CDP
Digital Audio Working Group

Digital Audio Best Practices

Version 2.1

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1. Introduction

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1.1. Purpose and Scope

There are many historic audio collections in museums, libraries and archives that may be in poor condition and becoming increasingly fragile due to their age or storage history. The transfer of original recordings to digital formats is a process that helps protect the original analog recordings from unnecessary handling, can mitigate the risk of format obsolescence, can serve as a preservation process, and can provide access that might otherwise be unavailable.

These digital surrogates may be copied without noticeable signal loss and safely accessed without concerns about the destruction of original material. This transfer process, when handled properly, can prove to be both easy and cost effective for most historic collections. As the technology continues to improve, this alternative will become even easier and more cost effective, helping to preserve and make accessible the historic audio collections of museums, libraries and archives.

The purpose of this document is to provide guidelines and a set of best practices for cultural heritage institutions interested in converting analog audio recordings to digital formats. Recording audio directly into digital formats is also addressed. We hope that this information will help to preserve these collections and make them more widely accessible.

If you are unfamiliar with audio terminology, or the terminology related to digital media, please refer to Section 12 for a glossary of terms. We recommend that you familiarize yourself with these terms before continuing.

1.2. Recommendations Strategy

Taking into consideration all of the items discussed in this document, our goal is not to provide absolute recommendations, but rather to provide guidelines for making informed decisions on best practices for particular projects. We offer a tiered approached to best practices that takes into consideration the nature and quality of the audio source material; the intended use of the resulting digital audio files; and the nature and available resources of the institution conducting the project.

1.3. Updating the Colorado Digitization Program Digital Audio Best Practices

In the fall of 2004 the Collaborative Digitization Program (CDP), formerly known as the Colorado Digitization Project, received funding from the Institute for Museum and Library Services (IMLS) to create an infrastructure for the delivery of digitized audio recordings. As part of this project, the CDP Digital Audio Working Group began the long process of reviewing and updating the Colorado Digitization Project's *Digital Audio Best Practices, Version 1.2, May 2003.* This document, *Version 2.*1, replaces the earlier version, and is an update of *Version 2.0,* released in November 2005. It is expanded to include best practices for a wide range of audio collections held by cultural heritage institutions, and to reflect the current state of best practices for digital audio in a field that is rapidly evolving.

1.4. Acknowledgements

We would like to thank all of the members of the CDP Audio Working Group for volunteering their expertise and hard work to complete this document. We would like to especially thank Richard Urban, former CDP Operations Coordinator, and former Chair of the CDP Audio Working Group, for his work on Version 1.2 and for his hard work on the early stages and direction of the current document. We would also like to extend special thanks to the Institute for Museum and Library Services for providing funding under the CDP's Sound Model Grant.

In addition, for their work in reviewing *Digital Audio Best Practices, Version 2.0,* and offering comments, additions and revisions, we would like to thank: George Blood, Safe Sound Archives, Philadelphia, Pennsylvania; Bridget Carr, Archivist, Boston Symphony Orchestra; Nathan Georgitis, Metadata Librarian, University of Oregon, and Chair, Society of American Archivists Recorded Sound Roundtable; David Glasser, GRAMMY Award-winning audio engineer, Airshow Mastering, Boulder, Colorado; David Seubert, Curator of the Performing Arts Collection, Special Collections, University of California, Santa Barbara, and Newsletter Editor for the Association of Recorded Sound Collections.

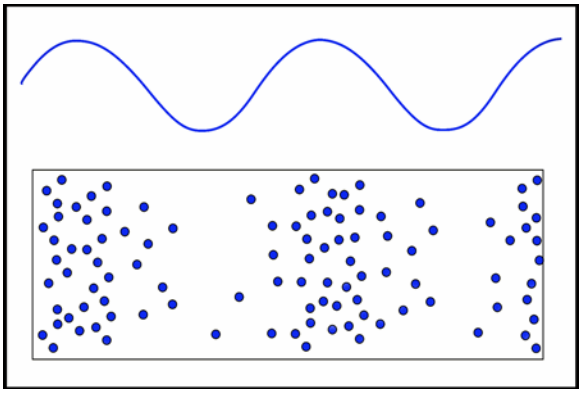
1.5. Supporting Documents and Appendices

A number of appendices and supporting documents are provided as supplementary materials. Appendices are available at the end of this document. They are also available as separate documents in PDF format on the Collaborative Digitization Program Web site www.cdpheritage.org, along with additional supporting documents in PDF format.

2. Understanding Audio

2.1 A Brief Overview

What we call "audio" is actually a continuous series of air pressure waves. When these waves strike the eardrum, nerves are stimulated within the ear, nerve signals are transmitted to the brain, and we "hear sound". In early sound recordings, such as wax cylinders, the pressure waves were converted into grooves on a cylinder that mimic the high and low pressure, or amplitude, in the air waves. The grooves are analogous to the pressure waves, so we call that an analog recording. Similarly, the airwaves striking the diaphragm of a microphone produce an electric current that varies with the air pressure waves. When this current is recorded on magnetic tape it is also an analog recording.



A sound wave is shown as a waveform with high and low pressure points, or "amplitude" (above). The corresponding wave is depicted as areas of high and low density air particles (below). Imagine that the wave is flowing past you as the pressure on your eardrum changes. (Illustration courtesy of George Blood, Safe Sound Archives.)

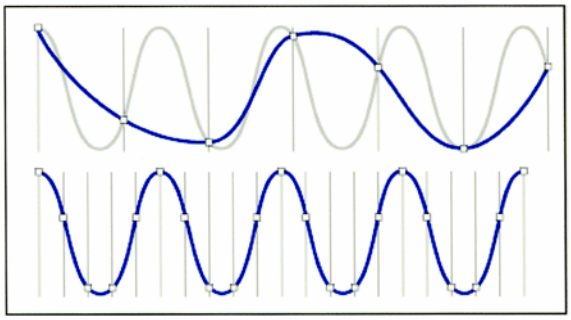
When audio is digitized, an analog recording is played back through an electronic device, and the variations of the electric current generated by the device are sampled at very fast time intervals. The amplitude of the current, corresponding

to the amplitude of the original sound wave, is recorded as a number at each sampling point.

The quality and resolution of digitized audio is determined by two factors:

1. The number of times per second the amplitude of the wave is measured
2. The range of numbers used to record each measurement.

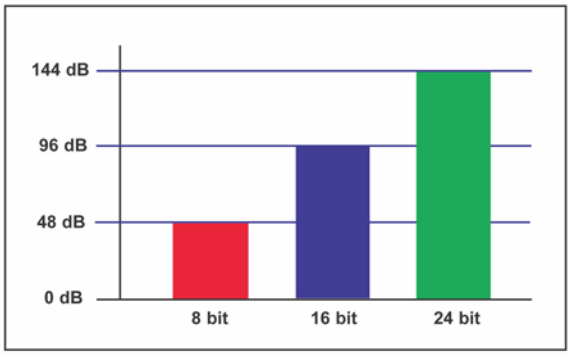
The first factor, the "sampling rate" is described in kilohertz (kHz), or thousands of samples per second. Consumer audio CDs are recorded at a sampling rate of 44.1 kHz. That means that each second of audio is represented as 44,100 separate amplitude measurements as the wave flows past a point.



Visual representation of two sample rates

A. The top wave represents a low sample rate which does not accurately reproduce the shape of the original sound wave
B. The bottom wave represents a high sample rate which more accurately reproduces the wave

The second factor, the"bit depth" describes the range of numbers used to represent each amplitude measurement. For example, if each measurement were represented on a scale from 1-10, that would be a rougher measurement than a scale from 1-1000. Sample size is measured in bits. Eight-bit numbers range from 0-255; 16-bit numbers range from 0-65,535; and 24-bit numbers range from 0-16,777,215. Since human ears are sensitive to the volume of sound, measured in decibals (dB), higher bit depths result in a “smoother” or more realistic representation of the audio source, or greater “dynamic range.” All audio CDs are 16 bit recordings.



Higher bit depths can represent a wider volume range, possessing a greater "dynamic range."

Please not that the discussion above discusses only factors related to digital audio reformatting. The quality of the original analog playback into the digital system will also greatly affect the final digital audio product.

2.2 Additional Considerations:

- The highest frequency pitch that a digital audio sample can record is one-half of the sampling rate. For example, 44.1 kHz audio CDs can only record frequencies up to 22.05 kHz.

- Most experts agree that most humans cannot hear pitches above 20 kHz. This is the rationale for the selection of the 44.1 kHz sampling rate for audio CDs.

- Most experts also agree that the human ear can only resolve between 15 and 17 bits per sample. Thus, some people may not be able to differentiate between a 16-bit recording and a 24-bit recording. Curiously though, some listeners, and especially experienced audio engineers, report a clear difference in the quality of a 24-bit recording compared to a 16-bit recording from the same audio source.

- One explanation for the audible difference between 16-bit and 24-bit recordings is that some 16-bit recordings do not take full advantage of the 16-bit depth, containing passages possibly as low as 8-bit. Likewise, 24-bit recordings may contain sections that do not fully take advantage of the 24-bit depth. In these cases, a comparison of the two digitally reformatted recordings from the same source audio will exhibit audible differences.

- Recording at a sampling rate higher than 44.1 kHz may not be effective in preserving more information for particular source materials, such as vinyl records or analog audio cassette tapes, because those sources are not capable of recording frequencies above 22.05 kHz. Indeed they may only

be 10kHz and could, theoretically, be sampled at 20kHz. Therefore 44.1 may be enough.

- Recording equipment may not be perfectly matched to a particular audio source. Sampling at the higher depth of 24-bit will more accurately reproduce any imperfections in equipment configurations, so the 24-bit depth requires greater care with analog recording playback. On the other hand, a 24 bit depth offers additional "headroom" for audio processing on computer-based audio editing systems.

- In addition, sampling rates and bit depths should be considered in relation to the nature of the original audio source, not only in relation to the range of human hearing. Many sounds, such as animals and electronic instruments, exhibit a frequency range much higher than 22.05 khz, and a higher sampling rate clearly records more audio information than a lower one. Our recommendations take these facts into consideration, recognizing that there are unknown future uses for digital audio files, and unknown potential for digital audio in this rapidly advancing technological field.

- A guide for choosing the Best Practices for your project is included in Section 7.

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3. Collection Development and Management

Before beginning an audio digitizing project, processes for collection development and management should already be in place.

Activities related to acquisition of audio materials should fall within guidelines clearly stated by institutional collection policies. Long-term value of materials may be determined by considerations related to legal value, informational value, uniqueness, and utility for future research. Preservation priorities may be assigned based on the uniqueness of materials, their fragility, or their probability of being at risk of deterioration. Access priorities may be placed based on priorities stated in the institution's mission statement, as well as demand by users.

A complete discussion of collection development and management is beyond the scope of this document. For further information, please refer to the *Resources* section. For a very thorough decision-tree on *Selection of Digital Materials for Long-Term Retention* you may consult the Digital Coalition Document at www.dpconline.org/graphics/handbook/dec-tree.html

4. Planning and Implementing an Audio Digitizing Project

Planning and implementing an audio digitizing project should include a thorough period of analysis and planning. It is important to:

1. Clearly articulate the goals of the project.
2. Identify the audience for the audio products.
3. Have a thorough understanding of methods and processes for completing the project.
4. Develop a realistic work plan.
5. Identify staffing or outsourcing needs.
6. Create budgets and funding sources to support the project through a series of stages.

As a guide to answering questions relevant to all phases of planning and implementing an audio digitizing project, please refer to *Appendix 1: Questions to Ask Before Beginning an Audio Digitizing.*

5. Legal, Copyright and Intellectual Property Issues

It is necessary to address the complex issues surrounding intellectual property before undertaking a project to digitize audio recordings. Whether it is a commercially produced recording of a musical performance or an oral history taped by the local historical society, any audio recording that is a creative expression fixed to a tangible medium is protected by copyright, and subject to restrictions if signed release forms are not available.

As a guide to answering questions relevant to all aspects of intellectual property issues for an audio digitizing project, please refer to *Appendix 2: Legal, Copyright and Intellectual Property Issues for an Audio Digitizing Project.*

6. Metadata for Digital Audio

The creation of quality metadata is a key component for the responsible management and long-term preservation of the digital files produced by your project. Metadata is the term used to describe traditional descriptive cataloging applied to digital files, in addition to information needed to retrieve, access, and manage those files. Frequently metadata creation begins with pre-existing descriptive cataloging, finding aids, or accession records that are extended by adding information about the digital files. Some projects will need to create new metadata as part of the project's overall workflow.

There is no one standard for metadata creation that meets all the needs of all types of collections and repositories, however most common metadata schema include the following sets of information:

Descriptive Metadata	Metadata describing the intellectual content of a resource.
Administrative Metadata	Metadata including information about ownership and rights management.
Structural Metadata	Metadata describing relationships between multiple digital files, such as the order of audio files that together form a series or set.
Technical Metadata	Metadata that describes the features of the digital file, such as file type, bit depth and sample rate.

6.1 Audio Metadata Standards

Several professional organizations are working to develop metadata standards that specifically deal with the description of digital audio files. Many of the emerging schemas recognize the importance of recording the technical aspects of digital audio files and original formats. References to specific audio metadata standards can be found in the *Resources* section of this document.

6.2 Audio Metadata in Dublin Core

Including technical metadata about the digital audio file is important because not all audio file formats are supported in current browsers. For instance, Windows MediaPlayer does not support 96kHz. Providing information about file size and duration of the audio helps users determine if they have sufficient bandwidth and time to access the resource. In addition, including the technical details of the master file will inform users about the conversion process and availability of higher quality recordings.

Examples of Format and Digitization Specifications metadata are shown below.

6.2.1 Format

Duration*:* the playtime of the audio recording
Example: 1 hour, 14 minutes, 40 seconds

6.2.2 Digitization Specifications

Digitization process: hardware and software used to digitize the original recording, particularly if any optimization was applied during the conversion.

Example: Nakamichi Dragon Cassette Deck; Digidesign Digi002 Analog-Digital Converter; ProTools version 3.0 audio software; WAVES XNoise noise reduction.

6.3 CDP Dublin Core Metadata Best Practices

A complete discussion of metadata best practices for digital audio is beyond the scope of this document. Projects planning to use the Dublin Core metadata scheme for describing digital audio files should refer to the supporting document, *CDP Dublin Core Metadata Best Practices Version 2.1,* available on the CDP Web site.

7. Guidelines for Creating Digital Audio

7.1. History of Audio Recording Devices

Audio recording began in 1877 with tin foil on a cylinder, which was commercialized with the introduction of the wax cylinder recorder by Thomas Edison. Since that time audio recording devices have gone through a series of technological advances. Commonly encountered recording media are summarized below. Please refer to the *Resources* section for links to more detailed information.

Format	Description	Years in Use
Wax Cylinder Records	About 2 - 4 minutes, wax or wax compound	1877 - 1929
Recordable Disc Records (Direct or Acetate Discs)	7, 12 or 16" recorded at 33 1/3 or 78. Generally vinyl on a paper, glass or metal base.	1929 - 1960s
Recording Wire	Spooled wire, usually in 15 - 30 minute lengths, one direction only.	c1945 - 1955
Open reel recording tape	1/4" - 2 inch, 3 - 10 1/2" reels, 15/16- 30 IPS (inches per second) speeds	c1945 - Present
Compact Cassette	1/8” tape in hard case. 1 7/8 IPS format (also 15/16 & 3 ¾)	1965 - Present
Microcassette / MiniCassette	Very small 2 – 4 cm cassette tapes.	1977 - Present
Digital disk,MP3 and other digital recorders	Audio recorded directly in digital files to optical disks or internal hard drives.	1984 – Present

It is possible to digitally reformat any of these audio materials. Audio quality will vary based on the type of device and the quality of the original recording, but with modern computer based audio editing software it is possible to “clean up” the audio within limits determined by the original audio quality and the software employed. A primary consideration in reformatting older audio formats is the limited availability of satisfactory playback devices and engineers knowledgeable with obsolete formats.

7.2. Modes of Capture

The transfer of existing analog audio to digital media is, in its simplest form, a basic process. The computer hardware and software required for digital reformatting are readily available and decreasing in cost as the technology advances. The end result is audio in a format not prone to signal loss or the generational degradation of analog audio formats.

Since most of the commonly encountered recordings exist on either audio cassette or open reel tape, those formats will be addressed primarily. However, the processes described are applicable to any analog audio format, assuming that the proper playback equipment is available.

Before beginning any tape conversion project the condition of the original materials should be checked to make sure they will not be damaged in the conversion process. Magnetic tape is made up of two layers: the base and the binder. The base is a strip of material on which an emulsion of ferromagnetic particles are held in a binder (“glue”) layer to make up the complete sound carrier. A very common problem with magnetic tape is hydrolysis. This is a condition in which the tape absorbs humidity from the air, over time, and causes the base and binder layers to stick together back to front. The result is that the tape becomes sticky and sheds material when it is played back in a recording machine. Hydrolysis can also cause the bond of the base and binder to detach and shed. This problem surfaces most often in polyester tape manufactured between 1972 and 1982, but can occur in any reel-to-reel tape, especially those which have not been stored properly.

If a tape has any signs of stickiness or shedding, consult with a conservator before proceeding. Be aware that recovery methods for hydrolysis are temporary and only serve to restore tape so that it can be duplicated or transferred. Sources for information on other common problems with original audio materials are included in the *Resources* section at the end of this document.

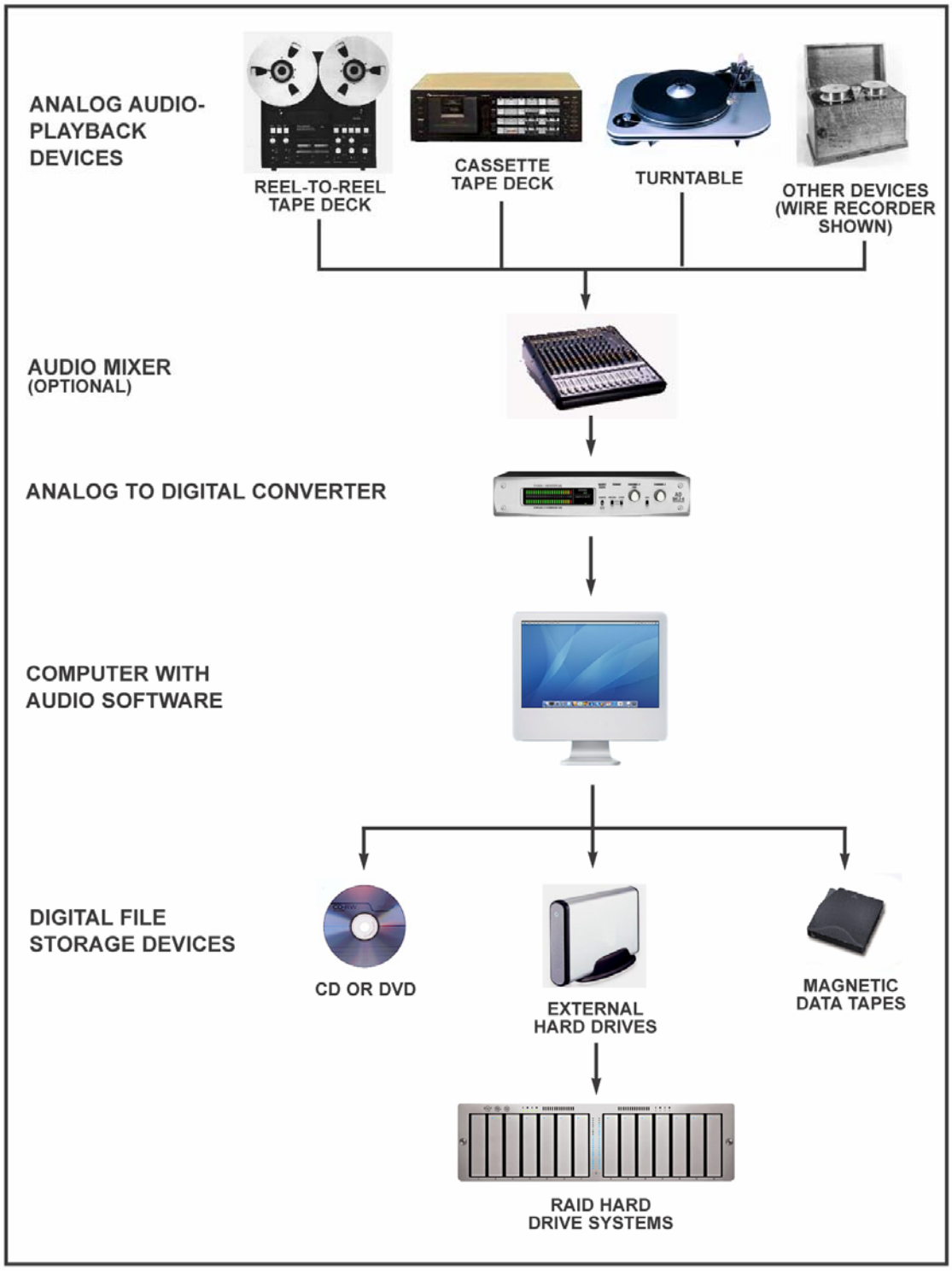
The basic digital reformatting process typically involves four devices: an analog audio playback device, an analog to digital (AD) converter, a computer to process the digital signal, and a device for digital file storage. A mixing device, such as an audio mixing board, can be utilized between the analog audio

playback device and the AD converter to connect multiple analog audio playback devices to the system. However, this is discouraged for preservation audio, as any additional device in the signal chain can negatively affect the audio signal.

Audio software programs, such as *Pro Tools*, *Sound Forge*, or *Adobe Audition* (formerly *Cool Edit Pro*), among others, allow the user to manipulate the audio files with processes like volume adjustments, tracking, equalization, noise reduction and compression, all methods to enhance the original sound or create surrogate files. For digital preservation efforts these methods are used sparingly, if at all.

Digital files can be recorded in many formats, with common examples being WAV, AIF and MP3 audio files. The primary issues to consider in selecting a file format are to select non-proprietary formats with a high potential for future readability, and uncompressed formats for maximum audio fidelity. Please note that WAV and AIF are uncompressed file formats, while MP3 is a compressed format. An additional consideration is, while in common use, WAV, AIF and MP3 are not open source file formats. Their specifications are owned by MicroSoft, Apple, and the Fraunhofer Institute..

The final step is to write the digital audio files to digital storage media. Commonly utilized storage media generally consist of a combination of CD/DVD; external hard drives, including RAID hard drive storage systems; and/or magnetic data tape backups.



Common components of a modular audio digitizing system

7.3. Sample Rate

As previously described, the selection of a sampling rate is one of two critical factors in determining the audio fidelity of the digitally reformatted audio.

The two acceptable choices for sampling rates are 96 kHz and 44.1 kHz. The 96 kHz sample rate is rapidly being accepted for archival preservation standards. If resources are not limited – in particular, if computer processing power, staff time, and digital storage space are not limited – then we recommend adhering to the 96 kHz standard for preservation master files.

For institutions that are limited by funding sources for digital storage, staff, or computer processing resources, we recommend that a sample rate be selected based on an analysis of the audio qualities of the analog materials. These factors relate to the frequency ranges of the original audio material, and also relate to the source type of the original audio. For example, it may be appropriate to use higher sampling rates for high quality music sources and lower sample rates for lower quality source materials such as oral history voice recordings. The nature of source types is addressed in more detail in Section 6.6

7.4. Bit Depth

The selection of a bit depth is the second critical factor in determining the audio fidelity of the digitally reformatted audio. In general we recommend adhering to the current professional standard 24 bit depth.

However, 24 bit audio files are not playable on many consumer audio devices, requiring an additional step for conversion of 24 bit files to16 bit files as user copies. Therefore, exceptions to the 24 bit standard could be made in cases where institutional resources are limited. Limiting resources could include, but not be limited to, the lack of adequate storage space required for larger 24 bit files, or the lack of adequate staff and/or equipment to create re-sampled user copies, or the use of CD audio disks as the only storage format.

The charts on the following pages summarize the pros and cons of bit depth and sample rate selections, and file storage requirements for each selection. A Microsoft Excel calculator is available in the Digital Toolbox on the CDP Web site to assist in performing calculations for storage requirements for your particular selections.

Comparison of Pros and Cons of Sample Rates and Bit Depths

	Sample Rate	Bit Depth	Pros	Cons
Minimum	44.1 kHz	16 bit	No file format conversion needed for Audio CD. Maximizes storage space. Appropriate for lower quality source files. Lowest level of processing time. Ubiquitous home audio standard. International standard for Compact Disk (Red Book Standard)	Lowest frequency range acceptable. May not provide sufficient quality for future formats. May have limitations for publication or broadcast, and migration to future digital formats. Limits ability to enhance source file for delivery.
Recommended	44.1 kHz	24 bit	More accurately reproduces sound of source material. Increased capability to enhance source file for delivery. Increased dynamic range. Acceptable for publication and broadcast. Reflects current professional audio standards.	

Optimal	96 kHz	24 bit	Standard for DVD/HD Audio. Increased frequency range. More accurately reproduces sound of high frequency, high quality source material, such as musical recordings. Increased potential for enhancement of source file for delivery. More potential for future applications. Potential recommended benchmark for future. Highest recommended current quality. Rapidly growing acceptance. Reflects emerging professional audio standards.	Increased storage space. Increased processing time. No perceptible improvement in sound quality for some source files. Requires conversion to 16 bit and 44.1kHz for delivery on Red Book Audio CD. May require frequency compression for delivery.

Sample Rate kHz	Bit Resolution	No. of Channels	File Size Megabytes	File Size Gigabytes
44.1 kHz	16	2 (stereo)	591 mb	0.59 gb
44.1 kHz	16	1 (mono)	296 mb	0.30 gb
44.1 kHz	24	2 (stereo)	887 mb	0.87 gb
44.1 kHz	24	1 (mono)	444 mb	0.44 gb
96 kHz	24	2 (stereo)	1931 mb	1.93 gb
96 kHz	24	1 (mono)	966 mb	0.97 gb

This table represents the file sizes for 1 hour of digitized audio at different sample rates and bit resolutions.

7.5. Source Types

As previously discussed, considering the source type of the original sound can also be helpful in making decisions related to sampling rates. Frequency ranges of various types of sounds can vary greatly. Considering these frequency ranges can be helpful in selecting either the 44.1 kHz or 96 kHz sampling rates. Remember that the range of frequencies recorded for each sampling rate is one half the rate, either 22.05 kHz or 48 kHz, and that the 96 kHz sampling rate will require more than double the storage space of the 44.1 kHz sampling rate. Following are some recommendations for basic source types:

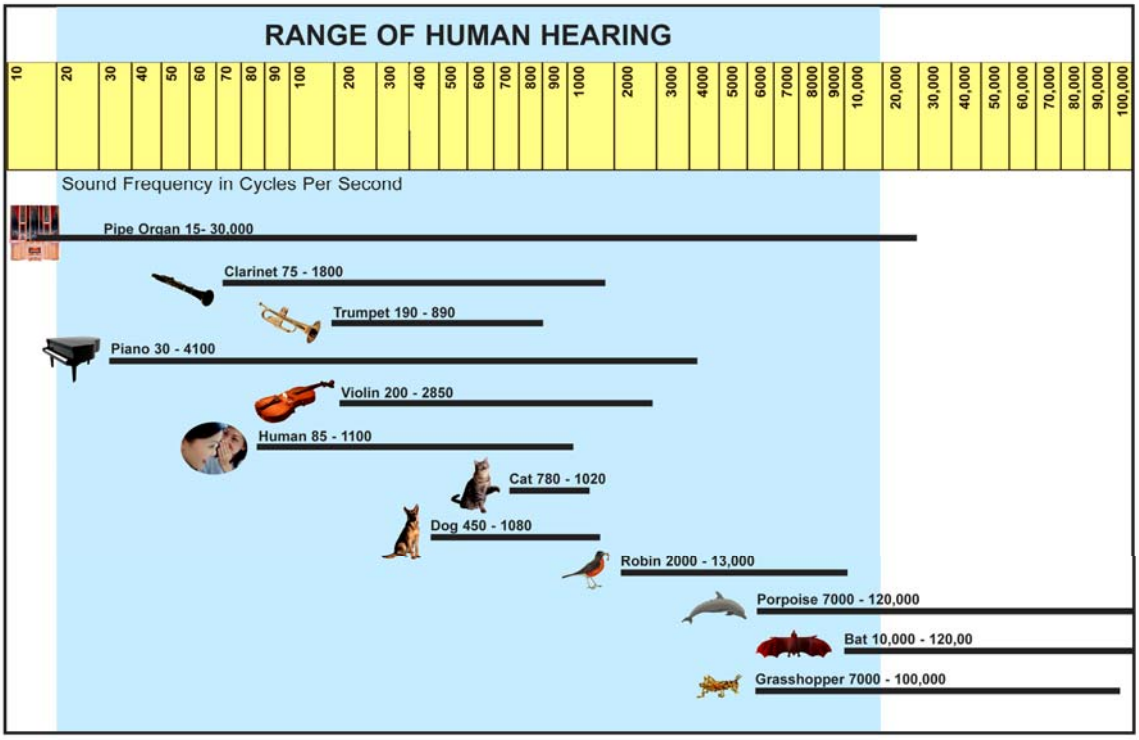
Spoken language: Virtually all human voices fall within the 50hz-20kHz frequency range, so the recommended sampling rate for spoken language is 44.1 kHz.

Field Recordings: We are generally referring to spoken language recordings occurring in the field, so the recommended sampling rate is, again, 44.1 kHz. For field recordings that include music, or wild sounds such as insects, birds, or other natural sounds, the 96 kHz sampling rate should be considered.

Musical Recordings: Musical instruments produce a wide range of frequencies, some above the 22.05 kHz capabilities of the 44.1 sampling rate. Although 44.1 kHz may be more than adequate for many musical recordings, in general we recommend the 96 kHz sampling rate, which will record frequencies up to 48 kHz, and provide additional information that may be useful during audio processing.

The following illustration may be used as an additional guide for matching source types to appropriate sample rates. This chart shows the frequency ranges of a few sound sources in relation to the range of human hearing. Please note that the frequency ranges on the chart are being used for comparative value of the fundamental source sound, and do not account for higher-frequency overtones that contribute to the full (or actual) sound we hear. Therefore, for the best reproduction, it's crucial that sounds be recorded at a minimum of 44.1 k to catch all frequencies within the normal range of human hearing.

Frequency Ranges of Selected Sound Sources



This chart shows the frequency ranges of a few sound sources in relation to the range of human hearing (shown in blue). Please note that the frequency ranges on the chart are being used for comparative value of the fundamental source sound, and do not account for higher-frequency overtones that contribute to the full (or actual) sound we hear.

7.6. File Types

As with other digital media, a number of file types are in use for storage of digital audio files. In selecting a file type it is important to consider the universality of the file type, and thus its readability by a variety of software programs. File types that are proprietary and at risk of obsolescence or lack of support should be avoided. File types that compress the audio file should also be avoided for preservation masters.

The WAV file type was developed by Microsoft, is in widespread use, and is readable by virtually all audio software programs. The AIF file type was developed by Apple Computer and is also in widespread use. Both of these file types are uncompressed and acceptable for long-term file storage. The WAV file type has become a standard and is recommended. In addition, the WAV file type is also available in a professional flavor, broadcast WAV (BWF), which has the

capability to store metadata in the file header. Although not all audio software programs are currently capable of reading or writing to the metadata header, the BWF format is emerging as the WAV file type of preference for archival audio projects.

With the emergence of compact hand-held digital recording devices, a number of other formats have become very popular. The MP3 format has become the file type of choice for many applications requiring downloads or uploads to the Web. This format has the advantage of being highly compressed for electronic transfer, but also has the disadvantages of compressed formats. Other popular compressed formats include Windows Media, and Real Audio and Quicktime for streaming downloads. Caution should be taken to avoid the proprietary formats of many of the hand-held media players. Reconstituting compressed files to WAV or AIF files for long-term storage is recommended. Although compressed file types are ideal for Web applications, none are recommended for long-term storage.

7.7 Digital Audio Toolbox

The selection of the proper equipment for digital transfer should be made with quality and not price in mind. The purpose of the Digital Audio Toolbox is to provide a basic level of familiarity with the hardware necessary to create a digital audio workstation (DAW). We do not endorse particular brands, but will mention them in cases where key equipment is nearing obsolescence and has been discontinued by the manufacturer. Furthermore, the largest expense in a digitization project will be labor and not hardware. The engineers doing the reformatting should be provided with equipment appropriate to the job.

Much of the equipment required for playback of analog audio recordings may be difficult to find, and likely only available through used equipment outlets. For assistance in locating this equipment, and in learning its operation, we recommend taking advantage of all available local resources. Sound engineers at local radio stations may be very helpful, as well as other local audiophiles or music collectors. It may be necessary to consult the phone book, make calls, or simply find local experts through word of mouth. You can also contact national experts by consulting the Web site for the Association of Recorded Sound Collections. http://www.arsc-audio.org/, or the Society of American Archivists Recorded Sound Roundtable, www.archivists.org

Of course, it is also possible to purchase quality used equipment through a number of online resources. Quality equipment can be found through on-line auction sites, but buyer beware. If you're not experienced with this type of equipment it's very possible to make a poor purchase.,If you are unfamiliar with the equipment we recommend that you consult audio experts before making significant purchases. After purchase, all used equipment should be

professionally inspected and maintained before use, and maintenance should continue on a regular timetable.

Reel-to-reel Tape Decks

Most systems for recording open reel tapes are either monophonic -- one track in each direction -- or stereo -- two tracks in each direction. It is important that the proper machine is selected with this in mind, as monophonic machines will give inferior reproduction of stereo tapes, with the separation of the two channels being lost, and stereo units will sometimes lose part of the audio information due to the space normally present between tracks. In the absence of a mono deck, the problems created in playing back monophonic recordings on stereo decks can be corrected by duplicating the mono track on the second stereo track using computer audio editing software.

Also, the proper speed must be determined. Modern open-reel consumer decks play back at 3 inches per second (IPS) and 7.5 IPS, whereas many older machines also can play at 1 7/8 IPS, a common speed for many oral history recordings. Professional units often only play back at 7.5 IPS and 15-IPS. Many older recordings will need to be played back on vintage equipment, if only to achieve the correct speed. Tapes played at improper speeds will be quite apparent, either exhibiting the slow dragged-out voices many of us have heard in improperly played recordings, or the fast squeaky pitch of a recording running too fast.

It is important to recognize the difference between consumer grade and professional grade tape decks. Ampex, Otari and Studer were popular manufacturers of professional reel-to-reel tape decks. Semi-professional and home decks were manufactured by Revox and Tandberg, among others.

Reel-to-reel tape decks require specialized maintenance and periodic alignment. Ideally, decks should be aligned for each tape and operators should be trained to properly adjust levels, and to adjust tape deck playback alignment and azimuth. In addition, decks and recorded tapes vary in their track configurations, and it is important to match the track configuration to that of the original recording. To determine the track configurations of reel-to-reel tape decks a product such as Magnaview may be used to visualize the recorded tracks. Common track configurations are 1/2 track, mono or stereo, and full-track, mono or stereo.

Cassette Tape Recording Decks

Although most cassette tapes are recorded at the speed of 1 7/8 IPS, some half-speed, and even double-speed, examples do exist. Also, cassette decks are subject to the same restrictions concerning mono versus stereo reproduction. Almost all portable decks prior to modern boom boxes are monophonic. Like open-reel tapes, the problems created in playing back monophonic recordings on stereo decks can be corrected by duplicating channels in computer audio software.

Also, as in open-reel decks, It is important to recognize the difference between consumer grade and professional grade tape decks. Pro decks will include a great deal of adjustability, including tape tension and head alignment adjustments, which are important due to the small track width on cassette tapes, as well as the wide range of misadjusted machines that may have been used to create the original recordings. Some popular manufacturers of professional cassette decks are Nakamichi, Teac, Tascam and Sony.

Turntables

Turntables are used to play audio most commonly recorded on 33-1/3 rpm (revolutions per minute), 45 rpm and 78 rpm vinyl disks. Early disks were also manufactured with other materials. With the recent resurgence in the popularity of the “DJ,” turntables have become widely available. Special attention should be paid to the quality of the cartridge, and other features such as the availability of weight, tracking and skating adjustments, affecting the performance of the tone arm. Other factors to consider during playback include proper adjustments for speed, centering, equalization and stylus selections. Many high-end models are currently available.

Mixers

Mixers are optional devices that can serve multiple purposes. They can be used for “equalization,” or adjusting the input levels on multiple channels. In systems requiring multiple inputs, such as a combination of tape decks, turntables, etc.,

the mixer can be used to connect all of the devices to a single input into the computer's analog to digital converter. Grace Designs manufactures a professional mixer but does not offer a console, as shown above. Beringer, Mackie, and Sabine all manufacture a number of popular low end models. Please beware that the path from the source audio to the A/D converter should be as direct as possible, so avoiding a low end console, especially a very inexpensive one, will yield the best results.

Analog to Digital (A/D) Converters

The analog to digital converter is a key hardware component. The quality of the digital signal from the A/D converter to the computer system is a key factor in the quality of the digital audio created. In general, external A/D converters are recommended, although internal sound cards are rapidly evolving. Low cost sound cards may, however, introduce noise into the audio system. External A/D converters will isolate this noise from the system. When purchasing an A/D converter pay special attention to the technical specifications. In particular, note the noise levels, shown in dBs, the sampling rates, shown in kHz, and the bit depths. All high quality A/D converters will include, minimally, both 44.1 kHz and 96 kHz sampling rates, as well as 16 and 24-bit depths.

Computer Systems

Many different computer systems can be utilized for a digital audio workstation. Virtually all computers currently marketed can be connected to an A/D converter through a sound card, or USB or Firewire (IEEE 1394) ports, and a variety of excellent audio software is available for both the Windows and Macintosh operating systems.

Two key specifications to consider in purchasing a computer for a DAW are the processing power of the computer and the quantity of RAM installed. As in all high-end computer applications, more is better. A 1 gHz processor and 640 MB of RAM is a minimum requirement. A 3-4 gHz processor with 1-16GB of RAM will show a considerable improvement in performance. If your audio software supports multiple processors, then you can benefit considerably from dual processors, or "dual core" chips (the equivalent of two processors on a single chip), especially when performing tasks that require file processing or rendering.

Working files should be stored on a separate external hard drive, with a minimum size of 40 GB recommended.

Because audio editing software requires considerable power, and can be affected in negative ways by other computer applications, it is recommended that the DAW be a stand-alone machine with no other programs running during the digitizing process. Virus protection and back up programs can be particularly problematic. It is also recommended that the DAW be disconnected from any Web or network connections.

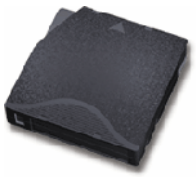
Monitors, Headphones, Microphones and Cables

It is important that the audio technician be able to accurately *hear* the quality of the sound as it is digitized and played back through the audio workstation. For this reason, a good pair of professional headphones and/or studio quality monitors (speakers) are another critical component of the system.

If the DAW is used for recording as well as digitizing functions, then a high quality microphone is a necessity. For high quality recording a high quality microphone, and possibly a microphone preamp, will be a critical factor in the final sound quality. Good microphones can now be found at relatively low cost, and if costs are critical the preamp included in your audio interface should prove adequate. Microphones that cost $1000 just a few years ago can now be purchased for under $300. There are a number of major brands with good track records, including Shure and AKG. (For example, the Shure SM58 is a durable and forgiving, tried-and-true microphone, used by many musicians for years, for under $150.) For voice recordings, clip on lavaliere microphones will yield good sound.

Cables are a component of the DAW that are often overlooked but can make a drastic difference in audio quality. Inexpensive cables can be microphonic, picking up noise and introducing it into the system. Quality cables will include shielding, non-oxygenated copper, and gold-plated connectors. Price is generally an indicator of quality. High quality cables are a good investment.



Digital Storage Devices are discussed in Section 8: Storage and Preservation

Software

A digital audio workstation may utilize a number of software programs. The primary program is the audio editing software, used to import the audio files into the system, and to make adjustments to the audio signal for optimal recording. Levels should be set carefully. If the levels are set too high, then overload and distortion will result. If the levels are set too low, then noise will intrude. A good meter, either in the A/D converter or the workstation, is essential. Recording levels should be set so that the highest peaks come to within a couple dB of '0'. Ideally, recording levels should be set individually for each recording.

Audio software can also be used in the creation of "optimized" listening copies – digitally enhanced files with volume levels adjusted and "normalized" across stereo channels; silent gaps deleted; noise reduction accomplished to eliminate hiss and hums; and more. Some commonly used programs are *Pro Tools*, *Sound Forge*, and *Adobe Audition* (formerly *Cool Edit Pro*), but there are many others. Please refer to the *Resources* section for additional information on audio programs and their functionality.

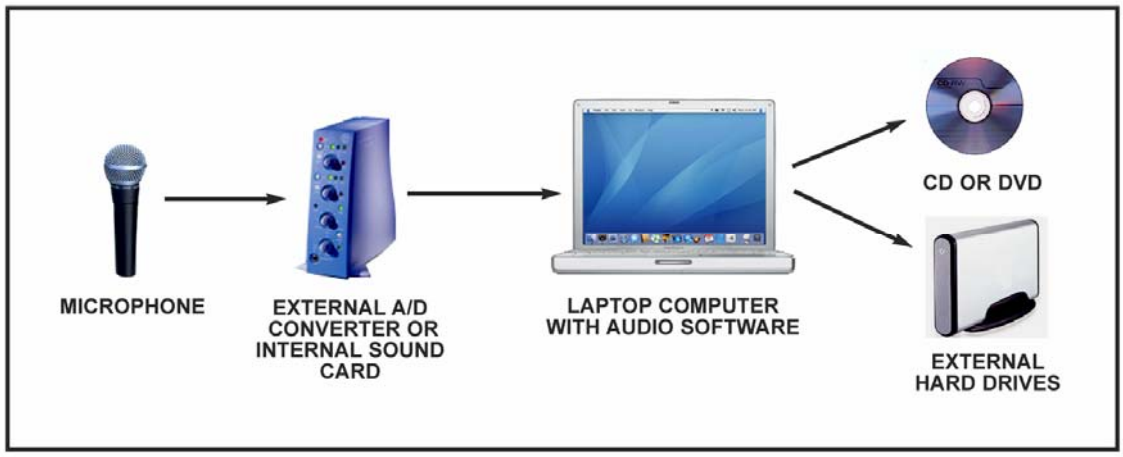
If you choose to store your files on CD-Audio discs, then a program to write the files to CDs may be required. Many lower end programs, such as *iTunes, Audition, Logik, and SoundForge* will perform this conversion automatically during the disc writing process.For converting your files from 24-bit master files to 16-bit files playable in common audio players, or for converting WAV files to compressed MP3s or other formats for download from the Web, a file conversion program will be required. There are a number of such programs available, most of which allow mass file conversions in batches. In addition, much audio and other related software is available as Freeware. Additional information related to these types of software is listed in the *Resources* section as well.

7.8 Born Digital Recording

With rapid advances in digital audio technology the phenomena of "born digital" recording is gaining ground. There are many advantages to recording with born digital systems, including the excellent sound quality of the high-end systems, and the capability to make digital audio files immediately accessible. As in the process of converting analog audio to digital, we recommend a tiered approach to born digital recordings, which should also keep in mind all of the previous recommendations related to sampling rates and bit depths.

Three types of born digital audio recording systems have emerged into the marketplace in the past few years, each with strengths and weaknesses. At the high end are modular systems that typically employ a laptop computer with CD/DVD writer; external compact AD converter that may also serve as a mixer, or a high quality internal sound card; hard drives for storage of files; and

microphones or other input devices. Mid-range systems are self-contained units with all of the components housed in a single case, primarily marketed for on-site recording and audio CD production at music venues, or more recently, for podcasting. Low-end systems are typically small hand-held recording devices, although Nagra and Sony both make hand-held devices that yield mid-range results.



Common components of a modular born digital recording system

The modular high-end system is recommended for archival born digital recordings. These have the advantage of recording at both 16 and 24-bit depths, at 44.1 or 96 kHz sampling rates – providing the highest quality audio of the born digital systems; serving as an audio editing workstation with software that can be easily updated; being easily updated with new hardware due to their modular nature; and may also serve as a separate computer workstation in the field. Disadvantages are their high cost and bulk; they require expertise for assembly, operation and maintenance; and they may have an affect on subjects due to their professional appearance.

We offer a few words of additional advice on internal sound cards for modular systems. Although we are hesitant to recommend these at this time, we recognize that this technology is changing rapidly and a number of satisfactory internal sound cards have entered the marketplace. If you choose to employ an internal sound card in a modular system we recommend the selection of a card that is specifically designed for audio capture, as opposed to cards employed for many gaming applications, designed primarily with audio playback in mind. Specifications for particular attention include sampling rates, bit depths and software compatibility.

Mid-range integrated recording systems have the advantage of being smaller self-contained systems that include recording functions in a single case, many with CD writing hardware; are turnkey systems that require minimal setup; and are less expensive than modular systems. Their disadvantages are that they may offer limited sampling rates and bit depths, most recording only at 16-bit depths; may store files on portable proprietary media; and the hardware and software cannot be updated. Please note that at the time of this writing mid-range recording technology is advancing rapidly, with high sample rate and high bit-depth recorders in development and being released into the marketplace, with accompanying developments in storage media.

Compact hand-held digital recording devices are not recommended for born digital recording. They have many disadvantages, including the storage of files in compressed, often proprietary formats; built-in microphones that users often employ may be very low quality; they are prone to rapid obsolescence; and their sound quality cannot compare to the high-end or mid-range systems. Their advantages are that they are inexpensive; small and very portable; require no setup time; and are easy to learn. This said, we understand that the use of these devices has become very widespread. In cases where recordings are received from these devices it is highly recommended that all files be converted immediately to standard WAV or AIF files, which should then be integrated into the organization's standard digital storage system.

8. Outsourcing Audio Reformatting

It is often not practical for a cultural heritage organization to digitize its audio collections in-house. Audio digitization equipment is specialized and can be expensive, and the technical expertise to create acceptable digital audio master files and derivatives may not be available. This is especially true if the materials to be digitized are fragile, deteriorated, or are recorded on rare or unusual media. For small to medium-sized audio digitization projects, or projects involving materials needing special handling, it will likely be more feasible to contract with a third party experienced in digitizing audio materials.

Managing an outsourced project involves monitoring the schedule, the budget, and the quality of the products created by the digitization vendor. The process has to be flexible, but also has to conform to schedule, budget, and quality constraints. For more information on outsourcing audio digitizing projects, please refer to the supporting document *Guidelines for Outsourcing Audio Reformatting.*

9. Quality Control

Quality control is an important, and sometimes overlooked, issue. The simple recommendation for quality control of digital audio is to just listen to it, but this may be easier said than done. The fact is that human ears exhibit great variations in what we hear, but our ears *can* be trained to hear better, especially if we know what to listen for. And this is also greatly aided by using a good set of professional headphones.

All digitized audio files should be sampled for sound quality. Technicians charged with quality control should listen for consistency in the audio quality at a number of points in the recording, listening for distortions in the sound, for proper playback speeds, and for artifacts such as hiss and hum. Technicians should specifically check that the volume levels are set correctly. Recordings should also be checked for completeness. Any distortions in the sound or other inconsistencies in the recordings should be noted in the metadata. Metadata should also be checked for accuracy and completeness, with special attention paid to accuracy of file names, which can lead to the effective loss of files when recorded inaccurately.

In addition, file integrity checks may be conducted. A “checksum” may be associated with a file when it is produced so that the checksum value may then be used to confirm the integrity of the file at each step from creation to migration. A checksum is an algorithm-based method of determining the integrity and authenticity of a digital data object, such as a digital audio file, used to check whether errors or alterations have occurred during the transmission or storage of a data object. Please note, however, that a checksum will only tell you there *is* an error. It cannot tell you what the error is, nor can it correct the error.

It is important to understand that quality control of audio can be a very subjective process. It is recommended that technicians performing this process be selected on the basis of their familiarity with a variety of types of recorded sound, and preferably have experience in a field that has already helped train their ears. Staff with previous audio experience such as audio engineers, are a natural selection, as are staff with formal musical training.

10. Storage and Preservation of Digital Audio

The significant resources institutions devote to the creation of digital collections has increased awareness of the need for careful planning for their storage and long-term preservation. Successful digitization projects should include planning and documentation for the responsible sustainability of these collections.

The process of transferring recorded material to digital media is usually approached from an archival standpoint. This means that every effort is made to transfer the material exactly as it appears on the original media without any sort of alteration, creating as 'exact' a copy of the recording as possible. This approach is recommended particularly in cases where the original recording is in danger of destruction, as might occur in a fragile transcription disc or wax cylinder.

Systematic file naming is important for system compatibility, interoperability, and to demonstrate ownership of the digital asset. File naming conventions specific to an institution may be used. These might include protocols that include institutional acronyms, collection identifiers, or part designators, among others. In general it is recommended that the characters in the file names be alpha-numeric, lowercase, and not utilize spaces, tabs, commas, periods or any other characters reserved for computer system use, such as slashes, asterisks, or question marks.

It is highly recommended that organizations utilize a strategy employing multiple redundant copies of digital files in separate locations, as a fail-safe strategy for the failure or destruction of the digital media. Acceptable media may be optical disks, hard drives, or magnetic data tapes – all of which have particular strengths and weaknesses.

Optical Media Storage

Optical media carriers include CD-R (Compact Disc – Recordable) and DVD-ROM (Digital Versatile Disc – Read Only Memory). Additionally, CD-Rs are available in two "flavors," CD-ROM (Compact Disc – Read Only Memory) and CD-DA (Compact Disc-Digital Audio). All employ a laser to read data from a metallic or dye coating over the disc, with a clear acrylic coating covering the recording layer for protection. Optical discs are a popular medium for transporting files and as a publication medium. Their integrity for storing digital masters is currently a matter of debate, primarily due to concerns about their longevity.

Issues of cost, convenience, speed of retrieval and security all factor into decisions regarding optical discs as a file storage and retrieval medium. It is recommended that digital assets be stored on CD-ROMs that conform to ISO 9660, the 1988 standard for volume and file structure of CDs for information interchange. Note, however, that CD-DA has also found a very strong place among machine-readable records.

Optical discs can provide a relatively low cost storage medium, but they can incur significant costs for accessing and managing the digital assets stored on them. These costs are related to slow writing and reading speeds that can be a burden on both staff and equipment, and costs associated with managing and migrating collections of discreet objects. Storage and retrieval costs will escalate as CD collections become larger and more challenging to manage. Digital collections stored on CDs may work well for small collections, but using this media as a long-term solution can present major challenges.

CDs have a limited physical life span and the files stored on them are vulnerable due to physical deterioration, mishandling, improper storage and obsolescence. Studies have indicated that the physical lifetimes of the media to range anywhere from 3 to 20 years, and obsolete equipment for reading the media poses a threat in the long term. Proper conditions can prolong the life of the discs, with optimal environmental levels at 72° Fahrenheit with a relative humidity between 20 and 50 percent.

Both adhesive labels and permanent ink markers can cause early failure of CDs through chemical interaction with the CD's recording layer. Best practice is to not write or label CDs directly on the body of the CD. Some projects have placed small identification numbers in the central plastic hub of the CD, and some more long-lasting brands of gold and silver CDs are manufactured with individual serial numbers.

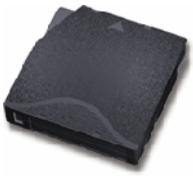
Projects considering CD-Rs for storage of master files should pay attention to the burning speed of the media they purchase and the maximum speed of the CD burner. Like the hardware used to create them, CD-Rs have a maximum burn speed that should not be exceeded even if the hardware is capable of higher speeds. Projects should also use the verification utilities in most CD burning software to ensure that there are no errors in the disks. Burning multiple copies of CDs from master files rather than copying a previously burned CD also decreases the possibility of introducing errors.

Hard Drive and RAID Storage

Storing digitized audio “live” on hard drives is a viable option for those wishing to store digital audio on a stable platform that offers sustainability, easy storage and retrieval, and ease of migration to new media. To prevent the loss of data, projects need to properly configure hardware and software, develop responsible backup and disaster recovery policies and procedures, and create realistic plans to deal with technological obsolescence, and plan migration to new media as drives reach their natural lifespan.

Hard drive systems may be configured with a distributed system of individual hard drives, or RAID arrays may be utilized. RAID arrays (Redundant Array of Independent Disks) are self-contained collections of disk drives that act as a single large hard drive storage system. These configurations are designed to enable a system to operate when an individual drive within the array fails, thus minimizing and ideally eliminating the potential for the loss of data. Currently, there are ten types of RAID configurations. Each configuration has its own unique strong and weak points. Some configurations are best suited for rebuild speed, some are designed to maximize disk capacity, and others are well suited for fault tolerance. In general, the better choices are RAID 5, 6 or 10.

Hard drive storage systems may be maintained locally by organizations with technical expertise on staff, they may be maintained by an organization’s IT department; or hard drive storage may also be outsourced to local vendors. Projects considering outsourcing should consider the costs of ingestion and ongoing maintenance fees; metadata requirements for outsourced files; workflow requirements; and accessibility requirements.



Magnetic Data Tape

Magnetic data tape has been the tried and true backup of choice for years by corporations storing massive amounts of data. Data tapes, properly stored and handled, have proven to be an extremely durable, economical and reliable backup medium. For archival purposes they are commonly used as the medium of choice when all other media fail.

Like analog audiotape, magnetic data tapes are prone to wear and tear, and the effects of improper storage. Additionally they depend upon the availability of tape playback devices, and more importantly, most are dependent upon proprietary software programs to retrieve the digital data from the tapes. Generally data tapes are not used for frequently accessing files, as they do not have the random access capabilities of hard drives or CDs – that is, they must be cued to a point in the tape to retrieve data. However, as the final stage in a fail-safe system magnetic data tapes should be considered.

Refreshment and Migration

Regardless of which storage technique your project chooses, migration of files to new media is one of the most important aspects of a sustainable project. Migration is the transfer of digital files from one storage medium to another, to ensure that the files remain retrievable as technology advances. Do you still have floppy disks with files that you cannot retrieve because you do not have a computer with a floppy drive? Obsolete digital media is a common occurrence and will continue to be an issue as computer technology evolves. Software obsolescence is also an important issue, as the longevity of the storage media may not be as important as the ability to access the information. To avoid this problem in the future, transfer files to new media as it becomes widely available. Considering the amount of time and money invested in your digitization project, it is worth the effort and cost to migrate your files frequently, and at the very least every five years. Failure to incur these small incremental costs may lead to very large costs down the road when you need to migrate from an obsolete data format or medium.

At the time of migration file integrity checks should be conducted. As previously noted, a “checksum” may be associated with a file when it is produced so that the checksum value may then be used to confirm the integrity of the file at the time of migration.

Every sustainable digitization project should include the costs of data migration as a yearly budget line item.

11. Delivery of Digital Audio

Once digitized, institutions have the option of delivering the audio files through the Web for listening or downloading, and/or they may want to provide delivery to onsite patrons. Institutions should consider the needs of their user groups before deciding upon delivery options, which could result in adopting both the Web and a public terminal computer that can play compact discs, WAV or MP3 media files.

11.1 On-site Delivery

For public listening stations, think in terms of disposability: public units suffer much wear and tear. Generally purchasing and maintaining a computer is more costly than “personal” style CD/MP3 players available at discount stores for less than $100 per unit. A good unit will come with a power supply and headphones, and will also have a display capable of showing some of the basic text metadata embedded into the MP3 files.

For personal computers, a variety of equipment is necessary to listen to the digital files, whether the patron is accessing the audio from a CD or via a link from your online catalog. Headphones generally provide the most manageable way for patrons to listen to the audio without interrupting other users, and patrons will need access to a software panel to control the volume of the audio.

- Hardware: each audio workstation requires a sound card or built-in sound capabilities or an external interface, CD-ROM drive, a network connection of some type -- for audio accessed via a local network or the Internet -- and headphones.
- Software: each workstation should have a software audio player such as Windows Media Player (which doesn’t support 96 kHz files) (http://www.microsoft.com/windows/windowsmedia/), iTunes (http://www.apple.com/itunes/), RealPlayer (http://www.real.com), etc., that is capable of playing a wide variety of audio formats including CD audio, MP3 files, and streaming media.

11.2 Online Delivery

It is important to note that the needs of your users should drive the technology decisions, and not the other way around. It is also important to consider the technology support that is available from your institution, but the needs of your users should drive format decisions. If support is not available internally, consider outsourcing or partnering with another organization that can support the desired format. There are presently two predominant ways of distributing audio via the Internet: downloading and streaming.

Streaming Audio is available in a number of proprietary formats, including

Real media (http://www.real.com),
Windows Media (http://www.microsoft.com/windows/windowsmedia/),
QuickTime (http://www.apple.com/quicktime/)
And others.

To provide streaming media, an authoring package, available through one of the above vendors, is needed to prepare the audio for streaming, as is the server

software and hardware capable of providing the number of simultaneous "streams" users will demand. Specific server hardware specifications will be determined by the software vendor. Although there are shortcuts to providing streaming media and some institutions skip the "streaming server" route and simply make the files available as simple downloads, be sure to consider the needs of your users when making server decisions.

Downloading the complete audio files is the simplest way of making your audio files available over the Internet, perhaps as MP3 files. By making the files available as a download, access is needed to a basic Web server -- either in-house or via an Internet Service Provider -- but no other special server hardware or software requirements are necessary. The primary requirement will be adequate server bandwidth to meet the needs of your users, and adequate disk space to store the audio files.

11.3 Podcasting

Although downloading audio files over the Internet has been available for years, the explosion of portable media players—particularly Apple's iPod—that allow users to play files at their convenience, has created a demand for online distribution of audio files.

A podcast is simply an audio recording posted for download, and can be coupled with RSS (really simple syndication) to allow users to subscribe to desired Web content and automatically receive updates that are downloaded to portable music players or computers with media player software. More information on RSS is available at the RSS Specifications site (http://blogs.law.harvard.edu/tech/rss).

The breadth of available podcasts can be found through several online directories, including

Podcast.net (http://www.podcast.net),
Podcasting News (http://www.podcastingnews.com),
Podcast Alley (http://www.podcastalley.com),
iPodder (http://www.ipodder.org), and
Apple iTunes (http://www.apple.com/itunes/).

There are also several free software programs such as Doppler (http://www.dopplerradio.net) and iPodder to assist users to subscribe to, and download podcasts. Once the address of a podcast is located, the Web address can be added to a user's list of subscriptions. Apple also makes available, for free, its iTunes software -- available for both PC and Mac -- that handles searching, subscribing, and downloading of audio files (http://www.apple.com/itunes/).

12. Digital Audio Glossary

8-track: Tape cartridge invented in the early 1960's. Became popular because major automakers began including an 8-track player as an option in cars in the late 1960's. 8-tracks remained popular throughout the 1970s until overtaken by the cassette tape. For detailed history see http://www.8trackheaven.com/early.html

AIFF (Audio Interchange File Format): Digital audio file format widely used with the Macintosh platform. AIF format is Windows-compatible.

Analog: Analog transmission is a method of sending signals in which the transmitted signal is a wave of reflection similar ("analogous") to the original signal.

Audio restoration: The process of restoring an audio source to its original form on a different medium (e.g. transfer of data on a cassette tape to a compact disc).

Bit: A bit is the smallest unit of data in a computer. A bit (binary digit) represents 0 or 1 to the computer. 8 bits make a byte. In PCM each bit is defined as 6dB.

Bit depth: In digital audio, bit depth describes the range of numbers used to represent each amplitude measurement of a sampled sound wave. In general, the more bits that are available, the more accurate the resulting output from the data being processed. From http://whatis.techtarget.com/definition/0,289893,sid9_gci213497,00.html

Born digital audio: Audio recordings created with digital computer recording systems, with no analog media involved in any stage of the recording process.

BWF: File extension for Broadcast WAV File, a professional, open source WAV file type with a clearly defined metadata area in the file header (See also WAV)

Cassette: Audio tape format introduced by Philips in 1962 as the "compact cassette." The format rose to popularity in the late 1970s and early 1980s.

Checksum: An algorithm-based method of determining the integrity and authenticity of a digital data object, such as a digital audio file, used to check whether errors or alterations have occurred during the transmission or storage of a data object.

Codec (compressor/decompressor) algorithm: As the name implies, codecs are used to encode and decode (or compress and decompress) various types of data--particularly those that would otherwise use up inordinate amounts of disk

space, such as sound and video files. Common codecs include those for converting analog video signals into compressed video files (such as MPEG) or analog sound signals into digitized sound (such as RealAudio or MP3). Codecs can be used with either streaming (live video or audio) or files-based (AVI, WAV, QT.) content. From http://www.cnet.com/Resources/Info/Glossary/Terms/codec.html

Compact disc: A compact disc (CD) is a medium for optically recording, storing, and playing back audio, video, text, and other information in digital form. CDs have generally replaced cassette tapes and LPs for playing back music. Initially, CDs were read-only, but newer technology allows users to record as well. CDs will probably continue to be popular for music recording and playback. A newer technology, the digital versatile disk (DVD), stores much more in the same space and is used for playing back movies. From: http://whatis.techtarget.com/definition/0,289893,sid9_gci507072,00.html

CD-ROM: CD-ROM (Compact Disc, read-only-memory) is an adaptation of the CD that is designed to store computer such as text , graphics or sound files. Philips and Sony defined the original data format standard. The physical format of the CD-ROM is the same as for audio CDs: a standard CD is 120 mm (4.75 inches) in diameter and 1.2 mm (0.05 inches) thick and is composed of a polycarbonate plastic substrate (underlayer - this is the main body of the disc), one or more thin reflective metal (usually aluminum) layers, and a lacquer coating. From: http://whatis.techtarget.com/definition/0,,sid9_gci211759,00.html

Compact disc book standards: These standards refer to the color coded books devised by CD manufacturers that address the types of data for encoding compact discs. For example, the Yellow Book (1988) standard covers CD-ROM and the Red Book describes audio CDs. CD-Rs are described in the Orange Book (See also Red Book)

Compression: The human ear's sensitive to any give sound varies. At different volumes we're more and less sensitive to high and low frequencies. Some sounds are inaudible in the presence of other sounds. Compression uses these "psychoacoustic" phenomenon to determine when a sound is "not needed", and therefore reduce the total amount of information (data) required to convey the essence of a recording: create smaller files that "sound like" the original. Compression can be lossy in that certain types of data are intelligently removed can cannot be recovered; or lossless in that no information is lost during the process.

DAT (Digital Audio Tape): DAT is a storage format for data or music, originally developed in the 1980's for music. Audio units and computers can use the same media but data is stored in the DDS format. DAT can be recorded on one side and is generally 120 minutes long.

Density: Density describes how tightly or loosely data is packed onto a storage medium. A higher density level means a device can store more data.

Digital: A description of data encoded in a binary format that is capable of being read or manipulated by electronic devices.

Digital audio data: This refers to sound that has been digitized into binary code. The code can be stored in a variety of formats (see: WAV, AIFF, MP3, WMA, QT, etc.)

Digital reformatting: The process of converting an item (physical, audio, or video) into a binary format capable of being read or reproduced by a computer (or, in the case of audio, a digital media player – CD player, iPod, etc.).

Error correction: The use of algorithms to correct corrupted data or blocks of data while receiving or processing.

Frequency: The rate or speed of a repeating sound wave (see Hertz). The rate at which something happens (see sample rate or frequency).

Gain: Audio level. Also referred to as volume.

Hertz: A measurement of periodic (recurring) occurrence. How fast something happens over and over. Measured in cycles per second (as in sound waves, sample rate for digitization, or clock speeds in computers).

IPS (inches per second): standard for measuring tape speed.

kHz: kilohertz: unit of measure representing 1000 hertz. kHz and mHz (megahertz) are often used to describe the bandwidth required to transport data.

MP3: MP3 is the file extension for audio files in MPEG Layer 3 format. MP3 files are tightly compressed but largely preserve the original quality of the recording. These files are small and travel easily via the Internet. MP3 audio files are popular not only because of size and playback quality, but also because a wide variety of players and downloadable audio files are available. See http://whatis.techtarget.com/definition/0,,sid9_gci212600,00.html

Print through: Print through is the process in which data is transferred to a new location through physical contact. This occurs primarily with magnetic tape. For example, data may transfer to a an adjacent layer on a tape that has sat idle for a long period of time. It manifests as an echo (“post-echo” if it occurs after the original sound), and, depending on which layer is printing through, the “echo” may occur before the actual sound (called “pre-echo”).

Red Book: Red book is the standard for audio compact discs, named after one set of color-bound books that contain the technical information on optical disc formats. The physical parameters and properties of the CD are specified in the standard, including the encoding of the digital audio file, error rates, modulation systems, channels and graphics.

Release forms: Release forms release the content of an audio recording to the owning institution or individual. Such forms should include a wide variety of details including the intended use of the recording and permissions to copy or reformat, distribute on the Web, etc.

RPM: Rotations per minute. Speed settings for turntables.

Sample size: Larger sample sizes reproduce higher quality sounds. See sampling rates below.

Sampling rates: The sample rate is the number of samples of a sound that are taken per second to represent sound digitally. The more samples taken per second, the better the reproduction of the sound. The current sample rate for CD-quality audio is 44,100 samples per second.

Sound card: A sound card is a board installed in a computer allowing it to play and manipulate audio files.

Sound Pressure/amplitude: Sound pressure levels are measured in decibels, notated as “dB”, and determine the level of volume created by a sound wave.

Streaming: A method of transferring data so it can be processed in a steady or continuous stream. RealAudio, Windows Media, and QuickTime are examples of streaming media players. Data can begin playing before the whole file is downloaded with a browser or plug-ins.

Transcript: A word-for-word written copy of an audio recording, or may also be written as summary transcripts.

WAV file (Waveform Audio File Format): Audio file format for Windows developed by Microsoft and IBM. WAV support was built into Windows 95 and has become an industry standard since. A variety of applications now support WAV files, as do additional operating system platforms, such as Macintosh. WAV indicates “sound file”, not a specific format of the file. WAV files can be 1-24 channels, 8-32 bit, fixed-point or floating point, compressed or uncompressed, etc. The WAV specification includes an “others” area, called the INFO CHUNK, which can be stored any additional data (e.g. a database, text, video, pictures, etc.). The INFO CHUNK, in the file “header”, is most commonly used to store metadata. While widely adopted, there is no standard format for this information. BWF (“broadcast wave”) does specify the format of the metadata area. This

narrower definition is a primary trait distinguishing a BWF from a WAV file. Most programs will open either format interchangeable; however, the metadata may or may not be transmitted as the file is processed (with either WAV or BWF).

13. Resources

Audio History, Preservation and Reformatting

CLIR pub 137: Capturing Analog Sound for Digital Preservation: Report of a Roundtable Discussion of Best Practices for Transferring Analog Discs and Tapes. *Commissioned for and sponsored by the National Recording Preservation Board, Library of Congress.* http://www.clir.org/pubs/abstract/pub137abst.html

Conservation On-Line, "Preservation of Audio Materials" 2003-04-23
http://sul-server-2.stanford.edu/bytopic/audio/

Digital Preservation Coalition, *Interactive Assessment: Selection of Digital Materials for Long Term Retention.*
www.dpconline.org/graphics/handbook/dec-tree.html

Gibbs, John .R, "Audio Preservation and Restoration" 2003-04-30 (University of Washington Music Library)
http://www.lib.washington.edu/music/preservation.html

Gilles St-Laurent, "The Care and Handling of Recorded Sound Materials" . CLIR (Council on Library and Inforamation Resources). 1996
http://palimpsest.stanford.edu/byauth/st-laurent/care.html

Henk J. Porck and René Teygeler, *Preservation Science Survey: An Overview of Recent Developments in Research on the Conservation of Selected Analog Library and Archival Materials* (Council on Library and Information Resources), 2000-12. http://www.clir.org/pubs/Abstract/pub95abst.html

History of Sound Recording Technology, n.d.
http://www.recording-history.org/

National Library of Australia, Preserving Access to Digital Information (PADI) "Audio and Audiovisual Material"
http://www.nla.gov.au/padi/topics/48.html

Library of Congress. 2005. "Project Documents from the First Phase of the Recorded Sound Digital Preservation Prototyping Project." Viewed 7/20/2005 at http://www.loc.gov/rr/mopic/avprot/avlcdocs.html Of particular interest are the "Audio transfer and image scanning specifications" – a sample statement of

work for contractor selection – and the “Additional Early Project Documents” section, which contains several attachments from LC’s Request for Quotes for this project particularly for in-house projects. Section IX, “Working with Others”, contains a subsection on outsourcing.

National Initiative for a Networked Cultural Heritage. 2002. “The NINCH Guide to Good Practice in the Digital Representation and Management of Cultural Heritage Materials.” http://www.nyu.edu/its/humanities/ninchguide/index.html Section VII, “Audio/Video Capture and Management”, covers technical issues in digitizing audio and video, and Section VIII, “Quality Control and Assurance”, contains a subsection specifically on digital audio and video. Section II, “Project Planning”, addresses general project management issues,

Newton, Graham, “Frequently Asked Questions about Audio-Restoration,” n.d. http://audio-restoration.com/faq.php Graham Newton is a company that transfers older analog media to digital media. He keeps a FAQ page about restoration and transfer as well as links to equipment suppliers

Research Libraries Group, 2005. “Tools for Digital Imaging.” http://www.rlg.org/en/page.php?Page_ID=408
While this page is oriented toward large imaging projects, it points to several good project planning resources, including guidelines to creating an RFP, and a sample RFP and RFI (Request for Information).

Safe Sound Archive, Links and Resources, http://www.safesoundarchive.com/links.cfm

Schoenherr, Steve, “Recording Technology History,” 2005-07-06 http://history.acusd.edu/gen/recording/notes.html

Sound Practice: A Report on the Best Practices for Digital Sound Meeting, 16 January 2001 at the Library of Congress http://www.rlg.org/preserv/diginews/diginews5-2.html#feature3

Van Bogart, Dr. John W.C., “Magnetic Tape Storage and Handling: A Guide for Libraries and Archives,” (National Media Laboratory), June 1995. http://www.clir.org/pubs/reports/pub54/index.html

Vidipax, a collection of articles regarding different issues on restoring and archiving magnetic media. http://www.vidipax.com/articles/

Digital Audio Collections and Related Projects

The Arhoolie Foundation's Strachwitz Frontera Collection Of Mexican And Mexican American Recordings with the UCLA Library.
http://digital.library.ucla.edu/frontera/.
Collection of commercially produced Mexican and Mexican-American Recordings (the Frontera Collection) is the largest repository of Mexican and Mexican-American vernacular recordings in existence.

British Library, "National Sound Archives," n.d.
http://www.bl.uk/collections/sound-archive/nsa.html

Harvard University Library Digital Initiative, "Audio Reformatting, "n.d.
http://hul.harvard.edu/ldi/html/reformatting_audio.html
LDI procedures are being developed as part of the Eda Kuhn Loeb Music Library's project. The site has links to industry standards and project guidelines.

Library of Congress - American Memory, "Technical Notes by Type of Material: Sound Recordings,"
http://memory.loc.gov/ammem/dli2/html/sound.html
General comments on digital reproductions of sound recordings for American Memory

National Gallery of the Spoken Word
http://www.ngsw.org/

Metadata

Audio Engineering Society (AES). Report of SC-06-06 Working Group on Audio Metadata of the SC-06 Subcommittee on Network and File Transfer of Audio meeting, held in conjunction with the AES 115th Convention in New York, NY., US., 2003-10-10
http://www.aes.org/standards/b_reports/b_meeting-reports/aes115-sc-06-06-report.cfm

Audiovisual Archives, 1999, or on-line at http://www.iasa-web.org/icat/icat001.htm

Encoded Archival Description *(EAD) Home Page*
http://www.loc.gov/ead/

IASA Cataloging Rules: A Manual for the Description of Sound Recordings and Related Audiovisual Media. Stockholm: International Association of Sound and International Symposium on Music Information Retrieval
http://ciir.cs.umass.edu/music2000/

Library of Congress -American Memory, "Technical Notes by Type of Material: Sound Recordings, " http://memory.loc.gov/ammem/dli2/html/sound.html
General comments on digital reproductions of sound recordings for American Memory

Library of Congress, "AV Prototype Project Working Documents: Extension Schemas for the Metadata Encoding and Transmission Standard"
http://lcweb.loc.gov/rr/mopic/avprot/metsmenu2.html
http://lcweb.loc.gov/rr/mopic/avprot/avprhome.html

Oral History Techniques

Matters, Marion. *Oral History Cataloging Manual,* Society of American Archivists: Chicago, 1995

Oral History Association, n.d.
http://www.dickinson.edu/organizations/oha

Smithsonian Folklife and Oral History Interviewing Guide,
http://www.folklife.si.edu/resources/pdf/InterviewingGuide.pdf

Professional Societies

Association for Recorded Sound Collections
Founded in 1966, the Association for Recorded Sound Collections (ARSC) is a non-profit organization dedicated to research, study, publication, and information exchange surrounding all aspects of recordings and recorded sound.
http://www.arsc-audio.org/

Audio Engineering Society
http://www.aes.org/
The Audio Engineering Society is devoted exclusively to audio technology. Its membership consists of engineers, scientists and other authorities. It encourages and disseminates new developments through annual technical meetings and exhibitions of professional equipment, and through the Journal of the Audio Engineering Society, the professional archival publication in the audio industry.

Society of American Archivists Oral History Section
The Oral History Section of the Society of American Archivists is composed of members of the Society and others who are interested in or are actively engaged in conducting oral history interviews and/or teach oral history methodology. The Oral History Section provides a forum for news, for discussion of issues and developments, and for establishing and maintaining communication and cooperation with other professional organizations.
http://www.archivists.org/saagroups/oralhistory/index.asp

Society of American Archivists Recorded Sound Roundtable
Serves as a forum for discussing the role, needs, and care of sound recordings in archival collections.
http://www.archivists.org/governance/handbook/section10.asp#description

Software

Adobe Audition (formerly Cool Edit Pro)
http://www.adobe.com/products/audition/main.html

Apple iTunes
http://www.apple.com/itunes/

Digital Audio Recorder
http://www.dartpro.com/

Mackie Tracktion 2
http://www.mackie.com/products/tracktion2/index.html

Pro Tools
http://www.digidesign.com/

Sound Forge
http://www.sonymediasoftware.com/

RealAudio
http://www.real.com

Microsoft Windows Media
http://www.microsoft.com/windows/windowsmedia/

WaveLab
http://www.steinberg.de/128_1.html

SonicStudio
http://www.sonicstudio.com/

Related Articles and Source Material

Besek, June M., *Copyright Issues Relevant to Digital Preservation and Dissemination of Pre-1972 Sound Recordings by Libraries and Archives*, Library of Congress/Council on Library and Information Services, ISBN 1-932326-23-5, December, 2005.

Conway, Paul, "Preservation in the Digital World," Yale University Library, March, 1996. Nearly ten years old but still very relevant.
http://www.clir.org/pubs/reports/conway2/

Edmondson, Ray, "Audio-Visual Archiving: Philosophy and Principles, UNESCO, 2004, http://unesdoc.unesco.org/images/0013/001364/136477e.pdf

European Broadcast Union, Broadcast Wave Format User Guide,
http://www.ebu.ch/en/technical/publications/userguides/bwf_user_guide.php

Folk Heritage Collections in Crisis. Wasington, D.C. CLIR, 2001.
Report of a conference held in December 2000 to formulate recommendation for the preservation and access of America's sound collections.

Johns, David, "An Introductory Guide to Audio and Video Encoding," *Cultivate Interactive,* 2001-10 http://www.cultivate-int.org/issue5/jam/

Library of Congress/Council on Library and Information Services,
Paton, Christopher Ann, "Preservation Re-Recording of Audio Recordings in Archives: Problems, Priorities, Technologies, and Recommendations," *American Archivist* 61:1 (Spring 1998), 188-219.

PrestoSpace – An Integrated Solution for Audio-visual Preservation and Access. http://www.prestospace.org The project's objective is to provide technical solutions and integrated systems for digital preservation of all types of audiovisual collections.

Ryan, Michael, "Save Those Priceless Tapes!" *Radio World,* Sept 29, 1999 Tips on storage and longevity.

Smith, Abby; David Randal Allen; and Karen Allen; "Survey of the State of Audio Collections in Academic Libraries" Council on Library and Information Resources, August 2004, http://www.clir.org/pubs/reports/pub128/pub128.pdf

St-Laurent, Gilles, "Digital Audio at the National Library of Canada" 1997-08-08
http://www.nlc-bnc.ca/9/1/p1-248-e.html

Vernon , Tom, "Keep Analog Tape Alive and Kicking," *Radio World* , September 20, 1995 an old but timeless article on analog machine maintenance.

Appendix 1

Questions to Ask Before Beginning a Digital Audio Project

1. What is your purpose for transferring analog audio recordings to digital formats?

There are many reasons for digitizing collections. Some of the first questions to ask are:

- For what purpose do you want to use the digitized materials and what are the benefits of having this collection in digital form?
- Is there a demand for the content of these materials in digital form?
- Is there a need for the entire collection to be digitized? Principles of selection for a digitization project are not unlike those for any collection-building activity. Preservation issues, access issues, programmatic needs, content value, popularity or level of use/demand, and fundability all play a role in that decision.
- Is the collection inaccessible to the public due to age, damage or value? Can digitizing the collection make it more accessible and help preserve the collection itself? Ultimately, the decision to digitize will have to support and be supported by the mission of your institution or organization.

2. Who is your audience?

This will determine the parameters of the project.

- Who will use the collection?
- Will the users be in-house only, or accessing the materials via the Internet?
- Are transcripts currently available for spoken word recordings, and if so, will your users prefer the actual recordings? Do the transcripts match the interview word for word? If not, this should be noted.
- What are the needs of your users and how can you best serve them?
- How are the materials presently cataloged?
- Will the materials become more available to the public after your project is complete?

3. Who owns the collection?

Copyright is important and it is essential to understand issues of ownership and intellectual property rights. Make certain that you have the authority to make recordings available to researchers or to use the content in programs or Web publications before you start digitizing.

- Who owns the materials?
- For oral histories, did the interviewees and interviewers sign a release form? Oral histories cannot be made available without appropriate releases from interviewees. There are ethical issues to consider when

applying a release that granted only in-library, controlled and limited use to a digitally re-formatted version that will be more widely available via the Web. Interviewees should be contacted wherever possible to ensure that they are aware of the greater access and that their privacy concerns are addressed.

- Are there restrictions on the duplication of the audio?
- Is the audio in the public domain? If not, can permission be obtained? Commercial sound recordings will require copyright clearance for re-formatting and broadcast.

4. What are the physical characteristics of the collection?

- What is the content of audio? Is it worthwhile to digitally reformat it? Sound recordings collected or created by libraries, archives, historical agencies and others will vary in quality of content or research value.
- What is the physical condition of the audio material?
- Can you determine the quality of the recording?
- Was the audio material stored in cool, dry, dark environment? Less than premium conditions cause faster aging.
- Are all of the parts audio tapes still connected? Is the leader connected to the hub?
- What is the age of audio tapes? Older tapes may “print-through,” which is the process of magnetic data from one part of the tape actually printing through onto the layer beneath it. As a result the recording is unclear and appears to have faint voices in the background. This also indicates deteriorating magnetic properties.
- How much have the materials been handled and how have they been handled?
- Have tapes been treated carefully and rewound yearly?
- Is tape twisted at all?
- Have materials been played on poor equipment or are they likely to be played on poor equipment?
- What is the length and format of audio tapes? 60 minute tapes are stronger and thicker than 90 or 120 minute tapes. Longer tapes must be handled carefully, rewound carefully and played on higher quality equipment. Speed determines the playing time of open reel tapes and some cassette tapes. Whether the tapes are monaural or stereo will determine the sort of equipment needed for playback.
- Consider the condition of equipment necessary to play tapes. Are you using the best possible?
- Does the entire collection need to be digitized? Perhaps only those of great demand or those that are in poor condition need to be transferred soonest? Know your collection, the level of use it receives, whether there are recordings that are asked for over and over again and others that have never been accessed. The programmatic needs of your institution may

also drive selection by content. Upcoming conferences, curriculum, or exhibition needs may provide the incentive, and the funding, to digitize portions of the collection.

- Are there antique or obsolete formats in your collection? Collections may contain sound recordings in formats so obsolete that playback or access has been close to impossible. Wax cylinders, transcription records, and wire recordings may be essentially unknown quantities until they can be reformatted.*Use a reputable vendor with experience in historical sound recordings and talk to specialists before attempting to reformat or play unfamiliar formats.* See the Association for Recorded Sound Collections Website at http://www.arsc-audio.org/ for additional information.

5. Will you attempt to preserve the original materials after reformatting?

- Can the original be played more than once? If not, then the transfer needs to be under ideal conditions. If your analog recordings show signs of physical deterioration, or if they are recorded on obsolete media or on standard quality cassette tapes they may be a priority for reformatting
- What file type is appropriate for an archival master? Consider the resources of your organization and select the highest quality possible. Understand that preservation reformatting involves a commitment to a long-term program of storage, maintenance and migration of digital files.

6. Who will assess the audio for sound quality?

Employ technicians who possess knowledge and skills to work with analog and digital recordings and equipment. Play a variety of tapes -- created different years, recorded at different speeds, recorded by different people, recorded on different kinds of tapes and tape players -- to determine what is acceptable digital sound quality.

- Will you use digitization as an enhancement tool? Digitization offers the opportunity to improve the quality of sound recordings. For example, digital enhancements can make possible the removal of a *thump* from an old wax cylinder recording; the reduction of background hums, buzzes, or other distractions. These enhancements will add to the cost of the project, but will aid listener's ability to understand what they are listening to. Targeting sound recordings where the quality of the recording may be greatly improved through digitization is one strategy to use when selecting material for re-formatting.

7. What is your time frame?

This is an important consideration, especially for grant-funded projects. As a rule, everything usually takes longer than planned. It is helpful to break the project schedule down into proposed durations, with milestones and expected completion dates.

8. How is the project being funded?

- Have you secured a source of funding for this project? Fundability may inform the selection decision: could a successful grant be written based on identification and re-formatting of all recordings relating to an event, an occupational or ethnic group, etc.?
- Can funding be tied to work at the collection-level, rather than the audio by itself?
- Can funding be tied to an exhibition budget, built into a conference fee, or become part of a grant proposal for programming?
- Have you considered local, state, national, philanthropic, and collaborative sources?
- Cost recovery is another approach to funding: will users be willing to bear the cost of re-formatting when they request a copy of an audiotape, including a second copy for the institution?
- What parts of the project will funding support? (Physical resources, hardware, software, networked access, personnel, dedicated space, vendor services, etc.)
- How will funding affect your time frame?
- How will funding affect the amount of material that can be digitized?
- Have you considered plans for maintaining access into the future and the ongoing costs?
- Is there a long-term institutional commitment to this project?
- Is funding available for long term maintenance? Does this include transfer to future technologies?

9. Who will be responsible at different stages of the production?

The allocation of staff is also an important consideration.

- What areas and levels of staff expertise are available to you?
- Is the workflow for creating digital audio significantly different to require staff other than those involved in previous digitization projects?
- Who will be responsible for selection and physical evaluation of the materials?
- Who will be responsible for testing of the tapes for sound?
- Who will be responsible for the transfer to digital format?
- What digital audio engineering skills might you need as you progress with a digitization project?
- Who will monitor, track, and confirm the vendor digital files?
- Who will be responsible for creating appropriate metadata for the files?
- Who is responsible for creating the cataloging and descriptive metadata to send to the vendor?
- Is the vendor responsible for metadata, technical and otherwise?
- Who will add metadata to the files after digitization?
- Will the metadata be “harvested” for cataloging, interfaces, etc.?

10. How will you perform the actual transfer?

- Where will the transfer to digital format take place? Off-site or on-site?
- If off-site, does the vendor have adequate, safe storage facilities?
- What is the level of sound quality you hope to obtain? How will this be defined?
- Will you perform any manipulation of the tapes to improve the sound quality?
- What is your criteria for acceptable sound when playing the digital recording? The same as it currently is or better?
- Are there specific guidelines specified by your funding source that you must adhere to?
- Will you create a preservation master as well as a user copy?
- What are the limitations of your hardware and software?

Appendix 2

Legal, Copyright and Intellectual Property Issues for an Audio Digitizing Project, with Sample Release Forms

It is necessary to address the complex issues surrounding intellectual property before undertaking a project to digitize audio recordings. Whether it is a commercially produced recording of a musical performance or an oral history taped by the local historical society, any audio recording that is a creative expression fixed to a tangible medium is protected by copyright.

Sound recordings are complex from an intellectual property perspective. Multiple individuals can hold copyright to different facets of the work. The performer, more broadly defined as the individual or group being recorded, has rights to the performance. The individual or group that makes the recording holds the rights to the recording itself. Furthermore, if it is a performance of music, then the composition (music and lyrics) may also be copyrighted.

To determine whether an audio recording made in the United States is in the public domain and can therefore be digitized legally, consider each of these facets independently. Compositions that were published before 1923 or compositions published before 1964 for which copyright was not renewed are in the public domain. Rights to the sound recording itself are more complex. Recordings made prior to 1972 were not covered by national copyright laws, but were subject to state anti-piracy laws.

If the material is not in the public domain, the institution undertaking the digitization project should seek permission from the copyright holder to reformat the recording and make it accessible. When the copyright holder originally donated the material, ownership of rights and terms of use may have been elucidated. Check the records for deposit agreements to determine if the institution has been granted the permissions necessary to digitize and provide access to the sound recording. Records of such an agreement may not exist or, more likely, the agreement may not specifically address digitization. In this case, the institution must contact the copyright holder to get permission.

Ideally, institutions should conduct an intellectual property audit of their audio collections and resolve any rights issues that are unclear, as a regular practice. If this is not possible, institutions can still effectively manage rights for incoming collections. As new items are accessioned, the institution should sign agreements with the donors that spell out terms of use. These agreements can be negotiated to give the institution the broadest possible terms of use and the language should not exclude the use of future technologies for reformatting or delivery. In general, broader statements (“all known and future formats” rather than “for digitization and the World Wide Web”) are better.

Institutions with questions about rights should review relevant copyright law and consult with legal counsel. For further reading, Georgia K. Harper presents a useful overview in *Copyright Law and Audio Preservation* from the 2003 Proceedings of the Sound Savings: Preserving Audio Collections Symposium. Anthony Seeger addresses rights management of sound recordings in *Intellectual Property and Audiovisual Archives and Collections*, a chapter in Folk Heritage Collections in Crisis (2001).

4.2 Ethical Issues

Some audio materials—oral histories or field recordings of religious ceremonies, for example—may contain sensitive information that was not intended for wide broadcast. Digitizing and mounting audio recordings on the Web promises, in essence, a vast audience, with little, if any, control over who accesses the material, how they use it, or, potentially, how they distribute it. For this reason, institutions should respect the individuals involved in the creation of the recording and disseminate the material appropriately.

In the case of oral histories, publishing interviews on the Internet can have several negative consequences. Narrators may become less than candid in interviews; may ask for broad restrictions on usage; or may not even consent to interviews at all. Some narrators will request anonymity, but anonymous interviews are troubling for oral historians since they create problems of historical authentication and place additional burdens on repositories.

With the possibility for vast new audiences, opportunities for quoting narrators out of context are heightened. In addition, some oral history projects don't require narrators to edit their interviews before they are made accessible. With wide dissemination, once again, the opportunities for quoting out of context, misunderstanding comments, and compromising the integrity of narrators and misrepresenting them are greatly enhanced. Many students, researchers and the general public now use the Web indiscriminately for historical research, often quoting out of context and not pursuing traditional sources for verification of facts.

Publishing oral histories on the Internet could be especially troublesome for interviewing populations that have been traditionally underrepresented in history or presented stereotypically. The Oral History Association guidelines (http://www.dickinson.edu/oha/pub_eg.html#Principles%20and%20Standards) warn oral historians to be sensitive to issues of exploitation of these people through the wide dissemination of interviews. This could also be a problem for oral historians working with corporations that naturally wish to maintain proprietary information, or fear the consequences of airing institutional information in public.

4.3 Release Forms

When institutions accession these types of materials, it is important to request the release forms that accompany the recordings. Without them access to the material is limited.

A release form is a statement signed by the interviewee that he or she understands the terms upon which the parties agreed to conduct the interview, including its final usage. The release form should be mentioned prior to the interview. If the interviewee has any objections to questions that might be asked or topics to be covered he or she should make that known before the interview begins. Obtain a signature from the interviewee and interviewer on the release form for each interview that is completed so that if there are specific restrictions, they can be applied to each individual interview. Individuals involved in the recording—interviewee and interviewers alike—have a right to place restriction on the terms of use. Some examples of restrictions include:

- Scholarly use only
- Staff use only
- Not using the person's real name
- Release the interview only after the person's death
- Omitting some information in the published interview that is on the tape
- Not releasing the interview for public use until a certain date
- Allowing access to the public but no duplication allowed
- Allowing access to the public but not available on the Internet
- Allowing access only with written permission of the narrator
- Allowing access only with an accompanying written record of who accesses it
- Cannot be shown publicly
- Cannot be copied
- Cannot be published

Sample release forms follow

UNIVERSITY OF WYOMING
AMERICAN HERITAGE CENTER
P.O. Box 3924 / Laramie, WY 82071-3924
(307) 766-4114 / fax: (307) 766-5511
e-mail: ahc@uwy.edu / www.uwyo.edu/ahc

LEGAL RELEASE FORM

(RELEASE OF RIGHTS IN ORAL OR VIDEO RECORDINGS)

I, _____, hereby give, grant, assign, and transfer, forever, to the University of
(Interviewee/Lecturer)

Wyoming, as a donation, all my rights, title and interest in and to the recorded oral or video recording made

by the American Heritage Center on _____ and any copies thereof, and any documentation
(Date)

accompany the recordings, for the use by said University of Wyoming and its patrons in any lawful way

including publication and broadcast, except for the conditions specified below, if any:

_____
(Signature)

_____
(Address)

_____
(City) (State) (Zip)

_____
(Date Signed)

Acceptance by the University of Wyoming:

_____
(Representative)

_____
(Date Accepted)

Naropa University, Inc.
a Colorado nonprofit corporation

RELEASE FORM

Audio/Video/Photo

NAROPA UNIVERSITY
a Colorado nonprofit corporation

MEDIA RELEASE
Naropa University Archives

I, the undersigned, hereby consent, grant and assign to, and authorize the use by, Naropa University, a Colorado nonprofit corporation, or anyone duly authorized by Naropa University, its assigns and legal representatives, the right to use, reproduce, and distribute on a royalty-free basis the audiotape and/or videotape and/or photographs of my readings/ performances/ lectures/ concerts/ panel discussions/ and plays held at or through Naropa on/or during _____(date), and any that are currently a part of the Naropa University Archives and/or Special Collections, (hereinafter individually and collectively referred to as the "Work")

The Work is released for the following uses, unless otherwise indicated. USES NOT PERMITTED are indicated by striking and initialing the related clauses:

Educational and Archival Uses. Naropa shall have the right to use all or any portion of the Work for educational and archival purposes. These uses shall include, but are not limited to:

i. The right to duplicate the recording of the Work for the purpose of physical preservation; and
ii. The right to make the intellectual content of the Work accessible to any individual or entity that requests a copy for research purposes; and
iii. The right to replay and/or rebroadcast all or any portion of the Work on a worldwide basis in all educational arenas such as schools and school classrooms, libraries, museums, businesses, clubs, and organizations as well as over the radio, in motion picture theaters, on cable, satellite and commercial television, and over the World Wide Web; and
iv. The right to incorporate all or any portion of the Work, or any adaptation thereof, into classroom or other educational curriculum; and
v. The right to create, produce, and distribute fundraising CD/DVDs and subsequent editions and to incorporate the Recording therein.

Promotional Uses. In addition to the foregoing, Naropa shall have the right to use all or any portion of the Work for the promotional and other uses set forth below:

i. Naropa may incorporate all or any portion of the Work, and any adaptation thereof, into Naropa's advertising materials, catalogs, news releases and other promotional presentations.
ii. In conjunction with the foregoing, I authorize Naropa to use my name, together with photographs of me, as necessary, in conjunction with the uses of the Work.

Other Uses I further agree that Naropa may make or cause to be made literary, dramatic, speaking, stage, motion picture, photographic, television, radio or other adaptations of the Work of every and any kind and character, and may edit the recording of the Work, and/or combine all or any portion of the Work with the Recordings of others for any and all purposes deemed reasonable and appropriate by Naropa.

Waiver of royalties. The undersigned hereby waives any royalties or future consideration for the foregoing assignment and release in order to support the enhancement and preservation of the Naropa University Archives and/or Special Collections.

I declare that I am eighteen (18) years old or older and am legally competent to execute this release or that I have acquired the written consent of my parent or guardian. I understand that the terms herein are contractual and not a mere recital, that this instrument is legally binding, and that I have voluntarily signed this document.

Signature of Presenter**:** _____ Date**:** _____

Printed Name of Presenter**:** _____

Address of Presenter**:** _____

_____

_____

Email Address _____ Phone: _____

Naropa Representative: _____

Signature _____

If Subject is under 18, the parent or legal guardian, if any, must sign.

Spelling of Parent/Guardian Name Phone _____

Signature of Parent/Guardian Date _____

Address _____

_____

_____

Witness Signature: _____

Witness Name (please print): _____

Appendix 3

Guidelines for Outsourcing Audio Reformatting

Planning for outsourcing:

1. **Know your institution's requirements and procedures for purchasing services.** Many institutions have rules governing the purchase of services that may limit the amount of money that can be spent, or require different procedures depending on the amount. These procedures can affect your project timeline by extending the bidding process or setting requirements for funding approval and monitoring. Before you develop your schedule, familiarize yourself with these procedures and requirements so you can allow time for them. Contact the person or department that will be handling your account as soon as you have rough estimates of schedule and budget, so they also can plan for your project. Your purchasing or accounting contact can be invaluable in helping you make sure procedures are followed, all required paperwork is filed on time, and other accounting requirements are met.

2. **Evaluate the work you will require.** How many originals will you have digitized? What formats will you be asking the vendor to work with? What condition are the materials in? Is there any special treatment you would like the vendor to perform, such as restoration of the originals or audio optimizing? Will the vendor create only your master files, or derivatives as well? Special handling or additional deliverables will add cost. You need to have a clear idea of what you want the vendor to do before you can get meaningful pricing information, plan an accurate budget and schedule. Also, consider how you will ship your originals to the vendor, and any requirements you may have for security and storage of your originals while in the vendor's hands. It may be desirable to state what services you do not want ("exclusions").

3. **Ask for recommendations from organizations that have outsourced similar projects.** Contact other organizations that have managed projects like the one you are considering. Ask them for vendor recommendations, pricing information, procedures, tips, pitfalls – any information that could help your own project go smoothly. Vendor recommendations are especially valuable at this stage. Contact any vendors that come well recommended and have handled materials like yours, to confirm pricing, technical capabilities and availability. Make it clear that this is informal information gathering, not a formal request for a bid or a promise that their services will be contracted. This will give you the information you need to plan your budget, refine your project scope to fit the funds and time available, and start a short list of vendors to contact for formal quotes or bids.

4. **Finalize your schedule, budget, and list of vendors.** Using the information you've gathered, make final decisions about project scope, deadlines, budget, and prospective vendors. Check again to make sure you've met your institution's purchasing requirements – for example, that your short list of vendors meets any requirements you may have for number of vendors bidding for your contract. Remember to budget for postage, packaging, insurance, and other expenses associated with shipping the originals to the vendor.

5. **Create the formal Request for Proposal to present to your list of vendors.** This is the document that will inform prospective vendors of your exact project requirements, and will serve as a basis for the contract for services. The type and contents of this document may be dictated by your institution's purchasing procedures. It should include *at least*:

- A list of the deliverables (master files, derivatives, restored originals) you will require the vendor to produce, detailed technical specifications for each type, including format and medium of delivery, and the naming convention to use for the digitized files;
- The number and type of originals to be digitized;
- The schedule for delivery of originals to the vendor, and deadlines for receipt of deliverables. This can include a small initial set of originals, so the vendor can adjust their configuration and you can evaluate the results in the early stages of the project. A small test set may even be sent to each vendor as part of the proposal acceptance process, and satisfactory results used as one of the proposal acceptance criteria;
- Invoicing requirements and/or payment schedule;
- Acceptance criteria and quality requirements for the deliverables. This can be qualitative, but should be as precise as possible. It can include the number of deliverables examined from each set – for example, 100% of the first delivered set are examined, and 20% from each subsequent delivery. You also may want to address how quality problems are resolved;
- Progress reporting requirements (for example, the vendor is required to submit weekly or monthly progress reports);
- Security, handling, and storage requirements of originals while in the vendor's keeping (for example, secured storage or a climate controlled environment);
- Request for information from the vendor, including how long they've been in business, their experience handling materials similar to yours, and references from other clients with similar projects;
- Deadline(s) and contact information for responding to the RFP.

6. **Send the RFP to prospective vendors, evaluate their responses, and select a vendor.** Vendors may have questions, so be prepared to discuss your requirements with them. Take notes during any phone conversations you have; write up a brief summary of the conversation, and send a copy to the vendor to confirm in writing any information or understandings that were reached. Once the response deadline has passed, evaluate the proposals you've received, and make a selection. Inform the selected vendor of your decision, and inform the other respondents in writing that they were not selected. Draw up a contract for services in cooperation with your institution's legal and purchasing departments. The contract must be signed by representatives of the vendor and your institution, with copies to each. Also, make sure an account is set up or a purchase order generated for your project, so the vendor will be paid promptly after they submit an invoice.

Ongoing project management:
Through the course of the project, make sure you stay in close touch with the vendor, so if the schedule slips or problems arise, they can be dealt with quickly. Again, make notes of any discussions you have with the vendor, and send them a written summary; this will go a long way toward preventing misunderstandings.

Set up an internal tracking system for all the materials you intend to ship to the vendor. This can be as simple as a straightforward spreadsheet. Record the title or unique identifier and number of pieces for each item (for example, one oral history consisting of several tapes), the date it was shipped to the vendor and the date it was received back. Tracking is easier if all the pieces for one item are sent together in the same shipment. If that isn't possible, you will need to record more than one shipping date and clearly list which pieces were shipped on each date. You should always know where all your originals are! This tracking system can be part of an overall project tracking system as well; dates and notes on in-house work like quality checking and production of derivatives (if not done by the vendor) can also be recorded here.

Stick as closely as possible to the shipment schedule you established. If originals are not shipped to the vendor according to schedule, your project may not meet its deadline. Draw up a manifest listing each physical item in the shipment, and include a copy with the shipment even if you hand-deliver. If you're using a shipping service, let the vendor know when you've sent a shipment, its tracking number and the expected time of delivery, and ask them to notify you when it arrives. If the condition of your originals allow, and the equipment is available, make copies before shipping; the sound quality of the copies will not be as high as that of the originals, but if the originals are lost or damaged your audio materials will not be lost with them.

Evaluate the deliverables promptly upon receipt, so problems can be addressed and corrected right away. This is enormously time consuming, so be prepared. Remember, the vendor will have people concentrating on your project and will

ship large volumes comparatively quickly. You must be ready to process and evaluate the returning files. You may want to have the vendor keep the originals until you've run your quality checks and approved the digitized audio. This will prevent the need for reshipment if something needs to be redigitized.

Make sure the vendor's invoices are paid as promptly as possible. Otherwise, you may find the work on your project becomes as prompt as your payments!

It's easy to think the project is over when you've received the last set of deliverables from the vendor. That isn't true. The project ends only when all the contractual obligations have been met: all the originals have been returned from the vendor, all deliverables have been received, and the vendor has submitted a final invoice and received payment. Before you wrap up the project, check again to make sure you've gotten all your originals back, and that the vendor has received final payment.

Additional Resources and Information on Audio Digitization Outsourcing

Library of Congress. 2005. "Project Documents from the First Phase of the Recorded Sound Digital Preservation Prototyping Project." Viewed 7/20/2005 at http://www.loc.gov/rr/mopic/avprot/avlcdocs.html

Of particular interest are the "Audio transfer and image scanning specifications" – a sample statement of work for contractor selection – and the "Additional Early Project Documents" section, which contains several attachments from LC's Request for Quotes for this project.

National Initiative for a Networked Cultural Heritage. 2002. "The NINCH Guide to Good Practice in the Digital Representation and Management of Cultural Heritage Materials." http://www.nyu.edu/its/humanities/ninchguide/index.html

Section VII, "Audio/Video Capture and Management", covers technical issues in digitizing audio and video, and Section VIII, "Quality Control and Assurance", contains a subsection specifically on digital audio and video. Section II, "Project Planning", addresses general project management issues, particularly for in-house projects. Section IX, "Working with Others", contains a subsection on outsourcing.

RLG. 2005. "Tools for Digital Imaging." http://www.rlg.org/en/page.php?Page_ID=408

While this page is oriented toward large imaging projects, it points to several good project planning resources, including guidelines to creating an RFP, and a sample RFP and RFI (Request for Information).