

# Audio Preservation

(An overview of issues and concerns for the creation, execution and maintenance of an audio archive)

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Digital Preservation  
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December 15, 2010

Recorded sound has become one of the most significant formats to relay cultural, historic and scientific information worldwide. The audio Preservation model is continually shifting. Emphasis on the preservation of the carrier is beginning to take a side seat to the preservation necessity of their content. It is shocking to say the least that these are some of the main formats that are in danger of being lost forever in just a few generations. This is due to the fact that we are in a time when technologies and the media are changing so rapidly rendering formats unplayable in such a short time. Although what I have to say and my findings are not new or shocking they state the concern that is growing for a need to find a means of properly storing and retrieving audio works. The world of digital puts emphasis on the coordination of Curators, collectors and experts in the field along with engineers and system experts to find not only a solution to audio preservation but to future access of audio files.

Since 1877 with Edison's invention of the phonograph the world has seen a rapid development and replacement of one audio format by another. Just 10 years after the phonograph Emile Berliner patented his disc gramophone. Soon the cylinders were replaced by the flat disk at approximately 78 revolutions per minute (rpm) and usually composed of hard but brittle shellac. Following World War II, the shellac 78 gave way to the introduction of the flexible vinyl 45-rpm single and 33-1/3-rpm long-playing (LP) record and soon to follow the magnetic recording tape. Magnetic tape, developed in Germany and brought to the United States after World War II, came into widespread use in commercial recording sessions by the late 1940s. In the 1960 we saw the eight track and soon the record industry along with the consumer helped to push the audio tape into a full blown revolution with the compact disk in 1982 the CD pushed tapes out and now DVD and MP3s are at the front.<sup>1</sup> The big debate that is still ongoing is that we do not yet know the longevity of digital formats so, many experts still feel that we should back up to analogue formats like tape and keep them in a secure place. But magnetic tapes are in just as much peril as a shellac disk or the fragility of a cylinder. They can be damaged by a variety of elements and upon playback; these tapes can break down and become unplayable. In the past dubbing from one analogue format to another much of the quality of the original recording was lost but with digital formats we are able to make exact copies and provide metadata to ensure copies are exact replicas in every way.<sup>2</sup> The general consensus now is that digital is the way to go. Preservationists are developing systems to manage sound recordings as digital files, to be archived in repositories and periodically refreshed and migrated.

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<sup>1</sup> Council on Library and Information Resources, "Capturing analog sound for digital preservation," Washington, D.C.: Library of Congress, 2006.  
<http://www.clir.org/pubs/reports/pub137/pub137.pdf>

<sup>2</sup> Council on Library and Information Resources, "Capturing analog sound for digital preservation," Washington, D.C.: Library of Congress, 2006.  
<http://www.clir.org/pubs/reports/pub137/pub137.pdf>

Audio recordings are not just musical or leisure oriented in nature. They are a primary source of vivid cultural and oral history. For over 115 years audio recordings have allowed us to share artistic and cultural information around the world. Communications of all sources like that of radio broadcast, Television and the World Wide Web are an important form of documentation of our cultural development. Audio recordings are growing rapidly over time for example, it was only just a few years ago that the cultural significance of Hip Hop recordings was dismissed and now the cultural relevance has been seen and libraries are finding a way to add these to their collections.

Of all forms of documentation and recorded history audio recordings have gone through a rapid amount of change in the past 25 years. This “digital revolution” has offered up a variety of new formats for consumers and collectors. Most archives and libraries are moving from storing in analogue formats like tape reels to digital formats. This is both exciting and challenging for libraries, archives and other cultural preservation organizations. New formats and ways of distributing information allow these organizations access to greater amounts of information faster but how do they handle this increase in information and the need to preserve it? The US Congress has recognized the importance of sound recordings and with the National Recording Preservation Act of 2000 that created the National Recording Preservation Board (NRPB). The Library of Congress the National Recording Registry of historically, culturally, and aesthetically significant recordings; the National Recording Preservation Foundation; and the National Recording Preservation Board, a body of recording industry and library professionals who advise the Library of Congress on preservation issues. Congress wanted to ensure the future of audio recordings through conducting studies on the current state of audio recordings and the methods being used for preservation. While libraries and other cultural organizations are working to preserve their digital collections they are still faced with challenges of preserving older analogue formats. These older formats require the maintaining of machines for playback and the implementation of efforts to reformat these recordings to migrate them into a format that can be played back in the future.

Analogue formats have a few steps to go through before they can be digitized. They are inspecting, preparing and cleaning the source material, configuring and calibrating playback equipment then finally transfer. Often it is suggested that a post-transfer quality control, which includes running check sums and checking the metadata for consistency. Other things to consider when transferring from analogue to digital are choosing the sampling rate and bit depth. 96kHz to 192kHz and 24 bit linear PCM files are the standard. One reason for this choice is that standards on DVD for audio is 96kHz and by sampling at 192kHz is that then you have more information for future advances in preservation technology and quality assurance.<sup>3</sup>

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<sup>3</sup> Majella Breen, Gila Flam, et al (Ed.). “Selection criteria of analogue and digital audio

Several systems are in place through out various institutions for assessment of prioritizing a collection and the preservation process. CALIPR out of California and AVDb the Columbia model are two examples of such a system. A survey instrument with its ability to prioritize preservation needs for reformatting based on the interaction of several relevant factors of historical documents: condition, use, and value to the collection. It is a classic matrix set up that ranks a collection on a scale of 0 to 5 based on which items need to preserve first due to risk of loss and value of materials.

The FADGI, Federal Agencies Digitization Guidelines Initiative was established to “identify, establish, and disseminate information about standards and practices for the digital reformatting of audio-visual materials by federal agencies. The effort will cover sound and video recordings and will consider the inclusion of motion picture film as the project proceeds. The main focus of the work is on older materials, with the formatting born-digital content to be considered where strong synergy exists. Topic areas include formatting, metadata, and related practices and methodology.”<sup>4</sup> Most all the information that they are working with and compiling was developed after the year 2000 due to initiatives desire to describe current not historical practices.

Proper collection of metadata is extremely important in the preservation of audio recordings. Digital audio recordings can and should contain several kinds of metadata including descriptive (e.g., track listings), administrative, and technical (e.g., a description of audio hardware used in digital transfer, hardware settings, and data compression used) Preservation metadata particularly digital preservation metadata should be even more detailed than administrative or descriptive. Whenever possible the individual responsible for the transfer should note all documentation including box notations that accompanies the analog source. During the preservation transfer process, transfer engineers should note anomalies in tape such as splice problems/repairs, speed variations, blocking/shedding, etc. Metadata to accompany the digital preservation copy could be embedded, eye legible, or both.<sup>5</sup>

Embedded Metadata provides information to support the functionality of an object at various stages of its preservation life cycle. Previously stated one form of metadata is rarely the only form of metadata used when preserving an object. In addition to the preservation metadata the systems used for cataloging and finding

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contents for transfer to data formats for preservation purposes”.  
[Aarhus,Denmark]:International Association of Sound and Audiovisual Archives (IASA), 2003

<http://www.iasa-web.org/task-force>

<sup>4</sup> “Embedding Metadata in Digital Audio Files: Introductory Discussion for the Federal Agencies Guidelines.” September 15, 2009. November 20 2010.

<http://www.digitizationguidelines.gov/audio-visual/>

<sup>5</sup> Council on Library and Information Resources, “Capturing analog sound for digital preservation,” Washington, D.C. : Library of Congress, 2006.

<http://www.clir.org/pubs/reports/pub137/pub137.pdf>

aids also contain metadata. “Redundancy supports long term preservation.”<sup>6</sup> Although metadata repeated in different locations can cause a problem when updated unless measures are taken by an organizations technical infrastructure.<sup>7</sup>

“The general topic of embedded metadata, in the broadest sense, is being explored by the Federal Agencies Digitization Initiative. Who are all of the actors (humans and systems) that the metadata ought to support? Which metadata elements serve their needs? When will these needs arise during the content lifecycle? A subgroup from the federal agencies initiative is developing a set of use cases that pertain to embedded metadata. The overall use-case effort is intended to be generic, representing both the still image and the audio-visual Working Groups.”<sup>8</sup> The current audio visual group is now focusing on a few particular aspects of different topics such as Format type, content lifecycle, master files more than derivative files, administrative and descriptive metadata including identifiers.

Embedding metadata is limited by the WAVE<sup>9</sup> and BWF<sup>10</sup> specifications and formats. Organizations like Microsoft-IBM RIFF have created specifications for embedding metadata by use of extendable structures made up of chunks.<sup>11</sup> In 2001 the European Broadcasting Union, EBU, added chunks as part of their broadcasting standard for WAVE formats. In 2003 the EBU drafted additional chunks for XML schema Although currently the use of chunks is not yet widely adopted by broadcasters and digital audio workstations and working groups are not yet fully aware of the archiving

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<sup>6</sup> “Embedding Metadata in Digital Audio Files: Introductory Discussion for the Federal Agencies Guidelines.” September 15, 2009. November 20 2010.  
<http://www.digitizationguidelines.gov/audio-visual/>

<sup>7</sup> “Embedding Metadata in Digital Audio Files: Introductory Discussion for the Federal Agencies Guidelines.” September 15, 2009. November 20 2010.  
<http://www.digitizationguidelines.gov/audio-visual/>

<sup>8</sup> “Embedding Metadata in Digital Audio Files: Introductory Discussion for the Federal Agencies Guidelines.” September 15, 2009. November 20 2010.  
<http://www.digitizationguidelines.gov/audio-visual/>

<sup>9</sup> <http://en.wikipedia.org/wiki/WAV>, **WAVE** or **WAV**, short for **Waveform Audio File Format**,<sup>[3][6][7][8]</sup> (also, but rarely, named, *Audio for Windows*<sup>[9]</sup>) is a Microsoft and IBM audio file format standard for storing an audio bitstream on PCs. It is an application of the RIFF bitstream format method for storing data in “chunks”, Though a WAV file can hold compressed audio, the most common WAV format contains uncompressed audio in the linear pulse code modulation (LPCM) format.

<sup>10</sup> <http://en.wikipedia.org/wiki/BWF>, Broadcast Wave Format, an extension of the popular WAV audio format

<sup>11</sup> <http://en.wikipedia.org/wiki/Chunk>, A **chunk** is a fragment of information which is used in many multimedia formats, such as PNG, MP3 and AVI. Each chunk contains a header which indicates some parameters (e.g. the type of chunk, comments, size etc.) In the middle there is a variable area containing data which are decoded by the program from the parameters in the header. In distributed computing, a chunk is a set of data which are sent to a processor or one of the parts of a computer for processing. For example a sub-set of rows of a matrix.

potential that these chunks and their formats provide. Currently the FADGI working groups are exploring solutions and improvements to the metadata embedding needs of preservation oriented archives.

Dublin Core, METS, MARC or other formats for embedding metadata are also useful in cataloging and describing audio files but the question that seems to be arising is that will the use of one cataloging or imbedded metadata format be enough? Do we need to find a system to embed metadata and catalog audio and audiovisual formats that contains more detailed information and multiple ways of identifying an item? Are some of the formats used like MARC creating workflow problems by having too many blank and irrelevant fields for audio works? There may be more than one identifier to be embedded in a file or object-packaging metadata. Since there is a good chance that a given object or file will be associated with multiple identifiers, there will be considerable value in having a metadata encoding that allows for repeating elements and/or attributes, like identifier type, identifier value. This approach would resemble that described for METS FLocat and LOCTYPE. Another perspective on multiple identifiers is provided by the DLF wiki Best Practices for OAI Data Provider Implementations and Shareable Metadata. The following recommendation pertains to circumstances in which multiple versions of a digital object may exist, looking from external Dublin Core metadata toward the digital content: in the case of digital objects, if the identifiers resolve to multiple versions of the resource, it is important to identify a single primary identifier that a service provider can label or use as the primary link to the resource. For example, only one <dc:identifier> element should be included with an actionable identifier (i.e. a URL). Additional <dc:identifier> elements might be included with a local identifier if not actionable (i.e. an end-user cannot click on the identifier to arrive at the resource).<sup>12</sup>

The new Kid on the block is AES-X098A Descriptive Metadata for Audio Objects: “This Audio Engineering Society (AES) draft standard was designed to set forth the descriptive metadata elements that shall be used to describe the basic characteristics of audio digital objects from their creation and through numerous migrations. These elements constitute the basic level of description required to define an audio digital object for archiving and use purposes. Since creating the draft, the AES has essentially decided to use EBUCore as its descriptive metadata schema. At the AES May 2009 meeting it was decided that both the EBU and the AES each publish the EBUCore document within their systems, with cross acknowledgement to the other body. This would allow latitude for each organization's maintenance procedures while acknowledging the rapport between them.” Coming soon, as of the 127th AES Convention in New York, October 2009, AES-X098B Draft Standard is just a few formalities away from being officially approved. AES-X098B Administrative and structural metadata for audio objects: “This Audio Engineering Society (AES) draft standard sets out the vocabulary to be used in describing digital and analog audio formats, including both those formats that exist in some tangible form such as a reel of tape and those that exist only as a stream of bits, united to a single audio carrier, such as a broadcast WAVE file. This vocabulary takes the form of an Extensible Markup Language (XML) schema.” AES-X098C Administrative metadata for audio objects has a draft in progress. “This

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<sup>12</sup> <http://webservices.its.umich.edu/mediawiki/oai/oaibp/index.php/IdentifyingTheResource>.

Audio Engineering Society (AES) draft standard sets out the vocabulary to be used in describing the processing and handling of audio objects in audio preservation work. This metadata, sometimes referred to as 'process history' or 'digi-prov', describes the details of how audio objects are treated and/or migrated. Essentially it provides the 'who', 'where', 'what' and 'how' information that clarifies the provenance of the audio object with regard to the work that has been done to restore and/or preserve the object."<sup>13</sup>

Basically when dealing with metadata and all the issues that surround it one needs to consider which method is best for embedding technical, administrative and descriptive metadata. Considering which formats give them the most options and flexibility for migration to future formats and that will be able to deal with multiple forms of metadata and allow for cohesive information retrieval for now and in the future.

The establishment of more and more digital preservation repositories and organizations willing to put efforts into these born and converted digital objects creates the need to hire and develop staff that has a strong working knowledge of these programs and policies needed to create digital repositories as well as access to funds to develop, coordinate and run these programs and repositories over an extended period of time.

A serious issue is that often these digital preservation efforts have guidelines set by librarians that have not consulted or do not know about audio engineering and the engineers that are not aware of particular institutional requirements and as whole they are all unaware of the proper management and facilities needed to manage digital storage and repositories. It is growing even more so now the importance to gather groups of professionals with knowledge to properly store and put in place policies for migration and access of audio files.<sup>14</sup>

The continued preservation of these audio formats is dependent on the collaboration or the proper training of audio engineers and preservationist. Professional engineers are needed to help keep up with the rapidly changing technologies, help in the upgrade of software and playback equipment as well as the maintenance of these machines. Individuals trained in these fields of audio engineering also are needed to assess collections and help manage them. Larger institutions like the library of congress have such a staff in place and have had for a while. But many other smaller institutes often due to financial constraints utilize whom ever they feel seems to have some minor working knowledge of audio equipment. This has led to many problems where audio recordings are to be migrated again or stovepiping projects,<sup>15</sup> that is when a systems that were built

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<sup>13</sup> METADATA STANDARDS AND GUIDELINES RELEVANT TO DIGITAL AUDIO, [http://www.ala.org/ala/mgrps/divs/alcts/resources/preserv/audio\\_metadata.pdf](http://www.ala.org/ala/mgrps/divs/alcts/resources/preserv/audio_metadata.pdf).

<sup>14</sup> Danielson, Virginia, "Towards a National Audio Preservation Program," Richard F. French Librarian and Curator of the Archive of World Music Eda Kuhn Loeb Music Library, January 31 2007. <http://www.loc.gov/rr/record/nrpb/pdf/harvard.pdf>

<sup>15</sup> Danielson, Virginia, "Towards a National Audio Preservation Program," Richard F. French Librarian and Curator of the Archive of World Music Eda Kuhn Loeb Music Library, January 31 2007. <http://www.loc.gov/rr/record/nrpb/pdf/harvard.pdf>

using old or *ad hoc* engineering methodologies for which support can no longer be found,<sup>16</sup> often demonstrating software brittleness in the audio preservation field. This need for obtaining the efforts of profession engineers is like that of bringing in paper exports and conservators. The need to develop audio preservation programs that include the knowledge of librarians, engineers, archivist and system administrators is extremely important to the proper preservation, migration and future access of these audio files. The problem is that most library schools do not offer the proper technical training for audio preservation efforts along with engineers not being taught methods and practice for proper administrative procedures to develop a preserved collection that can be utilized efficiently.<sup>17</sup>

The issue of ethics and copyright ownership is a whole other can of worms when discussing audio recordings and archiving. "First and foremost, archives have an obligation to comply with copyright and related law. This requires a high level of awareness of the relevant law, and a system of controls within the archives operating procedures which limit the possibility of material being inappropriately used within the archive or incorrectly supplied to a third party."<sup>18</sup> This is part of why several groups that I contacted did not feel comfortable in sharing their preservation formats. Copyright law and copyright ownership can become extremely complicated when dealing with certain typed of recorded information. Currently there are measures being taken to attempt to simplify copyright laws pertaining to audio materials but I feel we are a long way from a solution. Almost always published recordings is part of the commercial industry, distributed for profit and is compromised of recording and publishing companies. The laws dealing with copyright often vary from country to country but almost always they favor the owner of the copyrighted material to allow them to do with it as they please and to deny use of the material by others. Some exceptions are made for educational and archiving purposes. Archives should obtain as much information about the ownership of intellectual parties. Often archives can offer value to their clients through different services offered in making right available to the public, as long as it does not conflict with any privacy or confidentiality issues. Activities within archives such as digitization or preservation copying can potentially be in breach of copyright law. Measures need to be taken to ensure that the archive is not put at risk for breaching copyright agreements for example by purchasing copies and not making them in house. Exceptions are made for archives to support the

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<sup>16</sup> <http://en.wikipedia.org/wiki/Stovepipe>

<sup>17</sup> Danielson, Virginia, "Towards a National Audio Preservation Program," Richard F. French Librarian and Curator of the Archive of World Music Eda Kuhn Loeb Music Library, January 31 2007. <http://www.loc.gov/rr/record/nrpb/pdf/harvard.pdf>

<sup>18</sup> "The safeguarding of the audio heritage: Ethics, principles and preservation strategy" (version 3). Aarhus, Denmark: International Association of Sound and Audiovisual Archives (IASA), 2005 <http://www.iasa-web.org/ethical/241-archives-and-copyright-owners> 2.4.1



preservation of heritage recordings and the provision of access for research and educational purposes.<sup>19</sup>

Ethics are always a tricky place to tread but not only are we talking about the handling of private and sensitive materials but also issues with deaccessioning of the materials, preserving their players and the supporting materials such as photographs or writings. Some performers and collectors agree to only submit their recordings if the whole collection is kept intact. Archives have an ethical obligation to ensure that a recording is conserved using the safest most current forms of technologies and that their original content and physical representation shall be safeguarded from being modified, truncated, extended, falsified or censored in any way.<sup>20</sup> Audio archives in general try to follow ethical principals that are valid for the community of heritage institutions, museums, libraries, archives etc. The other issue is that of financial efforts. Yes we can all collaborate and utilize our experts in each field to create safe and accessible audio archives but how do we fund it? The cost in some areas are declining like that of storage but all other cost seem to rising. "Storage costs include the system needed to manage and preserve data, which covers checks on data integrity, backup procedures, checks for restoring information, automatic transfer to new tapes etc. The costs of digital storage are much higher than generally believed because much more is involved than most people realize. In the discussions of these issues it has been suggested from within the industry that as storage increases, the economic load increases faster. The fact that the capacity of storage media doubles each year results in the misconception that prices of storage are rapidly decreasing. For the short term - typically less than five years - this is true since not much has to be done to keep files accessible, but over the long term the costs of management will keep going up."<sup>21</sup> Audio preservation is still very new and all the efforts, policies and programs that are in place are still very new. Most institutions will have to go outside their facilities to seek help from other experts. This cost cannot be met by just rearranging a budget. Digitization and preservation are two separate and at times expensive costs.<sup>22</sup> Several programs are in place to help estimate the cost of converting analogue formats to digital formats and estimating the cost of different digital formats. Projects like Prestospace have preservation project cost pages that allow you to plug

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<sup>19</sup> "The safeguarding of the audio heritage: Ethics, principles and preservation strategy" (version 3). Aarhus, Denmark: International Association of Sound and Audiovisual Archives (IASA), 2005

[http://www.iasaweb.org/special\\_publications.asp](http://www.iasaweb.org/special_publications.asp) 2.4.2

<sup>20</sup> "The safeguarding of the audio heritage: Ethics, principles and preservation strategy" (version 3). Aarhus, Denmark: International Association of Sound and Audiovisual Archives (IASA), 2005 <http://www.iasa-web.org/ethical/221-archival-processing-and-preservation> 2.2.1

<sup>21</sup> Palm, Jonas, "The Digital Black Hole," [http://www.tape-online.net/docs/Palm\\_Black\\_Hole.pdf](http://www.tape-online.net/docs/Palm_Black_Hole.pdf). April 2006.

<sup>22</sup> Danielson, Virginia, "Towards a National Audio Preservation Program," Richard F. French Librarian and Curator of the Archive of World Music Eda Kuhn Loeb Music Library, January 31 2007. <http://www.loc.gov/rr/record/nrpb/pdf/harvard.pdf>

in the carrier and its type, evaluate and report the materials conditions, estimate the cost of transferring the material to digital formats then helps you estimate the cost of storage based on the storage quality and categories.<sup>23</sup> Prioritization is another factor to keep in mind when estimating the cost of preservation of a collection. Earlier I talked about CALIPR and AVDb models to help assess the risk of loss in a collection, it can help with cost estimation.

There is not one perfect solution to financial issues that seems to be the foundation for so many audio artifacts being lost or ending up in the “digital Black hole”<sup>24</sup> Collaborative efforts among different preservation groups such like Prestospace or MetaArchive are helping to find solutions to this problem but each organization will still the need to find a efficient, cohesive and affordable audio preservation method that works for their specific needs. Often a compromise between best practices and acceptable results is needed. Institutions need to list out what trade-offs and compromises they can make including if what they have in their collections needs to be migrated immediately or if it can be stored until a better technical treatments can be found.<sup>25</sup> One thought is that organizations need to be thinking about setting their budget for a decade. This may seem extreme to some but what is the point of preserving items if you only make a plan for 10 years! Yet, as time goes on we may find that we don’t want or need to keep everything that we have worked to digitize, only time will tell. Keeping everything in mind, a strong collection and good PR can often generate interest in a collection and private donors can be sought out to help with cost. The community and the government can also be reached out to by properly informing the community of a collections importance and proper fundraising techniques need to put into place.

The extensive amount of audio recordings throughout the world that are rare and or unique are in serious peril due to their carriers deteriorating and the players becoming obsolete. A variety of approaches to audio preservation are necessary to ensure that not only are these audio works preserved but can be accessed in the future. Programs that collaborate with private and public or academic facilities seem to be making the most headway in these efforts.<sup>26</sup> But what about smaller organizations or current cultural development groups such as satellite and public radio or television networks? Are they putting as much emphasis into making sure that their audio artifacts are properly stored and protected? We seem to making efforts to convert and store analogue material into proper safe digital formats but

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<sup>23</sup> Prestospace preservation project calculator, <http://prestospace-sam.ssl.co.uk/hosted/d13.2/newcalc.php>

Prestospace preservation project cost.

<sup>24</sup> Palm, Jonas. “The digital black hole,” April 2006.

[http://www.tape-online.net/docs/Palm\\_Black\\_Hole.pdf](http://www.tape-online.net/docs/Palm_Black_Hole.pdf)

<sup>25</sup> Council on Library and Information Resources, “Capturing analog sound for digital preservation,” Washington, D.C. : Library of Congress, 2006.

<http://www.clir.org/pubs/reports/pub137/pub137.pdf>

<sup>26</sup> Danielson, Virginia, “Towards a National Audio Preservation Program,” Richard F. French Librarian and Curator of the Archive of World Music Eda Kuhn Loeb Music Library, January 31 2007. <http://www.loc.gov/rr/record/nrpb/pdf/harvard.pdf>

what about all the new digital born audio artifacts? Are the same efforts being put into these formats? Yes, it is true that a magnetic tape is in great danger of physical decay or shellac disk are cracking and breaking apart. But, I feel that an even greater problem is the born digital audio files that are being put to the side with a sense of naïve inexperience that these formats will be accessible in the future. We have seen the problems with basic text programs like word versions that can no longer be opened with new upgraded software. We have seen the failure of hard drives along with CDs and DVDs in just a short period of time. Often in less than seven years and this indicates that we would need to reformat as much as soon as possible. But even if the funds were available the other resources just aren't. Yes the machines to read them are still being manufactured but the CDs and hard drives themselves are subject to a multitude of hostile environments that render them unreadable. There are just too many recordings that need to be treated to keep making mistakes and having to backtrack so much.

I spoke with several different individuals that work with audio formats. The three that I have quoted below were the ones that gave the most complete response to the set of questions. Cyrus Shahmir and Lear Bunda that work with Adult Swim at Turner Broadcasting in Atlanta Georgia. Both have been involved in television production for 7 years. Andy Lanset, New York Public Radio and Jamie Bush who is Music/Media Manager at Sirius XM Satellite Radio in Washington, DC. He began his career working in television production and has worked managing technology in broadcasting and libraries for over 25 years. He holds a Master's in Library Science and BA in Communication Studies.

I wanted to see what measures were being taken currently to archive audio files and recordings since the issue of preservation is now becoming more prominent. As academics we often are made aware of libraries, universities and other cultural organizations and how they are dealing with audio and visual preservation. But what about at the creation source, the TV and radio networks are they taking measures to preserve their works and provide information to help other preserve and retrieve their information in the future? Cyrus Shahmir, Lear Bunda and Jamie Bush answered the seven following questions:

**1. What Storage technologies or systems do you have in place for your audio archives?**

***Shahmir & Bunda:*** *Analog master tapes (1/4", 1/2", CD), Digital hard drive, DVD back ups, cassette and vinyl copies (of material that is completed)*

***JB:*** *Our audio content is stored using Dalet 5.1 (Digital Media System for TV/Radio). The storage network is an Isilon system.*

**2. What measures are you taking for protection of your collections? Back up, Mirroring, extra storage, Deduplication, virtualization?**

***Shahmir & Bunda:*** *Back up to DVD, print to tape, master to CD/vinyl, wav and mp3 stereo masters.*

**JB:** *All our digital media is backed up as part of our redundant Isilon storage network. Our physical CD collection is shelved using standard methods for CD storage. There is a mirrored system that is off-site.*

**3. What do you take into consideration when you are planning for “disaster” situations?**

**Shahmir & Bunda:** *That DVDs are a pretty good digital back up, haven't had any analog snafu's yet*

**JB:** *Our offsite-mirrored system would be used for data recovery. There are disaster protocols in place but I am not familiar with them.*

**4. What plans do you have for migration?**

**Shahmir & Bunda:** *Our goal is to keep my stuff back up in stereo formats (worst case) on CD and hard drive. A major goal is to also get mass duplication through vinyl, CD or cassette so that many final copies exist.*

**JB:** *We are currently upgrading our Dalet 5.1 Media system to Dalet Plus Enterprise. The migration of data is built into that upgrade plan.*

**5. Do you handle analogue and your born digital audio information differently? And if yes how?**

**Shahmir & Bunda:** *Analog is stored on tapes in a safe location. Digital information is back up on desktop, hard drive and DVD.*

**JB:** *Not really.*

**6. What was your biggest obstacle in creating this collection?**

**Shahmir & Bunda:** *Money, time and forethought.*

**JB:** *I was not part of the original acquisition of the collection. However, it is my understanding that the ingestion of the music content into Dalet was a challenge. The initial building of each channel's library was also challenging.*

**7. What do you see as your biggest obstacle for the future of the collection?**

**Shahmir & Bunda:** *Reading mechanisms (standardization) and durability of electronic devices.*

**JB:** *This is directly tied to our company's business objectives and the future of current broadcast systems, which I really can't speak about. However, from a music library perspective, delivery of music content is slowly moving toward*

*digital only. Our systems for ingestion and storage will need to keep pace with that trend. We have workflows and processes in place that are directly tied to the ingest and shelving of physical CDs. We will also need to consider what we will do with the physical music CD collection once digital delivery has become the norm. In terms of the digital music content itself, metadata will always be one of our biggest challenges. Because of the requirements of RIAA and DMCA we must report and maintain certain metadata for this content. Digital delivery makes this challenging because of the minimal metadata that accompanies the digital content as well as the lack of a physical CD. Traditionally, the physical CD has always been the primary source for metadata when ingesting. If satellite radio is held to the strict standards of reporting as it now, then digital delivery of music will need to provide richer metadata for us to fulfill our reporting requirements.*

I would like to note that Lear Bunda and Cyrus Shahmir are not the head of any audio preservation department at Turner but they were the only ones I could get to respond. They are sound engineers and do work with the audio librarians yet I feel that their answers to the questions were that of individuals that are not completely informed of all parts of the network's preservation process.

Unfortunately Andy Lanset was to meet with me after a lecture on Sunday the 12<sup>th</sup> of December but had to cancel due to a family emergency. Mr. Lanset did send me a copy of WNYC Radio - Proposal to the NEH (Humanities Collections and References Resources) WNYC Audio Preservation and Access Project July 15, 2009. This document was extremely useful and interesting to go through to see what an audio archive needs to consider when proposing a huge archiving project. The following is a summary of key points from the proposal and email correspondences.

Part of the reason that Andy Lanset was not able to fully answer my questions is that WNYC is currently involved in a huge project to digitize and preserve its entire archive.

*“Throughout its 85-year history, WNYC, New York Public Radio, has faithfully observed and documented the political, historical, scientific, and cultural events, both large and small, that have shaped New York City and the entire nation. Outside of the federal government, the WNYC Collection is the largest non-commercial collection of archival audio recordings and ephemera from an individual radio broadcaster. By creating free public access to these currently inaccessible primary sources, WNYC will support research, teaching, and learning across an array of humanities disciplines, including (but not limited to) history, American studies, geography, African-American studies, urban studies and planning, religion, the social sciences, and media and culture studies by scholars, journalists, teachers, media and communications professionals, and the general public.”*

*The bulk of the older WNYC Collection has been moved several times throughout its history: from WNYC's home at the Municipal Building to the Brooklyn Public Library (1953 to the mid- 1970s), to the New York Public Library (NYPL) Performing Arts Library at Lincoln Center (mid-1970s to the mid-1980s) to its current location at the New York City Municipal Archives. While the New York City Municipal Archives (NYCMA) has custody of the lacquer discs, which are held in Brooklyn, N.Y., the tapes remain stored with the New York Public Library for the Performing Arts. The*

WNYC Archives also now has numerous items stored in WNYC's new temperature-controlled facility on Varick Street in Manhattan. This collection represents the majority of the original older WNYC audio collection comprised of some 10,000 tapes and 14,000 discs. The proposed digitization project will draw its materials directly from the holdings kept at the NYCMA. WNYC has been keeping pace with evolving standards and best practices as outlined by IASA, ARSC, Indiana University/Harvard University (Sound Directions), and the National Recording Preservation Board of the Library of Congress.

Current State of the Collection: The WNYC lacquer disc collection's nomadic history has inevitably physically damaged the collection. At least ninety percent of the items in this collection are showing signs of deterioration. Preservation efforts have been made in the past; once in possession of the lacquer discs, the NYCMA received a grant from July 1987 to June 1988 from the New York State Library Conservation/Preservation program to clean and transfer a selected 199 hours of material from the WNYC lacquer disc collection to reel and cassette. The project continued with monies from the Municipal Archives Reference and Research Fund (MARRF) from 1988-1989. This produced another 200 hours of material, for a total of 399 hours. Unfortunately, the reformatted reels from this project are all approaching the end of their manufacturers' suggested shelf life and suffering from hydrolysis, also known as sticky shed syndrome.

The photocopied card catalog was scanned with OCR (optical character recognition) software about 10 years ago and still requires many hours of proofing and text corrections to make it computer word searchable. Since then, the OCR software has improved significantly. As part of this project we intend to rescan the catalog pages with current OCR software so that both the NYCMA and WNYC will have a word-searchable copy of the catalog that will not require an enormous amount of tedious text corrections by staff.

Criteria for Selection of Materials: The total number of items to be considered will be well above the project limit of 775 hours of running time.

The decision will be made based on the following criteria:

- Overall value to the humanities and local/national history
- Cultural/sociological significance with regard to the popular culture of the nation and

New York City

- Significance of content and usefulness/relevance of material to humanities-based research, teaching/education, and news/journalism

- Uniqueness of subject matter with regard to content

- State of deterioration or endangerment

- Availability of similar recordings at other sound archives

- The available means to provide a proper conservation treatment

Priority will be given to:

- High-value, at-risk transcription discs and tapes

- Discs and tapes of national as well as New York City cultural, political, and social history interest

- Discs actually cut by WNYC (numerous discs in the collection were commercially produced)

and were bought or given to WNYC; presumably these discs are available at other sound archives)

-Recordings that document the growth and development of WNYC and its role in city/regional/federal government

-Items singled out by project advisors as having particular historic or literary importance

Editorial Process for Writing Entries and Verifying Information: The full-time, library school trained cataloger will do the entry work after auditioning a duplicate of the CD reference copy or an MP3 derivative of the original BWF. Wav file. This work will include the MARC 21 record copy for the cooperating institutions as well as the PBCore entry for the WNYC catalog (samples in appendices). The cataloger will also scan photocopied catalog cards from the original old catalog and organize the listings into manageable word-searchable text files.

Criteria for Selecting the Hardware and Software for Preparing, Processing, or Disseminating Materials: The hardware and software we currently employ and expect to use for this project has selected in consultation with WNYC's professional engineering staff as well as consultation with other sound preservationists and archivists. This includes:

-Rosetta -Apogee 200 A-D converter for 94k/24bit conversion (BWF wav)

-Rosetta - Apogee A-D converter for 44.1/16bit conversion (CD copies)

-M-Audio Delta AP192 Sound Card

-Technics SP-15 Turntables with Shure 44-M cartridges and styli on SME 3012 tone arms

-KAB Souvenir EQSMK12 phono preamps

-Studer A-80 Tape Recorders

-Studer B-67 Tape Recorders

-Keith Monks Record Cleaning Machines

-Digital Asset Management System - DAVID (Digital Audio Visual Integration & Development) -ProTools Ingest Software

-PlexTools CD duplicating software

Justification of Storage Media and Digital Formats Selected: Our selection of media and digital formats is based on *Capturing Analog Sound for Digital Preservation: Report of the Roundtable Discussion On Best Practices for Transferring Analog Discs and Tapes* commissioned for and sponsored by the National Recording Preservation Board of the Library of Congress and published by CLIR in March 2006. We have also consulted the *Guidelines on the Production and Preservation of Digital Audio Objects (Second Edition IASA-TC04)* published by the International Association of Sound and Audiovisual Archives published this year and *Sound Directions* best practices from Indiana and Harvard universities.

How will the material be prepared (digital capture, keyboarding, optical character recognition, conversion from another electronic format)? Once selected, the original analog material will be cleaned properly and according to best practices. The item is then ready for signal transfer to the analog to digital converters; one feeding the reference CD burner, the second feeding the digital workstation where the BWF.wav file is created.

Methods for formatting the material and ensuring quality control:

Data reduction and file formats: For archival purposes a linear lossless digital

*BWF.wav format will be used to avoid compromising the integrity of the recording. Audiopath: The equipment used for conveying the source material will have specifications that equal or exceed the digital audio at 96 kHz and 24 bit rates. The specifications of the analog replay equipment and path will exceed the original carrier. We will also be implementing MD5 checksums using "Fastsum" or equivalent software to ensure the quality and integrity of the BWF over time or simply when moved or transferred. We will be using professional analog to digital converters to ensure that no additional noise or signal augmentation or processing is added to the transfer. There will be no compression or signal processing and all disc transfers will be done flat with no set equalization curve. The bit depth of the archive file copy will be at 24 bit to insure that the full dynamic range of the material is captured. The bit depth of the broadcast reference shelf copy (CD-R) will be at the standard CD rate of 16 bit. The stand alone analog to digital (A/D) converter we will be using is a professional unit that will not add noise or tone to the audio signal. The Apogee Rosetta A/D meet or exceed all of the specifications for THD+N @ 1 kHz, frequency response, distortion, IMD (SMPTE), dynamic range and clocking recommended by IASA. Additionally, the specifications for the audio path will either equal or exceed that of the digital audio at the rate of 96 kHz, 24 bit. The computer sound card will have a reliable digital input and will convey an unaltered digital audio stream. No individual component of noise will exceed -126dB. The soundcard will accept and correct digital input with a high level of jitter (up to 35ns) without producing dropouts and its own jitter will be less than 1 ns at 48 kHz. The computer based systems and software to be employed by WNYC Archives will be a professional broadcast audio computer system whose processing word length exceeds that of the file. (i.e., greater than 24 bit) and will not alter the file formats.*

*Organization of and Access to the Materialize structure, system capabilities, user access, and documentation: collection level MARC21 catalog records for the discs and tapes for the four institutions that will be receiving CD copies of each digitized item. Those items sent to the NYPL and the University of Maryland will also become part of the Research Libraries Network (RLIN). The cataloger will also create individual entries for WNYC's in-house database of sound recordings according to the criteria outlined for PBCore. Along with the descriptive metadata about the given item, the cataloger will indicate the structural metadata concerning multiple files of a single item, administrative metadata concerning the ownership of the original item (the NYC Municipal Archives) and rights status, and last, but not least, the technical metadata describing the file type, bit depth and sample rate. The technical metadata for material transferred from disc will be added to WNYC's PBCore entry and will include speed, condition, transfer issues/problems and styli used. This information will be logged and supplied by the technicians doing the transfers. The primary users of this material, other than researchers and scholars accessing it through our cooperating institutions (National Public Broadcasting Archives, NYPL, Municipal Archives and La Guardia Archives), will be WNYC producers. They will access this material through the WNYC catalog in the form of downloadable derivative files at 44.1 kHz and 16 bit for their broadcast needs using the station's digital asset manager (DAM) to draw from the digital mass storage system (DMSS).*

*Will the project's design allow for updating individual components? Yes.*



Describe and justify the metadata scheme(s) that will be used to describe the materials: Although it is currently in a trial and comment stage, we plan to use PBCore XSD (XML Schema) for the master BWF.wav files created at 96 kHz sampling rate and 24 bit resolution because it readily addresses the needs of public radio programming for descriptive, structural, technical and administrative metadata. We will also use the BEXT chunk of the BWF to hold a limited amount of metadata as recently outlined by the Federal Agencies AV Digitization Group and Library of Congress. These include title/description, originator, originator reference, originator date, originator time.

Information about metadata creation and controlled vocabularies (if applicable): All MARC21 records will follow Library of Congress guidelines for bibliographic control. For WNYC's catalog, as mentioned above, we will be drawing largely from the PBCore elements of the public broadcasting metadata dictionary. In the event of any gaps as far as language and vocabulary, we will fall back on the standards set by the Library of Congress.

Plans for storing, maintaining, and protecting the data: Once ingested by the archives digital audio work station (DAW), the digitized audio is immediately sent to a clustered storage solution by Isilon Systems, a storage provider who WNYC Radio was the catalyst for forming a partnership with DAVID digital asset management system (DAM). Now known as Silex Media's DAVID (Digital Audio Visual Integration and Development) system, is a DAM that is fairly common at European and Scandinavian broadcast facilities. Here in the United States, National Public Radio is in the process of implementing DAVID into their work flow. Our specific system is the model IQ6000i which includes nine nodes to connect with our broadcast VLAN, each with two GB network connections and eight 6TB storage arrays (48TB total raw storage) tied together with the company's InfiniBand intracluster network; together the system gives us high availability with a fully symmetrical clustered architecture. There are no single points of failure and the redundancy creates self-healing systems against node or disk failure; all files are striped across nodes in the entire cluster. There are several self-monitoring features of the system: the system allows environmental system monitoring as well as data integrity and node monitoring. Per the latter the system employs a continuous media scan in the background of all drives for proactively analyzing and healing file-level data.

Back-up: WNYC Radio will employ CommVault back-up software in conjunction with a fiber-connected Rorke Data/Qualstar RTL8466 2-drive, 66-slot, LTO4 stand alone tape carousel for backing up all data on the Isilon clustered storage array.

This media will follow WNYC Radio's enterprise back-up DR strategy of moving and storing tapes to an off-site data storage vault.

Plans for the preservation or other disposition of the original source materials: All materials will be stored vertically on metal shelving in the WNYC Archives after they are received from the Municipal Archives. After the discs are properly cleaned and recordings on them digitized, they will be placed in new acid-free sleeves before being returned to the Municipal Archives. The tapes will be tails-out and "library wind" and returned to their original boxes. Boxes will be replaced if their condition warrants. All tapes will receive new acid-free paper leaders at their head and tail.

The new WNYC Archives storage area maintains a storage facility at a stable 68 degree Fahrenheit and 45% relative humidity. The space has an air conditioning unit

separate from the rest of the station as well as separate dehumidifiers. All units are on the station's emergency circuit so that if power fails, these units will continue to function on the diesel powered emergency generator circuit. The space is monitored with a PEM2 monitor. All recordings will be kept away from sunlight and unshielded fluorescent lights. At the conclusion of the project, four copies of each source recording will exist: the original (which will be maintained until it deteriorates beyond recovery), the preservation master, a preservation back-up file and the CD-R reference copy. The original discs will go back to the New York City Municipal Archives storage in their off-site facility at Bush Terminal in Brooklyn, N.Y. The tapes will be returned to the Rose Building's climate controlled storage at the NYPL Performing Arts Library building at Lincoln Center. WNYC's CD reference copy will be on their reference shelf in controlled storage and the .wav file will be on a server with the Information Systems Department as discussed above.

Methods used to ensure that accidental or unauthorized changes or replacements do not occur in the electronic files: WNYC is in the process of planning for a digital asset management system. Any system selected will be able to assign access privileges for all of our content based on the specific user. Only archive staff will have edit privileges. The balance of the staff will have audition or listening access only. Once a master file is created for a given item, it will receive delete protection designation that cannot be removed without proper authorization by the station archivist.

Technical and administrative provisions for ensuring the preservation of and long-term access to the information: The digital asset management system (DAVID) affords WNYC several options for archival storage. These include; on-line, near on-line and off-line storage.

Report on the institution's capability and commitment to provide long-term access to the materials: The digital asset management systems now under consideration by WNYC Engineering all have self-policing mechanisms that insure the integrity of the data by constantly and automatically checking for significant error rates and recopying or migrating the data when there is any hint of loss.

IV. WORK PLAN: Staff will follow currently accepted practices in documenting transfer process and providing a clean archival transfer of the sonic material with the proper playback equalization and no signal processing. CD-R copies will be generated for reference purposes. These service copies will be used by the archive staff as duplication masters when fielding requests. The original source recordings will be returned to the Municipal Archives and retained as backups until they deteriorate beyond recovery. Unbranded, 74 minute, Mitsui Gold recordable compact discs CD-R with phthalocyanine dye will be used.

#### Workflow and procedures

Determination of Items: Items will be selected based on category summaries and lists provided to advisors. Project team, lead by Archivist, will provide a category print-out of the old catalog listings with the WNYC archive preferences noted to the advisors for their comment, confirmation and/or rejection.

Contact: Arrangements for borrowing selected discs and tapes will be done on bi-weekly basis. Requests will be emailed to the appropriate contacts at the NYC Municipal Archives as well as the Rodgers and Hammerstein Archives of Recorded

*Sound at the NYPL. WNYC's Archivist has a relationship with the staff at both facilities, thus ensuring there will be no difficulties in acquiring/accessing the items based on weather or staffing.*

*Conservation: Once selected, materials that are in-house they will be stored in our temperature/humidity controlled storage unit until work on them is ready to proceed. Transfer technicians will segregate any items that are damaged or that may require special handling or present particular difficulty in cleaning or transfer. The Archivist and Technical Consultant will proceed to determine the best course(s) of action depending item condition and composition. For more details on the conservation procedure please see appendix 6.*

*Transfer and Documentation: All aspects of the signal extraction will be documented and will become part of the BWF.wav file's technical metadata. This includes equipment used, speed, styli, flat transfer, disc or tape physical issues, etc. For quality control technicians will closely monitor the audio and wave form of the item during the transfer process.*

*Post-production: Post-production will involve quality control auditioning of materials transferred and review where needed with test equipment as well as the use of MD5 checksums for monitoring file integrity over time. Post production will also include CD duplication at 8x to maximize accuracy, testing using the PlexTools Professional XL V3.08 diagnostic software to check BLER-Block Error Rate).*

*Cataloging: Cataloger will work from the old catalog and reference CDs to come up with descriptive metadata and procure technical metadata from transfer technicians. Administrative metadata will be supplied by Archivist. The cataloger will also be responsible for adding essential metadata to BEXT chunk of the BWF based on recent Library of Congress recommendations. When caught up with transfer technicians, cataloger will work on rescanning old catalog cards (photocopies) and creating word-searchable text documents. Please see the discussion of "File Structure, System Capabilities, and Documentation" on page 15 for more information.*

*Oversight/Management/Review: The Archives Director/Archivist will review transfer and technical notes on a daily basis and discuss any particular issues with the technical consultant on a bi-weekly basis. He will oversee the above work and be 'on-call' for any questions and/or problems as they arise. Random items (BWF and CDs) will routinely be selected for spot checks and additional quality control."<sup>27</sup>*

In conclusion many varying factors need to be considered with audio preservation. First analogue formats the preservation and restoration of the carriers and players are important particularly since digitization is so new we want to keep these older analog formats in good working condition as long as possible till we have a confirmed set way to preserve the content. Next would be all the technical information to be created for audio formats including what programs to use and proper creation of metadata about the preserved object. In addition to the technical aspects Policies need to be put in place by preservation groups to ensure proper

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<sup>27</sup> WNYC Radio - Proposal to the NEH (Humanities Collections and References Resources) WNYC Audio Preservation and Access Project July 15, 2009, [http://www.neh.gov/grants/guidelines/HCRRsamples/WNYC\\_Radio.pdf](http://www.neh.gov/grants/guidelines/HCRRsamples/WNYC_Radio.pdf).

communication between librarians, preservationist, engineers, and administration to ensure the proper and best quality of an object is preserved. Consideration must also be given to external issues that are not physical like ethics and copyright laws. Financing and creating budgets not only for the collection and ingestion of audio objects but for long term preservation, migration and access all need to be considered. Experts have come a long way in a short period of time but the road that lies ahead is rocky and long. We can't save everything but we have a professional obligation to do our best to preserve what we can properly and efficiently for the education of those in the future and to preserve our cultural heritage. New policies are being made and with the help of collaborative efforts of all groups involved we should be able to make our way to a stronger more secure form of audio and audiovisual preservation.

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