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Technical Guidelines

Archiving Scheme 2

September 2018

This document sets out guidelines for the archiving of audio and video programme content (collectively audio-visual content), which was made for broadcast, to assist potential applicants in the preparation of an application for funding under Archiving Scheme 2 (“the Scheme”).

These guidelines are not intended to be overly prescriptive and/or detailed, but a resource to provide potential applicants with more supporting information around the Scheme to assist in a wider engagement with it across the independent broadcasting and production sectors than there has been heretofore.

In this regard, the Scheme is a support structure, operated by the BAI and funded through the television licence fee, to encourage and promote the development of an archiving culture in the Irish broadcasting sector as a whole, contributing to the safeguarding of Irish heritage. The BAI has published a policy document for this Scheme further to the Broadcasting Act 2009, ‘Funding Scheme for the Archiving of Programme Material (“Archiving Scheme 2”)’, which sets out the key elements of the Scheme in terms of objectives, role of the BAI, eligibility, available funding and operational matters. The BAI has also published guidance on potential strategic partnerships. These guidelines should be read in conjunction with this policy and the guidance.

In making an application, the BAI expects applicants to have regard to internationally accepted archiving standards in their respective archiving activities detailed in a proposal. The BAI is cognisant of the changing nature of archiving standards as digital technologies evolve. In this regard, these guidelines will be regularly reviewed and adapted to ensure adherence with internationally accepted standards for the archiving of programme material in digital format, both audio and audio-visual.

BAI publications and further information on the Scheme and functions of the BAI can be found at [www.bai.ie](http://www.bai.ie/).

If you have any queries in relation to these Technical Guidelines, please email [archiving@bai.ie](mailto:archiving@bai.ie) or phone (01) 6441 200.

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1. Strategic Objectives

**The BAI is obliged to develop a Scheme that achieves three strategic objectives:**

**a) an integrated approach to archiving of programme material;**

**b) develop suitable storage processes and formats to encourage and assist bodies in the restoration and/or storage of programme material; and,**

**c) to provide fast and accurate access to the archive.**

**The BAI recommends that a fundamental archiving goal for any applicant is the cataloguing, preserving and provision of access to digital audio-visual content.**

In order for the BAI to ensure that the strategic aims of the Scheme are met, it is essential that the Scheme supports the creation of digital audio-visual collections and that such proposed projects are based on an integrated approach. In this regard, it may be necessary for applicants who lack an archiving legacy, experience and/or expertise to develop partnerships with suitable entities and experts that can provide archiving and technical/digital expertise to enable a strategic approach to the applicant’s archiving practices. A partnership approach could provide the necessary technical know-how and storage solutions that otherwise are not available to an applicant. This approach could also assist in developing the applicant’s knowledge and capacity in the area of archiving.

Applicants should note that archiving projects supported under the Scheme will be expected to provide fast and accurate access to programme material by all interested parties including the public. The exact mechanisms will be negotiated on a project by project basis to accommodate the different stages of development of the various archives. Projects supported will also be expected to raise public awareness of the preservation and use of broadcast archive materials.

1. Technical Criteria

The technical choices that your organisation will make regarding audio-visual file formats will be driven by the needs of the organisation and its partners and stakeholders.

Within the practice of audio-visual archiving there are two key groups whose needs and objectives are somewhat different. In one group we have traditional archivists who seek the highest quality to support the objective of preservation and in the second group broadcasters and post production companies who seek interoperability to support the objective of distribution.

The following list of four criteria can be used to consider a principle-based approach to selecting the best audio-visual file configuration to meet the needs of your organisation and its objectives.

1. **Quality**: Digitisation of audio-visual materials to digital file formats that use compression typically results in a lower resolution or quality of sound/image, this is a trade-off as it also decreases the cost of storing the resulting file or delivering it to users across a network. Consider your source material and your target file format – choose a format that will preserve the native quality of the source and that is high enough quality to support future use. Where distribution and access are important consider having a digital ‘master’ file format for archiving and a ‘proxy’ format for distribution. If it is the case that the proxy file we may use today will not be suitable in the future, the master file should allow us to recreate new proxy files in a highly automated way as needed in the future.
2. **Openness**: Like software programmes the audio-visual signal compression technologies (codecs) and file containers (wrappers) that can be used to create digital audio-visual files can be proprietary or open source. Choose technologies that do not restrict your use and avoid those that may not be widely supported in the future.
3. **Adoption**: Consider the adoption of the technology by other archives or organisations similar to your own. The technology should be adopted by both content owning companies and the vendors who support them with products and services. If there is little evidence of adoption of a potential technology among your peers try to find out why this is the case. Avoid audio-visual file formats that are at risk of becoming obsolete too quickly and will require transcoding early in your digital archiving plan.
4. **Functionality**: Choose audio-visual file formats that support a range of applications and can be handled easily, efficiently and without risk of error. File formats that are easy to analyse for faults and features are useful and will support future automation of quality assurance and metadata harvesting workflows.
5. Video Formats

BAI recommends storage of Video Recordings as digital video files in one of three classes depending on the needs of your organisation:

* Class 1: Uncompressed Video
* Class 2: Lossless Compressed Video
* Class 3: Broadcast Quality Video

**Class 1: Uncompressed Video:**

Uncompressed 10bit video can be used where highest quality is required and data storage costs are not an issue, for example when working with a low volume of source recordings or low total duration of high value material. The use of uncompressed video file formats will result in a very large file size per hour of material digitized. As it is uncompressed the entirety of signal information is captured from the source video recording and no information is removed to reduce the filesize or resulting data storage overhead.

Uncompressed 10 bit video is widely supported but can be difficult to work with due to the size of the video files. 1 hour of uncompressed SD video will take up approximately 125GB of data storage space.

Uncompressed video files can be generated using a v210 codec and wrapped using a AVI or MOV container. MXF containers can also be used however they are more complex and can introduce interoperability issues and therefore should be fully tested.

**Class 2: Lossless Compressed Video**

Losslessly compressed video refers to digital video files that have been compressed to reduce the data storage overhead through a mathematically lossless technique. By using a lossless compression technology to create digital video files an organisation can significantly reduce the storage overhead for its digital video collections.

Lossless compression technologies are becoming popular among AV archivists as they offer high quality. However, they are not widely adopted by Broadcasters as they do not offer the same level of interoperability to support broadcast distribution and playout workflows as more common Broadcast Quality Video formats. 1 hour of lossless compressed SD video will take up approximately 50GB of storage.

Lossless video codecs used by audio-visual archives in the past decade include JPEG2000 and FFV1 which has been growing in popularity in recent years. JPEG2000 can use both open source or proprietary implementations and uses MXF or Quicktime (.mov) as a container. FFV1 is fully open source and is included in FFmpeg, a widely adopted open source technology platform for video encoding. When FFV1 is used with the Matroska (.mkv) container it is a fully open source solution that is popular with many national/public archives.

**Class 3: Broadcast Quality Video**

Broadcast Quality Video refers to digital video files that have been compressed in order to reduce the data storage overhead using a lossy video compression technique. Certain broadcast video file formats are typically used within the industry to drive interoperability, speed and efficiency in content workflows and have many advantages within that context.

Lossy compression will enable an organisation to store more video (greater duration of video material in hours and minutes) on digital storage systems than Uncompressed or Lossless Compressed video and therefore is a good choice where large amounts of video are to be digitised and storage costs are a concern.

Video compression is the process of lowering the data rate of a digital video signal by removing information that is redundant or unimportant. However, the removal of information can also result in a compression artefact or error where too much information is removed. Sometimes a video encoder will introduce small variations or distortions that can be visible to the eye as motion blurring or blockiness. The higher the compression ratio the more artefacts are likely to be encountered.

Broadcast Quality Video file formats that have been used in recent years by Broadcasters and Archivists include AS-11 which uses AVC Intra 100 for HD video and D10 for SD video sources. The AS-11 format is widely used for broadcast distribution in the UK and is the format preferred by the BAI for items deposited with the Irish Film Archive under the Sound and Vision scheme.

DV25 is often used in cases where the source is DV (such as DV Cam or MiniDV tape) as the native video encoding can be preserved.

Other video codecs such as H.264 are popular, particularly for online video production and distribution in addition to ProRes which is the Apple proprietary video format and DNxHD which is the Avid version. All of these are good options where interoperability and ease of distribution is important. However, as they can operate at various compression ratios it is important to understand how much compression is being used and what impact this will have on the long term viability of the video content to be preserved.

In summary, digital video formats, just like video tapes, are not designed to last forever and there will be a requirement to transcode files to new formats in the future. Where one chooses to use a high level of lossy compression it is at the expense of permanent loss of information that may at some future point be useful. There is no method to reverse this loss other than to replay and re-digitise the original video tape. From a preservation perspective, the costly tape to file conversion step should be a one time event and any future upgrades to a new format in the future should be an automated file based transcode process.

1. Audio File Formats

The BAI recommends storage of Audio Recordings as digital audio files in one of two classes depending on the needs of your organisation:

* Class 1: Linear Audio Files
* Class 2: Compressed Audio Files

**Class 1: Linear Audio Files**

Linear audio can be used where the highest quality is required. It is suitable for recordings that have not been previously compressed in the signal chain (e.g. off air radio recording). Because of the simplicity and ubiquity of linear Pulse Code Modulation (PCM) the International Association of Sound Archives recommends the use of WAV, (file extension .wav). These files are widely used in the professional audio industry.

Original recordings from cassette, acetate, vinyl, ¼” Reel or other analogue sources will benefit from being digitised to .wav files. At a minimum a .wav file should be generated using 16bit sampling at a 48kHz sampling frequency. However as set out in IASA TC-04 technical guidelines 24bit sampling rates and sampling frequencies of 96kHz are useful for high quality and sonically complex source material (e.g. an orchestral recording or live music concert).

Unlike video files, audio files will not take up a large amount of storage. 1 hour of .wav audio will take up approximately 1GB of storage.

**Class 2: Compressed Audio Files**

Compressed audio can be used where the source signal is an already compressed signal, for example where a recording is made from an internet audio stream.

As these signals are already compressed audio signals there will be little benefit to recording them using a linear audio format. However, when recording an already compressed signal, always use a level of compression that is at least equal to or lower ratio than the source (in both sampling frequency and bit rate) as this may avoid any further degeneration in quality of the recording.

For off air and streamed recordings an AAC format audio file generated at a bit rate of 128kbps is recommended. MP3 or AAC files of no less than 64kbps are acceptable however some consideration should be given to the type of sound you are recording. Speech only content will be less effected by the higher compression ratio (at 64kbps) than more sonically complex sound such as musical recordings.

1 hour of AAC at 128kbps audio will take up approximately 0.1GB of storage.

1. Metadata

The BAI supports the use of technical standards for metadata describing recordings of programme materials that enable contextual search and retrieval of files from within for example a media asset management system or website and that support seamless transfer to and interoperability with other archiving systems and projects.

Metadata should at a minimum include the following three types of information:

* ***Administrative:*** *Name of the licensed broadcaster or independent producer, date and time of transmission, Licence type / copyright*
* ***Descriptive:*** *A description of or keywords relating to the contents of the recording that may include topics, subject matter, notable places, people, events, dates. Names of presenter and contributors.*
* ***Technical:*** *The format of the audio or video file*

As a baseline BAI recommends the use of a constrained metadata model based upon the Dublin Core and EBU Core metadata models.

The following information can be stored for each file:

1. Title (file name)
2. Creator (such as Name of Station / Producer)
3. Date (Date of broadcast/Publication)
4. Type (Category of Programme Contents)
5. Description (Free text description – programme name, subjects, events, people, locations or other relevant information)
6. Contributors (Names of persons speaking in recording – useful for news and radio recordings)
7. Format (audio or video file format)
8. Language (Irish or English)
9. Copyright

On the following page are two samples of xml Dublin Core Metadata Records, the first describes an audio recording from Newstalk, the second a video promo from Rising Sun Productions:

Sample 1 (audio):

<?xml version=”1.0” encoding=”UTF-8”?>

<metadata

xmlns:xsi=”<http://www.w3.org/2001/XMLSchema-instance>”

xmlns:dc=”<http://purl.org/dc/elements/1.1/>”>

<dc:title>newstalk10620161202</dc:title>

<dc:creator>newstalk106</dc:creator>

<dc:date>20161202</dc:date>

<dc:type>news</dc:type>

<dc:description>Newstalk Breakfast, Son of Brian Stack responds to Gerry Adams' comments, Mick Clifford discusses upcoming whistle blower report</dc:description>

<dc:contributor>Shane Coleman</dc:contributor>

<dc:contributor> Brian Stack n</dc:contributor>

<dc:contributor> Mick Clifford </dc:contributor>

<dc:format>AAC Audio</dc:format>

<dc:language>English</dc:language>

<dc:copyright>Newstalk Ltd. Reg # 309181, Marconi House, Digges Lane Dublin</dc:copyright>

</metadata>

Sample 2 (video):

<?xml version=”1.0” encoding=”UTF-8”?>

<metadata

xmlns:xsi=”<http://www.w3.org/2001/XMLSchema-instance>”

Xmlns:dc=”<http://purl.org/dc/elements/1.1/>”>

<dc:title>Rising Sun Productions Promo Reel 2018</dc:title>

<dc:creator>Rising Sun Productions</dc:creator>

<dc:date>20180808</dc:date>

<dc:type>advertising</dc:type>

<dc:description>Rising Sun Production Promo Reel 2018 </dc:description>

<dc:creator>Shane McMahon</dc:creator>

<dc:publisher>Rising Sun Productions</dc:publisher>

<dc:format>AS11 Video</dc:format>

<dc:language>English</dc:language>

<dc:copyright>Rising Sun Productions Ltd. 3 Big St, Dublin 2 Reg IE 234154 </dc:copyright>

</metadata>

1. File Storage

The audio-visual file format that you choose and the duration of content that you will digitise can be used to calculate the storage requirements for your organisation to store and back up its digital audio-visual materials.

| Audio-visual File Format | Approximate Storage Requirements for 1 Hour of Material |
| --- | --- |
| Uncompressed HD Video (1080 x 1920 10 bit) | 650 GB per Hour |
| Uncompressed SD Video – (720 x 576 10bit) | 125 GB per Hour |
| Lossless Compressed SD Video  (FFV1 or JPEG200) | 50 GB per Hour |
| Broadcast Quality HD Video  (AS-11 AVC Intra 100) | 45 GB per Hour |
| Broadcast Quality SD Video  (AS-11 D10) | 25 GB per Hour |
| Broadcast Quality SD Video  (DV-25) | 10 GB per Hour |
| High Quality Internet Streaming File (Video)  (H.264 @ 5Mbps) | 2.5 GB per Hour |
| Uncompressed Audio File  (24bit/48kHz WAV) | 1 GB per Hour |
| Off Air Quality Audio File  (AAC Audio File @ 128kbps) | 0.1 GB per Hour |

Given the range of formats and duration of content held, in addition to the different access requirements of organisations there is no one storage solution that will suit all. Options exist for organisations to use any combination of cloud storage or on-premise storage of files on either network attached storage servers (online), robotic tape-based storage (near-line) or tape-based back up (off-line). A certain level of flexibility is also critical to allow for future technological developments that may emerge over the lifetime of the Scheme.

Consideration should be given to the longer-term preservation path for the audio-visual files in your collection as storage systems available today will become obsolete within 5-10 years. A plan should be put in place to upgrade storage systems as part of a longer-term preservation activities and budget and workflows to support such a digital migration project should be factored into your long term organisational plans.

The BAI proposes that all audio and audio-visual files and supporting metadata stored within any cloud based system or within any storage service must be backed up to guarantee the preservation of cultural record. The BAI recommends the use of LTFS format LTO data tape for back up of digital audio-visual files. The storage back up solution must enable the preservation and portability of all the recordings and descriptive metadata in an event of failure of the primary storage system or other unforeseen event.

Glossary

| Term | Explanation |
| --- | --- |
| Digitisation | The conversion of analogue information into digital information. |
| Digital video | Digital video is an electronic representation of moving visual images (video) in the form of encoded digital data. |
| Master File | The highest quality single reference version of a piece of audiovisual content. The origin or source file from which proxy files are created. |
| Proxy File | A lower resolution copy of a master file used for distribution or access. |
| Compression | Data compression involves encoding information using fewer bits than the original representation. |
| Lossless Compression | Lossless compression allows the original data to be perfectly reconstructed from the compressed data file. |
| Lossy Compression | Lossy file compression results in lost data and quality from the original version. |
| V210 | V210 Video Picture Encoding, digital, color-difference component video picture format. V210 employs 4:2:2 chroma subsampling with each sample represented by 10 bits of data. |
| Bit rate | The number of [bits](https://en.wikipedia.org/wiki/Bit) that are conveyed or processed per unit of time  1Mbps : 1 Million bits per second. |
| Sample Frequency | The number of samples per second taken from a continuous signal to make a discrete or digital signal. |
| FFV1 | FF video codec 1, is a lossless intra-frame video codec. |
| Matroska | The Matroska Multimedia Container is an open standard, free container format that can hold a number of video, audio, picture or subtitle tracks in one file. |
| Motion JPEG 2000 | Motion JPEG 2000 is a file format for motion sequences of JPEG 2000 images and associated audio, based on the MP4/QuickTime format. |
| AS-11 | A family of Specifications from the Advanced Media Workflow Association that define constrained media file formats for the delivery of finished media assets to a broadcaster or publisher. |
| h.264 | H.264 or MPEG-4 Part 10, Advanced Video Coding is a block-oriented motion-compensation-based video compression standard. It is one of the most commonly used formats for the recording, compression, and distribution of video content. |
| ProRes | Apple ProRes is a [lossy](https://en.wikipedia.org/wiki/Lossy_compression) [video compression](https://en.wikipedia.org/wiki/Video_compression) format developed by [Apple Inc.](https://en.wikipedia.org/wiki/Apple_Inc.) for use in [post-production](https://en.wikipedia.org/wiki/Post-production) that supports up to 8K. The benefit of an intermediate post-production codec is that it retains higher quality than end-user codecs while still requiring much less expensive disk systems compared to uncompressed video. |
| DNxHD | Avid DNxHD ("Digital Nonlinear Extensible High Definition") is a [lossy](https://en.wikipedia.org/wiki/Lossy_compression) [high-definition video](https://en.wikipedia.org/wiki/High-definition_video) [post-production](https://en.wikipedia.org/wiki/Post-production) [codec](https://en.wikipedia.org/wiki/Codec) developed by [Avid](https://en.wikipedia.org/wiki/Avid_(company)) for multi-generation [compositing](https://en.wikipedia.org/wiki/Compositing) with reduced storage and bandwidth requirements. It is an implementation of [SMPTE](https://en.wikipedia.org/wiki/Society_of_Motion_Picture_and_Television_Engineers) VC-3 standard. |
| WAV | Waveform Audio File Format (WAVE, or more commonly known as WAV due to its filename extension—both pronounced "wave") is a Microsoft and IBM audio file format standard for storing an audio bitstream on PCs. |
| AAC | Advanced Audio Coding (AAC) is a proprietary audio coding standard for lossy digital audio compression. Designed to be the successor of the MP3 format, AAC generally achieves better sound quality than MP3 at the same bit rate. |
| MP3 | MP3 is the name of the file extension and also the common name of the type of file for MPEG-1 audio layer 3. It is a common audio format for consumer audiostreaming and storage. |

