DAT330 – Principles of Digital Audio
Cogswell Polytechnical College
Spring 2009

Week 8 – Class Notes

Digital Archiving

Introduction

Digitized media proves to be far more convenient in terms of manipulation and delivery of information than analog media. Storage and duplication of the information is without considerable loss. Digital storage media also has a long shelf life and, by current standards, is quite reliable. Digitization also provides greater user accessibility in terms of manipulation, editing, comparison, searching. Digital media can be easily used to preserve the information contained in fragile materials or those whose format is obsolete and/or need special handling. Finally, digitized formats can be delivered or distributed in a number of ways.

The downsides of digitizing are mainly financial (considering equipment costs and the large amount of storage necessary for high-quality masters), technical (compression methods, distribution networks), difficulty in data recovery, and the uncertainty of ever changing data formats for preservation.

Audio Digitization

Dedicated analog-to-digital converters are needed in order to preserve the quality of the original recording. The choice of sampling rates and bit-depth depends on the application at hand. The standard 44.1 kHz, 16-bit CD quality format is good because of its widespread use. However, higher sampling rates and bit-depths can be used to capture sound with a large bandwidth and dynamic range. DVD quality 96 kHz, 24-bit is sometimes recommended. With increasing sampling rates and bit-depths, larger the storage capacity is needed.

For example, the Library of Congress specifies 96 or 48 kHz as a sampling frequency for a master file as a future replacement for reel-to-reel analog tape recordings currently designated as preservation masters. Harvard University Library uses a sampling rate of 88.2 kHz for capturing and preserving and a bit rate of 24 for capturing and preserving and 16 for delivering. The file sizes created at these sampling rates are approximately 30 MB per minute at capturing stage and 1MB per minute at delivery. In addition, research shows a clear difference in moving from 16 to 24 bit depth.

Let us consider two archiving contexts:

1. Studio work
2. Field work

The first can be easily described with the following diagram:

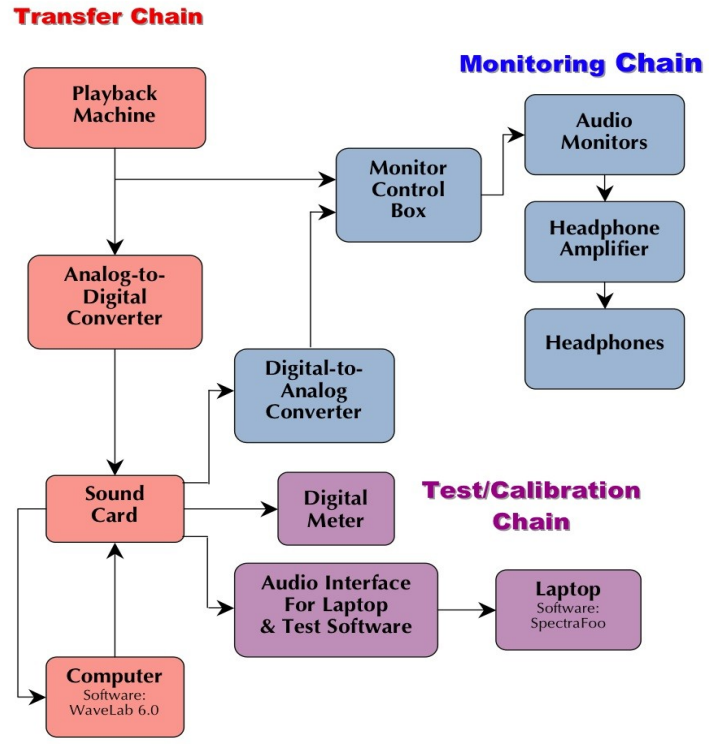

Figure 1: Indiana University ATM preservation studio signal chain

In the studio, these considerations must be taken:

1. An analog device to play back the tapes. It is easiest if this is the same kind of machine that was used to make the tapes originally. If not, be aware of the following concerns:
    a) Recording speed. Cassette tapes were usually recorded at 1 7/8-IPS (inches per second), but a small percentage were recorded at half of that speed. Reel-to-reel tapes may have been recorded at 3, 7, 1 7/8, or 15-IPS, but newer tape decks often can only play back at 7 and 15-IPS. If the playback speed is incorrect, you will be able to hear the difference, so be sure to listen to the recording before digitizing it.
    b) Monophonic vs. stereophonic. Older portable cassette tape recorders were often mono only; reel-to-reel decks came in both formats. Playing a mono tape on a stereo deck, or vice-versa, leads to loss of part of the signal, so be sure to use the right kind of playback device.

2. An audio analog to digital (AD) converter. Internal sound cards introduce noise into the signal, and generally do not produce digital audio of sufficient quality for long-term preservation; therefore, a high-quality external converter is needed. The right sort of converter will have the following specifications:
    a) Both 44.1 (or 48) and 96 kHz sampling rates.
    b) Both 16 and 24-bit depths.
    c) A low noise level, displayed in dB.

3. An audio software program, installed on the computer you'll be using. Pro Tools, Adobe Audition, Audacity, and Sound Forge are examples of the sort of software you'll need.
4. Digital storage media. This could include CDs, DVDs, external hard drives, or network servers.

In the second case, we must consider the following features when choosing equipment:

1. The ability to record in Linear PCM and to store in uncompressed WAV format. For this reason, MP3 players are not recommended for field recording, since they automatically save in compressed format. Similarly, MiniDisc recorders are unsuitable because they use ATRAC, a proprietary compression algorithm.
2. Digital output. Some devices record digitally, but only have an analog output, which leads to a 3 dB loss in recording quality.
3. Commonly available media. DAT recorders have been very useful for field work, but unfortunately, portable DAT recorders are no longer being manufactured. New recorders using flash memory are a good substitute. Analog recorders may still be useful in some situations, but it is becoming difficult to buy tapes, and it is harder to make and distribute copies.
4. An external microphone of good quality. A bad microphone can have a worse effect on sound quality than MP3 compression does.
5. A suitable power source. Even if electricity is available, it may fluctuate too much to be used for actual recording, but still be fine for recharging a battery. In areas without electricity, rechargeable batteries are useless without solar panels.
6. A bad cable or incompatible devices will be difficult to replace in the field. Be sure to test all of your equipment together before your trip, as well as any digitization procedures you intend to do in the field.

The digitization process encompasses the following aspects:

1. Connect the analog playback device to the converter, then connect the converter to your computer.
2. Start the audio software application on your computer, and follow the application's instructions to capture the signal from the playback device.
    a) Keep in mind that the time needed to digitize a recording equals the time the recording lasts; therefore, if you have half an hour of audio on one side of a tape, it will take that long to capture the audio on your computer.
    b) If you have separate sessions recorded on a tape, for example, two separate narratives, then you will need to either stop the tape and the audio application between the two, or else save them as one file and divide them later. The software has no way of knowing when one segment ends and another begins.
    c) At a minimum, you should use a sampling rate of 44.1 (or 48) kHz, and a bit-depth of 16.
3. When the recording is finished, stop the playback device and the application, and save the file.
    a) For long-term preservation, save the file in an uncompressed format, preferably WAV, Broadcast WAV (same as WAV. but with the capacity to save a small amount of metadata in the header), or AIFF.
    b) In general, the archival copy should not be edited in any way; that is, do not apply any form of noise reduction, equalization, or other processes that will

affect the sound quality. These can be applied later when making presentation copies, but the master copy should not be enhanced.

c) Give the file a name that will make sense to you, and hopefully others, later on. This could be a numeric ID, a date, some brief version of the topic or the consultant's name, or some other scheme. It's up to you, as long as you:

i) use a consistent file-naming scheme for all of your audio files, and

ii) keep the metadata (e.g., name of consultant(s), recording date, recording location, subject, digitization date, software application used, sampling rate and bit-depth used, etc.) in a separate document.

4. Make backup copies of the file as soon as possible, on CDs or DVDs or an external hard drive, or by uploading to a network. Make sure to have multiple backup duplicates.
5. Save the analog tapes; those are backup copies too.
6. After you've saved digital master copies of your recording, you can make presentation copies as needed (e.g., MP3 versions that can be downloaded quickly), but these should never replace the archival master copy.

Digital Audio Formats

Storage/Archival formats:

Master copies should always be stored in an uncompressed format such as WAV or AIFF. They are large formats, but they will encode all of the original data contained in the recorded signal, which is ideal for preservation purposes.

Furthermore, they should not have any compression (unless the signal is noisy and really soft) or any sort of processing. It should be as faithful as possible to the original recording.

Presentation formats

These are used to deliver audio either online, or CD/DVD distribution. They use data compression in order to reduce the size of the file. Some examples are MP3, .ra, .wma.

Metadata

Provides information about resources. It is often useful to include technical metadata specific to audio, including original medium (e.g., reel-to-reel), sampling rate and bit depth, digitization date, digitization software used, etc.

For instance, a metadata standard like METS (Metadata Encoding and Transmission Standard) can be used to describe the structure of a digital object. AV metadata standards such as METS (with the appropriate extension schema), or others like SMIL (Synchronized Multimedia Integration Language) can be used to describe the content and structure of time-based digital files such as audio and video.

Delivery and Management

The particular application or purpose of the media will determine which delivery and management options will be considered. Archival and preservation purposes will require uncompressed data formats that require large amounts of space for storage. If the purpose is the public access and distribution of the data, a compressed format will be ideal.

Storage will depend on the amount of data available. Usually, either disc formats are functional in the archiving of digital copies. However, large disc drives and servers prove to be very efficient for the management of large amounts of data.

References:

http://www.dlib.indiana.edu/projects/sounddirections/papersPresent/index.shtml

http://www.nyu.edu/its/humanities/ninchguide/VII/

http://www.emeld.org/school/classroom/audio/

http://www.dlib.org/dlib/january00/01hodge.html

http://www.lib.washington.edu/Music/preservation.html

http://www.nfsa.gov.au/preservation/care_audiovisual/care_for_audio.html

http://www.jazzpoparkisto.net/audio/

http://www.nla.gov.au/padi/topics/thesaurus.html