QoE (Quality of Experience)
 - Factors that affect QoE, 443-453
 - Industry initiatives, 468
 - Key performance indicators, 466-467
 - Measurement systems, 453-455
 - Metrics, 455-460
 - Service level agreements, 465-466
 - Testing tools and programs 460-465
- QoS (Quality of Service)
 - CableHome implementation, 192
 - Enforcement on an RG, 179
 - HomePNA QoS guarantees, 310
 - IPTV QoS management, 437-441
 - Speeding up channel changes, 169
 - WHMN implementation, 328-329
- QPSK (Quadrature-Phase-Shift-Keying), 220
- Quantization, 65, 68

- RG (Residential Gateway)
 - Features, 178-184
 - Impact on channel changing times, 161
 - Introduction, 175-178
 - Standardization, 184-193

- Routers,
 - Distribution, 123
 - Multicast, 130, 139
- RTCP (Real-Time Control Protocol), 349–350, 447–448
- RTP (Real-Time Transport Protocol)
 - Benefits, 90
 - Feedback mechanism, 447–449
 - Overview, 88
 - Packet structure, 92
 - VoD transport protocols, 349–350, 351
- RTSP (Real-Time Streaming Protocol), 350–358

- Sampling, 65
- SAP (Session Announcement Protocol), 171
- SARFT (State Administration of Radio, Film, and Television), 15
- SDH (Synchronous Digital Hierarchy), 57
- SDP (Session Description Protocol), 171
- SDTV (Standard definition TV), 12, 367
- SDV (Switched Digital Video), 35
- Secure Video Processor Alliance, 277–278
- SMPTE (Society of Motion Picture and Television Engineers), 79
- SNMP (Simple Network Management Protocol),
 - CableHome implementation, 192
 - IPTV network management, 426–428
- SOAP (Simple Object Access Protocol), 321
- SONET (Synchronous Optical Network), 35, 57
- SSDP (Simple Service Discovery Protocol), 321
- Statistical multiplexing, 72

- TCP (Transmission Control Protocol)
 - Comparison to UDP, 104–106
 - Troubleshooting, 476–478
 - Used to route IPTV content, 97–101, 102
- TDMA (Time division multiple access), 40, 57
- Telco TV, *see* IPTV
- TFTP (Trivial File Transfer Protocol), 44
- Transcoding, 120
- TS Packets, 85, 89, 203–205
- TV-Anytime, 392–393
- TV Web browsing, *see* IPTV application types

- UDP (User Datagram Protocol)
 - Comparison to TCP, 104–106
 - Benefits and drawbacks, 101, 103–104
 - Relationship to RTP, 89
- UDI (Unified Display Interface), 377
- Unicast, 124, 126, 152
- Universal Plug and Play, *see* DLNA
- UPA-DHS (Universal Powerline Alliance-Digital Home Standard), 305–307
- UWB (Ultra-wideband), 327, and also *see* HANA

- VBR (Variable Bit Rate), 72
- VC-1 (Video Codec 1)
 - Access units, 95–96
 - Characteristics, 79–80
 - Profile levels, 80
- VDSL (Very High Speed DSL)
 - VDSL 1, 31
 - VDSL 2, 31
 - VDSL (Long Reach), 31
 - VDSL (Short Reach), 31
- VESA (Video Electronics Standards Association), 375 and also *see* DisplayPort
- Video analyzers, 462 and also *see* QoE
- VLANs (Virtual LANs)
 - 801.1Q, 179, 328, 361
 - RG Implementation, 178
 - Technical overview, 359–363
- VoD (Video on Demand)
 - Application types, 335–340
 - Evolution, 334–335
 - Integration with other IP applications, 358–364
 - Overview 10, 396
 - PPV, 332–334
 - RAID (Redundant Array of Independent Disks), 342–343
 - Server clustering, 347–348
 - Server testing, 464–465
 - Streaming servers, 340–349

- WHMN (Whole Home Media Networking)
 - Middleware standards, 314–328
 - Phone and coaxial cable solutions, 307–314
 - Powerline solutions, 298–307
 - QoS implementation, 328
 - Structured cabling solutions, 288–294
 - Technology requirements, 286
 - Wireless solutions, 294–298
- WiMAX
 - Fixed, 48–50
 - Mobile, 50–51
- WiMAX Forum, 48–49
- WirelessHD Consortium, 15
- WLAN (Wireless LAN), *see* IEEE 802.11n
- X.509, *see* digital certificates
- XML (Extensible Markup Language), 169–170, 269–270, 279, 346