Preservation Handbook

Moving Image

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Definition

Moving image data is composed of a sequence of still images that, when shown in succession, create the impression of motion. It is often accompanied by audio that may be synchronised with a specific time point. Examples of moving images include animations, movies, television programs, and other visual output. This document describes platform-independent formats, such as MPEG and Quicktime.

Desktop Video

Moving image formats for use in the desktop video market are developed within particular emphasis upon playback and compression rates. The internal structure is a deciding factor in assessing the capabilities of a file format. The majority of formats share a common structure, consisting of four strata: moving image; audio data; and information necessary to decode (header) and describe (metadata) the data stream. Some formats constrain the type of information that may be encoded within the file (MPEG-1, MPEG-2), while others (QuickTime, AVI, RealMedia, MPEG4) serve as 'wrappers' that allow a degree of flexibility regarding the encoding method.

Compression rates often vary according to the algorithm in use, using temporal, spatial, lossy, lossless, symmetrical or asymmetrical calculations to compress video to a much smaller size. The majority of common video encoding formats are 'lossy', that operate by storing a key frame and recording subsequent changes to the image. This produces highly compressed data files, for example, a 450Mb MPEG-1 video may be compressed to a 180Mb Divx file. However, these files are difficult to edit and result in some loss of quality.

Unlike analogue videotape, that stores audio and video data concurrently, the distinction between the audio and video elements is important. Synchronicity is an issue when editing these files, often resulting in the video becoming out of sync with the audio – a character will move their mouth, but the words may be delayed by two seconds. However, the independence has one benefit – it enables developers to use their own video compression formats without adverse effects upon the audio data, and vice versa.

Preservation Policy

The rendering of moving image data is often associated with end-user requirements – a moving image file may be played through appropriate software, rendering the byte stream as a series of images to be displayed and with accompanying sound. This should not be limited to specific hardware devices and must be feasible for users of current desktop computers.

Guidance on the preservation of digital video should, by necessity, change over time. MPEG-1 is suitable for low-quality video. It is documented, may be manipulated using free software tools, and can be played on current computers and digital video players without additional software. However, it imposes restrictions in terms of resolution and dimensions, which may prove restrictive for born-digital content.

The MPEG-2 and MPEG-4 formats are better suited to high-quality digital video. MPEG-2 is better known for its use as a format for DVD-Video, which encourages confidence when considering the likelihood that the format will be readable in the long-term. The format has an average transfer rate of 2-5 megabits per second, but there may be disk space restraints and the software tools necessary to convert and store this format are costly. MPEG-4 has a lower transfer rate of 1-2 megabits per second and is intended for streaming video. Other codecs, such as QuickTime, Windows Media, Real Video and Open DIVX, are useful for specific purposes, but not suitable for preservation.

For details on the preservation of audio data, please consult the relevant handbook. If audio data is contained within the same digital file as the video data, it should be migrated to a format suitable for preservation and resaved. If this is not possible (i.e. the digital wrapper is capable of using only its own proprietary codec), the digital audio should be output as a separate digital audio file. This should be noted in the work log, along with details of any sequencing issues (e.g. audio must begin on the 5129 frame of the video) necessary to recombine it at a later date.

Additional Information

- An introduction to Digital Video
  < http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol1/sab/article1.html >
  Last checked 25/07/2005
- The DV, DVCAM, & DVCPRO Formats
  < http://www.adamwilt.com/DV.html > Last checked 25/07/2005
- DV format information
  < http://www.adamwilt.com/DV-tech.html > Last checked 25/07/2005
- Moving Picture Experts Group (MPEG) website
  < http://www.chiariglione.org/mpeg/ > Last checked 25/07/2005
- Divx
  < http://www.divx.com > Last checked 25/07/2005
- NINCH Guide to Good Practice
  < http://www.nyu.edu/its/humanities/ninchguide/VII/ > Last checked 25/07/2005
- General info on Video File Extensions
  < http://graphics.csail.mit.edu/~tbuehler/video/extensions.html > Last checked 25/07/2005
- Worldwide TV standards: A Web Guide
  < http://www.ee.surrey.ac.uk/Contrib/WorldTV/ > Last checked 25/07/05

Technical Environment

Desktop video data may be played on many current operating systems. The level of entry, in terms of hardware requirements necessary to decode the data and play it in real time, increases according to the complexity of the format. Migration and editing of these formats will require a faster machine, in order to complete the operation in a timely fashion.

Common Formats

Contemporary codecs, such as MPEG-4 offer significantly improved capabilities, in terms of smaller size and higher quality audio and video. However, a faster machine is required to encode and playback this data.

Digital Encoding	Playback Requirements	Notes
DivX (.divx .avi)	233MHz+ CPU, suitably fast graphics card, playback software (Windows Media Player) and appropriate codec. Later versions of DivX use better compression that requires faster hardware (800MHz+)	Open source codec, originally derived from MPEG-4. Is suitable as a distribution format, but not long-term preservation.
Microsoft Audio/Video Interleaved (.avi)	100MHz+ CPU, suitable playback software (provided free with most operating systems)	A proprietary RIFF A/V file specification that may contain multiple streams of different types of data (e.g. MJPEG, MPEG-2). Suitable as a distribution format, but not long-term preservation.
MJPEG	1.5GHz+ CPU, suitable playback software (VirtualDub) and appropriate codec (e.g. M-JPEG 2000).	Identical to photo-JPEG, Motion JPEG offers spatial compression, as opposed to the temporal compressed used by MPEG formats. It is suitable for preservation. However, it should be recompressed in an alternative file format for dissemination purposes.
MPEG-1 (.mpg .mpeg)	100MHz+ CPU, suitable playback software (provided free with most operating systems) and a CD-ROM (for VideoCD content)	VideoCD standard. Provides reasonable quality audio/video playback. Suitable for preservation.
MPEG-2 (.mpg .mpeg)	233MHz+ CPU, suitably fast graphics card, playback software (WinDVD, PowerDVD, etc.) and a DVD-ROM drive for DVD Video playback.	DVD standard and a suitable format for preservation.
MPEG-4 (.mpg4)	350MHz+ CPU, suitably fast graphics card, playback software (Windows Media Player 9+, Apple Quicktime Player 6.2+)	Online streaming standard. Possible Preservation format.
Quicktime (.mov .qt)	233MHz+ CPU, suitably fast graphics card, playback software (Quicktime	Proprietary codec that should not be used for long-term

	Player or Windows Media Player for older versions of Quicktime)	preservation. Suitable as a dissemination format.
Real Video (.ram, .rm)	120MHz+ CPU, 16Mb RAM for older versions of Real Video, later versions require a 233MHz CPU & 64Mb RAM minimum. Appropriate software player (Real One, MPlayer or Classic Media Player) also required.	Proprietary format that requires proprietary software. Unsuitable for long-term preservation.
Windows Media Video (.wmv, .asf)	233MHz+ CPU, suitably fast graphics card, playback software (Windows Media Player, Linux Mplayer)	Proprietary Microsoft Codec. Unsuitable for long-term preservation.

Ingest Checklist

Level 1 (Essential)

- Indication of the file format
- Indication of the audio codec, if it differs from the file format
- Indication of the video codec, if it differs from the file format
- Length of recording (in minutes and seconds)

Level 2 (Preferred)

- Details on file format/codec and/or digital tape deposited in a condition suitable for preservation. E.g. MPEG-2 or DV.
- Note Video dimensions, frames per second (FPS) and bit-rate.
- Audio bit-rate, and frequency, if applicable. Information on all bit-streams should be provided if the audio contains more than one channel.
- Copy protection, if applicable (e.g. CSS)
- Description of any metadata associated with the video

Level 3 (Best Practice)

- Adherence to open standards in file creation to make dissemination and playback as smooth as possible.
- Detailed Codec information - Frame rate, recording length, sampling frequency, bit rate etc.
- Information on the purpose/use of the digital footage
- Size of video file

Inform Depositor

- That we cannot guarantee the preservation of video files which are in proprietary or obsolete formats (e.g. CDXL).
- The quality of their video file may decrease during future software migrations.

Preservation

Significant Characteristics

For preservation purposes, the significant properties of digital video are the video length (e.g. 90 minutes, 20 seconds), frames per second (25 for PAL, 30 for NTSC), video dimensions (e.g. 720 pixels x 576 pixels), bit-rate (kbps), associated metadata, and file size. If audio is also provided, the audio bit-rate (kbps), frequency (kHz), and number of channels. If no documentation is provided, the Gspot tool will correctly identify common desktop A/V formats.

Technique

The most important stage for preservation will vary according to the source of the digital recording. For 'born-digital' resources (i.e. video stored in a DV format), the point of creation dictates the hardware & software that can be used to edit the digital video. To improve the likelihood that digital video may be preserved, it should be recorded using a standard DV camera and a backup of the digital tape should be taken. The DV footage should also be converted to MPEG-2 and stored on an appropriate media (hard disk, DVD-R/W, tape).

For digital video digitised from an analogue video source, the point of digitisation will be the most important stage. When possible, depositors are encouraged to deposit digital video in the MPEG-2 format. If they do not possess the appropriate software, the MPEG-1 format is accepted. Software dependent codecs (DivX, 3iVX, Xvid) and streaming media (wmv) are generally low in quality and would deteriorate badly during any future migration. To improve their longevity, convert the video into one of the formats suitable for preservation. This will not improve the video quality, but it will minimise any migration that needs to take place in the future.

To successfully preserve the video, the deposited data should be migrated into a format suitable for preservation. This may be achieved by performing the following:

- Use a software tool to ensure the video length (e.g. 90 minutes, 20 seconds), frames per second (25 for PAL, 30 for NTSC), video dimensions (e.g. 720 pixels x 576 pixels), video bit-rate (kbps), the audio bit-rate (kbps), audio frequency (kHz), number of audio channels, and file size equal those provided in the documentation.
- Locate suitable codecs and conversion software that can handle the source format and is capable of outputting the data as MPEG-1 or MPEG-2. The DivX Digest web site host several tools to perform this task.
- Configure the software to output at the same quality as the source data, ensuring that no video resizing, channel merging or other compression techniques are performed.
- If audio data is provided separately (e.g. an MJPEG movie with an independent Wave audio soundtrack), ensure the audio is migrated to the preservation format (see the Preservation Handbook for Digital Audio and follow these instructions).
- Choose a suitable video format, based upon video quality. MPEG-1 is suited to low quality with a picture size of 352 x 288, a maximum bit-rate of 1151929 bits/sec, and only one audio stream. MPEG-2 should be used for anything higher than these specifications. If in doubt, contact the AHDS Executive. The DivX Digest web site host several tools to perform any conversion.
- Ensure that associated metadata integrated into the file itself can be extracted in the software tool and stored in the preservation format. If not, the information should be manually output to an ASCII text file.

Validation of Data

- Generate a checksum for each file

- Compare the video length (e.g. 90 minutes, 20 seconds), frames per second (25 for PAL, 30 for NTSC), video dimensions (e.g. 720 pixels x 576 pixels), video bit-rate (kbps), audio bit-rate (kbps), audio frequency (kHz), number of audio streams, and file size with the documentation and the source data. Ensure that quality has not been reduced in any of these areas or that the video format has been converted from PAL to NTSC or visa-versa.
- Watch the video file to ensure A/V quality has not been significantly reduced, or that the audio and video have become out of sync. If these problems have occurred, return to the original file and migrate it.
- If audio has been recorded in stereo (2 audio outputs) or higher, ensure the audio channels have not been merged or switched to the opposite channel.
- Check the length of the video and audio track to ensure the length has not decreased (i.e. a couple of seconds have been lost).
- Ensure that embedded metadata that identify the author, title, or other information have not been lost on conversion and they are stored in a correct manner.

Specific Problems

Video data that requires a hard-to-find or specific version of a codec may cause problems if the repository is unable to view or convert the data on their systems. VirtualDub, MainActor, BbMPEG, AVI2MPG2, Flask MPEG and Lead Multimedia Converter may provide assistance. Obscure or obsolete formats (e.g. CDXL, IFF Animation) may require emulation software to be deployed in order to convert the source data into a format that can be viewed by mainstream users. The AHDS may also have difficulty playing MJPEG files, which require proprietary software tools or often-unstable codecs in order to view.

Synchronisation between audio and video is also difficult. Migration to a preservation format may affect the timing of the video. If this occurs, the migrated file should be deleted and a migration copy created again. Commercial packages may also be used to re-synchronise the audio and video data.

Additional Information

- bbMPEG and AVI2MPG2
  < http://www.divx-digest.com/software/avi2mpg2.html > Last checked 25/07/2005
- DivX Digest
  < http://www.divx-digest.com > Last checked 25/07/2005
- Flask MPEG
  < http://www.digital-digest.com/dvd/downloads/flaskmpeg.html > Last checked 25/07/2005
- Gspot A/V Identification Tool
  < http://www.free-codecs.com/download/GSpot.htm > Last checked 25/07/2005
- Lead Multimedia Converter
  < http://www.leadtools.com/utilities/video-codecs/multimedia-converters.htm > Last checked 25/07/2005
- MJPEG Tools
  < http://mjpeg.sourceforge.net/ > Last checked 25/07/2005
  Morgan Multimedia M-JPEG2000
  < http://www.morgan-multimedia.com/ > Last checked 25/07/2005
- VirtualDub
  < http://www.digital-digest.com/dvd/downloads/virtualdub.html > Last checked 25/07/2005