Preserving State Government Digital Information
Minnesota Historical Society

Digital Audio and Video White Paper

Summary

Offering online access to legislative floor sessions and committee meetings enhances access to government activities for a greater number of people. Sessions are often streamed live as well as archived for a certain period of time. This paper summarizes various components of digital audio and video files and covers important issues to consider when working with such files.

DISCLAIMER:
This white paper is a topical overview and is in no way intended to offer legal advice. Consult an attorney for assistance with specific concerns or for advice.

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1. Introduction

Legislative recordings are accessed by legislators, lawyers, and the general public for various reasons. To determine if audio or video files are available in a particular state, contact the state legislature or agency in charge of preserving government information, such as the state archive or the state library. Recordings may exist on reels, magnetic tape, as transcripts, or in digital formats. As it becomes harder to find equipment able to play reel-to-reel tapes, and as cassette tapes begin to disintegrate, many states are choosing to digitally record legislative sessions and are in turn offering online access to current and past legislative session recordings.

Many states have a long history of recording legislative sessions. Minnesota began recording sessions on reel-to-reel tapes in the 1960s, and by 1973, Minnesota was required by Rule to record floor sessions and standing committee meetings. These meetings were captured on cassette tape from the 1980s until 2004 when digital recordings came into use in both the House and Senate.[1] The Tennessee State Archives also began recording legislative sessions early; recording started in 1955 on reels, and continued in various formats until 2008 when they began digitally recording sessions.[2] There are many methods of recording legislative sessions; Minnesota and Tennessee are just two examples of states that have switched to digital formats to record and provide access to legislative materials.

Posting current and past legislative sessions online makes them accessible to a greater number of people, as more and more people have access to computers. Previously easy access was only available at the actual time of the broadcast. Live broadcasts of such sessions have previously been available on the radio or on public and cable television in many states. With advances in digital technology, states are now able to provide citizens with live and archived broadcasts of the legislative sessions online, often available instantly online at the user's convenience. Users can choose to listen to a session live or play a previously recorded session at a more convenient time, such as after work or during breakfast. The length of time previously recorded meetings/sessions are available online ranges from the current legislative session only to all previously recorded digital sessions over many years. The chart in Appendix 2 shows information on legislative session digital audio and video files as of February 2009. The chart indicates if sessions are broadcast live or can be played on demand, if they use audio or video files or both, and if previous session years are available.

[1] Previously to 2004, digital recordings were only for select coverage. Coverage began in the House in 1998 with both audio and video recordings. The Senate began select video coverage in 2002 and audio coverage in 2005. As of February 2009, the Minnesota Senate records sessions in MP3 format and the House uses a proprietary system called For the Record (FTR). Information gathered from personal interview with Jim Greenwalt, Minnesota Senate Information Systems Director, on February 5, 2009 and from the Legislative Reference Library website at http://www.leg.state.mn.us/leg/leghist/histstep.asp.

[2] The Tennessee States Archives recorded sessions on cassette tapes from 1987-2008. In October 2008 the Archives began digitally recording sessions using the DCR System which records, indexes, distributes, and archives the created digital files. Information gathered from a phone conversation with Greg Yates, Coordinator of Recording Program at the Tennessee State Archives on February 4, 2009.

Digital recording in the government arena is not new. "Digital audio recording has been an authorized method of making an official record of court proceedings since 1999."[3] More recently, in 2007 the United States District Court for the Eastern District of Pennsylvania participated in a national Digital Audio File Electronic Access Pilot Program, providing digital audio files of court proceedings through the Public Access to Court Electronic Records (PACER) system. The program allows users to download MP3 files of court proceedings for a small fee, less than the cost of accessing the paper files. U.S. Bankruptcy Judge J. Rich Leonard states "We're just treating the audio file as we would a written file."[4]

In addition to working with born digital materials there are many projects that involve converting analog files to digital resources. These projects are undertaken for many purposes, but often center on creating master and access copies of recordings to preserve the master material or information on the material while also increasing access to a collection. For example, Washington State Digital Archives and the Washington House of Representatives worked together to transfer the information held on 30,000 cassette tapes, some of which were physically degrading, into digital audio. Their goal was twofold, to preserve the information and provide better access. Access to the recorded floor sessions and committee meetings was improved by using speech search technology on the audio files. (Details on this project are found in Appendix 3.) To assist with digitization efforts, federal agencies have developed the *Digitization Guidelines Initiative* which includes a working group specifically for audio-visual materials with the goal to "identify, establish, and disseminate information about standards and practices for the digital reformatting of audio-visual materials by federal agencies."[5] The Library of Congress is also working hard to preserve audio-visual files and is the first archive to collect a petabyte (one million gigabytes) of digital audio-visual content.[6]

Following the trend of providing access to digitally recorded legislative sessions online and working with digital files. This paper provides background information and insight to help answer the new types of questions that states are faced with answering, such as:

- Do states/should states provide both digital audio and video feeds?
- How long should states archive the files for?
- Who stores the files? Where?
- Are there standards and best practices to follow?
- What file formats should be used?
- What metadata is useful?
- How does this process work? Who can you work with?

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[3] Kunz, Michael E. *Notice: Digital Audio File Electronic Access Pilot Program*. United States District Court. http://www.paed.uscourts.gov/documents/handbook/notices/app_bb.pdf

[4] Administration of the Federal Courts. "Pilot Project Will Post Digital Audio Recordings Online." *The Third Branch: Newsletter of the Federal Courts*. June 2007. Vol. 39, Number 6. http://www.uscourts.gov/ttb/2007-06/pilot/index.html

[5] Audio-Visual Working Group. *Audio-Visual Working Group*. Federal Agencies Digitization Guidelines Initiative. February 6, 2009. http://www.digitizationguidelines.gov/audio-visual/

[6] Audio-Visual Conservation. *Preserving the Collections*. Library of Congress. August 3, 2007. http://www.loc.gov/avconservation/preservation/. The Audio-Visual Conservation at the Library of Congress Home page is http://www.loc.gov/avconservation/.

2. Quality and File Formats

Digital audio and video files are very complex. There are many formats to choose from and many factors that affect the quality of the file. The discussion below introduces common audio and video file formats and addresses issues relating to file quality which are both important to consider when working with digital audio and video files.

Three factors influence audio quality, the compression format (codec), the number of bits used (bit-rate), and the sampling frequency.[7] Video quality is dependent on frame size, frame rate, and bit depth.[8] In addition to these factors, file format, and overall file size are important to consider when utilizing audio and video formats. As a file creator you must choose how to configure all of these dynamic features together in the best way possible to meet your specific needs.

Audio and video files are generally large and quickly fill available storage space. To help reduce the total amount of storage space required, large files are often compressed; audio and video files are no different. Audio files are often compressed so more songs can be stored on MP3 players and other portable storage devices. Video files are compressed to assist with playback on the Internet. Compression techniques used with streaming audio and video files allow for almost instantaneous playback.

Digital audio and video files are compressed using a "special piece of software called a codec, short for the type of '**co**mpression/**dec**ompression' algorithm that is used to translate uncompressed data into a compressed form for storage and to decompress that compressed form for access or playback."[9] Compression can be lossy or lossless. Lossy compression reduces the file size by permanently removing unessential data, such as background noise and sounds inaudible to the human ear, from a file. Lossless compression reduces the file size without altering the original data of the file; it will sound or look the same as an uncompressed file. Examples of lossy codecs include MP3[10] and WMA[11] (Windows Media Audio) for audio and MPEG4[12] for video; examples of lossless codecs include FLAC[13], OGG[14], and WMA Lossless[15]

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[7] Knight, Gareth and John McHugh. *Preservation Handbook: Digital Audio*. Arts and Humanities Data Service (AHDS). United Kingdom. July 25, 2005. http://ahds.ac.uk/preservation/audio-preservation-handbook.pdf

[8] Guy, Marieke. *QA Focus Documents: Choosing a Suitable Digital Video Format*. UKOLN. October 1, 2004. http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/html/

[9] Tittel, Ed. *A Quick 'Rip' Through Digital Audio File Formats*. Peachpit. July 30, 2004. http://www.peachpit.com/articles/article.aspx?p=212411

[10] University of Iowa. ITS Video Services: Terms and Explanation. August 6, 2008. http://www.its.uiowa.edu/tns/videoservices/streamdef.htm

[11] PCMag.com. *Definition of: WMA*. http://www.pcmag.com/encyclopedia_term/0,2542,t=WMA&i=54808,00.asp

[12] MPEG4.net. *Welcome to MPEG4.net!* Visual Light Digital Inc. 2009. http://www.mpeg4.net/

[13] Flac stands for Free Lossless Audio codec that was designed to reduce the file size of audio files without the loss of quality that is found in other audio codecs such as MP3. Flac: Free Lossless Audio Codec. *Home Page*. December 10, 2008. http://flac.sourceforge.net/

[14] Ogg is an open source audio codec. Vorbis.com. *Home Page*. http://www.vorbis.com/

for audio and Motion JPEG2000[16] for video. It is important to understand that codecs are not file formats, although the abbreviations for a file format may be the same as an abbreviation for a codec. A single file format can use multiple codecs, but a single codec must be chosen for each individual file. Different compression methods are used for different purposes and separate codec algorithms have been developed for audio files and video files. Codecs can also be run at different speeds, influencing the file size and quality of a file. For example, if a MP3 codec is sampled at 128kbps, 192kbps, 256kbps, and 320kbps, it creates file sizes that range from 2.9 MB to 7.1 MB respectively.[17]

2A. Audio Files

As stated before, the quality of audio files is determined by the codec, bit rate, sampling frequency, and file format. The chosen codec effects quality based on its compression type, lossy or lossless, and the rate at which it is encoded. Encoding is most commonly called the bit rate but is sometimes referred to as the sampling rate or data rate.

2Ai. Bit Rate

"Bit rate is the number of bits that pass a given point in a telecommunication network in a given amount of time, usually a second… The term bit rate is a synonym for data transfer rate."[18] Bit rate for digital audio files is generally measured in kilobits per second (kbps); the faster the bit rate, the higher the audio quality, the larger the file size as shown in the table below. "Encoding more bits [during the compression process] allows higher audio quality, while encoding fewer bits allows greater efficiency [creating a smaller file size]."[19]

Bit Rate and File Size[20]

Codec	Bit Rate (data rate)	File Size
MP3 (lossy compression)	At 128 kbps	2.9 MB
MP3 (lossy compression)	At 192 kbps	4.3 MB
MP3 (lossy compression)	At 256 kbps	5.7 MB
MP3 (lossy compression)	At 320 kbps	7.1 MB
FLAC (lossless compression)	Variable	16 MB

[15] WMA Lossless provides the highest quality for ripping audio CDs with a range of 206 to 411 MB, at bit rates of 470 to 940 kbps. PCMag.com. *Definition of WMA Lossless*. http://www.pcmag.com/encyclopedia_term/0,2542,t=WMA+Lossless&i=54810,00.asp#

[16] JPEG2000. Motion JPEG2000 (Part 3). JPEG2000. 2007. http://www.jpeg.org/jpeg2000/j2kpart3.html

[17] DigitalTips. *Digital Audio 101*. http://www.digitaltips.org/audio/audio101.asp

[18] SearchNetworking.com. *Definitions: Bit Rate*. July 25, 2001. http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci214389,00.html

[19] DigitalTips. *Digital Audio 101*. http://www.digitaltips.org/audio/audio101.asp

[20] Information in table compiled from: DigitalTips. *Digital Audio 101*. http://www.digitaltips.org/audio/audio101.asp

WAV (uncompressed)	1211 kbps	31.5 MB

2Aii. Sampling Frequency and Bit Depth

Bit rate alone does not determine the audio quality and file size, the sampling frequency or sampling rate and bit depth are also important. The process of sampling is the "digitizing of a waveform by measuring its amplitude fluctuations at some precisely timed intervals."[21] "The higher the sampling rate, the closer the shape of the digital waveform will be to that of the original analog waveform."[22] To reproduce accurate sound, the sampling rate must be twice the highest frequency one would like to capture. As a benchmark, commercial compact disks have a "sample rate of 44, 100 samples per second that allows sampling up to 22, 050 HZ, which is higher than the limit of human hearing, 20,000 Hz."[23] The quality of the sampling rate is determined by the bit depth. Bit depth measures the quality of the sampling rate by indicating the number of bits available to capture the audio sound.[24] In other words, bit depth is the number of bits used to describe a file; the larger the bit depth, the more information captured, resulting in a larger file size. A file with a bit depth of 16 has 65, 536 values and a file with bit depth of 24 has 16,777,216 values available to describe the audio file.[25] The Collaborative Digitization Program (CDP)'s Digital Audio Working Group has a useful discussion and chart comparing the pros and cons of various sampling rates and bit depths in *Digital Audio Best Practices Version 2.1*.[26]

2Aiii. Audio Formats

As discussed above, different file formats produce different file sizes and qualities based on bit rate, sampling rate and bit depth. However, the file formats themselves tell you nothing about audio quality as some file formats, such as MP3, can have different bit rates, sampling rates, and bit depths, varying the quality of the files within a single format (e.g. .mp3). The file format however may indicate the compression type (lossy or lossless) of a file, but not necessarily the compression codec itself.

The following chart, modified from the chart on the *Digital Audio File Format and Codecs* webpage, highlights many common digital audio formats and lists the dominant codec, sampling

[21] Cakewalk by Roland. *Desktop Music Handbook Glossary of MIDI and Digital Audio Terms*. http://www.cakewalk.com/Tips/desktop-glossary.asp
[22] Adobe. *Adobe Audition 1.0: A Digital Audio Primer*. 2003. http://www.adobe.com/products/audition/pdfs/audaudioprimer.pdf
[23] Adobe. *Adobe Audition 1.0: A Digital Audio Primer*. 2003. http://www.adobe.com/products/audition/pdfs/audaudioprimer.pdf
[24] Digital Conservancy. *Digital Audio Guidelines*. University of Minnesota. 2007. http://conservancy.umn.edu/bp-audio.jsp
[25] Adobe. *Adobe Audition 1.0: A Digital Audio Primer*. 2003. http://www.adobe.com/products/audition/pdfs/audaudioprimer.pdf
[26] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf

rate, bit depth, and the bit/data rate for each format.[27] Additional formats and codecs are included in Appendix 1.

Common Digital Audio Formats and Associated Information

File Format	Compression Codec	Sample Rate	Bit-Depth	Bit/Data Rate
Audio Interchange File Format (.aif)	none	variable but most common are 11, 22 & 44.1KHz	variable but most common is 16bit	variable
WAV (.wav)	none	variable but most common are 11, 22 & 44.1KHz	variable but most common is 16bit	variable
CD (Compact Disc) red book audio	none	44.1KHz	16bit	1.4 Mbits per sec. 10Mb per stereo minute (mono is therefore 5Mb per/min)
DVD audio	DVD video discs *can* use compressed or uncompressed audio	Uncompressed format allows for 44.1kHz, 48kHz, 88.2kHz, 96kHz, and 192kHz	24bit	1.5 - 9.6 Mbits per sec.
MPeg Layer 3 (MP3)	MP3	variable but typically 44.1KHz	variable but typically 16bit	Variable but typically between 32 and 320 Kbits per sec. Average file size at 128Kbits per sec is 1Mb per stereo minute.

[27] The chart was pulled from the Digital Audio File Format and Codecs webpage. Less common formats were removed. Ottewill, Matt. *Digital Audio File Formats and Codecs*. Planet of Tunes. http://www.planetoftunes.com/digiaudio/daudiofiles.html

2B. Video Files

The quality of video files not only depends on the chosen codec but must also take into account the optimal number of pixels for various display height and width (frame size) at certain speeds (number of frames per second – frame rate), color requirements (bit depth), as well as details on the audio track. Frame size is the height and width of the video window measured by the number of pixels in each direction. The greater the number of pixels, the larger the file size, and the more bandwidth required for download. Frame rate is the number of frames viewed per second. Video encoded at 15 frames per second or lower will result in poor quality files. The bit depth determines the number of colors used when displaying the video. The more colors the larger the file size.

The table below shows the relationship between frame size, frame rate, and bit depth to the required amount of bandwidth; keep in mind, the higher the bandwidth, the larger the resulting file size.

Relationship between Video Settings and Bandwidth[28]

Screen Size	Pixels per Frame	Bit Depth (bits)	Frames per Second	Bandwidth Required (megabits)
640 x 480	307,200	24	30	221.184
320 x 240	76,800	16	25	30.72
320 x 240	76,800	8	15	9.216
160 x 120	19,200	8	10	1.536
160 x 120	19,200	8	5	0.768

Carl Fleischhauer, program officer for the National Digital Information Infrastructure and Preservation Program (NDIIPP), states that the maturity of digitization knowledge and practice varies by media type; for example, still images have been digitized for over ten years, while information on video files is lacking and best practices for digital audio and video are less mature.[29] Fleischhauer also recognizes that there is a lot known about digitizing video for web output for sites such as YouTube, but much less is known about best practices and formats suitable for high-quality long-term preservation. One goal of the Audio-Visual Working Group of the Federal Agencies Digitization Guidelines Initiative is to determine a target format for preservation quality copies of digital audio and video files.[30]

Some common video formats are listed below followed by some general information about each. Additional formats and video codecs are included in Appendix 1.

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[28] Guy, Marieke. *QA Focus Documents: Choosing a Suitable Digital Video Format*. UKOLN. October 1, 2004. http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/html/

[29] Fleischhauer, Carl. *Federal News Radio Interview*. October 16, 2008. http://federalnewsradio.com/emedia/134896.mp3 as found on http://digitizationguidelines.gov/news/.

[30] Federal Agencies Digitization Guidelines Initiative. *Home Page*. February 19, 2009. http://www.digitizationguidelines.gov/

Common Digital Video Formats and Associated Information[31]

File Format	Notes
AVI : Audio Video Interleave (.avi)	Created by Microsoft; uses various codec encodings; typically compressed less than .mov and .mpeg; can be played by various players if they have the codec used to encode the file. Used for progressive downloads.
Windows Media Video (.wmv)	Based on Microsoft's Advanced Systems Format (ASF). Windows proprietary format, Windows Media Player required for playback. Compressed with Windows Media codecs. Used for streaming files and progressive downloads.
RealMedia (.rm)	RealMedia proprietary format, RealPlayer required for playback. Streaming and progressive download.
QuickTime (.mov)	Uses a proprietary codec developed by Apple Computer. QuickTime Player required, but compatible with both PC and Apple computers. Files can be streamed or downloaded.
MPEG-4 Video file (.mp4, .m4v)	Format commonly used for sharing video files on the web. Uses separate compression for video and audio track, video uses MPEG-4 compression, while the audio is compressed with AAC codec.
MXF: Material eXchange Format. (.mxf)	Designed by the broadcast industry with hopes to improve workflow interoperability, this open file format was created to assist with the interchange of audio-visual material with its associated data and metadata.

3. Standards

Standards for digital audio and video formats and compression methods are evolving with every new advancement of digital technology. Various institutions have adopted standards for digital audio files; however, standards for digital video are not well documented outside of broadcast video, making it harder to find recommended best practices for video files.

The Library of Congress has developed the *Sustainability of Digital Formats Planning for Library of Congress Collections*[32] website to provide information about digital formats including sound and moving image formats. Each format listed includes an overview, evaluation of, and

[31] Information about the digital video formats and codecs was compiles from the following resources: Delvin, Bruce. *MXF – the Material eXchange Format*. EBU Technical Review. July 2002. http://www.ebu.ch/en/technical/trev/trev_291-devlin.pdf; File Extensions. *Home Page*. March 6, 2009. http://www.file-extensions.org/ ; Guy, Marieke. *QA Focus Documents: Choosing a Suitable Digital Video Format*. UKOLN. October 1, 2004. http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/html/; Ottewill, Matt. *Digital Video File Formats and Codecs*. Planet of Tunes. November 2008. http://www.planetoftunes.com/dv/videofiles.html;

[32] Arms, Caroline R. and Carl Fleischhauer. *Sustainability of Digital Formats Planning for Library of Congress Collections*. Library of Congress. May 21, 2007. http://www.digitalpreservation.gov/formats/index.shtml

listing of sustainability factors providing a broad overview of most available formats. Inclusion on this page, however, does not indicate an endorsement by the Library of Congress.

3A. Audio Standards

The sampling rate and bit depth determine the resolution of an audio file. As previously stated, the sampling rate determines the number of times the sound wave is measured, and bit-depth measures the quality of the sampling rate by indicating the number of bits available to capture the sound. After being recorded, the bit depth and sample rate cannot be changed, so it is important to consider current and future use of the files before setting parameters and recording.[33]

Although not generally used for archival purposes, it was written in 2002 that "there is a general consensus that the digital configuration of standard compact disks (44.1 kHz, 16 bit) is inadequate, but [there is a] debate over how high the sampling rate and world length [bit depth] for digital preservation should be. Many engineers and conservators argue for a sampling rate of 192 kHz and word length [bit depth] of 24 bits, at a minimum."[34] However, most digital audio recording devices were not designed with preservation in mind and are not capable of recording at high sampling rates, including the recommended 192 kHz.[35]

Current guidelines for sampling rate and bit depth for audio files from the National Archives and Records Administration (NARA), University of Michigan, and the University of Minnesota are summarized in the chart below.

[33] Formats Group, Deep Blue. Best Practices for Producing Quality Digital Audio Files Version 1.0. University of Michigan. July 10, 2006. http://hdl.handle.net/2027.42/40248

[34] Brylawski, Samual. "Preservation of Digitally Recorded Sound." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf

[35] Brylawski, Samual. "Preservation of Digitally Recorded Sound." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf

NARA[36]		University of Michigan[37]		University of Minnesota[38]
Preferred		**Archival Quality**		**Optimal**
Sample Rate: 96 kHz		Sample rate: 96 kHz		Sample rate: 96 kHz
24 bit-depth		24 bit-depth		24 bit-depth
		Acceptable (DVD quality)		**Recommended**
		Sample rate: 48 kHz		Sample rate: 48 kHz
		16 bit-depth		24 bit-depth
Minimum		**Acceptable (CD quality)**		**Minimum**
Sample rate: 44.1 kHz		Sample rate: 44.1 kHz		Sample rate: 44.1 kHz
16 bit-depth		16 bit-depth		16 bit-depth

The Bibliographic Center for Research (BCR) further explains that the appropriate sample rate and bit-depth are dependent on the frequency of the recorded medium. The BCR's *Digital Audio Best Practices* guide states that the human voice falls within the 50hz -20kHz frequency range, which requires only a 44.1 kHz sampling rate to capture all of the sound, where music and animal sounds or other natural sounds often have a higher frequency, and should be recorded with the higher sampling rate of 96 kHz (which records frequencies up to 48 kHz).[39] If able to do so and unsure about the source frequency range, a higher standard should be used for all recordings to allow additional uses of the sound recordings in the future. Information not captured today will be lost forever.[40] The following chart shows the BCR, the University of Michigan and the University of Minnesota's recommendations for sampling rate by sound source type.

[36] The National Archives Records Administration (NARA). *Frequently Asked Questions (FAQ) About Digital Audio and Video Records*. The National Archives. http://www.archives.gov/records-mgmt/initiatives/dav-faq.html
[37] Formats Group, Deep Blue. Best Practices for Producing Quality Digital Audio Files Version 1.0. University of Michigan July 10, 2006. http://hdl.handle.net/2027.42/40248
[38] Digital Conservancy. *Digital Audio Guidelines*. University of Minnesota. 2007. http://conservancy.umn.edu/bp-audio.jsp
[39] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf
[40] Formats Group, Deep Blue. Best Practices for Producing Quality Digital Audio Files Version 1.0. University of Michigan July 10, 2006. http://hdl.handle.net/2027.42/40248

BCR[41]		University of Michigan[42]		University of Minnesota[43]
Spoken Word		**Spoken Word**		**Spoken Word**
Sample Rate: 44.1 kHz		Sample rate: 96 kHz		Sample rate: 96 kHz
Field Recordings		**Field Recordings**		**Field Recordings/Combo recordings**
44.1 kHz (voice only)		Sample rate: 96 kHz /48 kHz		Sample rate: 96 kHz
96 kHz (all other sound)				Combination recordings include voice, music, and all other sounds.
Music		**Music**		**Music**
96 kHz (all other)		Sample rate: 96 kHz /44.1 kHz		Sample rate: 44.1 kHz

There are a multitude of digital audio file formats available for use and standards are often chosen or developed in-house based on the resources available and needs of the institution. The National Archives Records Administration (NARA) states that in order to be able to preserve files, the formats should be publicly and openly documented, non-proprietary, in widespread use, and self-documenting; ensuring that they can be open, read and accessed using readily-available tools.[44] NARA is not currently issuing formal format standards because "of the rapidly evolving nature of digital audio and video formats and the lack of any open, national or international consensus standards for the creation and preservation of digital audio and video,"[45] but they have created guidelines for federal records. It is recommended that higher quality files use a non-proprietary format and are uncompressed or compressed using a lossless technique if they are going to be used as preservation copies.

To ensure the best audio recording possible, the Michigan State Court Administrative Office follows its *Standards for Digital Audio Recording Systems*[46] policy. This document specifically dictates that the recording systems in use meet the special requirements of the courtroom setting. Topics covered in the policy include: system design, audio recording, storage, playback and transcription, annotations, reliability and security, integration, analog duplication, and

[41] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. Digital Audio Best Practices Version 2.1. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf
[42] Formats Group, Deep Blue. Best Practices for Producing Quality Digital Audio Files Version 1.0. University of Michigan July 10, 2006. http://hdl.handle.net/2027.42/40248
[43] Digital Conservancy. *Digital Audio Guidelines*. University of Minnesota. 2007. http://conservancy.umn.edu/bp-audio.jsp
[44] The National Archives Records Administration (NARA). *Frequently Asked Questions (FAQ) About Digital Audio and Video Records*. The National Archives. http://www.archives.gov/records-mgmt/initiatives/dav-faq.html
[45] The National Archives Records Administration (NARA). *Frequently Asked Questions (FAQ) About Digital Audio and Video Records*. The National Archives. http://www.archives.gov/records-mgmt/initiatives/dav-faq.html
[46] Michigan State Court Administrative Office. *Standards for Digital Audio Recording Systems*. March 2007. http://courts.michigan.gov/scao/resources/standards/da_stds.pdf

administrative functions. The advantages and disadvantages of various digital recording systems are also discussed in the Bibliographic Center for Research's *Digital Audio Best Practices Guide*.[47]

The following chart shows digital audio format recommendations for digital audio files from NARA, the University of Michigan, and the University of Minnesota.

[47] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf

Audio File Format Recommendations

NARA[48]		University of Michigan[49]		University of Minnesota[50]
Recommended		**Recommended**		**Recommended**
AIFF (.aif): Audio Interchange Format		AIFF (.aiff, .aif)		AIFF (.aif): Developed by Apple computer, this file format is well supported and in widespread use.
WAV (.wav): Uncompressed Waveform audio format		WAV (.wav)		WAV (.wav): Developed by Microsoft, this file format is in widespread use and readable by a number of applications.
FLAC: Free format Lossless Audio Codec		FLAC (free lossless audio code, .flac)		
Uncompressed Broadcast Wave Format (BWF)				
Audio Format (AU)				
Motion Pictures Expert Group (MPEG) 4 Audio Lossless Coding format (ALS)				
Acceptable		**Acceptable**[51]		**Acceptable**
None listed.		ALAC (Apple lossless audio codec, lossless but proprietary; .alac)		Other formats such as MP3 are accepted; however they may receive a lower level of preservation support.
		MOV (.mov)		
		MP3 (.mp3, lossy but publicly documented)		
Not Recommended		**Not Recommended**		**Not Recommended**
Files created for streaming broadcast.		Advanced Audio Coding: AAC/MPEG-2 (.aac): proprietary and lossy		*None listed.*
Reference files of lower quality then the original		Real Audio (.ra, .rm, .ram)		
Most .mp3 files.		Windows Media Audio (.wma)		

[48] The National Archives Records Administration (NARA). *Frequently Asked Questions (FAQ) About Digital Audio and Video Records*. The National Archives. http://www.archives.gov/records-mgmt/initiatives/dav-faq.html

[49] Formats Group, Deep Blue. Best Practices for Producing Quality Digital Audio Files Version 1.0. University of Michigan July 10, 2006. http://hdl.handle.net/2027.42/40248

[50] Digital Conservancy. *Digital Audio Guidelines*. University of Minnesota. 2007. http://conservancy.umn.edu/bp-audio.jsp

[51] The University of Michigan states that it is best submit materials in a non-proprietary format, even if the file is compressed. It is suggested that you convert files in compressed proprietary formats to AIFF or WAV for long-term storage to insure no more data loss. Even though MP3 uses lossy compression, it is preferred over proprietary formats such as Real Audio or Windows Media file because it is publically documented. Formats Group, Deep Blue. Best Practices for Producing Quality Digital Audio Files Version 1.0. University of Michigan July 10, 2006. http://hdl.handle.net/2027.42/40248

Gareth Knight with the Arts and Humanities Data Service (AHDS) in the United Kingdom sums up the importance of all the components of digital audio files in *The Preservation Handbook: Digital Audio* when he states, "The moment of creation is the most important stage of digital audio preservation. The analogue sound has to be captured correctly and at a sample rate, which will not lead to a deterioration of the original sound."[52] To learn more about the AHDS specific procedures on how to migrate files to a suitable preservation format and to follow guidelines on how to validate data review their preservation handbook.[53]

3B. Video Standards

Standards for video files are not well developed outside of the broadcasting industry. Projects such as "Preserving Digital Public T.V.", a National Digital Information Infrastructure and Preservation Program (NDIIPP) project, are working on designing an archive for long-term preservation of digital public television which includes determining best practices and standards for files.[54] The general concepts addressed in the NDIIPP project correspond well to all digital video projects, however the specific formats and standards discussed are not comparable with the recording systems currently being used to record floor sessions and committee meetings. Although, audio visual archives as well movie producers and TV broadcasters working with high quality files have already begun to follow these types of standards.[55]

The digital video files that legislative bodies want to preserve are generally not television production quality, and the requirements for digital video files suggested by the National Archives Records Administration (NARA) may be more applicable. The details of the NARA recommendations are listed below.[56]

File Format:

- Audio-Video Interleave format (AVI)
- Material Exchange Format (MXF)
- Quicktime format (MOV)

Codec: (Agencies should be aware that not all codecs are appropriate for every format.)

- Motion JPEG2000 (lossless, open) [preferred]
- HuffyUV (lossless, open) [preferred]
- MPEG2 (lossy) [acceptable]
- MPEG4 (lossy) [acceptable]

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[52] Knight, Gareth and John McHugh. *Preservation Handbook: Digital Audio*. Arts and Humanities Data Service. July 25, 2005. http://ahds.ac.uk/preservation/audio-preservation-handbook.pdf

[53] Knight, Gareth and John McHugh. *Preservation Handbook: Digital Audio*. Arts and Humanities Data Service. July 25, 2005. http://ahds.ac.uk/preservation/audio-preservation-handbook.pdf

[54] Library of Congress. *Partners: Preserving Digital Public Television Program*. Digital Preservation. http://www.digitalpreservation.gov/partners/pdpt/pdpt.html

[55] Fleischhauer, Carl. *Video Formatting and Preservation*. DFL Forum. November 6, 2007. http://www.digitalpreservation.gov/library/resources/pubs/docs/Fleischhauer_DLF20071106.pdf

[56] The National Archives Records Administration (NARA). *Frequently Asked Questions (FAQ) About Digital Audio and Video Records*. The National Archives. http://www.archives.gov/records-mgmt/initiatives/dav-faq.html

- DV (lossy) [acceptable]
- MJPEG2000 (lossy) [acceptable]

Height and Width Requirements: NARA usually will accept whatever height and width the agency selects for its business needs; however NARA recommends a minimum 720x486 pixels at 30 frames per second.

Color Requirements: The color depth of a digital video should match the number of colors as well as the color encoding and luminance of the original material. Black and white originals should be recorded in grayscale; color originals should be recorded in full-range color (8 bits per channel with 10 bits per channel preferred).

Audio Track: The primary consideration is that agencies should record the audio tracks of digital video recordings at 48KHz.

Not Acceptable: NARA does not consider the following digital video files to have sufficient quality for archival retention:

- Files created for "streaming" broadcast (e.g. RealAudio, Windows Media) - these files sacrifice quality for file size. They are often reduced from high-resolution files by removing high and low frequency ranges and compressing the remaining signal.
- Reference files of lower quality than original (e.g. for web site use) - again, these sacrifice quality for file size.
- Files that have been transcoded. In other words, it is not acceptable to render previously encoded content through another codec. Agencies should not apply a second codec to a file that has already been encoded.

With the exception of the NARA guidelines, which cover a wide range of file types, detailed standards for non-broadcast quality video files are not well developed. Due to the lack of standards, people working with digital video files should answer the following questions to assist with the selection of specific recording elements, codecs, file formats, and thinking about long-term use as suggested in *Digital Video Archives: Managing Through Metadata*.[57]

- What should the sampling and quantization rates be?
- What compression strategies should be used – lossy or lossless?
- What media should be used to store the resulting digital files – optical (such as digital video disk [DVD]) or magnetic?
- What is the shelf life for such media, i.e., how often should the digital records be transferred to new media?
- What are the environmental factors for long-term media storage?
- What decompression software needs to exist for subsequent extraction of video recordings?

[57] Waclar, Howard D. and Michael G. Christel. "Digital Video Archives: Managing Through Metadata." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf

4. Delivery Methods

One advantage of digital files is the multitude of ways that the information contained within them can be shared. Digital files can be delivered electronically to users via email if the file size is reasonable. Larger files or numerous files can be burned to disk or downloaded onto a flash drive for easy transfer from one computer to another. Content can also be delivered via the Internet based on user-driven desires. Many personal media devices such as MP3 players, cell phones including smart phones, and PDAs have the ability to share digital files. However, no matter which method is used to deliver the files, some sort of software such as a media player is required to watch any video file or listen to any audio file.

There are many different media players; three of the most common players are Windows Media Player, RealOne (Real Media's player for RealAudio and RealVideo), and QuickTime (for playing .mov files). Each player handles specific file formats and has individual features and benefits, but to access all audio and video files on the web users may need access to multiple players, a direct result of the lack of universal format standards.[58] Personal media devices come equipped with various pieces of software that enable certain file types to be captured and read by each device. It is important to understand that not all the devices play the same types of files.

Using the Internet to deliver digital content is the most common method when working with legislative materials such as floor sessions and committee meetings. Files are too large to send via email and burning files to disk or flash drive for individual requests would be cost-prohibitive. There are three methods used to deliver audio and video content to users on the Internet: embedding files on web pages, enabling users to download files, and streaming files to users.[59] Keep in mind that may people may be accessing the Internet via their cell phones.

4A. Embedding

Embedding files on a website directly links the file and webpage. The file becomes part of the webpage content and the webpage is not fully loaded until the file is completely loaded, which takes time. The process of embedding files only requires a normal web server to deliver the files to your audience; however, the direct relationship between the webpage and file ultimately reduces the flexibility of this method.[60] Some concerns with embedding files include: having to republish the webpage each time the file is changed; needing to wait for the entire file to load before being able to play it; needing enough memory on the user's computer to store the file; and the limitation of file length is set to 16,000 frames.[61]

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[58] PC World. *Streaming Audio*. April 10, 2000. http://www.pcworld.com/article/16060/streaming_audio.html
[59] Adobe. *Flash Video Learning Guide: Delivery Options for Flash Video*. Adobe Developer Connection. http://www.adobe.com/devnet/flash/articles/video_guide_02.html
[60] Adobe. *Flash Video Learning Guide: Delivery Options for Flash Video*. Adobe Developer Connection. http://www.adobe.com/devnet/flash/articles/video_guide_02.html
[61] This connection between the webpage and file is what ultimately reduces the flexibility of this method.

4B. Downloading

Offering downloadable files on a website removes the direct link between the file and webpage. Unlike embedded videos, the video file is not attached to the webpage, so the file must be downloaded before it can be viewed. The user initiates the process by clicking a 'download now' button or similar icon on the webpage. The process of downloading can be done in two ways. The first is that a file is downloaded to a computer or device, and the file must be completely downloaded before the file can be accessed. The second is called progressive downloading. If a file's parameters were set to allow progressive download, the user can start to play the file before the download is complete, although they are not able to skip to a section of the file that has not yet been downloaded.[62] The method available is determined by how the person who developed the webpage set up the download process. Due to the lack of direct link between the file and the webpage, an advantage to using downloading is that the audio and video content can be changed without having to continuously update the webpage as was the case with embedded files. However, another thing to realize is that once a user downloads an audio or video clip, the file remains on their computer for future access unless intentionally deleted, for better or worse.

4C. Streaming

Streaming is a technique for transferring data that allows it to be processed as a steady and continuous stream. Streaming of files is possible because available bandwidth has increased, computers are more powerful, and more sophisticated audio and video compression algorithms have been developed reducing file sizes. With available bandwidth continuing to increase and the growing expectations of users, streaming has become a popular method for delivering audio and video content to users.

During the streaming process users open up a persistent connection to a server and create a one-on-one relationship with the server housing the file.[63] Special video or streaming servers are often used. The streaming media server includes a specialized piece of software that analyzes the video files and the users' experience and is able to recognize the appropriate amount of data to send to each individual user.[64] When a user initiates playback, the software or player used to view the file downloads several seconds worth of data from the server and places it into a buffer of the players software on the user's computer. When the buffer is full, the information is sent on to the player and the media is played. Information is continuously sent to the buffer and then onto the player until the entire file is downloaded and played. "This download-while-playing process allows streaming to offer near-immediate gratification,"[65] as users often expect to view video files on their computer as if they were watching TV and streaming technology continues to add features that mimic the TV experience. Unlike with downloading, users can jump ahead and

[62] Bouthillier, Larry. *Streaming vs. Downloading Video: Understanding the Differences*. StreamingMedia.com. July 22, 2003. http://www.streamingmedia.com/r/printerfriendly.asp?id=8456
[63] Adobe. *Flash Video Learning Guide: Delivery Options for Flash Video*. Adobe Developer Connection. http://www.adobe.com/devnet/flash/articles/video_guide_02.html
[64] Bouthillier, Larry. *Streaming vs. Downloading Video: Understanding the Differences*. StreamingMedia.com. July 22, 2003. http://www.streamingmedia.com/r/printerfriendly.asp?id=8456
[65] PC World. *Streaming Audio*. April 10, 2000. http://www.pcworld.com/article/16060/streaming_audio.html

select where in the file the streaming begins. Streaming technologies include Adobe Flash, G2 from RealNetwork, Microsoft's Windows Media Technologies, and Apple's QuickTime; all of which are being used in legislative recordings.[66]

Other advantages of streaming media files include:

- Users do not need to have space available on their computers to download files.
- Many programs allow data providers to track, report, and log activity relating to the files, allowing providers to analyze use.
- Streaming files can be used in video chat, video messaging, and video conferencing applications.[67]
- It is the only method that "allows you to deliver and record live video and audio, or capture video from a client's webcam or digital video camera."[68]
- Streaming "provides more secure delivery of media because media does not get saved to the client's cache when streamed. [For example,] Flash Media Server also allows form encrypted streaming, providing and additional level of security."[69]

4Ci. The Streaming Process

There are three basic hardware and software elements required for streaming – a video server, an encoder, and a player, each serving its own function. A video server is needed by the creator of streaming media to distribute streams of information on demand. The encoder is the software that compresses the audio/video source into a file that can be streamed over the network, and any computer that supports this software must have a fast processor and large amount of memory.[70] The player is a piece of software that users need to have on their computer or personal media device before streaming files will play.

The cost of streaming is associated with the amount of server space and bandwidth needed. The creator needs to have access to a streaming server to store the files on. Institutions can purchase their own server or can use external servers. Adobe Flash and Real Media both offer streaming media servers available at a negotiated price. Bandwidth must also be purchased and can range from hundreds to thousands of dollars a month, depending on the amount desired.[71]

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[66] SearchUnifiedCommunications.com. *Definitions: Streaming Video*. September 3, 2008. http://searchunifiedcommunications.techtarget.com/sDefinition/0,,sid186_gci213055,00.html

[67] Adobe. *Flash Video Learning Guide: Delivery Options for Flash Video*. Adobe Developer Connection. http://www.adobe.com/devnet/flash/articles/video_guide_02.html

[68] Adobe. *Flash Video Learning Guide: Delivery Options for Flash Video*. Adobe Developer Connection. http://www.adobe.com/devnet/flash/articles/video_guide_02.html

[69] Adobe. *Flash Video Learning Guide: Delivery Options for Flash Video*. Adobe Developer Connection. http://www.adobe.com/devnet/flash/articles/video_guide_02.html

[70] Strom, Jim. *Streaming Video: A Look Behind the Scenes*. Cultivate Interactive. May 2001. http://www.cultivate-int.org/issue4/scenes/

[71] MP3 Sound Stream. *History of Streaming Audio*. October 15, 2008. http://mp3soundstream.com/streaming-audio/history-of-streaming-audio/

Bandwidth is very important for streaming videos. The larger the bandwidth, the faster files can be viewed on the computer. Many things effect bandwidth, including the size of your connection, the size of your users' connection, and the number of people online at the same time. Most streaming software offers automatic bandwidth detection which allows the server to determine the correct amount of the data to send to each user. Having multiple encodings of the same video will ensure that files look equally good in varying bandwidths. However, available bandwidth can change while watching a video, which can cause interruptions to the video stream. Dynamic streaming, such as is offered with Flash Player 10 and Flash Media Server 3.5 allows the server to detect varying bandwidths and adjust the streams as necessary. This technology keeps users happy and is now offered by most streaming systems.[72]

One advantage to streaming technology is the ability to provide access to information to a large number of people in various locations at the same time. In addition, real-time coverage is available with live streaming. These advantages have only increased the popularity of streaming media via the Internet. Streaming media does, however, have some limitations. Users must have a high-speed connection to take full advantage of the forma; the streaming process can work for users with a lower connection, but they often become frustrated in the process. To assist with the streaming process, files are highly compressed and, in general, compressed files are not suitable for long-term preservation.

4Cii. Live Streaming[73]

Another advantage gained with using streaming technology is the ability to share live broadcasts. Government entities have found the ability to broadcast live events to a large audience over the Internet attractive. The process of "live streaming allows you to build the stream very quickly

[72] Streaming uses codecs as well as special data-transfer schemes (streaming protocols) (such as RealTime Streaming Protocol) to get the data to the user. "Real Time Streaming Protocol (RTSP) defines how media will be streamed between the server and client. It defines the different types of connections that will be used in different types of situations to deliver the content best." (MP3 Sound Stream. *History of Streaming Audio*. October 15, 2008. http://mp3soundstream.com/streaming-audio/history-of-streaming-audio/) This allows Internet users with different connection speeds to "view the same clip even though one person is on a 28.8 modem and another is on cable. This is possible thanks to RTSP's ability to handle multiple bandwidths on one stream. For example, you can encode a single audio music clip for 28.8 kbps modems, 56 kbps modems, 112 kbps dual ISDN, and T1 connections. Your Web page links to this single clip, and when a visitor clicks the link, RTSP determines which encoding to use based on the available bandwidth. RTSP can even adjust this choice to compensate for network connections. If a fast connection becomes bogged down because of high network traffic, RTSP seamlessly switches to a lower bandwidth encoding to prevent the presentation from stalling. When the congestion clears, RTSP switches back to the higher bandwidth encoding." (MP3 Sound Stream. *History of Streaming Audio*. October 15, 2008. http://mp3soundstream.com/streaming-audio/history-of-streaming-audio/) As bandwidth and format preferences do vary, consider making files available in at least three different bandwidths and in two or three different formats. (AboutVideoEditing.com. *Streaming Video Over the Web*. http://www.aboutvideoediting.com/articles/web-streaming-video.shtml)

[73] CNN Live is working with Flash to test a method for enhanced live video experiences called grid delivery. "Grid delivery is intended to provide a scalable solution for live events that helps content providers reach larger audiences and maintain a high quality of service at a lower cost than many existing solutions. For users, this should mean faster start-up times and a smoother live video experience." (Huang, Emmy. *Improving Live Video Experience*. Macromedia Flash Player. December 16, 2008. http://weblogs.macromedia.com/emmy/archives/2008/12/improving_live_video_experiences.html)

from the source, either a camera or microphone and record the event."[74] During live events, "the video signal is converted into a compressed digital signal and transmitted from a special Web server that is able to do multicast, sending the same file to multiple users at the same time."[75] Legislative sessions and committee meetings are often streamed online.

Adobe Flash also has the ability to archive live video streams in real time. By modifying technology used in digital video recorders, users are able to play, pause, and rewind live broadcasts just as if they were watching a prerecorded stream. The trend is that users are now watching live media on their own time and in their own terms.[76]

5. Metadata Standards

Capturing and creating metadata about audio and video files assists with finding, accessing, managing, and preserving media files. In general, the metadata records information that identifies content, assists with providing access, and helps with long-term management of the materials.[77] If metadata is not contained within the file itself, it is very important to keep the metadata associated with the files. Metadata can be used to provide information about file types, software and hardware used to create or needed to access the file, date of creation, and dates of modifications if any. Born digital files often have some of this metadata automatically attached. Often metadata recording content information must be entered manually. However, to support content based retrieval, automatic analysis of audio and video files become a necessary step to ensure metadata is being created in a cost effective manner.[78] Currently previously developed metadata standards such as Dublin Core are being adopted and modified for use with audio and video files and new standards are also being created to record appropriate metadata for these file types. The development of an automatic rather than manual analysis of audio and video content continues to be a goal.

Metadata can be categorized as being descriptive, structural, or administrative, all which provide various details about the digital object. Descriptive metadata describes the object and provides information that will allow users to determine if the file is of interest to them. Structural metadata explains the structure of the file itself as well as its relationships to other files; it "identifies and organizes the individual files of images and sound that represent a digitized

[74] MP3 Sound Stream. *History of Streaming Audio*. October 15, 2008. http://mp3soundstream.com/streaming-audio/history-of-streaming-audio/

[75] MediaSolv.com. *Video Live Streaming Solutions by MediaSolv* – Sri Lanka. http://www.mediasolv.com/video-streaming.html

[76] Towes, Kevin. *Introducing Adobe Flash Media Server 3.5*. Adobe Developer Connection. http://www.adobe.com/devnet/logged_in/ktowes_fms35.html

[77] Fells, Nick and Pauline Donachy and Catherine Owen. *Performing Arts Data Service Guide to Good Practice Creating Digital Audio Resources: 8. Documenting Digital Audio Resources.* Arts and Humanities Data Service (AHDS). http://ahds.ac.uk/creating/guides/audio-resources/GGP_Audio_8.1.htm

[78] Waclar, Howard D. and Michael G. Christel. "Digital Video Archives: Managing Through Metadata." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf

item."[79] Administrative metadata records information about the hardware and software used to create the file; information on compression type and rates; and provides information on how the object can be preserved.

In the *Journal of Archival Organization*, Jerome McDonough and Mona Jimenez have broken down administrative metadata into more specific categories that highlight specific features associated with digital audio and video files. McDonough and Jimenez suggest that intellectual property rights metadata and digital provenance metadata are important enough to be discussed separately.[80] Intellectual property rights management informs a user what they legally can or cannot do with a file, and this becomes especially important with audio and video files because of the complexity in their creation and use. Monitoring intellectual property rights has been increasingly difficult because of the ease in which digital files can be shared, modified, and replicated, it is necessary to inform users what they can and can't do with the files.[81] Files may contain various components each with different intellectual property rights associated with them, making the process more difficult.

Digital provenance metadata can be used to "establish integrity and authenticity of a digital file,"[82] however it is not yet completely understood what information is required. Research is being conducted to determine how much data is actually needed to establish and keep the integrity and authority of a file. They stress that "finding ways to reduce the costs of producing digital provenance metadata will be vital if libraries are going to retain sufficient information regarding an item's origins and history for scholars to evaluate the item's authenticity."[83] While this was said about libraries, the same holds true for any archive or repository trying to maintain control over their records for the long-term.

The Bibliographic Center for Research states that using metadata standards such as Dublin Core or the Metadata Encoding and Transmission Standard (METS) is a place to start and will help build collaborations and allow for the development of specific needs of the media.[84] While not developed specifically for audiovisual materials, Dublin Core and METS can be adapted and applied to audio and video files. More specific standards that more accurately capture metadata specific to audio and video files have been developed by the public broadcasting community and

[79] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf
[80] McDonough, Jerome and Mona Jimenez. "Video Preservation and Digital Reformatting: Pain and Possibility." *Journal of Archival Organization*, 2006, Vol. 4 Issue ½, p. 167-191, 25 p, 1 diagram.
[81] Creative Commons uses a combination of icons to inform users what they can and cannot do with material available on the Creative Commons website. http://creativecommons.org/about/licenses
[82] McDonough, Jerome and Mona Jimenez. "Video Preservation and Digital Reformatting: Pain and Possibility." *Journal of Archival Organization*, 2006, Vol. 4 Issue ½, p. 167-191, 25 p, 1 diagram.
[83] McDonough, Jerome and Mona Jimenez. "Video Preservation and Digital Reformatting: Pain and Possibility." *Journal of Archival Organization*, 2006, Vol. 4 Issue ½, p. 167-191, 25 p, 1 diagram.
[84] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf

Motion Picture Experts Group.[85] The public broadcasting community developed PBCore[86] and the Motion Picture Experts Group developed MPEG-7.[87]

Based on Dublin Core, PBCore was developed with the intent to create "a standard way of describing and using this data, allowing content to be more easily retrieved and shared among colleagues, software systems, institutions, community and production partners, private citizens, and educators. It can also be a guide for the onset of an archival or asset management process at an individual station or institutions."[88] PBCore currently consists of "53 elements arranged in 15 containers and 3 sub-containers, all organized under 4 content classes."[89]

The MPEG-7 metadata standard is more closely related to MARC (Machine Readable Catalog record) standards. MPEG-7 is made up of 48 elements that have been mapped to and from MARC. This feature assists with making the records more accessible and usable across disciplines as MARC records are used within the library sciences.[90] MPEG-7 is also working with the creators of Dublin Core to develop an XML-based mark-up language adding flexibility to this metadata set.

Penn State developed their own metadata set that included twenty six elements based on the PBCore and Dublin Core standards; these are shown in Kevin Clair's case study about audiovisual metadata.[91] By modifying an existing metadata set, the information could easily be added to Penn State's management system for still images (CONTENTdm[92]) which enhanced access to a larger collection of Penn State's digital holdings. Penn State developed a local metadata standard whose the elements will need to remain flexible, at least until a more uniform standard is set. One problem they identified was that "there is no method by which individual sections of a video file may be described."[93]

Harvard University published more specific information on their list of technical metadata for audio files defining twenty six elements for technical data alone.[94] A METS file is used to pull

[85] Clair, Kevin. "Developing an Audiovisual Metadata Application Profile: A Case Study." *Library Collections, Acquisitions, and Technical Services* 32, no. 1 (2008): 53-57.
[86]The PBCore website defines its purpose and goals. http://www.pbcore.org/index.html
[87] For more information about MPEG-7: http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm The Moving Pictures Expert Group home page is: http://www.chiariglione.org/mpeg/
[88]PBCore. *Background of the PBCore Public Broadcasting Metadata Dictionary Project*. Public Broadcasting Metadata Dictionary Project. 2005. http://www.pbcore.org/PBCore/PBCore_background.html
[89] PBCore. *Home Page for the PBCore Public Broadcasting Metadata Dictionary*. Public Broadcasting Metadata Dictionary Project. 2007. http://www.pbcore.org/PBCore/index.html
[90] Clair, Kevin. "Developing an Audiovisual Metadata Application Profile: A Case Study." *Library Collections, Acquisitions, and Technical Services* 32, no. 1 (2008): 53-57.
[91] Clair, Kevin. "Developing an Audiovisual Metadata Application Profile: A Case Study." *Library Collections, Acquisitions, and Technical Services* 32, no. 1 (2008): 53-57.
[92] CONTENTdm home page. http://www.contentdm.com/
[93] Clair, Kevin. "Developing an Audiovisual Metadata Application Profile: A Case Study." *Library Collections, Acquisitions, and Technical Services* 32, no. 1 (2008): 53-57.
[94] Harvard University Library. *Administrative Metadata for Digital Audio Files*. Harvard University Library: Library Digital Initiative. 2004. http://preserve.harvard.edu/resources/audiometadata.pdf

all the metadata information together. Indiana Digital Library also uses METS as the "glue that holds the digital object together."[95]

There are various methods for creating and recording metadata, and one must look at the goals of the institution and project to determine what information needs to be captured and what standard best fits current and future needs. No matter what metadata set is chosen, metadata itself is essential for digital files, assisting with searching, access, and preservation.

6. Storage

Audio and video files can be large and accumulate fast. Media outlets and the general public are generating audio and video content daily. Some government agencies are saving audio and video files of every floor session and committee meeting that is being streamed to the public. The amount of space needed to store these files adds up quickly. It is estimated that about a half a terabyte of space is needed each year for Minnesota Senate recordings alone.[96]

Where is this data stored? How do you gain access to it? Do you have instant access, or are the files archived off-line? Are files stored on-site or offsite in a repository? The answers will depend on the file size, number of files, and how you want to use and access the files. As storage concerns are related to the overall file organization and data structure of an institution, please review the Bibliographic Center for Research's CDP Digital Imaging Best Practices guide for a basic review of data centers and network design.[97]

Files stored on-site could reside on media servers or external hard drives, providing instant (online) or delayed (off-line) access respectively. Media servers allow immediate access limited only by the speed of your network connection and the amount of RAM (random access memory) of the computer. Retrieving archived files stored offline on optical media, external hard drives, or magnetic data tape would take time. If using on-site storage, you are responsible for hardware and software upgrades as well as data backup procedures. A redundant RAID system[98] can be used to backup files. Methods for ensuring the trustworthiness of your files must also be addressed in your institutions storage policy.

On a larger scale, the responsibility for storing files could be shared by using a digital repository, yours or someone else's. A repository could provide web access to digital files and offer

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[95] Dunn, Jon. Digital *Audio Preservation at Indiana University (continued)*. Digital Library Brown Bag Series, Indiana University. May 6, 2005. http://www.dlib.indiana.edu/education/brownbags/spring2005/audio/dunn.pdf

[96] This number is approximately how much space the Minnesota Senate uses a year on their floor sessions and committee meetings. The number will depend on the recording specifics and overall file sizes. The number of half a terabyte was taken from a conversation with Jim Greenwalt, Minnesota Senate Information Systems Director on February 5, 2009.

[97] Bibliographic Center for Research. *BCR's CDP Digital Imaging Best Practices Version 2.0*. June 2008. http://www.bcr.org/cdp/best/digital-imaging-bp.pdf

[98] RAID systems are disks that are arranged in a particular manner. RAIDS often create mirrors of themselves to help mitigate loss of data if a single disk goes bad. A RAID array uses a group of disks to help back up data on a daily basis. BCR's CDP *Digital Imaging Best Practices Guide's Appendix G* details the first five levels of RAID systems. Bibliographic Center for Research. *BCR's CDP Digital Imaging Best Practices Version 2.0.* June 2008. http://www.bcr.org/cdp/best/digital-imaging-bp.pdf

functions that enhance access to the data or a repository could focus only on providing preservation services.[99] As there are differences with the goals of a repository, make sure the one you choose fits your current and future goals.

If an external repository is chosen for storage, it is essential that the repository be a trusted provider. To help establish protocol for trustworthy repositories, in 2007 the Center for Research Libraries (CRL) and Online Computer Library Center (OCLC) published *Trustworthy Repositories Audit and Certification: Criteria and Checklist*.[100] The guide highlights the importance of knowing background information about the institution such as "its governance; organizational structure and staffing; policies and procedures; financial fitness and sustainability; the contracts, licenses, and liabilities under which it must operate; and trusted inheritors of data, as applicable."[101] Transparency of the repository can also increase the trustworthiness. A repository that understands and acknowledges threats to and possible risks within its systems including: "media failure, hardware failure, software failure, communication errors, failure of network services, media and hardware obsolescence, software obsolescence, operator error, natural disaster, external attack, internal attack, economic failure, and organizational failure"[102] shows an internal level of understanding about important issues.

When working with a repository, the depositor and repository must discuss and understand in advance the policies and procedures of ingest and storage of, and access to the files. Questions to ask include but are not limited to:

- How much data can you ingest at one time?
- What formats do you accept?
- Are files sent electronically or on external media?
- Is this an automatic process?
- How much human intervention is necessary?
- Do you have a storage limit for files?
- How much does it cost?
- How are the files backed up?
- How do users access the data?
- Can users search an online catalog?
- Can they visit the repository in person?
- Is repository staff available to answer users' questions, online or in person?
- Can the files be downloaded?
- Do you offer various file types for delivery?

One will want to make sure that "the digital object management practices, technological infrastructure, and data security [are sound]… [and that they are] reasonable and adequate to

[99] Dunn, Jon. *Digital Audio Preservation at Indiana University (continued).* Digital Library Brown Bag Series Indiana University. May 6, 2005. http://www.dlib.indiana.edu/education/brownbags/spring2005/audio/dunn.pdf
[100] http://www.crl.edu/PDF/trac.pdf
[101] The Center for Research Libraries (CRL) and Online Computer Library Center (OCLC). *Trustworthy Repositories Audit and Certification: Criteria and Checklist*. February 2007. http://www.crl.edu/PDF/trac.pdf
[102] The Center for Research Libraries (CRL) and Online Computer Library Center (OCLC). *Trustworthy Repositories Audit and Certification: Criteria and Checklist*. February 2007. http://www.crl.edu/PDF/trac.pdf

fulfill the mission and commitments of the repository."[103] "Trust involves scholarship, authenticity, reliability, and persistence over time."[104] However, storage management policies may prove to be the most important element to insure trust.[105] As stated in the CRL document, the Center for Research Libraries will assist with the process of certifying repositories in the United States. To learn more about the criteria for trustworthy repositories review *Trustworthy Repositories Audit and Certification: Criteria and Checklist.*[106]

In general there are three structural models repositories follow; a centralized repository, a distributed repository, and a distributed repository utilizing grid computing. Your institution should be aware of all of these types and use the model that you are most comfortable with making sure it fits your long-term goals.

A centralized repository collects, stores, and preserves files for one or more institutions and provides online access to files from any location. The Washington State Digital Archives is an example of this type of repository. They are currently working with four other states to preserve multi-state digital government information. Their system includes a "state-of-the-art data center, containing both system and power redundancies, and incorporates a functioning preservation framework for electronic records and documents based on the OAIS [Online Archival Information System[107]] model."[108] Partners share the associated costs.

The main idea behind a distributed system is that files should be duplicated and stored in multiple places, any of which could be used as backups if the main system fails. Lots Of Copies Keeps Stuff Safe (LOCKSS) is the best known example of this repository model.[109] Arizona has developed the Persistent Digital Archives and Library System (PeDALS[110]), a distributed system based on the open-source LOCKSS, with the goal to develop an "inexpensive storage network

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[103] Dunn, Jon. *Digital Audio Preservation at Indiana University (continued).* Digital Library Brown Bag Series Indiana University. May 6, 2005. http://www.dlib.indiana.edu/education/brownbags/spring2005/audio/dunn.pdf

[104] Jantz, Ronald and Michael Giarlo. "Digital Archiving and Preservation: Technologies and Processes for a Trusted Repository." *Journal of Archival Organization*. 2007. 4:1, 193-213.

[105] This issue of trust was tested by the Library of Congress (LC) with the San Diego Supercomputer Center (SDSC) who formed a depositor/repository relationship between May 2006 and October 2007. "The two main objectives of the project were 1) for SDSC to host LC content reliably and return it intact at the end of the project and 2) for LC to be able to remotely access, process, analyze, and manage that content" (NAME??? Data *Center for Library of Congress Digital Holdings: A Pilot Project*. October 17, 2007. http://chronopolis.sdsc.edu/assets/docs/SDSC_LC_data-storage_report_2.pdf) A collection of digital photographs and a collection of archived websites were used as testing materials. The final report, *Data Center for Library of Congress Digital Holdings: A Pilot Project*, discusses the experience and addresses what is important when trying to establish trust between two institutions. This Pilot Project evolved into Chronopolis Digital Preservation Demonstration Project (Chronopolis).

[106] The Center for Research Libraries (CRL) and Online Computer Library Center (OCLC). *Trustworthy Repositories Audit and Certification: Criteria and Checklist*. February 2007. http://www.crl.edu/PDF/trac.pdf

[107] Consultative Committee for Space Data Systems. Reference Model for Open Archival Information System (OAIS). January 2002. http://public.ccsds.org/publications/archive/650x0b1.pdf

[108] Washington State Digital Archives. *Multi-State Preservation Partnership*. Washington State Digital Archives. http://www.digitalarchives.wa.gov/Content.aspx?txt=LoCProjectSite

[109] http://www.lockss.org/lockss/Home

[110] http://rpm.lib.az.us/pedals/index.asp

that can preserve the authenticity and integrity of the collections".[111] The software also assists with migrations and audits files continually, assisting with file preservation.

Grid computing is also a distributed system, but the files are not duplicated as they are with LOCKSS. Files are distributed and stored in multiple places around the world, but you can gain access to files stored in any location as if they were on your own server. The San Diego Supercomputer Center (SDSC) is using a data grid framework called DataGrid[112] with their Chronopolis Projects[113] to store and preserve data. One of Chronopolis's projects involves preserving data from two of the Library of Congress's National Digital Information Infrastructure and Preservation Program (NDIIPP) projects, including 12 TB of data from the Data-PASS[114] project at the University of Michigan's Inter-University Consortium for Political and Social Research (ICPSR) and 25 TB of data from the California Digital Library (CDL) from the Web-At-Risk[115] project. This Chronopolis project aims to develop best practices for data packaging and transmission in digital archive systems.[116] In a second Chronopolis project, the SDSC will work with large quantities of data from the California Digital Library to help "understand issues in large scale transfer and replication of data in the context of digital preservation."[117] In addition to data storage, these projects focus on the preservation of the data and a method of developing a trust between institutions which may help develop future partnerships. Partnerships are important as they would allow institutions to share knowledge, share data, share storage space, and the associated costs. Collaborations can also help create standards and develop secure networks that are needed.[118]

These are a few examples of how some institutions have chosen to store large amounts of digital data. What you choose to do will vary with your long-term goals, storage needs (total file size), and budget. However, remember different repositories serve different functions, and make sure the goals of the repository meet or exceed your own goals.

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[111] http://rpm.lib.az.us/pedals/index.asp

[112] This grid technology is being worked on by the San Diego Supercomputer Center (SDSC), the UC San Diego Libraries (UCSDL), National Center for Atmospheric Research (NCAR) in Colorado and the University of Maryland's Institute for Advanced Computer Studies (UMIACS). Zverina, Jan. *Chronopolis Project Launched Under Library of Congress Partnership to Preserve At-Risk Digital Information*. UC San Diego News Center. April 14, 2008. http://ucsdnews.ucsd.edu/newsrel/supercomputer/04-08Chronopolis.asp "Grid computing is a component of distributed computing that allows researchers to harness the power of distributed computer, data storage systems and networks to create virtual supercomputers. Leveraging the power of many components to create one massive computational infrastructure." McDonald, Robert H. *Overview of the Chronopolis Digital Preservation Framework*. San Diego Supercomputer Center for NISO Forum. March 14, 2008. http://chronopolis.sdsc.edu/assets/docs/niso_mcdonald.pdf

[113] San Diego Supercomputer Center. Chronopolis Home Page. http://chronopolis.sdsc.edu/

[114] http://www.digitalpreservation.gov/partners/datapass/datapass.html (ADD INFO)

[115] http://www.digitalpreservation.gov/partners/web-at-risk/web-at-risk.html (ADD INFO)

[116] Zverina, Jan. *Chronopolis Project Launched Under Library of Congress Partnership to Preserve At-Risk Digital Information*. UC San Diego News Center. April 14, 2008. http://ucsdnews.ucsd.edu/newsrel/supercomputer/04-08Chronopolis.asp

[117] San Diego Supercomputer Center. *Mass Transit: Welcome*. http://masstransit.sdsc.edu/

[118] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf

7. Collaborations

Collaborations and sharing resources will become increasingly important as providing access to and preserving digital files can be expensive. Not all institutions that have a responsibility to preserve digital materials will have enough resources to do it alone. Working with other institutions to share resources (time, money, storage space, computer hardware and software, knowledge and skills) will be beneficial to all involved. Creating partnerships also reduces the redundancy of efforts and can help reduce duplication of efforts. You do not want to spend time, money or effort digitizing or preserving a collection someone else has already taken the time to care for. Sharing information about digital projects and preservation efforts is essential.

For more information about how to develop partnerships, structural models to follow, and understanding how to make collaborations successful read Chapter 11 of *Guidelines for the Preservation of Digital Heritage* prepared by the National Library of Australia.[119]

The Government Printing Office has created a registry of US Government Publications Digitization Projects[120] for all projects that include government records. If used correctly, this registry will become a hub of digitized government information. The National Digital Information Infrastructure and Preservation Program (NDIIPP) sponsored by the Library of Congress has a mission to "develop a national strategy to collect, archive and preserve the burgeoning amounts of digital content, especially materials that are created in only digital formats, for current and future generations."[121] NDIIPP focuses on various aspects of digital preservation and access including capturing, preserving and making available significant amounts of digital content; building and strengthening a network of partners; and developing a technical infrastructure of tools and services.[122]

8. Preservation

As more and more items are being born digital, the question of *if* we preserve digital files has been taken out of our hands and the question becomes *how* to preserve digital files. People often think that digital files will be easier to preserve indefinitely than paper files, however this is generally not the case. Most paper files can sit on a shelf and be accessed whenever necessary and read. Digital files need constant monitoring and care to keep them accessible and readable. If you want to try and save these files indefinitely, there are some guidelines to follow, starting with keeping up with the current standards for digital audio and video files. Success directly correlates to your institution's policies and procedures related to file formats, storage methods, and metadata standards. Chosen formats should be well documented and well supported. Relationships built within your organization or with digital repositories will greatly influence

[119] National Library of Australia. Guidelines for the Preservation of Digital Heritage. United Nations Educational, Scientific and Cultural Organization. March 2003. http://unesdoc.unesco.org/images/0013/001300/130071e.pdf
[120] The Registry can be found at: http://registry.fdlp.gov/. Information on the GPS's digitization and preservation initiatives can be found at: http://www.gpoaccess.gov/legacy/index.html.
[121] Library of Congress. *National Digital Information Infrastructure and Preservation Program: About the Program*. http://www.digitalpreservation.gov/library/
[122] Library of Congress. *National Digital Information Infrastructure and Preservation Program: NDIIPP Program Background*. http://www.digitalpreservation.gov/library/program_back.html

your preservation policies. Each choice leads to increased or decreased success of a preservation program.

The idea of early collaboration with associated partners is especially important because continued and future access and preservation may eventually fall to an archive or state library as the legislature may not store the files themselves. For example, responsibility for the cassette recordings of legislative session in Minnesota are transferred from the legislative body, to the Minnesota Legislative Reference Library (LRL), and then to the Minnesota Historical Society, requiring collaboration between all parties. Institutions need to form relationships early and work on long-term policies for preservation and access, including details on data transfer and transfer of responsibility. Digital files recorded by the Minnesota Senate are sent to the Office of Enterprise Technology for online accessibility. A copy of the file is also sent to the LRL, which intends to provide access indefinitely, not on their own website but via the legislative bodies' websites, making collaboration between agencies necessary.

Metadata also plays a large role in the preservation of digital files. Metadata is seen as the "glue that holds a digital object together,"[123] and without it digital objects have little chance to persist well into the future. The Bibliographic Center for Research (BCR) states that "the creation of metadata is a key component for the responsible management and long-term preservation of the digital files produced by your project,"[124] and it helps define the descriptive, structural, administrative, and technical aspects of a digital object, all of which are important for preservation. Howard Besser, Moving Image Archiving and Preservation Program Director at New York University Tisch School of the Arts, noted that "extensive metadata is our best way of minimizing the risks of a digital object becoming inaccessible."[125] Assuming you are working with partners and following best practices for metadata, storage procedures and file formats, you also need a method to ensure access to the files over time.

Three main methods to increase long-term access to digital files are migration/conversion, technology emulation[126], and technology preservation.[127] However, when discussing digital audio and video files, migration is the most practical choice. With the multitude of file formats available, continually evolving standard practices, and the ever changing digital environment,

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[123] Dunn, Jon. *Digital Audio Preservation at Indiana University (continued).* Digital Library Brown Bag Series Indiana University. May 6, 2005. http://www.dlib.indiana.edu/education/brownbags/spring2005/audio/dunn.pdf

[124] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf

[125] Besser, Howard. "Digital Longevity," in Maxine K. Sitts, ed., *Handbook for Digital Projects: A Management Tool for Preservation and Access*. Northeast Document Conservation Center. 2000. http://www.gseis.ucla.edu/~howard/Papers/sfs-longevity.html

[126] Emulation preserves the technologies used to create a digital file by recreating the environment in which a file was created. Emulation "seeks to preserve that environment not through the preservation of original hardware/software but by using current technology to mimic the original environment". UKOLN at the University of Bath. *Good Practice Guide for Developers of Cultural Heritage Web Services: Digital Preservation*. http://www.ukoln.ac.uk/interop-focus/gpg/Preservation/

[127] Technology preservation preserves the physical technology that created the file. This approach requires the saving and preserving of the hardware and software that was used during creation, which in itself creates a museum of physical hardware that are no longer in use. The physical space required for saving these materials as well as the degradation of the machines themselves makes this a very short-term solution for digital preservation.

Jon Dunn with Indiana University reiterates that migration of files remains key, and files must stay in a readable format.[128]

The Task Force on Archiving of Digital Information defines migration as "the periodic transfer of digital materials from one hardware/software configuration to another, or from one generation of computer technology to a subsequent generation."[129] Data migration is often also called data conversion and the terms are frequently used interchangeably, although data migration may or may not involve data format changes and by definition, data conversions involve a change from one file format to another.[130]

Migration is necessary to keep files up-to-date; files created in one version of software are moved (or migrated) to the most recent version of the software to keep them accessible. Migration is also essential when your chosen storage medium needs upgrading or is about to become unreliable. Storing files on a network server will greatly reduce the amount of data migration necessary over time, as servers are not in need of being constantly upgraded. However, if your files are stored on removable media, they will need to be migrated more often to remain viable. For example, data stored on floppy disks must be migrated to CDs before floppy disk drives become obsolete, and in turn the files stored on CD or DVD must be moved to another disk or new medium before the physical disk itself begins to degrade.

Data conversion, on the other hand, refers to format changes of the data itself. For example, if files were created in proprietary software and your institution chooses not to use that software any longer, the files will soon become unsupported and inaccessible. To ensure continued access, files should be converted to a well-supported format, minimizing the need to convert the files again in the future.

The Bibliographic Center of Research (BCR) recommends migrating files every five years to avoid having to migrate files when they are in an obsolete format, which would end up costing more.[131] If possible, files should be transferred to new formats or new media only when the new formats or media is well-documented, widely available and well-supported. While this may sound easy, there are some drawbacks to migration. The process of migration can be time consuming, and it is unknown how often it will need to be done. Migration must occur to keep up with evolving technology. The larger the project, the more time and cost absorbed by the action of migrating the files. Another disadvantage to migration is the risk involved; some of the original data may be lost in translation. Associates at the Cornell University Library were asked by the Council on Library and Information Resources (CLIR) to assess the risk of migrating digital files. Their results include a list of eight categories of risk associated with file format migration including content fixity, security, context and integrity, cost, staffing, functionality,

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[128] Dunn, Jon. *Digital Audio Preservation at Indiana University (continued).* Digital Library Brown Bag Series Indiana University. May 6, 2005. http://www.dlib.indiana.edu/education/brownbags/spring2005/audio/dunn.pdf

[129] The Commission on Preservation and Access and the Research Libraries Group. *Preserving Digital Information*. Report of the Task Force on Archiving Digital Information. May 1, 1996. http://www.ifla.org/documents/libraries/net/tfadi-fr.pdf

[130] Minnesota Historical Society. *Electronic Records Management Guidelines: Glossary*. March 2004. http://www.mnhs.org/preserve/records/electronicrecords/erglossary.html

[131] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf

legal concerns, and searching capabilities.[132] Please review their results for an in-depth discussion on the risks in *Risk Management of Digital Information: A File Format Investigation*.[133] As migration may cause data loss, BCR recommends using checksums to confirm the integrity of the files before and after migration.[134] As migration is key to preservation, BCR also recommends that "every sustainable digitization project should include the costs of data migration as a yearly budget line item."[135] Preservation costs are an ongoing investment and finances are needed for running, upgrading and maintaining the necessary hardware and software overtime.

In a report addressing issues in digital media archiving, Samual Brylawski from the Motion Picture, Broadcasting and Recorded Sound Division of the Library of Congress states, "no medium has proved stable enough to be called permanent."[136] He continues to say "most preservationists believe that resources spent to identify and develop a permanent medium are better spent building systems that acknowledge impermanence and exploit the potential of readily available technology. … The future of audio preservation is reformatting audio tapes to discs to computer files and systematically managing those files in a repository."[137] Brylawski explains that "digital audiovisual file repositories…are designed to back up their data systematically on the preferred storage format of the moment, under the assumption that the format will change from time to time. … Such systems are complex in design and inherently dependent on sophisticated technology that must be maintained in perpetuity. Yet, to many archivists they are liberating. The well-planned repository presumes media obsolescence, plans for it, and, according to its supporters, frees the archive community of the futile search for an affordable permanent medium."[138]

9. Access and Search Methods

Changes to technology have influenced the methods used for providing access to and the searching of audio and video files. Background information on methods used for providing access to government information is discussed as well as the new techniques developed for providing access to and searching for audio and video files.

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[132] Lawrence, Gregory W. et al. *Risk Management of Digital Information: A File Format Investigation*. Council on Library and Information Resources. June 2000. http://www.clir.org/pubs/reports/pub93/contents.html
[133] Lawrence, Gregory W. et al. *Risk Management of Digital Information: A File Format Investigation*. Council on Library and Information Resources. June 2000. http://www.clir.org/pubs/reports/pub93/contents.html
[134] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf
[135] Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006. http://www.bcr.org/cdp/best/digital-audio-bp.pdf
[136] Brylawski, Samual. "Preservation of Digitally Recorded Sound." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf
[137] Brylawski, Samual. "Preservation of Digitally Recorded Sound." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf
[138] Brylawski, Samual. "Preservation of Digitally Recorded Sound." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf

9A. Access

Easy access to government information and transparency in government is becoming increasingly important. Any policy or procedure that enhances access or provides constituents with more information about their government agencies should generally be viewed as a good investment.

Access to recordings of legislative sessions may not always be controlled by the government agency, state archive or state library. For states whose recordings are being done by outside agencies, the outside agency controls access to the files. The length of time that recordings are available usually depends on retention periods set by the recording agency or by the agency that is in charge of the long-term storage of the files. For example in Minnesota, the retention period for cassette audio recordings of the House and Senate was set at sixteen years by members of the legislative staff in conjunction with staff from the Minnesota Historical Society. It was found that recordings much older than three to five years were rarely looked at and saving cassette tapes for longer than the life expectancy of the storage media was not cost effective. In the case of an outside agency doing the recordings, the time period for keeping the files ranges from preserving all digital recordings to none at all.

Access to audio and video files can be provided by offering on-site access, duplicating and mailing materials out for a fee, and making online access available. Before the onset of digital recording, on-site access was often the only way to review some legislative materials. States that retain digital files online can provide onsite access by simply making computers with Internet access available to patrons. The institutions that maintain the legislative materials on a long-term basis in the states of California, Minnesota, and Tennessee currently provide on-site access to audio legislative materials in various formats including cassette tapes, VHS tapes, and digital files.[139]

If it is not possible to provide on-site access or the available on-site access or online services do not meet the needs of the patron, states or recording agencies may duplicate and send recordings to patrons for a fee on a request basis. Both a TV station in Alaska and the California State Senate Television Recording studio offer this service with varying conditions. Recordings of Alaska legislative meetings can be duplicated within a two week period following the recording date for an initial $40.00 fee, plus a $20.00 fee for each additional hour; where as recordings of the California State Senate can be duplicated within a three month period following the recording date for a $5.00 per hour fee.[140] If older programming of the California Senate is desired, the California State Archives has copies of all their recording since March 1992 which can be viewed on-site or purchased for a fee.

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[139] California policy: http://www.sen.ca.gov/~newsen/audiotv/archive.htp; Minnesota information: http://www.leg.state.mn.us/leg/leghist/histstep.asp; Tennessee Information: http://www.tennessee.gov/tsla/legislative.htm

[140] California State Senate. *How to Order Dubs*. http://www.sen.ca.gov/~newsen/audiotv/TVDUBS.HTP; KTOO-TV Juneau. *Video Copies of Gavel to Gavel Alaska Coverage*. 2009. http://www.ktoo.org/gavel/orders.cfm

Access to audio and video files is most commonly offered online. Kansas saw the vision back in 1991 when they developed a subscriber fee-based service model for eGovernment, of which 90% of the services offered still remain free of charge.[141] This web-based service provides access to various aspects of government, including live audio feeds of legislative sessions. Many government agencies are following suit and increasing their web presence as one method of government transparency. Recent developments within the state of New Mexico show how important the idea of transparency in government is. Until 2009, New Mexico was one of a handful of states that did not publicly broadcast the legislative sessions or committee meetings. Sessions were recorded but were only available for a fee through New Mexico Legislative Reports, an independent company. Supported by constituents, some members of the New Mexico legislature wanted to increase the level of government transparency by providing free online access to floor sessions and committee meetings to the public. This idea was met with some resistance but after a few weeks of internal and external pressures,[142] however the New Mexico House had a unanimous voice vote that approved audio webcasting of House proceedings, launched their first official audio webcast on February 6, 2009, and would like to offer live video no later than 2010.[143] The New Mexico Senate was also addressing this issue with Senate Bill 401, which was tabled indefinitely in March of 2009.

An advantage of online access is that it provides access to anyone with a computer that has an appropriate Internet connection; it is generally viewed as easy and convenient, however online access can be hindered by the user's local environment. Firewalls that block streaming files may limit access.[144] Connection speeds may be too low and decrease accessibility, especially if the files were encoded at too high of a speed. In addition, due to the multitude of file formats, users may need to download multiple media players, which may be inconvenient.

Online access can be provided in two ways, as live or archived feeds. Live access to legislative floor sessions and committee meetings allow people to watch what is happening at the time it is

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[141] AccessKansas. *Pioneers in eGovernment*. Information Network of Kansas, Inc. http://www.kansas.gov/board/anniversary_brochure/pdf/annbrochure.pdf

[142] A public radio station in New Mexico, KUNM 89.9FM, announced that they would begin broadcasting Senate floor sessions on their radio station, feeds, which as a media outlet, they had access to. The day before KUMN was to begin broadcasting Senate audio; Republican Representative Janice Arnold-Jones brought her own laptop and webcam to the House Taxation and Revenue Committee meeting and began live webcasting on her own accord, which could be viewed live on her website (http://www.civicplaza.net/house.php). The following week, KUNM was streaming both House and Senate floor sessions and at the same time New Mexico Legislative Reports announced that they would begin to offer audio webcasts of the House and Senate floor sessions for free, a service that until now had been a subscription based. NM Legislative Reports also announced that video may be available for free in the future. Soon after all of these pressures, the House began broadcasting live audio of their sessions. (For background information on this story please view: Childress, Marjorie. "Roundhouse Resists Entering 21st Century". *The New Mexico Independent*. January 22, 2009. http://newmexicoindependent.com/16041/roundhouse-resists-entering-21st-century.)

[143] Haussamen, Heath. "In a Victory for Open Government, NM House of Representatives Approves Audio Webcasting". *The New Mexico Independent*. February 4, 2009. http://newmexicoindependent.com/17351/in-a-victory-for-open-government-nm-house-of-representatives-approves-audio-webcasting ; Haussamen, Heath. "Martinex: House wants Video Webcasting". *The New Mexico Independent*. February 4, 2009. http://newmexicoindependent.com/17446/martinez-house-wants-video-webcasting

[144] In my own experience, I was able to search the Washington State Digital Archives for the audio House files but I was unable to listen to them, due to a firewall implemented on my local area network. Security measures may inadvertently limit access to files.

happening. If recorded, sessions may or may not be available online for playback after the fact at the convenience of the viewer. If sessions are placed online for future viewing, files are available for various lengths of time, determined by the agency that controls the files. Some states provide playback access to only the most recent legislative session while others provide access to all the digitally recorded files over the years. Other states choose to offer only the most recent session online, but store previous years offline, so they may be available on a request basis. If the overall intent is to provide access to the files indefinitely, great care must be taken when addressing your preservation plan.

9B. Searching

With changes in technology, methods for finding information have changed over the years. Previously, the only way to determine if a library or archives had an item of interest was to contact or visit the institution and physically search the catalogs and finding aids. As technology evolves, and more resources are available online, researchers' expectations of how to access the information has also changed. Many libraries and archives have made their catalogs and finding aids available online. In some cases, the content itself can be found online, as with scanned textual documents. Metadata assists users when searching for files. However, audio and video files are more complex and are not as readily accessible because there is no easy way to search within a file.

To remedy this, people have begun to 'tag' audio and video files with keywords about the content.[145] Tagging can be done by the file creator as well as by individuals who view the file if permissions have been set to allow this. Tags can be names, places, or things; if a keyword list is not enforced, any word or phrase can be used as a tag. Often this metadata and tagging allows people to find audio and video files that contain content of interest, but finding the specific location of desired information inside the audio or video file is another challenge. Some people have taken the time to tag or attach metadata to specific places within a file, but this takes a considerable amount of time. Each file must be gone through individually in its entirety and have tags or metadata attached, which is often cost prohibitive.

Working on finding additional ways to search audio files, the Washington State Digital Archive is one of the first archives to test audio indexing. Using a new technology developed by Microsoft Research, Washington is testing the Microsoft Audio/Video Indexing System (MAVIS) that searches the content of audio files. MAVIS reviews the audio file and indexes recognized words turning them into keywords. The search engine within the Washington State Digital Archive's database is able to retrieve audio files that contain the keywords that were searched for. The user can listen to entire files or jump to specific instances where the keyword is found. Keep in mind that MAVIS indexes 'recognized' words. A search for 'Mount St. Helens' retrieves no results, but if 'Mount Saint Helens' is entered, thirteen files are found. The indexing system does not always abbreviate words when indexing files. While not perfect, this

[145] Lockhorn, Jeremy. *Video Search Catches Up with Video Tagging*. ClickZ. January 29, 2007. http://www.clickz.com/3624735

method of searching had dramatically increased access to audio files. (This project is discussed in detail in Appendix 3.)

Google has also invested research into audio indexing technology but is texting audio indexing on video files. Their system is called GAudi, for **G**oogle **Aud**io **I**ndexing.[146] Google began testing this technology on 2008 election videos, as the content was relevant and plentiful. It was hoped that because of general interest in the election, greater feedback on the technology would be available. GAudi searches the audio tracks of online videos for spoken words, and indexes them. The words that are indexed become searchable. When a user performs a search, the video results are displayed with links to the top ten places in each video that mention the keyword. Users can listen to the entire video or jump anywhere including a specific instance of the chosen keyword. Google has not yet extended this technology to include non-political content.

On a wider scope, the School of Computer Science at Carnegie Mellon University is working on the Informedia Project. The project hopes to "achieve machine understanding of video and film media, including all aspects of search, retrieval, visualization and summarization in both contemporaneous and archival content collections"[147] by combining "speech, image and natural language understanding to automatically transcribe, segment and index linear video for intelligent search and image retrieval."[148]

Another method being explored to provide access to video content is facial recognition. One company that is testing facial recognition in videos is Viewdle. Viewdle is developing two separate databases of faces, one for professional videos and the other for user generated videos. Their goal is that everyone from "Obama to your mamma"[149] will be able to be recognized in videos. The databases are created by individually tagging people in videos, and after three or so separate tags, it is hoped that the database will be able to recognize the face and connect names with videos. Viewdle uses other technologies including object detection, optical character recognition, speaker separation, language detection, speech to text technology, existing tags, and the text of transcripts or other captions to help correctly identify people. To eliminate unwanted files many different algorithms are being used for detection and as filters.[150]

Viewdle is testing this technology in the professional arena with Reuters. Viewdle is being used by Reuters to link news stories and video files.[151] The search page on the Reuters site has a box for a person's name and another box for a keyword, because as a Viewdle representative states, you are often looking for a certain person speaking about a specific subject, this search method

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[146] Google Audio Indexing Labs. *GAudi: Google Audio Indexing FAQ*. 2008. http://labs.google.com/gaudi/static/faq.html http://labs.google.com/gaudi Home Page: http://labs.google.com/gaudi/static/faq.html

[147] Informedia. *Welcome to The Informedia Project!* Carnegie Mellon University. January 18, 2008. http://www.informedia.cs.cmu.edu/

[148] Informedia. *Welcome to The Informedia Project!* Carnegie Mellon University. January 18, 2008. http://www.informedia.cs.cmu.edu/

[149] Viewdle Representative. *Google TechTalk: People Recognition – A Leapfrog in Organizing Videos*. YouTube. October 2, 2008. http://www.youtube.com/watch?v=0h0mUoFJwc8

[150] Viewdle Representatives. *Google TechTalk: People Recognition – A Leapfrog in Organizing Videos*. YouTube. October 2, 2008. http://www.youtube.com/watch?v=0h0mUoFJwc8

[151] Reuters. *Search in Video*. 2006. http://reuters.viewdle.com/searchm

allows you to enter either a name or topic, or both.[152] However, the technology seems limited and selective. Faces are only tagged when they are looking directly at the camera. Also while many people might be tagged per video, only one person can be identified at a time; multiple people are not identified in the same frame at the same time.[153]

Viewdle technology could work within government circles because individuals would only need to be tagged a few times. With the exception of guest speakers and the visitors, the individuals participating in the floor sessions and committee meetings remain the same throughout the legislative session. This could be tested or utilized on a state by state basis, just as it is currently being tested using Reuters content only.

VideoSurf is another company that is testing facial recognition technology on videos posted on the Internet. VideoSurf is searching video content from at least forty different sites that contain videos. The technology behind VideoSurf has taught computers to read the video frame by frame and find relevant faces and content. The technology works so well that the computer can correctly identify Tina Fey as herself or playing Sarah Palin, by using things like the distance between her eyes or length of her nose.

Compared to Viewdle, it seems that VideoSurf has the ability to tag more than one person in a frame, but uses the name/s of the person/s searched for in the results list.[154] VideoSurf will also find videos of people it does not facially recognize by using other available metadata tags such as names found in a title of a video. VideoSurf finds content spread throughout the Internet while Viewdle's test only included files hosed by Reuters limiting search results.

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[152] Viewdle Representatives. *Google TechTalk: People Recognition – A Leapfrog in Organizing Videos*. YouTube. October 2, 2008. http://www.youtube.com/watch?v=0h0mUoFJwc8

[153] An added feature when searching Viewdle is that when entering a person's name in the search box on the Reuters site, a drop down of possible options are displayed with the name and photo of people, as you continue typing the selections change based on the alphabetical characters the results have in common with your search term. If you select a name, such as 'George Bush', you are prompted to select between 'George Bush' or 'George Herbert Walker Bush'. The results are then displayed with a description of the video mixed with a news story, direct links to specific instances where tagged people are represented in the video sorted by person, and a list of all the instances in chronological order. Viewdle is also testing facial recognition technology with the general public with a Facebook application. This application works in much the same way, except it is users themselves who are tagging people in the video files, creating a database of faces. After individuals are tagged a number of times, the database will then be able to identify individuals in new videos as they are posted. Allowing users to tag individuals in videos increases the amount of metadata attached to a file. As more and more users view a video, more and more metadata can be added as they recognize individuals in videos not already tagged. This in turn allows the computer to recognize more people and starts to include more computer generated tagging.

[154] The search results for VideoSurf are visual displays, a filmstrip of thumbnail images, of the 'best' moments in each video. Display options allow users to see these best clips, the entire video frame by frame, or just the frames with faces in them. The original search retrieves all videos that contain every instance of your search term as well as an image display of all people that were recognized in the videos. If you searched for a person, their image will also be contained in this list. Clicking on this person will retrieve the videos that the person actually appears in. This will probably not be the same number of videos as the original search results because other methods of recognition were used in the first search (i.e. the title of a video could contain a person's name who does not actually appear in the video, this video would be removed when clicking on the an individual face). If you want to see who else appears in an individual clip, select show faces and this will show head-on and profiles of others in the video. This thumbnail view allows viewers to select particular instances within the video that they are interested in. No longer does one need to watch an entire video to find the replay of winning score or the details on the latest news story. This leads to visual searches, visual navigation and visual discovery.

These are two examples of companies using video search technology, but there are many others working to improve the process.[155] In general, these companies are searching content that is posted on the Web and linking to the files. There are millions of audio and video files available from all of the different sites, but where are all the audio and video files stored?

[155] Other companies that are working with how to best search video content include…. Digital Smiths: http://www.digitalsmiths.com/index.php using character recognition, spatial recognition, and speech analysis to identify people and places in video. Their technology is being used by the WB and TMZ. : A Google representative mentioned TruVeo, Blinkx, and VeZoom in an interview. She stated that she found VeZoom, returns the most relevant results and they are marketing it as the World's Most Comprehensive Video Search engine. Viewdle reviewed by Google: http://vator.tv/news/show/2008-12-21-viewdle-reviewed-by-googles-marissa-mayer

Appendix 1: File Formats and Codecs

File Formats and Codecs

Common file formats and codecs are described below including their name, file extensions, compression status, uses and other notes.

Audio Formats and Codecs[156]

Advanced Audio Coding (.aac): Lossy compression, also known as MPEG-4 AAC, supports various compression rates (best known for iPod use).

Audio Interchange File Format (.aiff): Supports lossless compression. Variable sample rate, variable bit rate, variable data rate. This is the original uncompressed Apple sound file format (it is not used in devices). This is the "gold standard of 16-bit audio, travels well between almost all computers and software, includes header information like file name, sampling rate... Also capable of 24 and 32 bit resolution."[157]

MPEG-1 Level 3/MP3 (various extensions including .mp3): Lossy compression. Supported on most devices. Capable of producing various rates; sample rate, bit depth, and data rate can vary. Some compression rates can achieve near (but not) CD quality. Files are encoded at certain bit rates for target download speeds. Popular because of the file size vs. perceived quality and the ability to be downloaded and placed in mp3 players. Compression codec is MP3.

Free Lossless Audio Codec/FLAC (.flac): Designed to reduce the file size of audio files without the loss of quality that is found in other audio codecs such as MP3Lossless compression. Fast. Supported by various types of equipment. Streamable. Suitable for archiving.

OGG Vorbis (.ogg): Lossy compression, various rates. Open source. Supported on some devices.

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[156] Information about the digital audio formats and codecs was compiles from the following resources: DigitalTips. *Digital Audio 101*. http://www.digitaltips.org/audio/audio101.asp; Flac: Free Lossless Audio Codec. *Home Page*. December 10, 2008. http://flac.sourceforge.net/ ; Hass, Jeffrey. "Chapter 5: Digital Audio: 8: Digital audio file formats," in Introduction to Computer Music: Volume 1. 2005. http://www.indiana.edu/~emusic/etext/digital_audio/chapter5_file.shtml ; Ottewill, Matt. *Digital Audio File Formats and Codecs*. Planet of Tunes. http://www.planetoftunes.com/digiaudio/daudiofiles.html; Tittel, Ed. *A Quick 'Rip' Through Digital Audio File Formats*. Peachpit. July 30, 2004. http://www.peachpit.com/articles/article.aspx?p=212411; and Wikipedia. Audio File Format. March 2, 2009. http://en.wikipedia.org/wiki/Audio_file_format

[157] Hass, Jeffrey. "Chapter 5: Digital Audio: 8: Digital audio file formats," in Introduction to Computer Music: Volume 1. 2005. http://www.indiana.edu/~emusic/etext/digital_audio/chapter5_file.shtml

Quick Time Audio (.mov): Lossy compression, not used in devices. Can play back a wide range of compressed and uncompressed audio formats.

Real Audio Media (.ram, .ra): Lossy compression. Proprietary, not used in devices. Format developed by Real Media and used for streaming audio from a Real Audio server over the Internet. Can be encoded at multiple sampling rates to accommodate different user download speeds. Requires Real Audio Player.

Waveform Sound Files (.wav): Lossless compression. Used for sound systems on Windows PCs. Not in devices. Designed for Windows but usable with most audio programs Mac or PC. Similar to .aiff for sample rate and bit depth.

Windows Media Audio (.wma): Lossy compression with various sample rates, bit depths, and data rates including a non compressed version. Supported on most devices. Designed by Microsoft for use with Window Media Player with various compression ratios.

Video Formats and Codecs[158]

"Unlike the world of digital audio where two uncompressed formats (.wav, .aif) and one compressed format (MP3) dominate, digital video is a minefield."[159] There are multiple formats for multiple purposes, often formats and codec have the same name, and discipline wide standards have not yet been agreed upon.

Formats

Audio Video Interleave: Most common format for audio and video, created by Microsoft. Supports a wide variety of codecs. Plays in Windows Media Player. (.avi) http://www.fileinfo.net/extension/avi

Flash: Created to deliver vector graphics over the Internet to maximize scalability, speed, and simplicity. Uses the MPEG4 codec. Flash Player is required for delivery. (.swf)

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[158] Information about the digital video formats and codecs was compiles from the following resources: Buchanan, Matt. *Giz Explains: Every Video Format You Need to Know*. Gizmodo: The Gadget Blog. November 20, 2008. http://gizmodo.com/5093670/giz-explains-every-video-format-you-need-to-know ; Delvin, Bruce. *MXF – the Material eXchange Format*. EBU Technical Review. July 2002. http://www.ebu.ch/en/technical/trev/trev_291-devlin.pdf; File Extensions. *Home Page*. March 6, 2009. http://www.file-extensions.org/ ; Guy, Marieke. *QA Focus Documents: Choosing a Suitable Digital Video Format*. UKOLN. October 1, 2004. http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/html/; Ottewill, Matt. *Digital Video File Formats and Codecs*. Planet of Tunes. November 2008. http://www.planetoftunes.com/dv/videofiles.html ; Wikipedia Video Codecs. February 14, 2009. http://en.wikipedia.org/wiki/Video_codec ;

[159] Ottewill, Matt. *Digital Video File Formats and Codecs*. Planet of Tunes. November 2008. http://www.planetoftunes.com/dv/videofiles.html

Material eXchange Format: Designed by the broadcast industry with hopes to improve workflow interoperability, this open file format was created to assist with the interchange of audio-visual material with its associated data and metadata. (.mxf)

MPEG-1: Is a file format and codec that is good for CD ROM and web delivery. Various file extension including but not limited to .mpg, mp1, and .mpv.

MPEG-2: Is a file format and a codec that is good for TV broadcasting and DVD video disks. (.m2p)

MPEG-4: Specifically MPEG-4 Part 14. Standard container for MPEG-4 compressed files. Delivery methods available for most devices including HD DVD, digital TV, mobile phones, PSP, and ipods. **S**upports many codecs including H.264. (.m4v, .mp4)

QuickTime: Standard video file for Macintosh. Format supports multiple codecs. Needs QuickTime Player for delivery. (.mov)

RealMedia: RealMedia proprietary format, RealPlayer required for playback. Streaming and progressive download. (.rm)

Windows Media Video: Also known as Advanced Systems format. Format supports multiple codecs. Must use Windows Media Player for delivery. (.wmv or .asf)

(broadcast video) MXF: http://www.ebu.ch/en/technical/trev/trev_291-devlin.pdf , http://fiatifta.org/restricted/Antalya2002/mxf.pdf http://www.media-matters.net/docs/resources/Wrapper-Container%20File%20Formats/MXF/MXF%20faq%20in%20wp%20format%205%2002.pdf

Codecs

Huffy UV: Lossless compression. Website of the developer: http://neuron2.net/www.math.berkeley.edu/benrg/huffyuv.html

MJPEG2000/ Motion JPEG2000: Lossless compression

MPEG-2 Part 2 / H.262: Used on DVD, SVCD, and in digital video broadcasting and cable distribution systems. Standard used for VCDs, but not a current standard.

MPEG-4: Includes codecs developed for low end and high end products that range from mobile phones to Blu-ray discs. The two different codecs of importance are part 2 and part 4 as seen below. http://www.apple.com/quicktime/technologies/mpeg4/

MPEG4 Part 2 / H.263: developed for video conferencing, replaced H.261: standard that can be used for the internet, broadcast and on storage media. Supports progressive scan and interlaced video. H.263 is used to encode most

Flash video as well as for video intended for mobile networks. (DivX - proprietary, XvidD – open source and 3ivx are all separate codec variations on MPEG 4 part 2.)

MPEG-4 Part 10 / H.264: Also known as Advanced Video Coding (AVC). Becoming a new state of the art standard and is adapted into and supported by many different products including PlayStation Portable, iPods, and HD DVD/Blu-ray Disc.

In addition there are other proprietary codecs created by Microsoft and Apple for their respective media players.

Appendix 2: Survey of State Use of Digital Audio and Video in the Legislature

This report illustrates what individual states are doing with digital audio and video files available on the Internet. Websites and online resources for all fifty states were researched for information about access to digital audio and video files of legislative proceedings. Many of the states may also have audio or video recordings in different formats (reel-to-reel or cassette tapes), however the focus of this research was on digital files. For information on audio and video recordings in other formats, contact the agency responsible for preserving government records, such as the legislative body itself or the state library or state archives. For more information about the digital audio and video files or the process each state has gone through in developing their digital programs, contact the agencies listed in the chart below.

The chart below displays the state name, type of feed (audio or video, live or archived), required player for access, direct links to media, and notes that summarize the findings. The date that the information and links were verified is listed under the individual state name. It has been found that these links change rapidly; however, now that most legislative sessions have started, it is hoped that the links will remain stable throughout the session.

*The chart below uses the following abbreviations: a = audio files; v = video files; a/v = audio and video files

State	Type of Feed	Required Player	Source /Link to digital audio and video files	Notes/Comments
Alabama [February 11, 2009]	Live audio of House and Senate	Widows Media Player; Internet Explorer	http://www.legislature.state.al.us/ Main page of the Alabama State Legislature: links to both the House and Senate audio feeds.	Alabama provides live audio broadcasts of the House and Senate sessions. Audio services are designed to work with Windows Media Player and Internet Explorer. No archived feeds found.
Alaska [February 11, 2009]	Live and archived audio and video of House and Senate	Windows Media Player (a/v), Real Player (a), or Winamp (a)	http://www.ktoo.org/gavel/stream.cfm Link from Alaska State Legislature Home Page.	Alaska provides live audio and video of House and Senate sessions. Audio files of past session are available from 2001. Audio is an MP3 stream. Select video files are available from 2002. Gavel to Gavel Alaska is a service of KTOO-TV Juneau. "Not all legislative meetings are recorded, and KTOO normally retains the video recordings for only two weeks" (http://www.ktoo.org/gavel/orders.cfm) More information can be found at: http://www.ktoo.org/gavel/about.cfm
Arizona [February 11, 2009]	Live and archived audio and video of House and Senate	Windows Media Player 9.0 or higher	Live proceedings: http://azleg.granicus.com/Mediaplayer.php?publish_id=5	Live video and audio proceedings of the House and Senate. [The company Granicus is being used: http://www.granicus.com/Streaming-Media-Government.aspx]
			Cable TV: http://azleg.granicus.com/Mediaplayer.php?publish_id=21	Arizona Cable TV (ACTV) is a statewide cable TV channel patterned after C-SPAN.

			Archived proceedings: http://azleg.granicus.com/ViewPublisher.php?view_id=7 linked off of the main page for the Arizona State Legislature.	Video for 2007, 2008, 2009 available. A list of video feeds is displayed. A search box allows the user to keyword search for feeds on particular bills or topics. There is a place to select the legislative session back to 1997, but the connection between the video feeds and past sessions has not been located.
Arkansas [February 11, 2009]	Very limited archived feeds (weekly reports) of the House only.	Windows Media Player	House of Representative Weekly Updates: http://www.arkansas.gov/house/ and http://www.arkansas.gov/house/newsroom/index.php?do:newsDetail=1&news_id=2	Speaker of the House Broadcasts. Do not seem to have any particular grouping of files. Podcasts may be available for the Weekly Broadcasts Session updates of the House. Media services associated with Senate were not found.
California [February 11, 2009]	Live and limited archived audio and video of House and Senate.	Windows Media Player	The California Channel: http://www.calchannel.com/	View legislative proceedings on The California Channel on live TV and web broadcasts for the House and Senate. The online archive goes back one year. This channel is a cable TV broadcast set up like C-SPAN displaying legislative bodies in action.
			http://www.legislature.ca.gov/the_state_legislature/calendar_and_schedules/audio_tv.html	General page for Audio and Video. Links to both the House and Senate audio feeds, as well as the California Channel video feeds.

			Senate Audio: http://www.sen.ca.gov/htbin/testbin/noframe_raudio House Audio: http://www.assembly.ca.gov/Committee_hearings/ *Not working very well (as of 2/11/2009).* VHS tape and recording information: http://www.sen.ca.gov/~newsen/audiotv/TVDUBS.HTP ; and http://www.sen.ca.gov/~newsen/audiotv/archive.htp	Listen to live Hearings, Floor Sessions, and Press Conferences online. There are no direct links to TV for the Senate with the exception of the California Channel, but it stated that "the Senate Television Program keeps the masters of all Senate floor sessions and committee hearings for three months." Televised events since March 1992 are available at the State Archives. VHS tapes of Senate floor sessions and committee meetings are also available for viewing or purchase.
Colorado [February 11, 2009]	Live audio of the House and Senate. Live and archived video of the House.	Windows Media Player version 9 or higher	Legislative Video: http://www.coloradochannel.net/	Live legislative coverage for the Colorado House of Representatives is available from the Colorado Channel, the cable TV channel. Each session will be available for 18 months on the Colorado Channel.
			Audio Files: Live feeds of House and Senate Chambers and Committee Rooms: http://www.leg.state.co.us/clics/clics2008a/cslFrontPages.nsf/Audio?OpenForm	Live feeds of Live feeds of House and Senate Chambers and Committee Rooms. "Currently there are no archived audio files available via the internet, only live audio is available. For accessing archived audio files contact the Colorado State Archives." (source: http://www.coloradochannel.net/) More information about Legislative Audio Tapes.[160]

[160] Legislative Audio Tapes (1973 - Present) Audio recordings of the proceedings of all Colorado House and Senate committees of reference, and full House and Senate floor debates. Proceedings prior to 1973 are documented in the House and Senate journals mentioned above. Researchers interested in listening to these tapes must schedule an appointment by contacting the Colorado State Archives. http://www.colorado.gov/dpa/doit/archives/legis.html

Connecticut [February 11, 2009]	Live audio and video coverage of House and Senate. Only video archived.	Podcasts use: MP4 (v), MP3 (a). Windows Media Player 10 is needed to view Closed Captioning.	Home Page: of The Connecticut Network (CT-N). http://www.ctn.state.ct.us/index.asp Live coverage: http://www.ctn.state.ct.us/ctn_web.asp Archived content: http://www.ctn.state.ct.us/ondemand.asp	The home page provides access to both live and archived media coverage. Three channels broadcast live video, one for the House, one for the Senate, and the third for scheduled programming. Archived videos available for 2007 and 2008. *[This is a very busy website.]*
Delaware [February 11, 2009]	*Live audio for House only?*	*no data found*	http://legis.delaware.gov/	Site says "Audio Link Unavailable - House Not Convened". No archived audio or video found. (As of 2/11/2009, have not been able to access audio/video.)
Florida [February 11, 2009]	Live video of House and Senate	Video: Windows Media Player 9 Podcast: MP3	Senate broadcast schedule: http://www.flsenate.gov/Session/index.cfm?Mode=Video&Submenu=8&Tab=session House broadcast schedule: http://www.myfloridahouse.gov/Sections/HouseCalendar/broadcast.aspx House Podcasts: http://www.myfloridahouse.gov/contentViewer.aspx?Category=HouseFeatures&File=podcasts.htm	Live video broadcasts of House, Senate, and joint meetings are available online. Both website provide access to the House and Senate broadcasts. The previous five sessions are archived on this same page. [Older videos have not been found.] The Podcasts from the House also show the past five days and can be downloaded in MP3 format.
Georgia [February 11,	Live and archived video of	Real Media	Live coverage Senate, House, and House Rule Committee: http://www.georgia.gov/00/channel/0,2141,4802_61071	The Georgia Technology Authority provides live coverage of the legislative sessions. Rebroadcasts will be available 4 days later in the video archive link. Session

2009]	House and Senate		01,00.html Archived Sessions: http://www.georgia.gov/00/channel_title_desc/0,2754,4802_6107103,00.html	archives are available in Real Media format from 2003-2009.
Hawaii [February 11, 2009]	Selective live video for House and Senate on TV	Not listed	http://www.capitol.hawaii.gov/site1/info/bcast/bcast.asp	Broadcasts of the Senate Committee on Ways and Means (WAM) and the House Committee on Finance (FIN) on public television. Live broadcasts with rebroadcasts (on cable TV) to be announced. No immediate access available online.
Idaho [February 11, 2009]	Live and archived video of the House and Senate	Windows Media Player	Public Television and Internet Feeds: http://www.idahoptv.org/leglive/ Idaho Reports, public television website: http://www.idahoptv.org/idreports/ Archive: http://www.idahoptv.org/idreports/irthisweek.cfm	Public television channels, one for the House another for the Senate. A third channel is available on the radio near the capitol building only. All three channels have a live internet feed using Windows Media Player. Collectively these are called Idaho Legislature Live. Idaho Reports is the public television website with links to the archives. Select programs are available in the archives and are available on the Idaho Reports webpage for the 2008 session. Windows Media Player, MP4, and MP3 (audio only) are available.
Illinois [February 11, 2009]	Live audio and video of House and Senate	Windows Media Player	General Assembly: http://www.ilga.gov Senate: http://www.ilga.gov/senate/audvid.asp House: http://www.ilga.gov/house/audvid.asp	Both the Senate and the House have live audio and video broadcasts. Windows Media Player is required.

Indiana [February 11, 2009]	Live and archived audio and video of House and Senate	Windows Media Player	General: http://www.in.gov/legislative/session/video.html House Archives: http://www.in.gov/legislative/house_democrats/webcasts_archive_index.html Senate Archive: http://www.in.gov/legislative/session/senatearchive.html	The general link provides access to available video/audio broadcasts. Various conference rooms and the House and Senate floors are covered. Various committees may also be recorded; however the website points the user to individual committee pages for those links. Committee Archives cover the current session and the 2007-2009 sessions. Windows Media player is required.
Iowa [February 11, 2009]	Live audio of House and Senate	Windows Media Player 9	Live Audio: http://www.legis.state.ia.us/Audio/Audio.html	Live audio for both the House and Senate when is session. Windows Media player 9 is required. No archived files found.
Kansas [February 11, 2009]	Live audio of House and Senate.	Winamp or Real Player	Listen In Live: http://www.kslegislature.org/legsrv-legisportal/listen.do	Listen to live audio broadcasts of the House and Senate activities. No archived files were found.
Kentucky [February 11, 2009]	Live and archived audio and video of House and Senate.	Windows Media Player and Real Player (archives only) MP3 audio, iPod video (MP4)	KET Video Stream Site: http://www.ket.org/legislature/	Live and archived audio and video of House and Senate. Live streaming of Senate and House chambers and committee meetings. The archives include meetings, gubernatorial addresses, and available highlight programs. The archive goes back to 2001. Daily Legislative highlights are available in MP3, MP4, and Windows Media video formats.

Louisiana [February 11, 2009]	Live audio and video of House and Senate. Archive of House audio and video, possibly for the Senate.	Real Player 8	Home Page: http://www.legis.state.la.us/ (link to current audio and video feeds if available) House Live Video and Audio: http://house.louisiana.gov/H_Video/Hse_Video_Today.htm House Archived Video: http://house.louisiana.gov/H_Video/Hse_Video_OnDemand.htm (back to 2003) Senate Live Broadcasts: http://senate.legis.state.la.us/SessionInfo/LiveBroadcasts.asp (2008 session; Committee meetings currently broadcasting, full 2009 session starts in April.) Senate Archived Video and Audio: http://senate.legis.state.la.us/video/ (2008 and 2009 only)	Live broadcasts of most House and Senate committee rooms as well as floor sessions of both the House and Senate chambers. The archive for the House goes back to 2003, where certain files are available. Select records from 1999-2002 are available upon request. The website states that Senate Committee meeting rooms are not archived, however access to the current session as well as the 2008 session are available online. Real Player version 8 is needed to view the broadcasts.
Maine [February 11, 2009]	Live video of House and Senate.	Windows Media Player	General: http://janus.state.me.us/legis/ (Links to both House and Senate live video broadcasts.) Additional Links (to live audio and video for House and Senate): http://www.maine.gov/legis/house/haudlink.htm	Live video of House and Senate activities. Live audio of House, Senate, special programming, and special committee meetings. Archives not found.
Maryland [February 11, 2009]	Live and archived audio for House and Senate.	RealPlayer	Home Page: http://mlis.state.md.us/ Live Audio: http://mlis.state.md.us/asp/listen.asp Archive Audio: http://mlis.state.md.us/mgaweb/pyaudio.aspx	The home page links to both House and Senate audio feeds as well as information about each day, linking to individual bills. The live audio link is for both the House and Senate. The archived audio is for both the House and Senate from 2000-2008. RealPlayer is needed.

Massachusetts [February 11, 2009]	Live and archived video of House and Senate.	Adobe Flash Player 8 or higher.	http://masslegislature.tv/	Live video of House and Senate activities. The video archive covers 2006 to the present for both the House and Senate. Adobe Flash Player is required to view the files. Audio only is not available.
Michigan [February 11, 2009]	Live audio and video of House and Senate.	Windows Media Player (best with version 10)	House Live Video/Audio: http://house.michigan.gov/htv.asp Senate Live Video/Audio: http://senate.michigan.gov/SenateTvpages/tvpage4.htm	Watch or listen to the House and Senate live. Windows Media player required. No archive information found.
Minnesota [February 11, 2009]	Live and archived audio and video for House and Senate.	Windows Media Player (House and Senate), Real Player (senate only)	General: http://www.leg.state.mn.us/ House (live and archived): http://www.house.leg.state.mn.us/audio/default.asp Senate (live and archived): http://www.senate.leg.state.mn.us/media/index.php?ls=	Select coverage for the House begins in 1998, full coverage in 2001. Coverage for the Senate begins in 2001 with full coverage in 2002. Floor sessions, committees, press conferences, informational video, and other materials are covered.
Mississippi [February 11, 2009]	Live House and Senate webcasts.	Windows Media Player	Live Webcasts for House and Senate: http://billstatus.ls.state.ms.us/ls_webcast.htm	Live broadcasts of House and Senate chambers. No information on archived files.
Missouri [February 11,	Live audio and video of House and	Windows Media Player; MP3 for Senate	House Media Center: http://www.house.mo.gov/sitemap.aspx?pid=136	House and Senate debates can be viewed live. The House and Senate have daily audio and video clips and audio summaries available for current session as well as

2009]	Senate. Archived video clips available.	Podcasts	Senate Home page for live feeds: http://www.senate.mo.gov/ Senate Media Center: http://www.senate.mo.gov/05info/press-room/main.html	partially for the past session. These are of the more significant events and are not full recordings. The Senate archives video of chosen programs.
Montana [February 11, 2009]	Live audio and video of House and Senate.	Real Player	Online: http://leg.mt.gov/css/Audio/audio_broadcast.asp Cable TV (informational): http://leg.mt.gov/css/Services%20Division/tvmt.asp	Live coverage of select legislative proceedings and meetings is available online. Archive is only of current session. Television Montana provides unedited coverage of floor sessions, committee meetings, and legislative proceedings live and rebroadcasted on cable TV.
Nebraska [February 11, 2009]	Live audio and video coverage of the Senate (no House in Nebraska)	Flash Player and Quick Time Player	Live Coverage: http://www.netnebraska.org/publicmedia/capitol.html	Live coverage of floor activity and public hearings. Available for high and low bandwidth and audio only formats. No information on archived footage found.
Nevada [February 11, 2009]	Live audio and video of Senate and Assembly.	Windows Media Player.	Live broadcasts: http://www.leg.state.nv.us/audio/AudioVideo.cfm	Audio is available in all locations, but video is limited. View in low or high speed. No archive information found.
New Hampshire [February 11,	Live and archived audio and video for	Windows Media Player 6 or higher or Real Media	House Live and Archived Audio/Video : http://www.gencourt.state.nh.us/house/media/default.htm	Live audio and video coverage of the House. Live audio of the Senate. House Committee meetings may also be audio recorded. The Senate archive dates back to 2003.

2009]	House audio only for Senate	Player 10 or higher	Senate Live Audio: http://www.gencourt.state.nh.us/live/senate.html	(Links to House archives can't find server.)
New Jersey [February 11, 2009]	Live and archived audio and video of House and Senate	Windows Media Player	Live: http://www.njleg.state.nj.us/media/live_audio.asp Archives: http://www.njleg.state.nj.us/media/archive_audio.asp?SESSION=2008	Based on the archives, House, Senate, and Joint sessions a as well as the committee meetings are selectively recorded. Most committees are audio while the sessions are also recorded. Archives available with select coverage from 2001 on. (fewer items had coverage in 2001)
New Mexico [February 11, 2009]	Live audio for House legislative sessions. Some committees provide live audio. Nothing is currently being archived.	Windows Media Player; KUNM uses Quicktime (?)	House live audio: http://www.nmlegis.gov/lcs/webcast/house.aspx Appropriations and Finance Committee live audio: http://www.nmlegis.gov/lcs/webcast/hafc.aspx Radio KUNM webcast (live feed only, broken link when not broadcasting): http://129.24.35.149/kunmliveremote.sdp Live webcast of the New Mexico House Tax and Revenue Committee in the House, by Rep. Janice Arnold-Jones: http://www.civicplaza.net/house.php Lawmakers Live! Audio for House and Senate, from NM Legislative Reports: http://www.lawmakerslive.com/	Live audio and video of the House and Senate.[i] No archives available online, except for on Janice Arnold-Jones's own website. Files can be accessed for a fee via New Mexico Legislative Reports.

New York [February 11, 2009]	Live audio and video of Assembly and Senate	Real Media Format 6 or higher	Assembly: http://assembly.state.ny.us/av/ Senate: http://www.senate.state.ny.us/senatehomepage.nsf/SenNetTV?OpenForm	Live coverage of legislative proceedings for the Assembly and Senate. The Assembly is also broadcast on cable TV that provides unedited gavel-to-gavel coverage of Assembly sessions and other legislative proceedings. Information on archived footage was not found.
North Carolina [February 11, 2009]	Live audio for House and Senate.	Windows Media Player	Live House and Senate Audio: http://www.ncga.state.nc.us/Audio/Audio.html	Live audio for House and Senate sessions, and business taking place in the press conference room, and appropriations and finance committee rooms. The House files from the current session are archived as mp3 files.
North Dakota [February 11, 2009]	Live and archived audio and video of House and Senate.	Real Player 8 or higher	Current Session: http://www.legis.nd.gov/assembly/61-2009/dailysess/	Live audio for House and Senate floor proceedings. Live steaming video of the House and Senate will be available on an alternating weekly schedule (House, Senate, House…) Archive for audio and video starts in 2005. Incomplete live and archived video for House and Senate. Links can be found under the legislative session of interest.
Ohio [February 11, 2009]	Live and archived video of House and Senate.	Real Video, Flash video, works with Windows Media Player and Quicktime (?)	Session Video for both House and Senate: http://www.ohiochannel.org/	Live video of House and Senate proceedings. Archives start in 1997. Audio only is not found. Files are in Real Video, or Flash Video formats. Can be read by Windows Media Player.

Oklahoma [February 11, 2009]	Live and archived audio and video of Senate. Live and archived audio of House.	Windows Media Player, mp3, wav files for audio	House and Senate: http://www.lsb.state.ok.us/	The Oklahoma State Legislature has chosen to use the same address for every page on their website. To access the audio and video files one must first navigate to the home page of the House or Senate and find the links to audio and video files. The Senate has live and archived audio and video, while the House only has live and archived audio. The House audio is archived from 2005, the Senate from 2003. The Senate also has podcasts from 2007 on.
Oregon [February 11, 2009]	Live video, live and archived audio for House and Senate.	Real Media	General: http://www.leg.state.or.us/listn/	Live audio and video feed is available for the House and Senate chambers as well as eleven hearing rooms. The audio recordings from 1999 on are available online. The video broadcasts are not archived.
Pennsylvania [February 11, 2009]	Live audio and video of House and Senate.	Windows Media Player	Senate Live Video: http://www.pasen.gov/Video/SenateVideo.cfm; Senate TV: http://www.pasen.gov/senate_tv.cfm House Session Live: http://www.house.state.pa.us/Video/HouseVideo.cfm	The Senate and House both have live video broadcasts. The Senate also has their sessions live and rebroadcast on cable TV. Audio only files were not found. Archived files were not found.
Rhode Island [February 11, 2009]	Live video of the House and Senate.	NA	Capital Television: http://www.rilin.state.ri.us/CapitolTV/	Capital Television broadcasts all House and Senate sessions statewide. The House Finance Committee, and select other committees are also broadcast. No information was found about previous programming. No information was found about viewing options on the Internet.

South Carolina [February 11, 2009]	Live video of House and Senate.	Real Player and Windows Media Player	General: http://www.scstatehouse.gov/#	Live video broadcasts of House and Senate activities. Real Player or Windows Media Player formats available, including Closed Captioned Real Player. Information on audio only formats or archived sessions not found.
South Dakota [February 20, 2009]	Live audio of House and Senate, and committees. TV coverage of some activities.	Real Media Player	Links Live audio broadcasts: http://legis.state.sd.us/sessions/2009/CommitteeMenu.aspx South Dakota Public Broadcasting -"Statehouse '09" - Radio, TV, Online: http://sdpb.org/Statehouse/index.asp Online Radio: http://www.sdpb.org/statehouse/radio.asp	Statehouse 09: Audio of House, Senate, Committees, and Press briefings are offered online via Real Media. Daily podcasts are also available. Video of daily Statehouse program available online. Live audio of SDPB Radio is also available live online as a way to listen to daily reports and special features from the Legislative Session. Archives from the South Dakota Public Broadcasting include audio for the House, Senate, Committee meetings, and press briefing from 2001 to the present. TV coverage is also archived from 2000 to the present.
Tennessee [February 11, 2009]	Live video of House, Senate, Joint Committees .	Windows Media Player 9	Live Video: http://wapp.capitol.tn.gov/apps/livevideo/ Archived audio: http://www.tennessee.gov/tsla/legislative.htm	Live streaming video of the House, Senate, and Joint Committees. The Tennessee State Archives does audio recordings of the House and Senate.[161] Information on audio only formats directly from the House and Senate was not found. Video archive of current session.
Texas	Live and	Real Player	House video and audio:	Live audio and video of House and Senate activities are

[161] The Tennessee State Archives has been recordings sessions since 1955. In 2008 they started digitally recording sessions. All files are available at the State Archives, including indexed logs. The digital files have text logs attached.

[February 11, 2009]	archived audio and video of House and Senate.		http://www.house.state.tx.us/media/welcome.php Senate video and audio: http://www.senate.state.tx.us/bin/live.php	available online using Real Player. Archived audio and video files are available from 1999 in the Senate and 2001 in the House.
Utah [February 11, 2009]	Archived audio of House and Senate.	Real Player	House audio: http://www.le.state.ut.us/asp/audio/index.asp?Sess=none&Bill=&Day=&House=H Senate audio: http://www.le.state.ut.us/asp/audio/index.asp?Sess=none&Bill=&Day=&House=S	Archived audio of House and Senate available from 1990 on. More recent files also have video. The archive includes links to particular points in the audio/video based on bill number or actions. Do not see links to live audio or video.
Vermont [February 11, 2009]	Live audio of House and Senate.	VPR audio player; MP3, Windows Media Player; online directly	General: http://www.vpr.net/news/vpr_news/vermont_legislature/	Live audio streaming of House and Senate proceedings. Do not see links to archived files.
Virginia [February 11, 2009]	Live video of House and Senate.	House: Adobe Flash Player; Senate: Microsoft Media Player 9 or higher	House: http://legis.state.va.us/hod_session_streaming.html Senate: http://legis.state.va.us/sov_session_streaming.html	Live video of House and Senate sessions. No archived feeds found.
Washington	Live and archived	Windows Media Player	General: http://www.tvw.org/index.cfm?bhcp=1	Information not easily accessible from main state legislative website. Audio and video available for House

[February 11, 2009]	audio and video of House and Senate.	(a/v), Real Player (a) Podcasts are also available.	Archive: http://www.tvw.org/media/archives.cfm?CFID=1734232&CFTOKEN=27222813&bhcp=1	and Senate floor events, committee meetings, joint sessions and other government activities. Legislative events archived from 1997 on.[162]
West Virginia [February 11, 2009]	*Nothing found.*			Found a report that states TV stations do broadcasting, but did not find specifics or any information about live audio or video on the Internet. (http://www.legis.state.wv.us/Wrapup/pdfs/Vol.XVI_issue4.pdf)
Wisconsin [February 11, 2009]	Live and archived audio and video of House and Senate.	Windows Media Player.	General: http://av.legis.state.wi.us/LegisAV/LegisAV.aspx or http://wisconsineye.org/ Video archive: http://wisconsineye.org/wisEye_programming/wisEye_VideoArchive_09.html	House and Senate floor and committee discussions for the current and previous legislative session. Archive maintained by WisconsinEye, not the state government.
Wyoming [February 11, 2009]	Live and archived audio for House and Senate.	MP3 files, Windows Media Player can read them. Real Player for	Live audio: http://legisweb.state.wy.us/2009/audio/AudioMenu1.htm Archive:	Live audio is available for activities of both the House and Senate. Archive of 2007 legislative session available. The 2009 session started using MP3 files for the audio feed. Previous versions used Real Player.

[162] NEW: Washington State Digital Archives: 1973-2002 audio recordings of House Committee meetings. Audio is searchable. (http://www.digitalarchives.wa.gov/TitleInfo.aspx?TID=509)

		archived files.	http://legisweb.state.wy.us/sessions/legsess.htm	
US Senate and US House of Representatives	Live video coverage of the House, Senate, and the Congressional committee	Windows Media Player, Real Media Player, Flash Player	CSPAN: http://www.c-span.org/Watch/C-SPAN_wm.aspx Senate Dome: http://www.senate.gov/general/capcam.htm	CSPAN offers live coverage of the House, Senate, and the Congressional committee available, plays in both Windows Media and Real Media. Sessions are archived. (Adobe Flash is used for some of these files.) Live video stream of the capitol dome.

Appendix 3: Washington State Digital Archives Example

In 2005, the Washington State Archives began the process to preserve and provide access to recordings from the House of Representatives that were recorded on 30,000 audio cassette tapes between the years 1973 to 2005. The cassette tapes were converted into digital format (.wav files) by interns at the State Archives. These uncompressed .wav files are then stored as master copies from which derivative access copies could be made. The goal was to make these files available to the public, which was done by creating .mp3 files that could be streamed over the Internet.

As the information on the cassettes and .wav and .mp3 files is recorded spoken words, the information contained within the files was not very accessible. The original cassette tapes were only labeled with the date and committee name which did not provide information about the content. After digitizing the cassettes, the partnership between the Washington State Archives and Microsoft Research Corporation enhanced the public access to these files by using speech search technology to allow keyword searching of the content. Microsoft Research technology uses an audio indexer to 'transcribe' the audio files. The 'transcription' is not a word for word transcription. The Microsoft Audio/Video Indexing System (MAVIS) "uses a large-vocabulary continuous speech recognition (LVCSR) engine to index the spoken content of recorded conversations. LVCSR turns the audio signals into text using a preconfigured vocabulary and language grammar, and then converts the text data into an index that contains information about all of the words in the recording."[163]

Although not 100 percent accurate, this technology allows users enter a keyword and retrieve individual files that contain content of interest. Users can choose to listen to the entire committee meeting or jump to specific sections of the recording that include the topic of interest. Without the audio indexing, users would need to study other legislative materials to determine which cassette tape contained content of interest, and then listen to the entire file to find the relevant information. Microsoft and the Washington Archives continue to work together on improving the indexing by increasing proper name recognition and decreasing spelling mistakes during the process.

Details about the project are summarized below from correspondence with Adam Miller an Application Developer with the Washington State Digital Archives.

> **Format:** Master audio files are uncompressed .wav files, access copies are .mp3.
>
> **Standards:** Preservation copies are uncompressed .wav files. Access copies are compressed at a 22kHz sample rate, 1 channel, and 96kbps bit rate. As the audio files are only spoken word, the requirements are quite low, which is standard for these file types.

[163] Klie, Leonard. *Making Public Records Public*. Speech Technology. February 6, 2009. http://www.speechtechmag.com/Articles/Editorial/Deployments/Making-Public-Records-Public-52498.aspx

Delivery method: Audio files are streamed from a media server, but the files also reside in a database.

Storage/ Cost: As a general example, the Washington Archives has found that 10TB of storage can range from $10 thousand to $30 thousand dollars, depending on the storage method (speed and size of servers and storage method).

Backups: Inside the database, all files are stored on active high-availability storage arrays in a mixture of RAID 1+0 and RAID 5. The entire database is also backed up in full as well as incrementally. These backups are stored on a backup server and moved to tape.

Preservation: Over time file formats will change, so forward migration is necessary. The database and individual files will need to be migrated as file formats become obsolete. Using open formats is preferred.

Authenticity: Documentation of the chain of custody of files being digitized and ingested into the database helps prove authenticity of the files.

Future plans/video: Other states are interested in this technology. Washington Archives would like to see video files indexed the same way. The technology would index the audio track of the video and access could be provided using keyword searches. Providing searchable audio and video files to users greatly adds to the amount of useful content available.

Appendix 4: Minnesota Senate Audio and Video Files Summary

From discussions with the Minnesota Senate about audio/video recording, this is the history and the plans for the future….

Senate Audio

The Minnesota Senate began audio recording a few floor sessions and committee meetings in the 1960s. In 1973 it became required by Rule that all standing committees be recorded, which was done on reel-to-reels. Audio recording continued on the reels until the 1980s when they were replaced by cassette tapes. Cassettes were replaced in 2005 when the Senate began digitally recording floor sessions and committee meetings. The Senate digitally captures the recordings as MP3 files on a data card inserted into a recorder. In general files are between 120-300mb, which varies considerably based on length and file resolution. Files are automatically saved in multiple resolutions useful in various methods of providing access including streaming, downloading and broadcasting. While the files are being recorded, they are also streamed live over the Internet.

After the files are recorded they are downloaded onto a computer using a card reader. Files are then renamed based on an internal naming convention including the capturing the date and committee name, which is generally the only administrative metadata captured. Files are then sent to the Office of Enterprise Technology (OET) for storage on their RealMedia server. OET has the available bandwidth to stream the files. Because a RealMedia server is being used, RealPlayer is needed to play the audio files.

Senate Video

Senate activities have been video recorded since the 1980s on broadcast quality VHS tapes. Many of these tapes have been made available online in both Windows Media format and RealMedia format. They are also housed on the RealMedia server at OET. In 2009, the Senate began digital recording sessions and select committee meetings. The Senate is currently using MP3s but will probably move to recording in Flash in the near future. If this is done, the Flash files would need to be converted to another file type for archiving. Video recording is done remotely.

Main Concern

The importance of preserving digital files is not yet fully recognized. There needs to be a cost benefit analysis that shows how much information is at stake and how investing in digital preservation now will assist us down the road.

Appendix 5: Selected Resources

AboutVideoEditing.com. *Streaming Video Over the Web*. 2008.
http://www.aboutvideoediting.com/articles/web-streaming-video.shtml

> A discussion about streaming media including advantages and disadvantages of the technology as well as an explanation of the process and how to choose the best format and encoding parameters. Includes general information on the features of RealPlayer, QuickTime and Windows Media Player.

Adobe. *Adobe Audition 1.0: A Digital Audio Primer*. 2003.
http://www.adobe.com/products/audition/pdfs/audaudioprimer.pdf

> The basic ideas of digital audio are explained in this primer starting with the fundamentals of analog sound moving into the details of digital audio. Graphs help to clarify the physics of sound and provide a physical explanation of sampling rate and bit depth.

Arms, Caroline R. and Carl Fleischhauer. *Sustainability of Digital Formats Planning for Library of Congress Collections*. Library of Congress. May 21, 2007.
http://www.digitalpreservation.gov/formats/index.shtml

> This website gathers information on digital file formats and places them in a centralized location. The site includes an inventory of current and emerging digital formats with descriptions about how they can be used and if they are appropriate for long-term preservation. Information on audio and video files as well as still images and textual formats are included.

Audio-Visual Working Group. *Audio-Visual Working Group*. Federal Agencies Digitization Guidelines Initiative. February 6, 2009. http://www.digitizationguidelines.gov/audio-visual/

> A working group whose goal it is to develop and share information on standards and best practices for digital reformatting of audio-visual materials with some consideration of born digital materials for federal agencies. Formats and metadata are major topics of discussion.

Besser, Howard. "Digital Longevity," in Maxine K. Sitts, ed., *Handbook for Digital Projects: A Management Tool for Preservation and Access*. Northeast Document Conservation Center. 2000. http://www.gseis.ucla.edu/~howard/Papers/sfs-longevity.html

Addresses many issues digital files may be effected by in the process of trying to preserve them including; format obsolescence, software incompatibilities, and lack of preservation policies. A few options for improving access over time are also discussed including the value of metadata.

Bibliographic Center for Research. *BCR's CDP Digital Imaging Best Practices Version 2.0.* June 2008. http://www.bcr.org/cdp/best/digital-imaging-bp.pdf

A general best practice guide that addresses all aspects of a digitization project including background information, creation basics, hardware and software considerations, guidelines for master images, preservation metadata, storage options, and long-term access. Audio and video files are included.

Bouthillier, Larry. *Streaming vs. Downloading Video: Understanding the Differences*. StreamingMedia.com. July 22, 2003. http://www.streamingmedia.com/r/printerfriendly.asp?id=8456

An explanation of two methods of transmitting files, streaming and downloading with a discussion about storing files on a web server vs. a streaming server.

Brylawski, Samual. "Preservation of Digitally Recorded Sound." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf

Addresses preservation concerns including format changes, distribution concerns, rights management, and the importance of metadata. The importance of developing standards, using repositories and collaboration is also covered.

Cakewalk by Roland. *Desktop Music Handbook Glossary of MIDI and Digital Audio Terms*. http://www.cakewalk.com/Tips/desktop-glossary.asp

Glossary of digital audio terms.

Casey, Mike and Bruce Gordon. Sound Directions: Best Practices Guide for Audio Preservation. 2007. Indiana University Digital Library Program.
http://www.dlib.indiana.edu/projects/sounddirections/papersPresent/sd_bp_07.pdf

Includes best practice information on required personnel and equipment, digital formats, metadata, storage practices, and preservation systems. Specific details are provided by Indiana University and Harvard University for each recommendation.

The Center for Research Libraries (CRL) and Online Computer Library Center (OCLC). *Trustworthy Repositories Audit and Certification: Criteria and Checklist*. February 2007.
http://www.crl.edu/PDF/trac.pdf

This guide and checklist can be used to evaluate repositories for levels of trustworthiness based on their organizational structure, digital object management practices, technical infrastructure, and security.

Clair, Kevin. "Developing an Audiovisual Metadata Application Profile: A Case Study." *Library Collections, Acquisitions, and Technical Services* 32, no. 1 (2008): 53-57.

Discusses how audiovisual materials have additional metadata requirements than textual documents. The application profile they created uses both Dublin Core and PBCore. It is hoped that by developing and sharing strategies for metadata implementation best practices can be developed.

Collaborative Digitization Program (CDP)'s Digital Audio Working Group. *Digital Audio Best Practices Version 2.1*. Bibliographic Center for Research. October 2006.
http://www.bcr.org/cdp/best/digital-audio-bp.pdf

Best practice guide that focuses on digital audio materials. The guide discusses planning, implementing, and managing an audio digitizing project. Metadata standards for digital audio are discussed including how to document the legal and intellectual property rights issues. Explanation of how Dublin Core is used as the metadata best practice. Guidelines of audio recording methods are also covered, including modes of capture, sample rate, bit depth, source types, and file types. The issues of storage, preservation and access to files are addressed.

Columbia University Libraries: Preservation Division. *Survey Instrument for Audio and Moving Image Collections*. Columbia University Libraries. 2005. http://www.columbia.edu/cu/lweb/services/preservation/audiosurvey.html

The Preservation Division of the Columbia University Libraries developed and tested a survey instrument that helps inventory and addresses the physical condition and intellectual control of audio and moving image materials in a collection. The survey instrument and instruction manual are available for free download.

The Commission on Preservation and Access and the Research Libraries Group. *Preserving Digital Information*. Report of the Task Force on Archiving Digital Information. May 1, 1996. http://www.ifla.org/documents/libraries/net/tfadi-fr.pdf

General concerns about archiving digital information including technological obsolescence, migration, legal concerns, and data integrity. A depository library model and a digital archive model are explained as methods of preservation and access.

Dance Heritage Coalition. *Digital Video Preservation Reformatting Project*. Dance Heritage Coalition, Inc. June 2004. http://www.media-matters.net/docs/resources/Digital%20Files/MotionJPEG%202000/DigitalVideoPreservation1.pdf

A report on a specific digital video reformatting project including documentation of the entire process of choosing a suitable file format, analyzing various codecs, and testing the conversion process. A summary analysis of the project and recommendations follow.

Digital Conservancy. *Digital Audio Guidelines*. University of Minnesota. 2007. http://conservancy.umn.edu/bp-audio.jsp

Guidelines in place at the University of Minnesota for digital audio files at the Digital Conservancy. Minimum, recommended and optimal standards for sample rate and bit-depth are given. Preferred file formats are also discussed.

DigitalTips. *Digital Audio 101*. http://www.digitaltips.org/audio/audio101.asp

Information about digital audio files including how they work, compression types, file formats, storage devices, and playback concerns.

Fells, Nick and Pauline Donachy and Catherine Owen. *Arts and Humanities Data Service Guides to Good Practice: Creating Digital Audio Resources: A Guide to Good Practice.* Arts and Humanities Data Service (AHDS). http://ahds.ac.uk/creating/guides/audio-resources/GGP_Audio_Overview.htm

The Arts and Humanities Data Service created a guide that addresses best practices when working with digital audio. Copyright issues, digitization methods, playback concerns, delivery methods, and preservation are all covered. The guide also includes a glossary, bibliography, and case studies. Chapter 8: *Documenting Digital Audio Resources.* (http://ahds.ac.uk/creating/guides/audio-resources/GGP_Audio_8.1.htm) discusses metadata.

Formats Group, Deep Blue. *Best Practices for Producing Quality Digital Audio Files Version 1.0*. University of Michigan July 10, 2006. http://hdl.handle.net/2027.42/40248

Guidelines in place at the University of Michigan for digital audio files. Minimum, recommended and optimal standards for sample rate and bit-depth are given. Preferred file formats are also discussed. Differentiates direct to digital and analog to digital processes for creating high quality files.

Grammy Foundation. Grammy Foundation Basic Methodology for Preservation, Conservation and Archiving Recorded Media. May 2008. http://www.grammy.com/PDFs/GRAMMY_Foundation/Methodology_2009_Final.pdf

Includes information on the long-term storage efforts of the Grammy Foundation. Links to industry standards are included. Conversions, archiving, and preservation standards are addressed.

Guy, Marieke. *QA Focus Documents: Choosing a Suitable Digital Video Format*. UKOLN. October 1, 2004. http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/html/

Provides general background information on digital video files. Information on screen size, pixels per frame, bit depth, frames per second, and bandwidth, all of which effect video quality, are discussed. Also discusses distribution methods and possible challenges, and defines relevant terms for digital video files.

Harvard University Library. *Administrative Metadata for Digital Audio Files*. Harvard University Library: Library Digital Initiative. 2004.
http://preserve.harvard.edu/resources/audiometadata.pdf

Discusses and provides definitions for technical metadata necessary when describing digital audio files. Includes specific information on the metadata tag, if it is required or optional, repeatable or not, and details on its values; examples for each are included.

Hass, Jeffrey. "Chapter 5: Digital Audio: 8: Digital audio file formats," in Introduction to Computer Music: Volume 1. 2005.
http://www.indiana.edu/~emusic/etext/digital_audio/chapter5_file.shtml

General background on digital audio files followed by a list of common file formats.

Jantz, Ronald and Michael Giarlo. "Digital Archiving and Preservation: Technologies and Processes for a Trusted Repository." *Journal of Archival Organization*. 2007. 4:1, 193-213.

Discusses the need for a trusted repository as a method for long-term preservation of digital items. Trust is associated with the standards, policies, and technological infrastructure of the repository as well as the trustworthiness of the hardware and software used in the system. Examples are given in regards to workflow scenarios. Key ideas include digital signatures, persistent identifiers, validating object integrity, audit trails, and overall stability.

Knight, Gareth and John McHugh. *Preservation Handbook: Digital Audio*. Arts and Humanities Data Service (AHDS). United Kingdom. July 25, 2005.
http://ahds.ac.uk/preservation/audio-preservation-handbook.pdf

Quality of audio files is affected by sampling frequency, bit-rate, and codec, all of which are discussed here. Compression techniques are also discussed. Includes a chart of common formats listing format name, extension, and selected information about each format.

Lawrence, Gregory W. et al. *Risk Management of Digital Information: A File Format Investigation*. Council on Library and Information Resources. June 2000.
http://www.clir.org/pubs/reports/pub93/contents.html

Categories of risk that may affect migration and long-term preservation of file formats are defined and explained. A case study and risk assessment workbook are included.

Lockhorn, Jeremy. *Video Search Catches Up with Video Tagging*. ClickZ. January 29, 2007. http://www.clickz.com/3624735

Addresses video tagging as a method of maximizing video distribution and consumption and its importance in search functions.

McDonough, Jerome and Mona Jimenez. "Video Preservation and Digital Reformatting: Pain and Possibility." *Journal of Archival Organization*, 2006, Vol. 4 Issue ½, p. 167-191, 25 p, 1 diagram.

Discusses the importance of metadata in regards to digital video preservation. Covers descriptive metadata as well as intellectual property rights metadata, technical metadata, digital provenance metadata, and structural metadata. Other issues surrounding digital artifacts are also covered.

MP3 Sound Stream. *History of Streaming Audio*. October 15, 2008. http://mp3soundstream.com/streaming-audio/history-of-streaming-audio/

The development of streaming technology, its shortcomings, associated costs, current use, and future use are all discussed. A more general history of digital audio is also included.

National Archives Records Administration (NARA). *Frequently Asked Questions (FAQ) About Digital Audio and Video Records*. The National Archives. http://www.archives.gov/records-mgmt/initiatives/dav-faq.html

NARA's general guidelines for digital audio and video files are found in the Frequently Asked Questions section as formal guidelines have not been issued. General questions about selecting file formats, conversion processes, metadata, data structure and codecs are answered. Answers to more specific questions about digital audio and video files follow, including recommendations on appropriate file formats, codecs, bit depth, sample rate, height and width requirements, and color requirements.

Ottewill, Matt. *Digital Audio File Formats and Codecs*. Planet of Tunes. http://www.planetoftunes.com/digiaudio/daudiofiles.html

Introduction to digital audio file formats and associated codecs. Parameters that affect digital audio quality are also defined. A chart shows file format, compression codecs, sample rate, bit depth and number of channels for common audio file formats. The relationship between compression, audio file parameters, and file size are discussed.

Ottewill, Matt. *Digital Video File Formats and Codecs*. Planet of Tunes. November 2008. http://www.planetoftunes.com/dv/videofiles.html

A discussion on video quality and file size as affected by the codec. Explains the range of locations a codec can be found and used on video formats. A chart with some file formats, their associated codec/s, and methods of use shows the variety of digital video file formats.

Tittel, Ed. *A Quick 'Rip' Through Digital Audio File Formats*. Peachpit. July 30, 2004, updated October 11, 2004. http://www.peachpit.com/articles/article.aspx?p=212411

A discussion about digital audio quality, types of players, and compression methods including a chart of common digital audio formats with file format name, extension, date of creation, compression type, and various notes about each format. A resource list is also included.

UKOLN at the University of Bath. *Good Practice Guide for Developers of Cultural Heritage Web Services.* July 2008. http://www.ukoln.ac.uk/interop-focus/gpg/

Intended to provide advice for cultural heritage agencies developing web services, this resource provides information on digitization and preservation of digital formats including audio and video. The section on *Image Formats* (http://www.ukoln.ac.uk/interop-focus/gpg/Formats/ updated April 2006) and the section on *Digital Preservation* (http://www.ukoln.ac.uk/interop-focus/gpg/Preservation/ updated January 2005) are especially relevant.

University of Iowa. *ITS Video Services: Terms and Explanation*. August 6, 2008. http://www.its.uiowa.edu/tns/videoservices/streamdef.htm

Although written specifically for University of Iowa's systems, this includes a general explanation of the streaming process with a graphical representation of streaming vs. downloading. Definitions of basic terms including selected codecs and file formats are also included.

Waclar, Howard D. and Michael G. Christel. "Digital Video Archives: Managing Through Metadata." *Building a National Strategy for Digital Preservation: Issues in Digital Media Archiving*. Council on Library and Information Resources and Library of Congress. April 2002. http://www.clir.org/pubs/reports/pub106/pub106.pdf

Addresses the concerns and issues relating to digital video metadata. Dublin Core, and video production level metadata standards are discussed including MPEG-7 and MPEG-21. The relationship between metadata and preservation is also discussed.

[i] January and February 2009 have seen many changes in live audio and video feeds of the New Mexico legislature. Previous legislative sessions were audio recorded by New Mexico Legislative Reports and were available for a fee. Government transparency had become an issue with some representatives who wanted to offer live audio and video feeds of sessions, and received mixed reviews. On January 23, 2009 KUNM 89.9FM, a public radio station, announced that they would began broadcasting Senate floor sessions on their radio station. "The radio station did not need to seek permission, as media outlets have access to audio feeds from the House and Senate that they can tap into at anytime." (source: http://newmexicoindependent.com/16167/radio-station-to-webcast-audio-from-legislature; http://www.unm.edu/~market/cgi-bin/archives/003570.html) This action was part of the effort to push the legislature into broadcasting audio and video from the House and Senate floors. The day before KUNM planned on broadcasting Senate audio, Republican Janice Arnold-Jones brought her own laptop and webcam to the House Taxation and Revenue Committee meeting and began live webcasting on her own accord. The broadcasts can be viewed live on her website. (http://www.civicplaza.net/house.php) Her videos are also archived and cover the House Voters and Elections Committee, and Capital Outlay. (source: http://newmexicoindependent.com/16306/webcasting-revolution-begins-this-afternoon) A week later, KUNM was streaming both House and Senate floor sessions. (source: http://newmexicoindependent.com/16958/lawmakers-recommend-that-audio-webcasting-commence-next-week) At the same time, New Mexico Legislative Reports stated that it would offer its audio webcasts of the House and Senate floor sessions for free, a service that had previously been paid for. They also stated that they might consider offering video feeds. (source: http://newmexicoindependent.com/17088/another-web-site-to-offer-free-audio-webcasting). Two days later, a unanimous voice vote in the House approved audio webcasting of its proceedings. (source: http://newmexicoindependent.com/17351/in-a-victory-for-open-government-nm-house-of-representatives-approves-audio-webcasting) The House would like to be offering live video no later than 2010. (source: http://newmexicoindependent.com/17446/martinez-house-wants-video-webcasting) On February 6, 2009, the House launched its first official audio webcast. (source: http://newmexicoindependent.com/17657/house-begins-official-audio-webcasting). The Senate is still deliberating over the issue of live webcasting. (For background information, please view: http://newmexicoindependent.com/16041/roundhouse-resists-entering-21st-century.)