

Indiana University

Media Digitization and Preservation Initiative

File Types and Roles

I. Introduction

Digitization produces different file types that are assigned specific roles within the preservation system. The metadata that identifies the file type and its role must be preserved so that files may be managed in a way that is appropriate to their function for long-term preservation. Written guidelines are needed to define the characteristics of the various file types and the procedures used to produce them within the context of the digitization workflow. This document examines the types and roles assigned to the files created by audio and video digitization within the Media Digitization and Preservation Initiative (MDPI) at Indiana University.

Metadata that identifies the type/role of any given file is located in the filename. MDPI filenames include the following element that identifies the type/role of a file:

pres = Preservation master
presInt = Preservation master-intermediate
prod = Production master
mezz = Mezzanine

For example, below are filenames for a preservation master file and a mezzanine file:

MDPI_40000000537292_01_pres.wav

MDPI_40000002631663_01_mezz.mov

This not ideal for long-term preservation as filenames are managed by the computer operating system and technically do not reside with the file. Also, filenames are easily changed accidentally or on purpose. For these reasons, MDPI embeds the filename, including the metadata that identifies type, into the file itself. Even better would be placing file type metadata into an external metadata system, but we have not done that as of yet.

II. File Types and Roles

A. Preservation Master File

The principal role of the preservation master file is to act as the primary surrogate for the long-term preservation of the target content.

The most important, and most valuable, type of file produced by digitization is the preservation master file, colloquially called a '*pres*' file at MDPI. Preservation master files contain the highest quality representation of the source recording. We define this file type as consisting of complete, unaltered data from the source audio or video object exactly as reproduced by the playback machine. It functions as the carrier of the raw material from digitization. It thus fulfils the following preservation principle:

The products of preservation work must be as accurate as possible, representing the source recordings completely, faithfully, and with the highest level of integrity.

In addition to the above, a preservation master file

- is uncompressed or uses mathematically lossless compression,
- is produced without permanent data reduction (lossy compression),
- is produced without any equalization other than that inherent in the playback machine (NAB or IEC for tape machines, for example),
- is not signal processed, contains no gain or level changes (including normalizing) or dithering in the digital domain,
- is not edited.

Audio preservation masters at MDPI may include multiple blocks of complete, unaltered data from the playback machine. For example, an open reel audio tape that changes speed in the middle will force the engineer to stop digitization, roll back to create an overlap, and then begin again at the correct speed. The preservation master will contain a section at the first speed and a separate section at the second speed.

B. Preservation Master-Intermediate File

The principal role of the preservation master-intermediate is to provide a co-master with basic optimizations for use in place of the preservation master file. These optimizations do not affect the interpretation of the content.

The preservation master-intermediate file (*presInt*, for short) is considered a co-master and may be used as a valid stand-in for the preservation master. It is a faithful representation of the source object, optimized with a type of processing that does not lead to the substantive loss or misinterpretation of any content but provides a more user-friendly listening experience for the end user. Using the *presInt* file type affords more flexibility in presenting content, while allowing us to maintain the strict definition of the *pres* as the unaltered, raw material from digitization.

Here are examples of how and when MDPI used the preservation master-intermediate file type:

1. Locked grooves, skips, and needle drops on disc recordings that must be edited out by the engineer. These edits, which are performed in such a way that no content is lost or obscured unless unavoidable, are done in the *presInt*, not the *pres* file.
2. If a disc requires a playback equalization curve (the parameters of which may be unknown), it is applied in the *presInt* file. The *pres* file does *not* contain the curve so that it may be used as the starting point to select a different curve in a new *presInt*, if desired. The stereo transfer of discs (capturing both the right and left groove walls in a separate channel) is also summed to mono in the *presInt*.
3. For the DV format, the direct data output or digital transfer via FireWire is defined as a preservation master. This is a raw DV file. The simultaneous capture of the content via SDI, into an FFv1/Matroska file, is designated a preservation master-intermediate. While we consider the SDI to FFv1 file a more user-friendly co-master, it can also be argued that it does not completely meet the standard of being a faithful representation, given the use of error correction by SDI.
4. For the Quad (2" open reel video) format, the preservation master file is a 10-bit uncompressed .avi file created by the vendor. However, MDPI's preferred format for the preservation of analog video is FFv1 with a Matroska wrapper. The *presInt* file type is used to produce a co-master in our preferred format, which is created by transcoding from the uncompressed .avi.
5. For the cylinder format, the *presInt* is mono-summed, has gain applied to bring it into a listenable range, has the results of editing for skips and locked grooves, and reverses all backwards content to forwards.
6. For the Orson Welles *War of the Worlds* lacquer discs transferred using IRENE at NEDCC, the preservation master files are the .tif image files from IRENE and the preservation master-intermediates are 24/96 .wav files created from raw 130 kHz files from the IRENE software.

C. Production Master File

The role of the production master is to provide a version that can accommodate as much optimization as is desired by the end user, while serving as the file from which all other versions are made.

The production master file (*prod*) is created from its corresponding preservation master or, if it exists, preservation master-intermediate, and is used to generate all further copies including deliverable files. At MDPI, the term 'production master' is used for audio formats only. The equivalent term for video is mezzanine.

Unlike the *pres*, the *prod* may be altered in ways that optimize the sound for end users. For example, the *prod* file may be signal processed to make it more listenable, more understandable, or to support the clarity of the target content. This could include noise removal

algorithms for de-clicking, de-crackling, de-humming, and others. If the target content requires editing, this is performed in the production master.¹ It is anticipated that, over time, production master files may be replaced or stand side-by-side with new versions that result from new and better signal processing work or other changes that are considered desirable.

Production master files were created for all audio and video (see mezzanine, below) content for the following reasons:

- To limit handling of preservation masters—for example, when further copies are needed, production masters are used to produce them
- So that no analysis is needed when accessing files to produce deliverables—the procedure is simply to find the production master
- To provide flexibility in accessing content. Production masters can be stored somewhere other than deep preservation storage in a location that provides quicker and easier access, if useful

D. Mezzanine File

This is the video equivalent to the audio production master. While it is, and could be called, a production master, we used the term ‘mezzanine’ because it is widespread in the video industry and it can be useful to be able to quickly differentiate audio from video files via the filename.

The video mezzanine file often differs from an audio production master in that it is much easier to play than its corresponding preservation master. The large sizes of, and relatively small number of tools available for, uncompressed or mathematically lossless files can make it difficult to play or transcode video preservation masters. Mezzanine files, often in a common format well-suited for editing or production needs, may be needed simply to provide quick, high-quality access to the content.

Note that for both audio and video files, the preservation master may include stops and starts and overlaps from such anomalies as speed changes. It may also include repeated material from techniques used to get a recording to play smoothly. In these situations, the duration of the preservation master file will be different than its corresponding production/mezzanine file. Typically, these problems will be corrected in production master files so that the content plays seamlessly. This also affects duration.

¹ Editing is exceedingly rare and is directed by the IU unit curators and custodians of the content who may, for example, need to respond to things like a request to restrict access to a ceremony performed by a specific native group.

E. Delivery Files

The principal role of delivery files is to provide access to end users via whatever access system, software, or means is used.

To some extent, delivery files are considered expendable and are expected to change over time. Delivery files for MDPI content were made in accordance with the needs of the access system, the Avalon Media System, with its public face, Media Collections Online, during the time period 2015-2021.

III. File Formats and Wrappers

A. Audio

1. Preservation master file

Relationship to source recording	One side or one direction of source
Encoding	PCM s24le (signed 24 bit little endian)
Format	Broadcast Wave Format (BWF)
Bit depth and sample rate	24/96 except for DAT which may be 16/44.1 or 16/48 and CD-R which is 16/44.1
Channels	1 audio stream-2 channels. 2 channels if source is stereo, 1 if mono. 2 channels (each groove wall) for mono discs.
Metadata	Embedded in bext and LIST chunks

Exceptions:

CD-R: wav file with 1 audio stream. Audio pcm_s16le, 16/44.1kHz, 2 channels.

DAT: wav file with 1 audio stream. Audio pcm_s16le, 16/0kHz, (1, 2) channels.

Magnabelt: 1 audio channel

2. Preservation master-intermediate

Relationship to source recording	1:1 correspondence with preservation master file
Encoding	PCM s24le (signed 24 bit little endian)
Format	Broadcast Wave Format (BWF)
Bit depth and sample rate	Same as corresponding preservation master file
Channels	1 audio stream-2 channels. 2 channels if source is stereo, 1 if mono. 2 channels (each groove wall) for mono discs.
Metadata	Embedded in bext and LIST chunks

Exceptions:

CD-R: wav file with 1 audio stream. Audio pcm_s16le, 16/44.

3. Production master file

Relationship to source recording	Typically, a 1:1 correspondence with preservation master-intermediate file if present, or with preservation master file if there is no <i>presInt</i> . However, it may be whatever is desired. For example, multiple source recordings edited together to present all of one continuous event.
Encoding	PCM s24le (signed 24 bit little endian)
Format	Broadcast Wave Format (BWF)
Bit depth and sample rate	Often the same as <i>pres</i> or <i>presInt</i> but may be whatever is desired
Audio streams	1 stream, 1 or 2 channels. Same as corresponding <i>presInt</i> if present. If not, same as corresponding <i>pres</i> .
Metadata	None

Exceptions:

CD-R: wav file with 1 audio stream. Audio pcm_s16le, 16/44.1kHz, 2 channels

4. Delivery (access) files

Relationship to source recording	Same as production master
Encoding	AAC
Format	MPEG 4
Bitrate	High: 320 kbps Medium: 128 kbps. There is no low variant
Channels	Same as corresponding <i>prod</i> if present
Metadata	None

B. Video**1. Preservation master file**

Relationship to source recording	Entire source recording
Codec	FFv1
Wrapper format	Matroska
Video streams	1
Video characteristics	720x486, 29.97fps, pixel format yuv422p10le

Audio encoding	PCM s24le (signed 24 bit little endian)
Audio bit depth and sample rate	24/48
Audio streams/channels	4 channels
Metadata	Embedded in the wrapper

Exceptions (related to audio streams and channels):

1. Betamax sources with normal audio only=1 stream with a stereo pair. Betamax sources with normal and HiFi audio=4 stream/channels.
2. 8mm sources with AFM audio only=1 stream with a stereo pair. 8mm sources with AFM and PCM audio=4 stream/channels.
3. U-matic: 2 mono audio streams
4. 1" open reel video: 2 mono audio streams

For 2" Quad (digitized by Larry Odham at Quad Tape Transfer)

Relationship to source recording	Entire source recording
Codec	V210
Wrapper format	avi
Video streams	1
Video characteristics	720x486, 29.97fps, pixel format yuv422p10le
Audio encoding	PCM s24le (signed 24 bit little endian)
Audio bit depth and sample rate	24/96
Audio streams/channels	1 audio stream only with a stereo pair-program audio channel on left channel, cue track on right channel
Metadata	Embedded in the wrapper

For DV

Codec	.dv raw
Audio streams/channels	2 or 4 channels

For DVD:

Relationship to source recording	Entire source recording
Format	ISO disc image
Audio bit depth and sample rate	24/48
Audio channels	2 mono
Metadata	None

2. Preservation master-intermediate file

Relationship to source recording	1:1 correspondence with preservation master file
Codec	FFv1 (for DV and Quad)
Video characteristics	720x486, 29.97fps, pixel format yuv422p10le
Wrapper format	Matroska
Video streams	1
Audio bit depth and sample rate	24/48
Audio streams	4 for DV, 2 for Quad
Metadata	Embedded in the wrapper

3. Mezzanine file

Relationship to source recording	Entire source recording
Codec	MPEG-2, 4:2:2 profile at 50 Mbps (IMX50, SMPTE D10)
Wrapper format	QuickTime
Audio bit depth and sample rate	24/48
Streams	Same as preservation master
Metadata	None

For DVD:

Relationship to source recording	Entire source recording
Codec	MPEG-2, 4:2:0
Wrapper format	MP4
Audio bit depth and sample rate	320 kbps/48 kHz
Channels	2
Metadata	None

For DV:

Relationship to source recording	Entire source recording
Codec	MPEG-2, 720X480, 25 Mbps
Wrapper format	QuickTime
Video characteristics	720x480, 29.97fps, pixel format yuv422p.
Audio encoding	pcm_12le, pcm_16le, pcm_s24le
Audio bit depth and sample rate	12 bit, 16 bit, or 24 bit/ 24/0 kHz
Audio streams	4 mono
Metadata	None

For ½" Open reel videotape

Relationship to source recording	Entire source recording
Codec	MPEG-2, 4:2:2 profile at 50 Mbs (IMX50, SMPTE D10)
Wrapper format	QuickTime
Video characteristics	720x512, 29.97fps, pixel format yuv422p
Audio bit depth and sample rate	Audio pcm_s24le, 24/48kHz, 1 channel
Audio streams	1 mono stream
Metadata	None

4. Delivery (access) files

Relationship to source recording	Same as production master
Encoding—video	h.264, yuv420p, frame rate = 30
Encoding—audio	aac/44.1 k2
Bitrate	High: 960X720@2 Mbps with audio @192 Kbps Medium: 640X480@1 Mbps with audio @128 Kbps Low: 480x360 @ 512Kbps with audio @128Kbps
Channels	1 stream with a stereo pair
Metadata	None