2024

NFSA Technical Specifications for Preservation Digitisation

Contents

1. Background

This document details the technical specifications for the National Film and Sound Archive of Australia's (NFSA) digital objects, covering the preservation and distribution of digitised materials. We recognise that evolving with new technologies is integral to the future of audiovisual archives. From the 1930s to the present, the NFSA and its predecessor institutions have worked on and with emerging media technologies. Our approach to selecting, reviewing, and implementing digital object formats reflect current best industry and archival standards.

2. Purpose

The NFSA takes an active role in advising on technical specifications and implementing policies and procedures which contribute to best practice across international GLAMR (Galleries, Libraries, Archives, Museums and Research) sectors. We align our activities across curation, preservation, digitisation, and collection management with the conventions, codes, and protocols developed by national and international peak bodies across film, sound, broadcast and video game archives and museums. We debate principles, participate in and monitor developments, and formulate preservation and distribution strategies based on our own research and through conversations with peers.

Our specifications acknowledge and contribute to the work conducted by the International Federation of Film Archives (FIAF), the International Association of Sound and Audiovisual Archives (IASA), the Australian Museum and Galleries Association (AMaGA) and the Australian Society of Archivists (ASA). We subscribe to the protocols, declarations, and recommendations of UNESCO and its Coordinating Council of Audiovisual Archival Associations (CCAAA).

3. Scope

The Digital Preservation team, in consultation with the Curatorial, Rights & Licensing, and Collection Digitisation teams, is responsible for the selection and recommendation of digital object specifications for the purpose of long-term preservation, discovery, distribution, and use.

The NFSA adheres to peer-reviewed standards when considering the selection and implementation of digital object specifications for long-term preservation, as is widely adopted by leading archival institutions. Digital objects within this document are referenced by their respective standards organisation. Digital objects that are not ratified or those which are currently under standards ratification will reference current technical specifications or white papers at time of publication. Under these guidelines, the referencing of standards and technical specifications ensures that new digital objects are compliant and interoperable.

4. Discovery and Use

Audiovisual content and methods of media consumption are perpetually evolving. In response, the NFSA continues to invest in custom digital interfaces that enable engagement with our collection.

The NFSA's Search the Collection web portal provides public access to the Catalogue and facilitates licensing requests to collection items for commercial and educational use. The NFSA Player streaming platform offers on demand access to selected titles, showcasing its diverse audiovisual collection. Additional access is provided by;

- NFSA YouTube Channel
- NFSA SoundCloud

To aid discoverability of collection items, the NFSA builds its own machine learning and artificial intelligence tools following the principles outlined in the NFSA Principles for Machine Learning and Artificial Intelligence Creation and Use.

5. Digital Object Obsolescence

As audiovisual technologies advance quickly and older technologies fade from use, it is necessary for archives to protect their digital assets from obsolescence by selecting appropriate lossless digital object formats for the purpose of long-term preservation, discovery and distribution. To ensure the ongoing availability of collection items, the NFSA maintains superseded equipment, undertakes scheduled data migrations, utilities software and hardware emulation and monitors the field for technological changes.

The NFSA's preferred digital object specifications are selected or developed following the below requirements, contextually applied:

- Open and non-proprietary

- Mathematically lossless compression or uncompressed

- Wide adoption or common usage

- Endorsed by standards organisations

- Documented

- Unencrypted

- Metadata support

- Maturity of format

Nothing is ever *preserved*, as preservation is an ongoing activity. Digital objects are not immune to obsolescence, requiring a systemised process of monitoring, migration, and normalisation to support continual preservation and access. Contributors to digital obsolescence include unsupported software, hardware, and unsupported digital object containers and codecs. Collection custodians must periodically audit their digital collections to determine if digital objects are at risk and to plan for 'normalisation'.

Normalisation is the process of lossless transcoding of a digital object from an obsolete or at-risk format to an archive's preferred long-term preservation format. Normalisation should not lead to the loss of technical metadata or degradation of quality. Normalisation results in a long-term preservation version of a digital object that no longer at risk of obsolescence. The original digital object is retained in perpetuity as a historical record.

Digital objects received through NFSA acquisition programs are preserved 'as received' in their original format. The NFSA does not normalise this content.

6. NFSA Digital Collection Usage Categories

The NFSA's digital collection is comprised of three usage categories which are defined by the purpose of the digital object.

- **Preservation Material**
    - *Archival version*
- **Distribution/Broadcast Copy**
    - *Production or editorial version, mezzanine*
- **Browse Copy**
    - *Proxy*

PRESERVATION MATERIAL

Preservation Material is a representation of a physical or digital collection item for the purpose of long-term storage and preservation. Preservation Material digital objects represent the original collection item and are created without degradation or loss of quality during the preservation process.

The NFSA's Preservation Material digital objects use mathematically lossless or uncompressed codecs for video, film, audio, and still images. From the Preservation Material digital object, digital derivatives can be created for various purposes.

DISTRIBUTION/BROADCAST COPY

The Distribution/Broadcast Copy is an intermediate format created from the Preservation Material during digitisation or transcoded from the Preservation Material post-digitisation for internal or client use. Typical application of the Distribution/Broadcast Copy includes editorial or broadcast transmission.

BROWSE COPY

The Browse Copy is a low fidelity digital object format created from the Preservation Material during digitisation or transcoded from the Preservation Material post-digitisation and is used for the purpose of immediate browsing via the NFSA Digital Asset Management System (DAMS).

7. Complex Digital Objects

Complex Digital Objects (CDO) comprise of two or more digital objects (files) that are interrelated. They can be structured or unstructured. The original hierarchical structure and filename syntax must be retained. In some cases, the loss of original structure and filename compromises the complex digital objects' integrity and render it unsuitable for long-term preservation and access.

STRUCTURED COMPLEX DIGITAL OBJECTS

Structured complex digital objects are consistently organised within folders (directories) with a file naming convention that has a syntax, and the types of digital objects are defined. Structured complex digital objects are standardised by their respective industry or standards organisation. Digital Cinema Package (DCP) and Interoperable Master Format (IMF) are structured complex digital objects that are standardised and documented by the Digital Cinema Initiative (DCI) and the Society of Motion Picture and Television Engineers (SMPTE).

UNSTRUCTURED COMPLEX DIGITAL OBJECTS

Unstructured complex digital objects don't have consistent organisation, filename syntax, or other standardisations. The structure and filenames are defined by the original author. For example, software, games, websites, and source code with associated digital assets. Where possible, the original author should provide documentation describing the structure and descriptions of the digital objects.

USE OF TAR FORMAT

The NFSA Digitisation teams often scan and digitise physical sets of collection items that are subsequently included within a single TAR (tape archive). For example, digitised reels of film or pages of a script consisting of many images in sequential order.

Due to the importance of retaining original hierarchical structure and filename syntax, the NFSA contains complex digital objects within a TAR format. NFSA chooses not to span or compress the TAR. TAR has no native data compression method.

Due to the opaque nature of a TAR, a Media Hash List (MHL) manifest is generated detailing the digital assets within the TAR. The MHL contains the folder structure, name, data size, and cryptographic hash of each digital object. The MHL manifest is attached to a digital object record within the NFSA Media Asset Management System (MAMS) and used by supported applications to validate the contents of a TAR. MHL's are currently generated for all supplied born-digital collection items.

8. Digital Collection Management

The NFSA's management of its digital collection aligns with the Open Archival Information System model (OAIS – ISO 14721). This model identifies mandatory responsibilities for digital object acquisition, authentication, long-term storage, and discoverability.

The digital collection management fundamentals we follow are:

- Quarantine and authentication of supplied third-party digital objects

- Verification of data integrity at various steps of the data migration path via the usage of checksums

- Quality assurance of digital objects

- Periodic verification of data within the archive via Extended Data Life Cycle management processes

- Long-term data storage on Linear Tape Open (LTO) format. One primary LTO with two copies. LTO supplied by three manufacturers and stored separately across three physical locations, with the third copy geographically isolated from the other two copies

- Periodic migration of the LTO library from the current generation LTO to the next viable generation

The NFSA has adopted LTO for long-term archival storage of the digital collection. LTO 8 is the current generation the archive will migrate to. LTO 8 provides a native (uncompressed) storage capacity of 12 Terabytes (TB) per LTO.

9. Technical Metadata

The following tables detail digital object specifications created during digitisation or post-digitisation via transcoding. Technical metadata varies per digital object, as a result, tables will only contain line items that are relevant to that digital object format. Further information can be found in the definitions chapter.

AUDIO SERVICES					
	Preservation Material			**Distribution / Broadcast Copy**	**Browse Copy**
File Type	Broadcast Wave			Broadcast Wave	Motion Picture Expert Group, Audio Layer 3
File Type Extension	.wav			.wav	.mp3
MIME	audio/wav, audio/wave, audio/x-pn-wav, audio/x-wav (draft), audio/vnd.wave			audio/wav, audio/wave, audio/x-pn-wav, audio/x-wav (draft), audio/vnd.wave	audio/mpeg (RFC 3003)
Developed By	European Broadcast Union (EBU)			European Broadcast Union (EBU)	Fraunhofer Institute for Integrated Circuits (IIS)
Standard Reference	EBU–TECH 3285 (BWF), EBU–TECH 3306 (RF64)			EBU–TECH 3285 (BWF), EBU–TECH 3306 (RF64)	ISO/IEC 11172-3:1993
Professional Community Reference	International Association of Sound and Audiovisual Archives (IASA), IASA TC-04 Guidelines on the Production and Preservation of Digital Audio Objects				
Carrier Format	**Magnetic Tape**	**Compact Disc**	**Digital**		
Audio Encoding	Linear pulse code modulation (LPCM)	Linear pulse code modulation (LPCM)	Linear pulse code modulation (LPCM)	Linear pulse code modulation (LPCM)	MPEG Audio, Version 1, Layer 3
Audio Bit Rate Mode	Constant	Constant	Constant	Constant	Constant
Audio Bit Rate					128 Kbps
Audio Channels	2 or more	2	2 to 8	2 or more	1 or 2
Audio Sampling Rate	96 kHz	44.1 kHz	32 kHz to 48 kHz	44.1 kHz, 48 kHz, 96 kHz	44.1 kHz
Audio Quantisation Bit Depth	24 bit	16 bit	16 to 24 bit	16 or 24 bit	
Audio Compression Mode	Uncompressed	Uncompressed	Uncompressed	Uncompressed	Lossy
Audio Configuration	See notes	Stereo	See Notes	Stereo, Joint Stereo, Dual channel, Single Channel	Stereo, Joint Stereo, Dual channel, Single Channel
Notes	• Open standard developed by European Broadcast Union (EBU). • Broadcast WAV (BWF) is an extension of WAV, developed by Microsoft and IBM. • BWF contains the 'Broadcast extension' chunk, coded 'bext' detailing strict metadata requirements. • The source media determines the number of audio channels, quantisation depth and sampling rate. • Digital media like Minidisc and digital audio tape are digitised with their sample rate and quantisation preserved.				April 23rd, 2017, Technicolor's mp3 licensing program for certain mp3 related patents and software of Technicolor and Fraunhofer IIS has been terminated. Fraunhofer ISS MP3 licensing program

Digital Audio Formats

Format	Channels	Sampling Rate	Bit Depth
ADAT (linear)	2 to 8	48kHz, 96kHz, 192kHz	16/20/24 bit
DA88/HR (linear)	8	44.1kHz, 48kHz	16/24 bit
Digital Compact Cassette (lossy)	2	32kHz, 44.1kHz, 48kHz	16/18 bit
MiniDisc (lossy)	2	44.1kHz	16 bit
R-DAT (linear)	2	32kHz, 44.1kHz, 48kHz	16 bit

- Audio configuration is determined by the number of audio channels, configurations are Stereo, Joint Stereo, Dual channel, Single Channel and Multi-Channel.
- Multi-track media digitised as mono tracks and TAR (tape archive) wrapped

AUDIO SERVICES – FILM SOUND

	Preservation Material		Distribution / Broadcast Copy	Browse Copy
File Type	Broadcast Wave		Broadcast Wave	
File Type Extension	.wav		.wav	
MIME	audio/wav, audio/wave, audio/x-pn-wav, audio/x-wav (draft), audio/vnd.wave		audio/wav, audio/wave, audio/x-pn-wav, audio/x-wav (draft), audio/vnd.wave	
Developed By	European Broadcast Union (EBU)		European Broadcast Union (EBU)	
Standard Reference	EBU-TECH 3285 (BWF), EBU-TECH 3306 (RF64)		EBU-TECH 3285 (BWF), EBU-TECH 3306 (RF64)	
Professional Community Reference	International Association of Sound and Audiovisual Archives (IASA) IASA TC-04, Guidelines on the Production and Preservation of Digital Audio Objects		International Association of Sound and Audiovisual Archives (IASA) IASA TC-04, Guidelines on the Production and Preservation of Digital Audio Objects	
Carrier Format	**Magnetic**	**Optical**		
Audio Encoding	Linear pulse code modulation (LPCM)	Linear pulse code modulation (LPCM)	Linear pulse code modulation (LPCM)	
Audio Bit Rate Mode	Constant	Constant	Constant	
Audio Bit Rate				
Audio Channels	1 or more. See notes.	1 or more. See notes.	1 or more. See Preservation Material notes.	
Audio Sampling Rate	96 kHz	48 kHz or 96 kHz	48 kHz	
Audio Quantisation Bit Depth	24 bit	24 bit	24 bit	
Audio Compression Mode	Uncompressed	Uncompressed	Uncompressed	
Audio Configuration	See notes	See notes	See Preservation Material notes.	
Notes	• Open standard developed by European Broadcast Union (EBU). Broadcast WAV (BWF) is an extension of WAV, developed by Microsoft and IBM. BWF contains the 'Broadcast extension' chunk, coded 'bext' detailing strict metadata requirements. • Audio configuration is determined by the carrier format. Configurations are Mono, Dual Mono, Stereo, Matrixed LTRT or Matrixed LCRS. • 16mm full coat film can contain 2 tracks of audio. • 35mm film can contain matrixed Left Total, Right Total (LTRT) or Centre, Right, Surround (LCRS). **Left (L)**: Carries sound from the left, including dialogue, music, and effects. **Centre (C)**: Primarily for dialogue to anchor voices, also handles centrally located music and effects. **Right (R)**: Similar to Left, carries sound from the right side, including dialogue and effects. **Surround (S)**: Adds ambient sounds and effects for spatial immersion, such as background noises and off-screen effects. • 35mm full coat can have up to 6 stereo tracks, 3 stereo pairs.		Created on demand and supplied to internal or external clients. Specifications may vary pending client requirements.	

FILM SERVICES – MOVING IMAGE – 8MM AND 9.5MM GAUGE FILM

	Preservation Material	Distribution / Broadcast Copy	Browse Copy
File Type	Digital Picture Exchange	Apple QuickTime Movie	Moving Picture Experts Group (MPEG)
File Type Extension	.dpx	.mov	.mp4
MIME	image/x-dpx	video/quicktime (RFC 6381)	video/mp4
Developed By	Society Motion Picture Television Engineers based on the Kodak Cineon digital object format	Apple Inc.	Moving Picture Experts Group
Standard Reference	SMPTE 268M-1994, SMPTE 268M-2003, ST 268-01:2014, ST 268-2:2018	QuickTime File Format and Apple ProRes White Paper	The Moving Picture Experts Group and Coding of audio-visual objects Part 10: Advanced video coding
Professional Community Reference	International Federation of Film Archives (FIAF) and DIN SPEC 15587		
Image Container	DPX version 1.0 or 2.0 if available		
Image Width x Height (Open Gate)	2048 x 1556		
Image Aspect Ratio (Clean Aperture)	~4:3 (~1.33:1)		
Image Bits Per Sample	16 bit linear or logarithmic		
Image Bit Depth	48		
Image Byte Order	Big-endian		
Image Compression Mode	Uncompressed		
Image Photometric Interpretation	RGB (Red Green Blue)		
Video Container		QuickTime MOV	MPEG-4 Part 10
Video Codec		ProRes 4444 (excluding alpha channel)	H.264, Advanced Video Codec, Main Profile @ L3.1
Video Compression mode		Lossy	Lossy
Video Width x Height		1920 x 1080 (High Definition Clean Aperture)	1024 x 576 (Standard Definition Clean Aperture)
Video Display Aspect ratio		16:9	16:9
Video Pixel aspect ratio		1.0	1.0
Video Bit rate		~264 Mbps (~264,000 Kbps as per Apple ProRes White Paper)	1.5 Mbps (1500 Kbps)
Video Bit Rate Mode		Variable	Constant
Video Frame Rate		Re-timed native film frame rate to 24p	Re-timed native film frame rate to 24p
Video Colour space		YUV	YUV
Video Chroma Subsampling		4:4:4	4:2:0
Video Bit Depth		12 bits	8 bits
Video Scan Mode / Order		Progressive	Progressive
Audio Encoding		Pulse Code Modulation (PCM), signed, little-endian	Advanced Audio Codec Low Complexity
Audio Bit Rate Mode		Constant	Constant
Audio Bit Rate			128 Kbps
Audio Channels		2	2
Audio Sampling Rate		48 kHz	48 kHz
Audio Quantisation Bit Depth		24 bits	24 bits
Audio Compression Mode		Lossy	Lossy
Audio Configuration		Left / Right (Mono, Dual Mono or Stereo) or mute	Left / Right (Mono, Dual Mono or Stereo) or mute
Timecode (TC)	Image sequence scanned sequentially and numerically ordered. Frame Rate determined by the film scanner TC MODE that specifies how the scanner transforms frame count to timecode and embedded as metadata within the DPX header as dpx: tv.time.code.	QuickTime Timecode metadata track.	Burnt In Timecode (BITC) overlay.
Notes	Open Gate, the Film is scanned to include partial perforations, frame lines and if available the optical soundtrack. No colour profile is applied to ensure an authentic and unchanged representation of the film in digital format. The DPX image sequence and if available WAV (See Audio Film Sound) audio components are wrapped into a TAR (Tape Archive) container.	Clean Aperture, the DPX image sequence is cropped to exclude perforation and frame lines conforming to a 1920 x 1080 resolution. Frame rates other than 24 fps are re-timed implementing frame rate conversion via frame interpolation or blending. A primary colour grade is applied. Audio may consist of 1 channel, mono, Left or 2 channels, stereo, Left and Right. For silent film audio tracks are mute.	Browse Copy is a representation of the Distribution / Broadcast Copy therefore not representative of the original Preservation Material.

FILM SERVICES – MOVING IMAGE – 16MM GAUGE FILM

	Preservation Material	Distribution / Broadcast Copy	Browse Copy
File Type	Digital Picture Exchange	Apple QuickTime Movie	Moving Picture Experts Group (MPEG)
File Type Extension	.dpx	.mov	.mp4
MIME	image/x-dpx	video/QuickTime (RFC 6381)	video/mp4
Developed By	Society Motion Picture Television Engineers based on the Kodak Cineon digital object format	Apple Inc.	Moving Picture Experts Group
Standard Reference	SMPTE 268M-1994, SMPTE 268M-2003, ST 268-01:2014, ST 268-2:2018	QuickTime File Format and Apple ProRes White Paper	The Moving Picture Experts Group and Coding of audio-visual objects Part 10: Advanced video coding
Professional Community Reference	International Federation of Film Archives (FIAF) and DIN SPEC 15587		
Image Container	DPX version 1.0 or 2.0 if available		
Image Width x Height (Open Gate)	2150 x 1334		
Image Aspect Ratio (Clean Aperture)	16:10 (1.61:1)		
Image Bits Per Sample	16 bit linear or logarithmic		
Image Bit Depth	64		
Image Byte Order	Big-endian		
Image Compression Mode	Uncompressed		
Image Photometric Interpretation	RGBA (Red Green Blue Alpha)		
Video Container		QuickTime MOV	MPEG-4 Part 10
Video Codec		ProRes 4444 (excluding alpha channel)	H.264, Advanced Video Codec, Main Profile @ L3.1
Video Compression mode		Lossy	Lossy
Video Width x Height		1920 x 1080 (High Definition Clean Aperture)	1024 x 576 (Standard Definition Clean Aperture)
Video Display Aspect ratio		16:9	16:9
Video Pixel aspect ratio		1.0	1.0
Video Bit rate		~264 Mbps (~264,000 Kbps as per Apple ProRes White Paper)	1.5 Mbps (1500 Kbps)
Video Bit Rate Mode		Variable	Constant
Video Frame Rate		Re-timed native film frame rate to 24 fps	Re-timed native film frame rate to 24 fps
Video Colour space		YUV	YUV
Video Chroma Subsampling		4:4:4	4:2:0
Video Bit Depth		12 bits	8 bits
Video Scan Mode / Order		Progressive	Progressive
Audio Encoding		Pulse Code Modulation (PCM), signed, little-endian	Advanced Audio Codec Low Complexity
Audio Bit Rate Mode		Constant	Constant
Audio Bit Rate			128 Kbps
Audio Channels		1 to 2. See notes	1 to 2. See notes
Audio Sampling Rate		48 kHz	48 kHz
Audio Quantisation Bit Depth		24 bits	24 bits
Audio Compression Mode		Lossy	Lossy
Audio Configuration		Left / Right (Mono, Dual Mono or Stereo) or mute. See notes.	Left / Right (Mono, Dual Mono or Stereo) or mute. See notes.
Timecode (TC)	Image sequence scanned sequentially and numerically ordered. Frame Rate determined by the film scanner TC MODE that specifies how the scanner transforms frame count to timecode and embedded as metadata within the DPX header as dpx: tv.time.code.	QuickTime Timecode metadata track.	Burnt In Timecode (BITC) overlay.
Notes	Open Gate, the Film is scanned to include partial perforations and frame lines, ~5% overscan of the clean aperture. No colour profile is applied to ensure an authentic and unchanged representation of the film in digital format. The DPX image sequence and if available WAV (See Audio Film Sound) audio components are wrapped into a TAR (Tape Archive) container.	Clean Aperture, the DPX image sequence is cropped to exclude perforation and frame lines conforming to a 1920 x 1080 resolution. Widescreen formats will remain hard matted letterbox. Frame rates other than 24 fps are re-timed implementing frame rate conversion via frame interpolation or blending. A primary colour grade is applied. Audio may consist of 1 channel, mono, Front Center or 2 channels, stereo, Front Left and Front Right. Silent film, audio tracks are absent from the MOV. If applicable, audio timing will be corrected to match frame rate.	Browse Copy is a representation of the Distribution / Broadcast Copy therefore not representative of the original Preservation Material.

FILM SERVICES – MOVING IMAGE – 28MM GAUGE FILM

	Preservation Material	Distribution / Broadcast Copy	Browse Copy
File Type	Digital Picture Exchange	Apple QuickTime Movie	Moving Picture Experts Group (MPEG)
File Type Extension	.dpx	.mov	.mp4
MIME	image/x-dpx	video/quicktime (RFC 6381)	video/mp4
Developed By	Society Motion Picture Television Engineers based on the Kodak Cineon digital object format	Apple Inc.	Moving Picture Experts Group
Standard Reference	SMPTE 268M-1994, SMPTE 268M-2003, ST 268-01:2014, ST 268-2:2018	QuickTime File Format and Apple ProRes White Paper	The Moving Picture Experts Group and Coding of audio-visual objects Part 10: Advanced video coding
Professional Community Reference	International Federation of Film Archives (FIAF) and DIN SPEC 15587		
Image Container	DPX version 1.0 or 2.0 if available		
Image Width x Height (Open Gate)	4096 x 3112		
Image Aspect Ratio (Clean Aperture)	4:3 (1.33:1)		
Image Bits Per Sample	16 bit linear or logarithmic		
Image Bit Depth	48		
Image Byte Order	Big-endian		
Image Compression Mode	Uncompressed		
Image Photometric Interpretation	RGB (Red Green Blue)		
Video Container		QuickTime MOV	MPEG-4 Part 10
Video Codec		ProRes 4444 (excluding alpha channel)	H.264, Advanced Video Codec, Main Profile @ L3.1
Video Compression mode		Lossy	Lossy
Video Width x Height		3840 x 2160 (Quad Full High Definition Clean Aperture)	1024 x 576 (Standard Definition Clean Aperture)
Video Display Aspect ratio		16:9	16:9
Video Pixel aspect ratio		1.0	1.0
Video Bit rate		~1061 Mbps (~1,061,000 Kbps as per Apple ProRes White Paper)	1.5 Mbps (1500 Kbps)
Video Bit Rate Mode		Variable	Constant
Video Frame Rate		Re-timed native film frame rate to 24 fps	Re-timed native film frame rate to 24 fps
Video Colour space		YUV	YUV
Video Chroma Subsampling		4:4:4	4:2:0
Video Bit Depth		12 bits	8 bits
Video Scan Mode / Order		Progressive	Progressive
Audio Encoding		Pulse Code Modulation (PCM), signed, little-endian	Advanced Audio Codec Low Complexity
Audio Bit Rate Mode		Constant	Constant
Audio Bit Rate			128 Kbps
Audio Channels		1 to more. See notes	1 to 2. See notes
Audio Sampling Rate		48 kHz	48 kHz
Audio Quantisation Bit Depth		24 bits	24 bits
Audio Compression Mode		Lossy	Lossy
Audio Configuration		See Audio Services Film Sound and Notes	Left / Right (Mono, Dual Mono or Stereo) or mute. See notes.
Timecode (TC)	Image sequence scanned sequentially and numerically ordered. Frame Rate determined by the film scanner TC MODE that specifies how the scanner transforms frame count to timecode and embedded as metadata within the DPX header as dpx: tv.time.code.	QuickTime Timecode metadata track.	Burnt In Timecode (BITC) overlay.
Notes	Open Gate, the Film is scanned to include partial perforations and frame lines, ~5% overscan of the clean aperture. No colour profile is applied to ensure an authentic and unchanged representation of the film in digital format. The DPX image sequence and if available WAV (See Audio Film Sound) audio components are wrapped into a TAR (Tape Archive) container.	Clean Aperture, the DPX image sequence is cropped to exclude perforation and frame lines conforming to a 3840 x 2160 resolution. The films native aperture determines if masking is applied resulting in one of three outcomes, letter or pillar box or full frame image. Frame rates other than 24 fps are re-timed implementing frame rate conversion via frame interpolation or blending. A primary colour grade is applied. Audio may consist of 1 channel (mono, Front Centre) or 2 channels, (stereo, Front Left and Front Right). Silent film, audio tracks are absent from the MOV. If applicable, audio timing will be corrected to match frame rate.	Browse Copy is a representation of the Distribution / Broadcast Copy therefore not representative of the original Preservation Material.

FILM SERVICES – MOVING IMAGE – 35MM GAUGE FILM

	Preservation Material			Distribution / Broadcast Copy	Browse Copy
File Type	Digital Picture Exchange			Apple QuickTime Movie	Moving Picture Experts Group (MPEG)
File Type Extension	.dpx			.mov	.mp4
MIME	image/x-dpx			video/quicktime (RFC 6381)	video/mp4
Developed By	Society Motion Picture Television Engineers based on the Kodak Cineon digital object format			Apple Inc.	Moving Picture Experts Group
Standard Reference	SMPTE 268M-1994, SMPTE 268M-2003, ST 268-01:2014, ST 268-2:2018			QuickTime File Format and Apple ProRes White Paper	The Moving Picture Experts Group and Coding of audio-visual objects Part 10: Advanced video coding
Professional Community Reference	International Federation of Film Archives (FIAF) and DIN SPEC 15587				
Carrier Format	**Academy and Wide Screen**	**Cinemascope**	**Techniscope**		
Carrier Perforations	2, 3 or 4	4	2		
Image Width x Height (Open Gate)	4,300 x 3,324	4,300 x 3,324	4,300 x 1,660		
Image Aspect Ratio (Clean Aperture)	1.37:1	2.35:1 to 2.39.1	2:35:1		
Image Container	DPX version 1.0 or 2.0 if available				
Image Bits Per Sample	16 bit linear or logarithmic				
Image Bit Depth	64				
Image Byte Order	Big-endian				
Image Compression Mode	Uncompressed				
Image Photometric Interpretation	RGBA (Red Green Blue Alpha)				
Video Container				QuickTime MOV	MPEG-4 Part 10
Video Codec				ProRes 4444 (excluding alpha channel)	H.264, Advanced Video Codec, Main Profile @ L3.1
Video Compression mode				Lossy	Lossy
Video Width x Height				3840 x 2160 (Quad Full High Definition Clean Aperture)	1024 x 576 (Standard Definition Clean Aperture)
Video Display Aspect ratio				16:9	16:9
Video Pixel aspect ratio				1.0	1.0
Video Bit rate				~1061 Mbps (~1,061,000 Kbps as per Apple ProRes White Paper)	1.5 Mbps (1500 Kbps)
Video Bit Rate Mode				Variable	Constant
Video Frame Rate				Re-timed native film frame rate to 24 fps	Re-timed native film frame rate to 24 fps
Video Colour space				YUV	YUV
Video Chroma Subsampling				4:4:4	4:2:0
Video Bit Depth				12 bits	8 bits
Video Scan Mode / Order				Progressive	Progressive
Audio Encoding				Pulse Code Modulation (PCM), signed, little-endian	Advanced Audio Codec Low Complexity
Audio Bit Rate Mode				Constant	Constant
Audio Bit Rate					128 Kbps
Audio Channels				1 or more. See notes	1 to 2. See notes
Audio Sampling Rate				48 kHz	48 kHz
Audio Quantisation Bit Depth				24 bits	24 bits
Audio Compression Mode				Lossy	Lossy
Audio Configuration				See Audio Services Film Sound and Notes	See Notes
Timecode (TC)	Image sequence scanned sequentially and numerically ordered. Frame Rate determined by the film scanner TC MODE that specifies how the scanner transforms frame count to timecode and embedded as metadata within the DPX header as dpx: tv.time.code.			QuickTime Timecode metadata track.	Burnt In Timecode (BITC) overlay.
Notes	Open Gate, the Film is scanned to include partial perforations and frame lines, ~5% overscan of the clean aperture. No colour profile is applied to ensure an authentic and unchanged representation of the film in digital format. The DPX image sequence and if available WAV (See Audio Film Sound) audio components are wrapped into a TAR (Tape Archive) container.			Clean Aperture, the DPX image sequence is cropped to exclude perforation and frame lines conforming to a 3840 x 2160 resolution. The films native aperture determines if masking is applied resulting in one of three outcomes, letter or pillar box or full frame image. Frame rates other than 24 fps are re-timed implementing frame rate conversion via frame interpolation or blending. A primary colour grade is applied. Audio may consist of 1 channel (mono, Front Centre) or 2 channels, (stereo, Front Left and Front Right). Silent film, audio tracks are absent from the MOV. If applicable, audio timing will be corrected to match frame rate.	Browse Copy is a representation of the Distribution / Broadcast Copy therefore not representative of the original Preservation Material.

FILM SERVICES – DIGITAL IMAGING

	Preservation Material		Preservation Material	Distribution / Broadcast Copy		Browse Copy
File Type	Tagged Image File Format		Portable Document Format	Tagged Image File Format		Joint Photographic Experts Group
File Type Extension	.tif		.pdf	.tif		.jpg
MIME	Image/tiff (RFC3302)		application/pdf	Image/tiff (RFC3302)		image/jpeg
Developed By	Aldus, acquired by Adobe Systems		Adobe Systems	Aldus, acquired by Adobe Systems		Joint Photographic Experts Group
Standard Reference	ISO 12234		ISO 32000	ISO 12234		ISO/IEC 10918
Professional Community Reference						
Material Size (inches)	Larger than 11" x 14"	Smaller than 11" x 14"		Larger than 11" x 14"	Smaller than 11" x 14"	See notes
Image Resolution (Dots Per Inch)	300 DPI	600 DPI		300 DPI	600 DPI	300 DPI
Image Container	tif			tif		jpg
Image Width x Height	Determined by material size			Determined by material size		See notes
Image Bits Per Sample	16 bits			8 bits		8 bits
Image Bit Depth	48 bits			24 bits		24 bits
Image Byte Order						
Image Compression Mode	Uncompressed		Lossy	Uncompressed		Lossy
Image Photometric Interpretation	Profoto ICC			Adobe RGB 1998		Adobe sRGB
Notes	- The specification document titled "TIFF Revision 6.0, Final – June 3, 1992" can be obtained from Adobe Systems Incorporated. - The file type extension can be written as .tif or .tiff. - Multi-page TIFF images are wrapped in Tape Archive (TAR) format, and a Portable Document Format (PDF) catalogue is generated.		- Published as an open standard by Adobe on the 1st of July, 2008. It is an ASCII–based digital object containing binary components. - PDF is used as a catalogue or proof sheet containing the images of scanned material.			The image width can change but is limited to a height of 640 pixels to preserve the original aspect ratio.

VIDEO SERVICES – STANDARD DEFINITION AND STANDARD DYNAMIC RANGE

	Preservation Material	Distribution / Broadcast Copy	Browse Copy
File Type	Material Exchange Format	Apple QuickTime Movie	Moving Picture Experts Group (MPEG)
File Type Extension	.mxf	.mov	.mp4
MIME	application/mxf	video/quicktime (RFC 6381)	video/mp4
Developed By	JPEG (Joint Photographic Expert Group) 2000 developed by Joint Technical Committee ISOAEC JTC 1	Apple Inc.	Moving Picture Experts Group
Standard Reference	SMPTE ST 377-1:2011, SMPTE ST 378:2004, SMPTE ST 379-1:2009, SMPTE ST 380:2004, SMPTE 382:2007, SMPTE 422:2014, SMPTE 436:2006, ISO/IEC 15444-1:2016	QuickTime File Format and Apple ProRes White Paper	The Moving Picture Experts Group and Coding of audio-visual objects Part 10: Advanced video coding
Professional Community Reference	International Association of Sound and Audiovisual Archives (IASA), IASA TC-06 Guidelines for the Preservation of Video Recordings		
Video Container	MXF (Material Exchange Format), version 1.2 (SMPTE ST 377)	MOV (QuickTime Movie)	MPEG-4 Part 10
Video Operational pattern	Op-1a (SMPTE ST 378)		
Video Essence wrapping	Frame wrapped (SMPTE ST 379)		
Video Codec	Motion JPEG2000 (ISO/IEC 15444-1:2016, SMPTE 422:2014)	ProRes 422 HQ	H.264, Advanced Video Codec, Main Profile @ L3.1
Video Compression mode	Lossless	Lossy	Lossy
Video Width x Height	See common video formats	See common video formats	1024 x 576
Video Display Aspect ratio	See common video formats	See common video formats	16:9
Video Pixel aspect ratio	See common video formats	See common video formats	1.0
Video Maximum Bit rate	~100 Mbps (~100,000 Kbps)	PAL, ~61 Mbps NTSC, ~63 Mbps	1.5 Mbps (1500 Kbps)
Video Bit Rate Mode	Variable	Variable	Constant
Video Frame Rate	PAL 50i or NTSC 59.94i	PAL 50i or NTSC 59.94i	PAL 25p or NTSC 29.97p
Video Edit units	50/1 or 60/1 edit units per second		
Video Broadcast standard	*PAL or NTSC. See common video formats*	*PAL or NTSC. See common video formats*	
Video Colour space	*YUV or YcbCr (As per source material)*	*YUV or YcbCr (As per source material)*	YUV
Video Chroma Subsampling	4:2:2	4:2:2	4:2:0
Video Bit Depth	10 bits	10 bits	8 bits
Video Scan Mode / Order	Interlaced / Top Field First or as per source material	Interlaced / Top Field First or as per source material	Progressive
Audio Format	MXF-GC AES-BWF Audio (SMPTE ST 382:2007)	Pulse Code Modulation, signed little-endian	Advanced Audio Codec Low Complexity
Audio Bit Rate Mode	Constant	Constant	Constant
Audio Bit Rate	4.608 Mbps (4,608 Kbps)	1.152 Mbps (1152 Kbps)	128 Kbps (0.128 Mbps)
Audio Channels	4	4	2
Audio Sampling Rate	48 kHz	48 kHz	48 kHz
Audio Quantisation Bit Depth	24 bits	24 bits	24 bits
Audio Compression Mode	Uncompressed	Uncompressed	Lossy
Audio Configuration	As per source material	As per source material	2 channels (or absent from source material, audio can be silent)
Timecode (TC)	Control timecode track (CTC), Non-drop frame, striped. MXF Source package (embedded), non-drop frame. MXF material package (striped), non-drop frame, striped.	QuickTime Timecode metadata track.	Burnt In Timecode (BITC) overlay.
Notes	• SMPTE ST 379 - Each field are stored in a separate key length value (KLV). One KLV/field by edit unit. • See common video formats for more information.	Video and Audio characteristic are identical to the Preservation Material, created either during Digitisation or transcoded from the Preservation Material post digitisation.	• Created post Digitisation transcoded from the Preservation Material. • Content with a 4:3 aspect ratio is pillar boxed. Interlaced field-based content is deinterlaced. • Additional burnt in overlays include the NFSA logo and Media Asset Manager Media Identification. • Multi-track audio sources with more than 2 audio channels requires evaluation prior to mixing down due to variations in audio channel assignments.

VIDEO SERVICES – HIGH DEFINITION AND STANDARD DYNAMIC RANGE

	Preservation Material	Distribution / Broadcast Copy	Browse Copy
File Type	Material Exchange Format	Apple QuickTime Movie	Moving Picture Experts Group (MPEG)
File Type Extension	.mxf	.mov	.mp4
MIME	application/mxf	video/quicktime (RFC 6381)	video/mp4
Developed By	JPEG (Joint Photographic Expert Group) 2000 developed by Joint Technical Committee ISOAEC JTC 1	Apple Inc.	Moving Picture Experts Group
Standard Reference	SMPTE ST 377-1:2011, SMPTE ST 378:2004, SMPTE ST 379-1:2009, SMPTE ST 380:2004, SMPTE ST 382:2007, SMPTE 422:2014, SMPTE 436:2006, ISO/IEC 15444-1:2016	QuickTime File Format and Apple ProRes White Paper	The Moving Picture Experts Group and Coding of audio-visual objects Part 10: Advanced video coding
Professional Community Reference	International Association of Sound and Audiovisual Archives (IASA), IASA TC-06 Guidelines for the Preservation of Video Recordings		
Video Container	MXF (Material Exchange Format), version 1.2 (SMPTE ST 377)	MOV (QuickTime Movie)	MPEG-4 Part 10
Video Operational pattern	Op-1a (SMPTE ST 378)		
Video Essence wrapping	Frame wrapped (SMPTE ST 379)		
Video Codec	Motion JPEG2000 (ISO/IEC 15444-1:2016, SMPTE 422:2014)	ProRes 4444 (Excluding Alpha Channel)	H.264, Advanced Video Codec, Main Profile @ L3.1
Video Compression mode	Lossless	Lossy	Lossy
Video Width x Height	1920 x 1080	1920 x 1080	1024 x 576
Video Display Aspect ratio	16:9 (1.78:1)	16:9 (1.78:1)	16:9
Video Pixel aspect ratio	1.0	1.0	1.0
Video Maximum Bit rate	~492 Mbps (~492,000 Kbps)	~264 to ~660 Mbps (264,000 to 660,000 Kbps)	1.5 Mbps (1500 Kbps)
Video Bit Rate Mode	Variable	Variable	Constant
Video Frame Rate	As per source material PAL 50i or NTSC 59.94i (interlaced) 23.98PsF, 24PsF, 25PsF (progressive segmented frames)	As per source material PAL 50i or NTSC 59.94i (interlaced) 23.98PsF, 24PsF, 25PsF (progressive segmented frames)	As per source material PAL 25p or NTSC 29.97p 23.98PsF, 24PsF, 25PsF (progressive segmented frames)
Video Edit units	Match source material		
Video Broadcast standard	See common video formats	*See common video formats*	
Video Colour space	*As per source material, YUV or YcbCr*	*As per source material, YUV or YcbCr*	YUV
Video Chroma Subsampling	4:2:2	4:4:4	4:2:0
Video Bit Depth	10 bits	10 bits	8 bits
Video Scan Mode / Order	As per source material. Interlaced / Top Field First or Progressive	As per source material. Interlaced / Top Field First or Progressive	Progressive
Audio Format	MXF-GC AES-BWF Audio (SMPTE ST 382:2007)	Pulse Code Modulation, signed little-endian	Advanced Audio Codec Low Complexity
Audio Bit Rate Mode	Constant	Constant	Constant
Audio Bit Rate	18.4 Mbps (18,400 Kbps)	~1.152 Mbps (1152 Kbps)	128 Kbps (0.128 Mbps)
Audio Channels	4 to 16	4 to 16	2
Audio Sampling Rate	48 kHz	48 kHz	48 kHz
Audio Quantisation Bit Depth	24 bits	24 bits	24 bits
Audio Compression Mode	Uncompressed	Uncompressed	Lossy
Audio Configuration	As per source material	As per source material	2 channels (or absent from source material, audio can be silent)
Timecode (TC)	Control timecode track (CTC), Non-drop frame, striped. MXF Source package (embedded), non-drop frame. MXF material package (striped), non-drop frame, striped.	QuickTime Timecode metadata track.	Burnt In Timecode (BITC) overlay.
Notes	SMPTE ST 379 - Each field are stored in a separate key length value (KLV). One KLV/field by edit unit. See common video formats for more information.	Video and Audio characteristic are identical to the Preservation Material, created either during Digitisation or transcoded from the Preservation Material post digitisation.	• Created post Digitisation transcoded from the Preservation Material. • Content with a 4:3 aspect ratio is pillar boxed. Interlaced field-based content is deinterlaced. • Additional burnt in overlays include the NFSA logo and Media Asset Manager Media Identification. • Multi-track audio sources with more than 2 audio channels requires evaluation prior to mixing down due to variations in audio channel assignments.

10. Common Video Resolutions

PAL, STANDARD DEFINITION (SD)				
Display Aspect Ratio	**Pixel Aspect Ratio**	**Active Resolution**	**Scan Type**	**Common Name**
4:3 (1.33:1)	1.092	720 x 576	Interlaced	576i
16:9 (1.78:1)	1.456	720 x 576	Interlaced	576i Anamorphic

NTSC, STANDARD DEFINITION (SD)				
Display Aspect Ratio	**Pixel Aspect Ratio**	**Active Resolution**	**Scan Type**	**Common Name**
4:3 (1.33:1)	0.909	720 x 480	Interlaced	480i
16:9 (1.78:1)	1.212	720 x 480	Interlaced	480i Anamorphic

HIGH DEFINITION (HD)				
Display Aspect Ratio	**Pixel Aspect Ratio**	**Active Resolution**	**Scan Type**	**Common Name**
16:9 (1.78:1)	1.1	1280 x 720	Progressive	720p
16:9 (1.78:1)	1.1	1920 x 1080	Interlaced	1080i
16:9 (1.78:1)	1.1	1920 x 1080	Progressive	1080p

11. NFSA Glossary

Accessioning	Process whereby selected material is received and incorporated into the National Audiovisual Collection.
Acquisition	Collection or single instance of material received by the NFSA.
Analogue Tech Info	Custom Metadata document containing technical information relating to a Media Item in the National Collection, defined by item type: Disc (Audio), Disc (Moving Image), Film, Object, Paper, Photograph, Tape Moving Image, Tape Audio, Tape (Software), Magnetic Disk (Software), Cartridge (Software), or Optical Disc (Software).
Article	Representation in an acquisition of single or multiple instances of an analogue or digital item type. Articles may be selected or non-selected. Articles accessioned into the National Audiovisual Collection become Media Items.
Attachments	Personal, professional, company, collection or record label name records in the media asset management system that can be attached to acquisitions, versions and/or media items as sources, credits or record label catalogue information.
Authorities	Personal, professional, company, collection or record label name records in the media asset management system that can be attached to acquisitions, versions and media items as sources, credits or record label catalogue information. Authorities can also be linked to Rights records.
Barcode	A unique number applied to a carrier or a storage location. Generated by the system upon creation of a carrier or location. Used to track items in the media asset management system against their physical locations.
Carrier	Represents the physical part of a whole media item, for instance reel 1 of 6 reels of film that make up one film media item of an original release version. Each carrier has its own unique barcode. Does not apply to digital items.

Digital Carrier (Data Carrier)	Physical data storage device, for example, hard drive (HDD), solid state drive (SSD), Universal Serial Bus (USB), optical disk, floppy disc etc. Digital carrier is also referred to as a data carrier, describe as "any medium holding machine readable data".
Condition	Physical description of the condition of a carrier, eg. Scratches, entered at Carrier level. Description is selected from a Condition list, and a severity is entered, extra notes can also be entered.
Consignment Transfer	Process which accessions items in bulk.
Container	Represents the containers in which material or articles are originally received (called Original or Preselected) and then later, the containers in which the material or articles are distributed into for processing, eg. Examination, Selected, Non-Selected, On Loan for Copying. Each container has a unique barcode for tracking purposes. Containers can also be manually created and have carriers scanned into them.
Custom Metadata	Custom metadata can include intellectual or physical information and be related to different record types.
Deaccession	The process of amending catalogue records to document that a previously held work has been removed from the collection. At the NFSA, the catalogue record is retained in perpetuity, so once an item has been deselected its status is changed to 'deaccessioned material'.
Deselection	The formal process of research and assessment resulting in a decision to remove an item from the national audiovisual collection. NFSA staff may recommend an item be deselected. Once this recommendation is formally approved the item is permanently removed, it is deaccessioned and documented accordingly.
Form	Content sub-category, such as script, poster, series, oral history, etc. The NFSA currently uses approximately 50 forms options and one item can have multiple forms selected assigned.
Genre	Genre is a secondary descriptor after Form. It is optional and multi-value.

Groups	List of items as selected by staff.
Ingest	Process by which digital copies of existing media items, made in-house, are incorporated into the National Audiovisual Collection. Different to accessioning digital material received in an acquisition.
Item	Interchangeable term with Media Item. Represents the physical item of the version, e.g. the set of six reels of film of an original release version. Contains technical information relating to the item as a whole.
Item Format	Technical category applied to Media Items, designated at the point of article creation in Acquisitions, or job creation with Make or Ingest tasks. Categories include Film, Disc (Audio), Disc (Moving Image), Digital, Photographic, Paper, Object, Tape (Audio), Tape (Moving Image), Tape (Software), Magnetic Disk (Software), Cartridge (Software), or Optical Disc (Software).
Item Type	Technical sub-category applied to Media Items, designated during the processing of accessioning or make tasks. There are currently 34 categories, most are sub-categories of Item Formats: Paper, Object or Photographic. The remaining are simply re-iterations of Item Formats: Film, Disc (Audio), Disc (Moving Image), Digital, Tape (Audio), Tape (Moving Image).
Job	Interchangeable term with workflow, process in the media asset manager that groups different types of tasks, or a single task. Typically, users use workflow presets which have been built to incorporate different tasks into one workflow and can be selected to be raised on items and articles. Workflow presets can be assigned or designed for work group areas or individuals. Individual tasks in a workflow may be carried out by different Users, according to task type, or automatically completed by the media asset manager.
Made	Origin of an item made denotes that the item was made in house at the NFSA, rather than received in an acquisition (Supplied).
Make Task	Workflow task that creates a new item from an existing item.

Media Item	Interchangeable term with Item. Represents the physical item of the version, e.g. the set of six reels of film of an original release version. Contains technical information relating to the item as a whole.
Medium	Unique content category applied to collection items. There are currently five mediums: Artefact, Audio, Documentation, Moving Image and Multimedia.
Media ID1	Also may be listed in the system as MIID1. Media Item number, generally the item's version number, followed by sequential number indicating order of creation (i.e. item 0003 created before item 0004).
Media ID2	Also may be listed in the system as MIID2. Acquisition number, Container number and Article Number. To search on this number, you must insert a wildcard symbol % or * at the end of the number.
Movement	A movement request can be generated for one or more items; it is created by a user to have analogue material moved from one part of the NFSA to another. Movements are raised within the NFSA Media Asset Manager.
Non–select	Material received in an acquisition that is not selected to be held in the National Audiovisual Collection. Material may be returned to the donor or client and is actioned according to the acquisition agreement.
On Loan for Copying	Material received in an acquisition that the NFSA has been permitted to copy to make items for the National Audiovisual Collection, with the originals returned to the source client.
Origin	Refers to the method by which media is brought into the collection. The two options are MADE, material created by the NFSA or SUPPLIED, material acquired by the NFSA.
Picklist	Groups of records. Some picklists form a list e.g. Media Picklist and others have functionality associated with them e.g. Copying picklists.
Rack Number	Unique ID created by MAVIS, a previous MAMS at the NFSA. Alpha–numerical identifier applied to carriers based on usage, format and size. Eg. A preservation colour film in a 2000' can would have the prefix: PCZ followed by number applied sequentially according to

	creation order. Used in the media asset manager as the carriers' unique barcode to track the carrier's movements. See also Barcode in this glossary.
Selected	Material received in an acquisition that is selected to be held in the National Audiovisual Collection. This material will be processed into the Collection through accessioning tasks.
Sub-medium	Content sub-category. There are currently nine mediums: Artefact, Documentation, Film, Multimedia, Networked Media, Radio, Sound Recording Published, Sound Recording Unpublished and Television. Only one category can be applied at a time.
Supplied	Origin of an item supplied denotes that the item was received from an external source through an acquisition, rather than made in house at the NFSA (Made).
Task	Archive processes that are contained in a workflow and carried out by NFSA staff. Process may be a movement, an ingest of a file, accessioning of an item, transcode of a file etc.
Tech Code	Concatenated technical description of a Media Item. Technical codes are built from particular descriptors assigned to the different item types. Eg. Film item type has seven descriptors: Description, Colour Process, Sound, Aspect Ratio, Roll, A or B and Material. Each descriptor has a set list of terms to choose from, each with their own abbreviation which forms part of the tech code. Not each descriptor is a mandatory field, meaning some can be left blank. This means the tech code can vary in appearance from one item of the same type to another.
Title	First level of data in the media asset management system. Represents the overarching work, i.e. Mad Max, which then contains various iterations, i.e. Original Release, Director's Cut etc. Contains limited intellectual and descriptive information relating to the work as a whole.
Transcode	Task that creates a digital media item, of a different file and usage type, from an existing digital media item. Eg. The creation of an Browse jpeg image from a Preservation tiff image.

Treatment	Term used to denote a preservation treatment applied to a carrier, eg. preservation wind entered at Carrier level. Specific treatment is selected from a Treatment list, notes can also be entered accordingly.
Usage	Archival category of a Media Item which affects where the item is stored and its possible use. Broadly defined as Preservation, Duping or Browse, with some variations on those depending on format. Any media item that is the only representation of a version is given the usage of Preservation. If subsequent items are received, the usage of that item may be altered depending on the additional formats received and their condition.
Version	Second level of data in the media asset management system, below Titles. Represents the different iterations, i.e. Original Release, Director's Cut, of an overarching work/title, i.e. Mad Max. Contains intellectual and descriptive information specific to that version of the work. Most intellectual data is found in the Versions. Includes production and credit details and summary descriptions of the content of the version.
Workflow	Interchangeable term with job, process in the media asset manager that groups different types of tasks, or a single task. Typically, users utilise workflow presets which have been built to incorporate different tasks into one workflow and can be selected to be raised on items and articles. Workflow presets can be assigned or designed for work group areas or individuals. Individual tasks in a workflow may be carried out by different Users, according to task type, or automatically completed by the media asset manager.

12. Technical Definitions

Alpha Channel (motion picture)	Infrared (IR) capable scanners employ infrared light for illumination and sensors that can measure data within the IR range. IR introduces an extra channel to the conventional red, green, and blue (RBG) channels, known as the Alpha channel, which specifies the opacity of the colour forming the RGBA colour space. The alpha channel is utilised within restoration software to detect anomalies such as dust, dirt, and scratches on film surfaces. This data creates a dirt matte, effectively pinpointing the areas that require correction for image restoration purposes. IR limited to colour film stock.
Audio channels	Number of audio channel streams stored within a digital object.
Audio configuration	Audio within a digital object is comprised of one or more audio channels. Audio configuration describes how the audio channels are stored and reproduced and is representative of the original source media.
Audio sampling rate	Number of samples of audio per second measured in hertz (Hz) or kilohertz (kHz). 1 kHz = 1000 Hz.
Bit	Short for binary digit. The smallest computational unit symbolised by zeros and ones.
Bit depth (audio)	Digital audio bit depth refers to the resolution of a digital audio object by the number of bits of information per sample. See Bits Per Sample (audio). A higher bit depth will capture a wider dynamic range with 24–bit samples providing c. 144 decibels of dynamic range.
Bit depth (image)	Image bit depth refers to the number of bits used per colour channel of an image. Example, 8 bits is comprised of 256 shades of Red, 256 shades of Green and 256 shades of Blue (RGB), producing a total of 16.7 million colours.
	Higher bit depths reduce banding artefacts in an image that can occur when using a lower bit depth. Higher bit depths provide high colour accuracy of an image during digitisation or scanning, improving colour resolution.
	Colour accuracy and resolution is determined by the acquisition method. For example, a film telecine bayer chip camera, with a single sensor captures the red,

green, and blue colour channels with a chroma subsampling of 4:2:2. At 8 bits, this produces an image with 16.7 million colours with a reduced colour resolution requiring a de-bayer process that interpolates colours.

A film linear scan camera capturing at 16 bits, produces an image with 281 trillion colours at a sharper colour resolution due to the scanner having three linear scan sensors each for the red, green, and blue colour channels with a chroma sampling of 4:4:4, resulting in a higher colour resolution as interpolation is not required.

Colours per channel (squared):

8 bits = 256 (2^8) colours

10 bits = 1024 (2^{10}) colours

12 bits = 4096 (2^{12}) colours

16 bits = 65,536 (2^{16}) colours

24 bits = 16,777,216 (2^{24}) colours

32 bits = 4,294,967,296 (2^{32}) colours

Total colours (cubed):

8 bits = 16,777,216 (256^3)

10 bits = 1,073,741,824 (1024^3)

12 bits = 68,719,476,736 (4096^3)

16 bits = 281,474,976,710,656 ($65,536^3$)

24 bits = 4,722,366,482,869,645,213,696 (4.7 sextillion)

32 bits = 79,228,162,514,264,337,593,543,950,336 (79 octillion)

Bit rate	The number of bits per unit of time typically measured in seconds. Digital object bit rates are defined by their associated standards organisations. Higher bit rates typically, with exceptions, result in higher quality digital objects.
Bit rate mode	Digital object bit rate can be defined as constant or variable.
	Constant bit rate is a fixed data rate, which informs the compressor or decompressor that the reproduction of a video image regardless of data complexity should remain the same.
	Variable bit rate is not a fixed data rate. Informs the compressor or decompressor that the reproduction of a video image or audio sample will vary based on

	computational analysis of the image while maintaining quality within the defined range of the bit rate.
Bits per sample (audio)	Refers to the number of bits used to describe data per sample unit. 8 bits = 256 (2^8) 10 bits = 1,024 (2^10) 12 bits = 4,096 (2^12) 16 bits = 65,536 (2^16) 24 bits = 16,777,216 (2^24) 32 bits (float) = 4,294,967,296 (3.4 x 10^38)
Browse Copy	A digital object that is made for browsing of the digital collection. The Browse Copy is made accessible via online systems and can be distributed to clients prior to them making a final decision on desirability of material.
Channel layout	Audio-visual multitrack recordings can consist of more than one audio channel. Surround sound recordings are a typical example. For example, channel 1 is assigned to the left speaker and channel 2 is assigned to the right speaker. Each channel allocation is derived from the original production recording. Society of Motion Picture and Television Engineers (SMPTE) and International Telecommunication Union (ITU) standards outline the professional recording and playback of multitrack audio configurations such as 5.1 and 7.1 surround sound. SMPTE ST 2067-1:2016 standard specifies the use of Material Exchange Format (MXF) for the interchange of multichannel audio supporting various configurations. ITU-R BS.2102 standard covers the audio coding for broadcasting, the following example consists of a 12 channel, multitrack production recording consists of stereo channels with discrete 5.1 surround, encoded 5.1 surround and mono/stereo channels. 1. Stereo Left (L) 2. Stereo Right (R) 3. 5.1 Front Left (FL) 4. 5.1 Front Right (FR) 5. 5.1 Centre (C) 6. 5.1 Low Frequency Effects (LFE) 7. 5.1 Surround left (Ls) 8. 5.1 Surround right (Rs)

	9. Optional encoded 5.1 10. Optional encoded 5.1 11. Other 12. Other Tracks 1 and 2 (Stereo), can be a mix down of the multichannel surround sound. Tracks 11 and 12 could be used for alternative commentary(s), different language tracks or audio description, in mono or stereo. Unmixed audio multi–track recordings demonstrate a further example of multi– channel content. In these instances, tracks are not assigned directly to speakers and will require further mixing.
Chroma subsampling	Chroma subsampling is the practice of encoding images by implementing less resolution for chroma information than for luminance information, taking advantage of the human visual system's lower acuity for colour differences than for luminance. For example, with 4:2:2 the first number refers to the luminance (brightness) part of the signal, and the second two refer to the colour (chroma). In this example, luminance is sampled 4 times while the chroma is sampled twice. Luminance has a higher sample due to the human eye is more sensitive to brightness than colour. Technical representation as follows: 4:2:2 – 4=Y (Luma), 2=R–Y (Red minus Luma), 2=B–Y (Blue minus Luma). Analogue signals are typically represented as YUV (Y=Luma, UV=Chroma). Digital signals are typically represented as YCbCr (Y–Luma, CbCr=Chroma). 4:4:4 chroma signal is not subsampled, providing high colour resolution, and twice the colour resolution of 4:2:2. The luminance sample remains the same.
Codec	Combination of the two words coder and decoder. An input data signal is encoded into a compression format and decoded on output. Codec is commonly referred as compression format, for example JPEG2000.
Coding settings	Codecs contain parameters that can be altered that affect the quality during encoding or decoding of a digital object. Some parameters can affect the quality outcome of a digital object, where others are format

	dependant and are required to meet standards specification.
Colour space	The colour space is the method of defining the perceptual characteristics of colour information within a digital object. For example, television references colour as RGB (Red Green Blue) or Y R–Y B–Y (Luminance Red minus luminance Blue minus luminance) that is also represented as YCbCr. Print for example references CMYK (Cyan, Magenta, Yellow and Black). Scanned film is RGB while digital cinema is X'Y'Z. The above definitions are ambiguous and overlapping.

RGBA	RGBA (Red Green Blue Alpha)
sRGB	sRGB (standard Red Green Blue) created by HP and Microsoft. Specified in IEC 61966–2.1:1999. World standard for digital images.
sYCC	YCC transmits or represents the three Red, Green, and Blue (RGB) channels as a luminance channel (Y) and two colour-difference channels, Cr and Cb.
	sYCC is simply YCC created from sRGB. YCC is just a shorter way of saying YCrCb.
YCbCr	Y' luminance, Cb blue difference, Cr red difference. Abbreviated as YCC. Difference, YUV is analogue and YCbCr is digital. Standards describing colour conversion known as transfer characteristics are as follows:
	ITU-R BT.601 – Standard Definition (SD) standard
	ITU-R BT.709 – High Definition (HD) standard
	ITU-R BT.2020 – Ultra High Definition (UHD) standard
	ITU-R BT.2100 – High Dynamic Range (HDR) Standard
YUV	Used in PAL composite colour video (excluding PAL-N). One Y' luminance, Two UV chrominance. YUV colour space developed to provide compatibility

	between colour and black / white analogue television. YPbPr is the component variation sometimes referred to Y'UV. Y'IQ analogue NTSC broadcasting systems. YDbDr analogue SECAM and PAL–N.
Container	A container or wrapper is a method of storing a variety of encoded streams of data or essence with metadata that describe the data within the container.
Complex Digital Object	Complex Digital Object (CDO) comprises interrelated digital objects that are structured or unstructured. Complex digital objects are reliant on each other to form a complete data set. Complex digital objects require their original file names and folder structures to remain intact.
Compression mode	Encoding of a digital signal can result in a lossy or lossless compression determined by the codec parameters or specification applicable to the digital object.
	Lossy mode: during the encoding process of a digital signal, information is lost. Audio–visual digital objects can be reproduced that appear to the human eye or ear as a one for one copy, but due to the compression process digital signal information has been lost.
	Lossless mode: during the encoding process of a digital signal, no information is lost, resulting in a one for one recreation of the data signal. The signal data can be compressed with mathematically lossless algorithms to reduce the size of the resulting digital object.
Digital Object	A digital object is structured data presented as a digital file format for use on computing systems. Majority of Digital objects contain technical metadata to determine which application can read and display the data in a human readable format. Also referred to as a file.
Display aspect ratio	Also known as DAR. The ratio of an image or display, width to height.
Display width x height	Display width and height of an image measured in pixel units.
Distribution/Broadcast Copy	The Distribution/Broadcast Copy is an intermediate digital object format created from the Preservation

	Material or during digitisation, for internal or external use. Typical application of the Distribution/Broadcast Copy includes, but is not limited to, editorial or broadcast transmission.
Edit units	Interlaced video is comprised of two fields per frame of video, often described as odd or even (upper or lower). Edit unit is the interpretation of a single field of video stored within the codec essence of the material exchange format (MXF) container.
	Australian broadcast standard for analogue terrestrial transmission is known as PAL (Phase Alternating Line). PAL standard references the video frame rate as 25 frames per second (FPS).
	SAMMA JPEG2000 stores each field as a single image, this method does not introduce interlaced or motion artefacts. Considering PAL has a frame rate of 25 frames per second, edit unit would equate to 50 fields per second. Also represented as 50i.
	SMPTE standard ST422-2014 describes edit units and field-based wrapping within a MXF container.
Essence profile	Essence refers to the coded stream within a wrapper or container, consisting of but not limited to, an audio or video codec. Profile defines a set of capabilities that target applications and inform the decoder as to the requirements to decode the stream. For example, MPEG (Motion Pictures Expert Group) has various application specific profiles.
Essence wrapping	Essence refers to the coded stream within a wrapper or container, consisting of an audio or video codec. Wrapping is how the essence is stored within a wrapper or container. For example, SAMMA SOLO JPEG2000 is frame wrapped.
Filename extension	A suffix given to digital objects to identify its type in human readable form and inform the computing systems which application to use to open the digital object.
Film gauge	See Motion Picture Film Formats and Gauges
Frame rate	Number of whole frames of an image per unit of measured time, normally in blocks of 1 second, also referred as frames per second (FPS). Australian

	television for example is 25 FPS. Common film frame rates are 16, 18 and 24 FPS.
Image resolution	Still image horizontal and vertical measurement measured in dots per inch (DPI).
Logarithmic & Linear colour space (Kodak Cineon & Film)	Kodak created a computer based digital film system known as the Cineon System, with the development of the Cineon 10-bit log digital object format. The Cineon format has 10 bits, 1024 colours per channel of Red, Green, and Blue (RGB). Colour channels are stored in a logarithmic format that corresponds to the density of the original negative, defined as Log Colour or Log Gamma. Log Colour retains most of the dynamic range of information from the film negative, retaining detail in areas of extreme light and dark (luminance) areas. The resulting film image has the characteristics of a washed-out image also known as a flat image. A flat image is corrected by colour grading or applying a LUT (Look Up Table). LUTs are used to create a 'look' of an image and change from one colour space to another, giving a linear appearance. Linear Colour or Linear Gamma has constant luminance values true to their exact mathematical value. With the discontinuation of the Cineon System, SMPTE developed the digital object format Digital Picture Exchange (DPX), SMTPE standard; ST 268M:2003, current version.
Lossless compression	Digital object where the data is not compressed or data compression that is reversible, equating to zero loss of quality during encoding or decoding process.
Material Exchange format (MXF)	Material Exchange Format is a container format comprised of video, audio, and ancillary metadata within the one digital object that is interoperable between various professional audio-visual systems.
Mediaflex definition: "Made"	Origin of an item made denotes that the item was made in house at the NFSA, rather than received in an acquisition.
Mediaflex definition: "Supplied"	Origin of an item supplied denotes that the item was received from an external source through an acquisition, rather than made in-house at the NFSA.

MIME	Multipurpose Internet Mail Extension (MIME) is an internet standard developed to extend the types of data digital objects originally supported by email. Each standard is allocated a Request for Comment (RFC) number and is governed by the Internet Engineering Task Force (IEFT) and the Internet Society (ISOC). Note: There are registered and unregistered types.
Motion Picture Preservation Film Scans	Motion picture preservation film scans aims to faithfully reproduce the colour and lighting qualities of the original materials. No colour profiles are applied to ensure an authentic and unchanged representation of the film in digital format. This means, for instance, a colour negative film remains a negative during the point of capture and is inverted during later post-production stages.
Motion Picture Film Formats and Gauges	Refers to the dimensions of the apertures used in motion picture cameras to expose cinematograph film and in projectors for its presentation on the screen of the cinema theatre. They have been internationally standardized for all gauges of film now in commercial use. It is general practise for the camera aperture to be slightly larger all round than the mask used in the projector, so as to avoid the image of an unexposed area of negative being projected, but camera masks or reduced apertures smaller than the projector aperture height are sometimes used in photography of wide screen formats.
	The printed area on the positive and release print is always made larger than the projector aperture and usually corresponds at least to the area exposed on the camera negative.
	Film gauge is the physical width of the film measured in units of millimetres. Measurement includes the film perforation and soundtrack.
	A comprehensive list of formats can be found on the NFSA website <u>Film Formats.</u>
Negative Film	An image in which the tonal and colour values are reversed. Used to make a positive image, normally a print by projection. A negative image is an image in which the values of light and shade of the original subject are represented in inverse order.
	In a Black and White film image, light objects of the original subject are represented by high densities and dark densities are represented by low densities. In

	colour negatives, colours are represented by their complementary colours.
Operational pattern	The structure of the Material Exchange Format (MXF) is defined by operational patterns (OP), defining a single essence stream within the MXF container.
PAL broadcast standard	Globally there are various broadcast television standards for the transmission and reception of terrestrial television signals. Standards are set by the International Telecommunication Union (ITU). Australia adopted the PAL colour system (Phase Alternating Line), standard B (PAL–B) for analogue signals. For digital terrestrial television (DVT), Australia adopted digital video broadcasting – terrestrial DVB–T (digital video broadcasting terrestrial) (digital video broadcasting terrestrial) standard.
Photometric interpretation	Specifies the intended interpretation of the image pixel data. For example, RGB = Red Green Blue.
Pixel aspect ratio	Also known as PAR. The ratio of a pixel in a digital image, width to height.
Preservation Material	Lossless digital objects are made from the physical item or supplied born digital objects. They are kept in the archive, regardless of the compression algorithm they are made with, to be used as the primary preservation digital object.
Quantisation depth (Audio)	Also known as audio bit depth is the number of bits per sample of audio that corresponds to the resolution of each sample. Bit depth is only referenced in pulse code modulation (PCM) digital signal. Audio formats that are not PCM based and are lossy compression do not have associated bit depths.
Sampling rate	Number of samples of audio per second measured in Hz (hertz) or kHz (1000 Hz).
Scan mode	A digital video image can be comprised of interleaved lines, known as fields or interlaced scan, or progressive scan. Interlaced scan: The image is captured and reproduced two separate times due to having two fields. The fields are known as odd and even and to capture or

	reproduce the image, all the odd fields are captured followed by the even fields.
	Progressive scan: Each line of an image is captured and reproduced in sequence from top to bottom of the image.
Standard reference	Digital objects described in this document are governed by international organisations who define the technical specifications. If a digital object technical specification is not ratified by any of the audio–visual organisations, a reference to appropriate documentation will be provided if available.
	Standard Organisations:
	Audio Engineering Society (AES)
	European Broadcasting Union (EBU)
	European Computer Manufacturers Association (ECMA)
	International Electrotechnical Commission (IEC)
	International Organisation for Standardisation (ISO)
	International Telecommunication Union (ITU)
	Society of Motion Picture & Television Engineers (SMPTE)
Timecode	A method that identifies every frame of digital or analogue video media using a time stamp represented as hours, minutes, seconds, and frames.
	Timecode Standards:
	SMPTE ST 12–1:2014 – Time and Control Code
	SMPTE ST 12–2 – Transmission of Time Code in the Ancillary Data Space
	SMPTE ST 12–3:2016 – Time Code for High Frame Rate Signals and Formatting in the Ancillary Data Space
	SMPTE ST 266:2002 – Digital Vertical Interval Time Code

13. Technical References

EBU TECH 3285	This is version 2 of the Broadcast Wave Format (BWF) specification. This is a substantial revision that incorporates Loudness Metadata (in accordance with EBU R 128) and which takes account of the publication of Supplements 1 – 6 and other relevant documentation. BWF – A format for audio data files in broadcasting
EBU TECH 3306	RF64 is intended to meet the requirements for multichannel sound in broadcasting and audio archiving. It is based on the Microsoft RIFF/WAVE format and Wave Format Extensible for multichannel parameters. The 2009 update adds a 'r64m' marker chunk. RF64: An Extended File Format for Audio
ISO/IEC 11172–3:1993	Specifies the coded representation of high-quality audio for storage media and the method for decoding of high-quality audio signals. Is intended for application to digital storage media providing a total continuous transfer rate of about 1,5 Mbit/s for both audio and video bit streams, such as CD, DAT, and magnetic hard disc, and for sampling rates of 32 kHz, 44,1 kHz, and 48 kHz. Information technology — Coding of moving pictures and associated audio for digital storage media
ISO/IEC 15444–1:2024	Information technology – JPEG 2000 image coding system – Part 1
IEC 61966–2–1:1999	Applies to the encoding and communication of RGB colours used in computer systems and similar applications, by defining encoding transformations for use in defined reference conditions. The contents of the corrigendum of January 2014 have been included in this copy. Multimedia systems and equipment – Colour measurement and management – Part 2-1: Colour management – Default RGB colour space – sRGB
ST 421:2013	VC-1 Compressed Video bit stream Format and Decoding Process. SMPTE Documents

ST 268:2014	Digital Object Format for Digital Moving - Picture Exchange (DPX).
	<u>SMPTE Documents</u>
ISO 12639:2004	Specifies a media-independent means for prepress electronic data exchange using a tag image file format (TIFF). ISO 12639:2004 defines the digital object image formats for encoding colour continuous-tone picture images, colour line-art images, high-resolution continuous-tone images, monochrome continuous-tone picture images, binary picture images, binary line-art images, screened data, and images of composite final pages.
	<u>Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)</u>
ISO/IEC 10918-1:1994	Specifies processes for converting source image data to compressed image data, processes for converting compressed image data to reconstructed image data, coded representations for compressed image data, and gives guidance on how to implement these processes in practice. Is applicable to continuous-tone - grayscale or colour - digital still image data and to a wide range of applications which require use of compressed images. Is not applicable to bi-level image data.
	<u>Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines</u>
ECMA-376	This Standard defines Office Open XML vocabularies and document representation and packaging. It also specifies requirements for consumers and producers of Office Open XML.
	<u>Office Open XML file formats</u>
ISO/IEC 29500-1:2016	Defines a set of XML vocabularies for representing word-processing documents, spreadsheets, and presentations, based on the Microsoft Office 2008 applications. It specifies requirements for Office Open XML consumers and producers that comply to the strict conformance category.
	<u>Information technology — Document description and processing languages — Office Open XML File Formats</u>
ISO 32000-2:2017	Specifies a digital form for representing electronic documents to enable users to exchange and view electronic documents independent of the environment in which they were created or the environment in which they are viewed or printed. It is intended for developers of software that creates

PDF (portable document format) digital objects (PDF writers), software that reads existing PDFs and (usually) interprets their contents for display (PDF readers), software that reads and displays PDF content and interacts with the computer users to possibly modify and save the PDF (interactive PDF processors) and PDF products that read and/or write PDFs for a variety of other purposes (PDF processors). (PDF writers and PDF readers are more specialised classifications of interactive PDF processors and all are PDF processors).

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ST 377–1:2011	SMPTE Standard – Material Exchange Format (MXF) – File Format Specification. SMPTE Documents
ST 378:2004	SMPTE Standard for Television – Material Exchange Format (MXF) – Operational pattern 1A (Single Item, Single Package). SMPTE Documents
ST 379–2:2010	SMPTE Standard for Television – Material Exchange Format (MXF) – MXF Constrained Generic Container. SMPTE Documents
ST 382:2007 (Am2:2013)	SMPTE Amendment – Material Exchange Format – Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container – Amendment 2. SMPTE Documents
ST 422:2014	SMPTE Standard – Material Exchange Format – Mapping JPEG 2000 code streams into the MXF Generic Container. SMPTE Documents
ST 356:2001	Television – Type D–10 Stream Specifications – MPEG–2 4:2:2P @ ML for 525/60 and 625/50. SMPTE Documents
ISO 14721:2012	Open Archival Information System (OAIS) Space data and information transfer systems – Open archival information system (OAIS) – Reference model

14. Other References

Australian Digital Alliance	http://www.digital.org.au
Australian Digital Access to Collections Initiative	http://www.glampeak.org.au
Museums Australia and Galleries Association	https://www.amaga.org.au/
National Film and Sound Archive Australia	https://www.nfsa.gov.au/
International Federation of Film Archives	http://www.fiafnet.org
International Association of Sound and Audiovisual Archives	http://www.iasa-web.org
Australian Society of Archivists	https://www.archivists.org.au
United Nations Educational, Scientific and Cultural Organisations	https://whc.unesco.org