Audio Compression

URLs

Who	Why important?	URL
4C Entity	Content protection for DVD + other media.	www.4centity.com
Advanced Television Systems Committee (ATSC)	Get most recent AC-3 standard here --- free!	www.atsc.org
American National Standards Institute	Order standards from here, e.g. MP-3 standard (see standards list)	webstore.ansi.org
APT	Developed DTS algorithm	http://www.aptx.com/
Articulate Audio	A professional recording engineer compares Real Audio G2, Quicktime.	www.articulateaudio.com/streaming.html
Audio Engineering Society (AES)	Key professional organization for audio engineers. Order AES standards, proceedings, preprints, follow AES standards work.	www.aes.org
Coding Technologies	Developed mp3PRO, aacPLUS, mpegSurround. Bought by Dolby, 2007.	www.codingtechnologies.com/
Consumer Electronics Association	Key trade association for consumer electronics. Lots of good market info, as well as links to other organzations and standards bodies.	www.ce.org/
DAKX	Lossless compression algorithm.	www.dakx.com
Digital Radio Mondiale Consortium	Digital radio in AM band	www.drm.org
Digital Theatre Systems	DTS. 20 February 2007 press release: cinema business to be sold.	www.dtsonline.com
Dolby	Search for articles and spec errata sheet on AC-3; the exact locations move occasionally.	www.dolby.com
DVD forum	DVD audio.	www.dvdforum.org
Electronic Frontier Foundation	Civil liberties group concerned with electronic privacy and freedom of expression.	www.eff.org
Emedia	good Blu-Ray FAQ	http://www.emedialive.com/articles/readarticle.aspx?articleid=11397#iii
Fraunhofer Institut Integrierte Schaltungen	Audio web site from one of the major developers of MPEG. History videos.	http://www.iis.fraunhofer.de/EN/index.jsp
Global Engineering	Order standards from here if you can't find them anywhere else.	global.ihs.com
Hannover University / MIT Reflector.	Was a MPEG audio web site. February 2008, apparently only the MIT reflector still online and not much maintained anymore.	sound.media.mit.edu/mpeg4/audio/

URLs

iBiquity Digital	Information on HD Radio, which once wanted to use PAC	www.ibiquity.com/
Internet Media Streaming Alliance	Streaming media over Internet Protocol (IP)	www.isma.tv
International Organization for Standardization (ISO)	Order ISO standards, but see ANSI, Global.	www.iso.ch
International Telecommunication Union (ITU)	Order ITU testing standards.	www.itu.int
Intertrust	Digital rights management.	www.intertrust.com
Lawrence Lessig	Stanford Professor engaged in internet rights	www.lessig.org/
Microsoft	Windows Media Technologies	www.windowsmedia.com/MediaGuide/Home
MiniDisc	Articles, links for ATRAC. Still hanging on.	www.minidisc.org
MPEG-2 AAC	Overview, products, press, licensing for AAC, MPEG-4 AAC and HE AAC.	www.vialicensing.com/
MPEG LA	Licenses groups of patents, including for MPEG.	www.mpegla.com
MP3 and Internet audio handbook	Superb text. Click on "Sample Chapters" for "The MP3 and Internet Audio Handbook"	http://www.mp3handbook.com/
MP3.com	Major commercial site for MP3.	www.mp3.com
mp3licensing. Thomson, Fraunhofer.	License MP3 for consumer, professional devices. Good overview of major patents.	mp3licensing.com
MP3'Tech	Public source for many MPEG encoders, decoders.	www.mp3-tech.org
MPEG.ORG		www.mpeg.org
MPEG-4 Industry Forum		www.m4if.org
National Association of Broadcasters	Key trade organization for broadcasting. Great info on current and future trends on broadcasting.	www.nab.org
National Cable Television Association (NCTA)	Represents the industry's interests. Info on digital TV in2009.	www.ncta.com
OGG	Open-source encoder/decoder.	www.vorbis.com
Q-Design	Used in QuickTime 4.0. Now owned by DTS. This site outdated and no longer maintained. Qdesign is now owned by DTS.	www.qdesign.com
Real Networks	RealAudio.	www.real.com
Sirius Satellite Radio	(Was CD Radio) One competitor for US digital audio broadcast.	www.siriusradio.com
Sisvel	Manages Phillips, IRT patents. Filed lawsuits in 2006, especially against SanDisk.	www.sisvel.com/

URLs		
Sony Digital Dynamic Sound	Sony cinema.	www.sdds.com
Twin VQ	Home page, English version, of one technology inside MPEG-4.	www.twinvq.org/english/index_en.html
Verance	Watermarking/Security provider	www.verance.com
XM Satellite Radio	Another digital audio broadcast competitor.	www.xmradio.com

Updated 7 March 2008

Audio Compression

Standards Documents

Standard	Source	Document Number/URL
AAC (MPEG-2 Advanced Audio Coding)	International Organization for Standardization (ISO)	ISO/IEC JTC1/SC29 WG11 International Standard IS 13818-7, 1997
AC-3	Advanced Television Systems Committee (ATSC)	A/52. "Digital audio compression (AC-3) standard."
MPEG-1 Audio	ISO	ISO/IEC JTC1/SC29 WG11 International Standard IS 11172-3, 1992
MPEG-2 Audio	ISO	ISO/IEC JTC1/SC29 WG11 International Standard IS 13818-3, 1994
MPEG-4 Audio	ISO	ISO 14496-3, 1999/2000
Methods for the Subjective Assessment of Small Impairments in Audio Systems including Multichannel Sound Systems.	International Telecommunication Union (ITU)	Recommendation ITU-R BS.1116 (Rev.1), 1997
Method for objective measurements of perceived audio quality (PEAQ).	ITU	Recommendation ITU-R BS.1387, 1999

Tip: Buying standards is expensive. Go to the ANSI online store, webstore.ansi.org, and try to find "INCITS" versions. The text is identical to the ISO/IEC standard. In March 2008, the INCITS copy of 11172-3 was $30 and the ISO/IEC copy was $146.

Second tip: be sure to order also any errata documents.

Audio Compression

Suggested further reading
John Strawn

I have not listed here the many dozens of articles in the Journal of the Audio Engineering Society, and the AES convention preprints. Use the online database at www.aes.org to search. Updated 3 March 2008

Begault, Durand R.. "The Sonic CD-ROM for Desktop Audio Production: An Electronic Guide to Producing Computer Audio for Multimedia," Academic Press Professional, 1996. $44.95. ISBN 0-12-084738-8.

Bosi, Marina, and R. Goldberg. *Introduction to digital audio coding and standards*. Kluwer, 2003. Marina Bosi is one of the inventors of AAC.

Brandenburg, K., and M. Bosi, eds. *Proceedings, AES 17th International Conference*, Florence, 1999.

Britanak, Vladimir, Patrick Yip, Kamisetty Rao. *Discrete Cosine and Sine Transforms: General Properties, Fast Algorithms, and Integer Approximations*. Amsterdam: Elsevier, 2007. A bible on the DCT.

Buser, Pierre, and Michel Imbert. *Audition.* Translated by R. H. Kay. Cambridge: MIT Press, 1992. Excellent psychoacoustics introduction.

Dooley, Wesley, and R. Streicher. "M-S Stereo: A powerful technique for working in stereo." *Journal of the Audio Engineering Society* 30(10):707-718, October 1982.

Gilchrist, Neil, and Christer Grewin. *Collected papers on digital audio bit-rate reduction.* New York: Audio Engineering Society, 1996. Order from www.aes.org/publications.

Herrmann, Frank, et al. "The Evolution of DAB." *EBU Technical Review*, July 2007. http://www.ebu.ch/en/technical/trev/trev_311-dab_dmb.pdf.

"Tutorial Issue on the MPEG-4 Standard." *Image Communication Journal*. Vol. 15, Nos. 4-5, January 2000, pp. 281-298.

Kahrs, Mark, and Karlheinz Brandenburg, eds. *Applications of digital signal processing to audio and acoustics.* Boston: Kluwer, 1998. Chapter by Karlheinz Brandenburg on compression.

Koenen, Bob. "MPEG-4: Multimedia for our time." IEEE Spectrum 36(2):26-33, February 1999.

Lazzaro, John, and John Wawrzynek. *The MPEG-4 Structured Audio Book*. http://www.cs.berkeley.edu/~lazzaro/sa/book/index.html. On MPEG-4 SASL and SAOL.

Mitchell, Joan L., W. B. Pennebaker, C. E. Fogg, D. J. LeGall. *MPEG Video Compression Standard.* New York: Chapman & Hall, 1997.

Noll, Peter. "MPEG Digital Audio Coding." *IEEE Signal Processing Magazine* 14(5):59-81, September 1997. An excellent introduction to MPEG and to perceptual coding in general, by one of the pioneers.

Painter, Ted, and Andreas Spinias. "Perceptual Coding of Digital Audio." *Proceedings of the IEEE*, 88(4):451-513, April 2000. Fantastic overview, massive references. This article has won awards.

Smyth, M. "White Paper: An overview of the Coherent Acoustics sound system." June 1999. http://www.dtsonline.com/media/uploads/pdfs/whitepaper.pdf (click on "Technical Literature.")
    Good technical overview of DTS' more recent algorithm.

Watkinson, John. *MPEG Handbook.* Oxford: Focal Press, 2004.
    Video as well as audio.

Wikipedia. Start with these: http://en.wikipedia.org/wiki/Comparison_of_audio_codecs. http://en.wikipedia.org/wiki/Audio_codec. http://en.wikipedia.org/wiki/List_of_codecs. See also http://en.wikipedia.org/wiki/Gapless_playback.

Zölzer, Udo. *Digital Audio Signal Processing*. John Wiley & Sons, New York, 1997 ISBN 0-471-97226-6

Zwicker, E., and H. Fastl. *Psychoacoustics: Facts and Methods*. 2nd updated edition, paperback. Berlin: Springer, 1999.   Another excellent introduction.