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"Guidelines on the Production and Preservation of Digital Audio Objects" - optimalizing quality access through digital preservation practice

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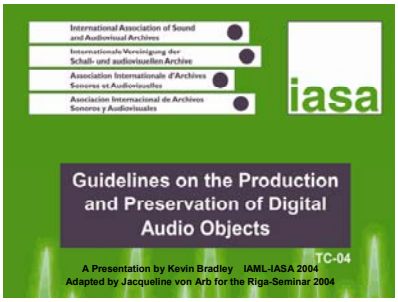
Abstract:
Most libraries around the world have some of their holdings in an audio-format. This sound material, kept in its analogue form, has a microscopic life expectancy compared to material found on a paper medium. To delay a migration to a digital medium for another decade could be the coup de grace for many such sound collections, or cost an eye and a leg because of the unavailability of adequate analogue replay machines. Both IFLA's Audio-Visual Media Section and the International Association of Sound and Audiovisual Archives (IASA) recommend digitization as the best means to safeguard the audio heritage for the future.

When planning to make audio-material accessible through digitization, time and financial limitations make it imperative to create the best possible archival quality digital transfer the first time around. Once a digital archival quality copy is at hand, and preservation ensured, access is optimalized through duplication. Surrogates can be made in an array of digital formats targeting the institution's different users : high quality original form for research, cleaned up and compressed in-house browsing format, internet dissemination formats, etc.

The newly published "Guidelines on the Production and Preservation of Digital Audio Objects" (August 2004) provides recommended practices to ensure the best quality of analogue to digital transfer. This publication of the IASA Technical Committee (TC) is intended to provide a practical guide through the maze of technical solutions, keeping in mind the ethics, principles and preservation strategy found both in previous IASA-TC and IFLA-AVMS publications. The publication is endorsed by UNESCO's Memory of the World as "best practice".

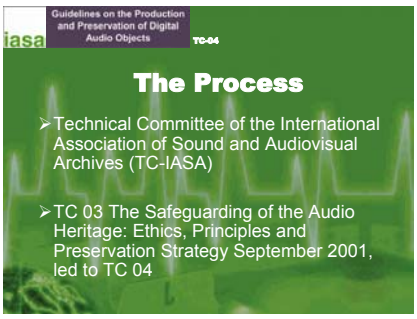
Jacqueline von Arb, Director of the Norwegian Institute of Recorded Sound, and Lars Gaustad from the National Library of Norway and Chair of IASA's Technical Committee, will present these Guidelines and show how to extract the most of these Guidelines, both from a managerial point of view and from a technical standpoint.



Slide 1

Guidelines on the Production and Preservation of Digital Audio Objects (ed. Kevin Bradley)

A presentation written by Kevin Bradley, Jacqueline von Arb (speaker) and Lars Gaustad (speaker).



Slide 2

The Process

Technical Committee of the International Association of Sound and Audiovisual Archives (TC-IASA)

The London IASA Conference in 2001 launched the TC 03: **The Safeguarding of the Audio Heritage: Ethics, Principles and Preservation Strategy (**Version 2, September 2001)

It was recognised even during the process of negotiating the language and content of TC 03 that it had significant limitations and explanatory power, and so the "Guidelines on the Production and Preservation of Digital Audio Objects" was begun. For all practical purposes, let's call the document "The guidelines".

It is best to be clear about what we mean when we talk about ethics, and standards of practice or guidelines. Codes of ethics are typified as reflecting a set of personal values to which a group have agreed, which are not susceptible to change and are codified by its authors. Standards of practice are similar, in that a group must agree to them, and the philosophy that underpins them, and a record of the precise form of what was agreed to must be made. In other aspects however, according to the authors, they manifest explicit differences. Standards of practice may be rigorously measured and enforced, may change as technology provides new options and generally include detailed recommendations. A code of practice finds its specificity in the technology of the day, while a code of ethics should express enduring principles. F.example, the declaration that all sonic content must be captured in the transfer of a particular sound recording from analogue to digital could fall within the gamut of a code of ethics, but the stipulation that an analogue recordings should be encoded at a minimum standard of 24 bit, 96 kHz can only be included in a standard of practice, even though the latter may encompass, or be informed by, the former.

The Guidelines, or TC 04, are a standard of practice based in the ethical guidance of TC 03. TC 03 is currently being revised to better reflect its role as a set of ethics – and its present form is available on the IASA-site.

Hence "The Guidelines" (for short) began in earnest with Kevin Bradley of the National Library of Australia (and vice-chair of the IASA Technical committee) as editor and a number of specialist contributors on various topics.

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The Contributors

Kevin Bradley National Library of Australia, ed.
George Brock-Nannestad, Patent Tactics
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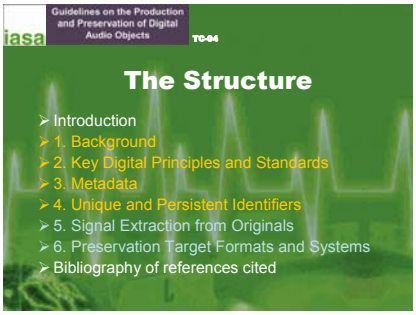
Reviewed by the IASA-Technical Committee

The topics were collected and distributed to the whole technical committee, and after a period of passionate debate and discussion, threads were pulled together into a document that all could endorse.

Kevin Bradley then had the tedious task of sewing the topics into a document which will be used as a reference document by both technical colleagues as well as non-technically inclined members of the sound archiving industry. On a personal note, I may add that I, as a non-technical person, find this document refreshingly free of technical condescension, penned in an understandable vocabulary, and useful to me on the managerial level, for instance in finding rhetorical arguments with which to persuade funding authorities.

The language is one thing, but the different hierarchal layers of the archival world also mandate a different focus and language. The structure of the document caters to these.



Slide 4

The Structure

Introduction

The introduction, for instance, is aimed at the managerial level. While Chapters 1-4 are aimed at the curator, the librarian and/or the collection manager.

1. Background
2. Key Digital Principles and Standards
3. Metadata
4. Unique and Persistent Identifiers

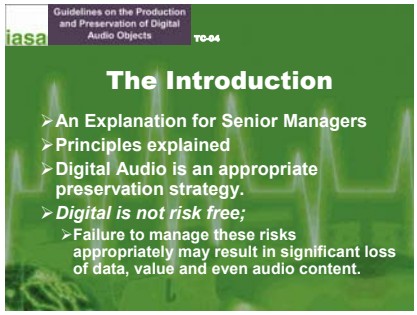
The last two chapters present all the technical details, simply and matter-of-factly explained, but with the depth and detail mandated to become a good reference document, both for technical staff and as an in depth introduction for others.

5. Signal Extraction from Originals

6. Preservation Target Formats and Systems

If this isn't enough, the extensive bibliography at the end of the booklet.

Bibliography of references cited



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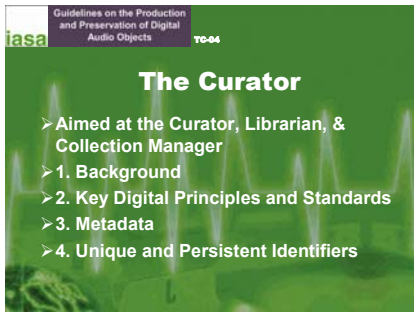
The Introduction

is aimed at Managers. It starts with the statement that digital preservation is possible but must be undertaken correctly.

Digital audio has, over the past few years, reached a level of development that makes it both effective and affordable for use in the preservation of audio collections of every magnitude. The integration of audio into data systems, the development of appropriate standards, and the wide acceptance of digital audio delivery mechanisms have replaced all other media to such an extent that there is little choice for sound preservation except digital storage approaches.

Digital, however, is not risk free; it is not in itself an eternal answer, but is a technological process by which ongoing sustainability can be achieved.

The guidelines provide a warning: **Failure to manage these risks appropriately may result in significant loss of data, value and even audio content.**



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The Curator

The first four chapters are aimed at the Curator, Librarian, & Collection Manager

1. Background

Archives are responsible for the preservation of cultural heritage, yet do, like libraries have a goal of rendering content accessible, preferably without risk to the original.

When considering digital reproduction, it is recommended to produce a so-called preservation copy as true to 'the original' as possible (a digital surrogate); then access copies can be derived from the original in an appropriate format for the user.

Compared to a paper medium, the lifetime of audio carriers is infinitely small. Even more worrisome is the dependence on replay equipment that may have an even shorter lifetime than what it replays, due to obsolescence, a lack of replacement parts and repair competency being ever harder to obtain. Continual migration is here to stay. Serial duplication in the analogue domain produces a gradual degradation of the audio signal, it is therefore advisable to consider a migration to a digital domain.

Digitization can be a costly and time-consuming affair. Furthermore, the parameters of digitization that one chooses (formats, resolutions, technology) have a permanent effect on the quality of the digital object that cannot be changed unless the procedure is repeated.

It is therefore important to do it right the first time (and hopefully the only time). This implies an optimal signal extraction from the original carriers, and this should be carried out before the physical and/or chemical degradation of the carrier or the obsolescence of hardware becomes critical.

The ability to reproduce content without signal loss ensures preservation and access is facilitated by an easy generation of lower resolution copies. This can easily seem like an eternal solution, but the production of a digital collection poses new managerial responsibilities: the main threat now becomes a poor system management which can affect the integrity of audio content or even the ability to *find* content, create a greater strain on staff than the intended to save and thereby endangering the collection.

2. Key Digital Principles and Standards

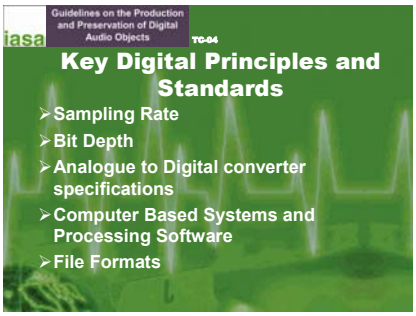
It is integral to the preservation of audio that the formats, resolutions and carrier and technology systems selected adhere to internationally agreed standards appropriate to the intended archival purposes. Non –standard formats, resolutions and versions may not include preservation pathways that will enable long term access and future format migration. We will come back to the specific standards on the next slide.

3. Metadata

There are many metadata standards currently being developed. When recording metadata records of digital objects, it is important to maintain explicit, comprehensive and discrete records of all technical details: Data creation and record of changes, including dates and responsibility. Some of it may be stored in the header of the file, but the space there is limited. It may be a wiser strategy to keep audio files and metadata separate, establish appropriate links between them and update the records.

4. Unique and Persistent Identifiers

An item is, for all pratical purposes, effectively non existent and therefore lost if it cannot be found through a link and the metadata that gives it meaning. Every digital item needs to be unambiguously and uniquely named.



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Key Digital Principles and Standards

Sampling Rate:
48kHz minimum, 96kHz preferred

Bit Depth:
24 bit minimum (do maintain existing bit depth for born digital material)

Analogue to Digital converter
Should add nothing to the signal. A/D's incorporated in a computer's sound card would add "computer noise", it is therefore recommended to use a stand-alone converter, and the specifications can be found in 2.4.

Computer Based Systems and Processing Software
A professional audio computer based system should be used in order to avoid systems that alter files (either compressing the word length of an item or the file format) to process them.

File Formats
Recommends .wav files, preferably .bwv (which are basically .wav files with an extra metadata header), as preferred for all 2 track recordings, with a note regarding MXF and AES 31 as developing standards for multi-track audio and film or video soundtracks.

And now, we'll go a bit more in depth with the more nitty-gritty technical stuff. Chapters 5 and 6 are, as said before, aimed at the technical staff.

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5. Signal Extraction from Originals

5.1 Introduction 11
5.2 Reproduction of Historical Mechanical and other Obsolete Formats
5.3 Reproduction of Vinyl LP Records
5.4 Reproduction of Analogue Magnetic Tapes
5.5 Reproduction of Digital Magnetic Carriers
5.6 Reproduction of Optical Disk Media (CD and DVD)

The fifth chapter of the book concerns itself with signal extraction from originals and is divided into five sub-chapters covering historical mechanical and other obsolete formats, vinyl LP records, analogue magnetic tapes, digital magnetic carriers and optical disk media, but firstly it lays out some general principles

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Shared Principles for Signal extraction

The first, and most significant part of the digitisation process is the optimisation of signal retrieval from the original carriers. As a general principle, the originals should always be kept for possible future re-consultation. However, for two simple, practical reasons any transfer should attempt to extract the optimal signal from the original. Firstly, the original carrier may deteriorate, and future replay may not achieve the same quality, or may in fact become impossible, and secondly, signal extraction is such a time consuming effort that financial considerations call for an optimisation at the first attempt.

The critical message is that replay of audio material is a specialised task. Expertise is required to extract the optimal signal from the original. All the best digital technology in the world is wasted if the original audio is not retrieved to its optimal level.

The following topics are covered for each of the five types of carriers in the previous slide.

Selection of best copy.

All available copies (preferably also from other institutions) should be gathered for selection. This admonishes on making sure that the takes of the recording do not indicate non-identical recordings, and stresses the importance of good working space and lighting to do correct assessments.

Cleaning, carrier restoration.

Before a document is replayed, it may be necessary to clean it. Also, its chemical makeup and/or physical condition may negatively influence the replay signal, sometimes even make replay impossible. Chemical/restoration restoration may be possible, or indeed necessary, to improve/allow replay.

Replay equipment.

Replay equipment must comply with all specific parameters of a given format. It is, however, a mistake to think that historic equipment should be employed. Generally, modern equipment introduces significantly less replay distortions and should, therefore, be used, provided, however, the it is capable of or may be adapted to, replaying the specific format parameters.

Speed.

Although speed correction is also possible in the digital domain, it is better to avoid such later digital correction and to carefully choose replay speed in the first transfer process, and to document chosen speed and justification.

Replay equalization.

The signal representation in most analogue audio formats is deliberately not linear in terms of frequency response. Correct replay, therefore, calls for appropriate equalization of the frequency response.

Corrections for errors caused by misaligned recording equipment.

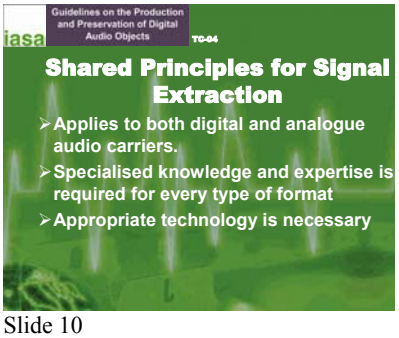
Misalignment of recording equipment leads to recording imperfections, which can take manifold form. While many if them are not or hardly correctable, some of them can objectively be detected and compensated for. It is imperative to take compensation measures in the replay process of the original documents incurred, as no such correction will be possible once the signal has been transferred to another carrier.

Removal of storage related signal artefacts.

It is preferable in most cases to minimise the storage related signal artefacts before undertaking digitisation. In linear analogue magnetic recording, for example, print-through is a well-known and disturbing phenomenon. The reduction of this unwanted signal can only be undertaken on the original tape.

Time factor.

The time needed for copying contents of audio material varies greatly, and is highly dependent on the nature and status of the original carrier. F.eks. well-documented radio recordings can have a time factor of 3 to 1, i.e. 3 hours of work for one hour of material. Tapes needing restauration or in need of further documentation will take much longer to conserve, transfer & preserve.



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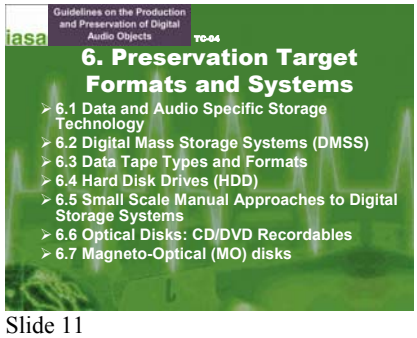
To summarise optimal signal extraction:

- **Applies to both digital and analogue audio carriers.**

There are guidelines for the extraction of the highest level quality sound

- **Specialised knowledge and expertise is required for every type of format**
- **Appropriate technology is necessary**



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6. Preservation Target formats and systems

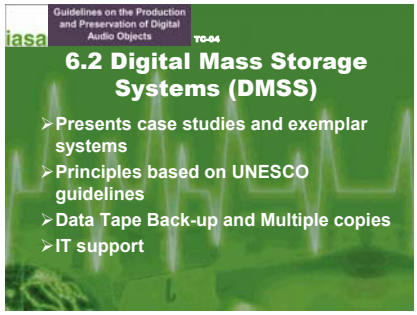
The next section is about where the signal goes to, and the guidelines cover the following formats:

6.1 Data and Audio Specific Storage Technology
6.2 Digital Mass Storage Systems (DMSS)
6.3 Data Tape Types and Formats
6.4 Hard Disk Drives (HDD)
6.5 Small Scale Manual Approaches to Digital Storage Systems
6.6 Optical Disks: CD/DVD Recordables
6.7 Magneto-Optical (MO) disks

6.1 Data & Audio Specific Storage Technology

The next part of the Guidelines discusses Data & Audio Specific Storage Technology.

The choice of technological storage system is dependent on many factors, of which cost is but one. Though the type of technology selected for preserving a collection may differ according to the specific circumstances, there is general agreement amongst sound archivists that data formats are preferable to audio specific carriers. Data formats are the file types, such as .wav, bwf or aiff, which computer systems recognise. Unlike audio specific carriers, they are closed and are generally encoded in such a way that a loss of data is recognised and remedied by the host system. Regardless of whether a physical audio format or file format is used, the system must be capable of storing and transferring linear/incremental PCM.



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6.2 Digital Mass Storage Systems (DMSS)

The next part of the Guidelines discusses Data & Audio Specific Storage Technology.

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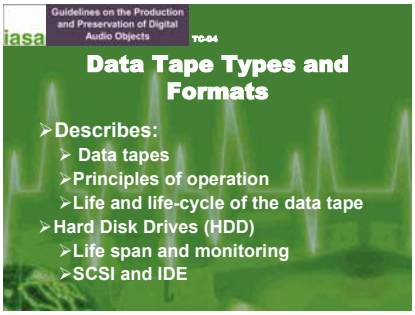

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6.3 Data Tape Types and Formats

The following is an outline of some of the main data tape formats and tape automation systems that may be used for storing AV content in data form. Data tapes are only used in conjunction with other components of a DMSS. An important reminder is that no carrier is permanent and that, all things being equal, they will only be viable as long as the data system in which they are incorporated continue to support them. This section covers :

- Data tapes, principles of operation, life of the data tape
- Varied types of tapes and their life span and comparative costs.
- Shows the wide range of data tapes and their specs.
- The history and road maps of the formats are discussed

6.4 Hard Disk Drives (HDD)

Their lifespan, their general failure rate and the necessity for adequate back up are discussed, as well as RAID (the Redundant array of Inexpensive (or independent) Disks) technology and the aspect of potential monitoring and HDD technology is explained reflecting on SCSI vs ATA/IDE. Fibre Channel (FC) SCSI drives are most frequently used in enterprise or business systems while the cheaper ATA/IDE drives are designed for the personal market, and the quality of the products are reflected in the price.

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6.5 Small Scale Manual Approaches to Digital Storage Systems.

This section outlines broadly two situations under which small scale storage systems may be implemented; a single operator digitising onto a single storage device, and a situation where more than one operator requires access to the storage device. The risks involved are discussed.

Though the design of such systems seems to incorporate a very high level of redundancy, one has to bear in mind that the digital components and carriers may fail at any moment without any warning. Therefore it is imperative to have at any stage of the digitisation process and the further storage at the very minimum two copies of the linear archive file. Any flaw will inevitably lead to the loss of a smaller or greater amount of data, however, if suitable strategies have been put in place, this will not be fatal because the redundant copies are available. In view of the time consuming process of transfer not to mention the inevitable losses of older materials, all efforts have to be made to avoid the necessity of re-digitising

materials as an outcome of an inconsistent security architecture or sloppy conduct in the concrete approach.

6.6 Optical disks (CD-R/DVD-R)

This last sub chapter contains a technological lay-out of the three main format families using optical reading capability, namely recordable CDs, recordable DVDs and Magneto-Optical Disks.

The only way to know the condition of a digital collection is constant and comprehensive testing. This cannot be stated too strongly; no collection using CD-R as an archival carrier should be without a reliable CD tester. The error correction capability of CD replay equipment will mask all audible effects of degradation until the errors are well into the uncorrectable region. When this point is reached, all subsequent copies are irreversibly flawed. On the other hand, a comprehensive testing regime allows for best possible planning of preservation

This sub-chapter concludes: Test your newly recorded disks. If a CD test program is beyond budget, choose a different storage medium

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Conclusion

The Guidelines on the Production and Preservation of Digital Audio Objects give you comprehensive guidance on matters pertinent to digital preservation of our audio legacy. It is endorsed by UNESCO's Memory of the World Programme as a document on best practice for audiovisual archiving, and will hopefully guide our community in our quest for the preservation of the audio legacy of the world.

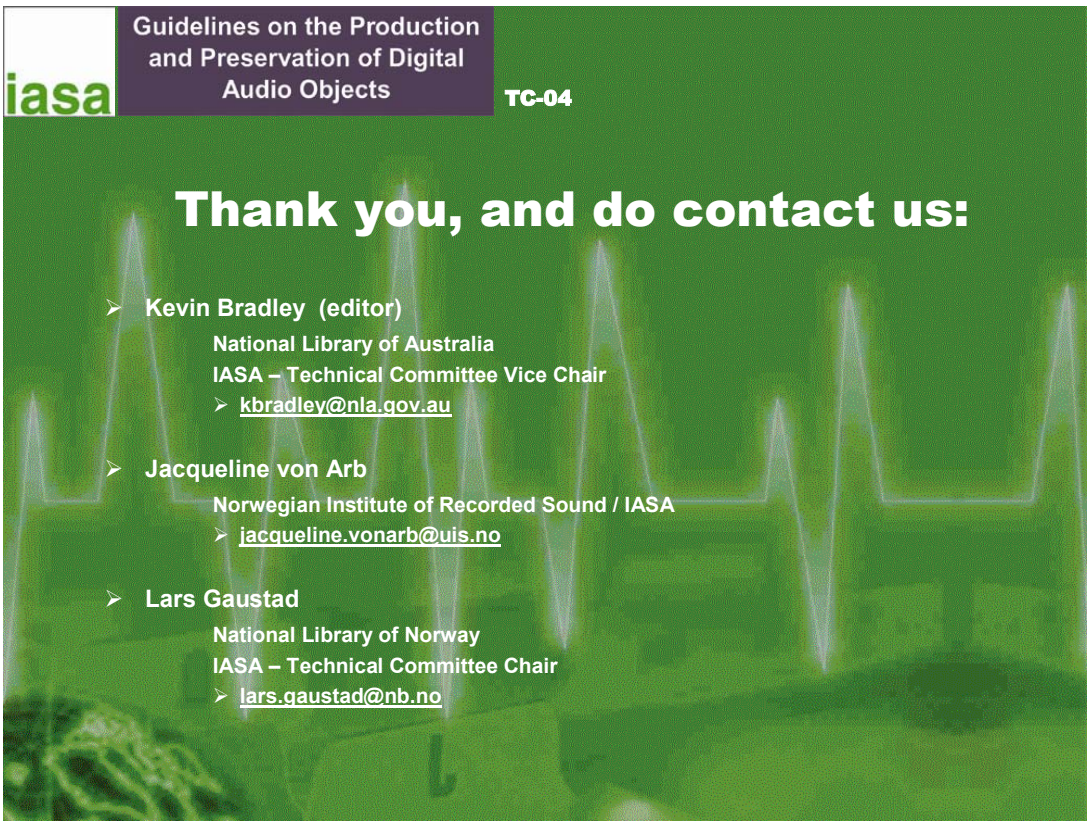
Remember, these are *recommendations* for a minimum standard for preservation. A manager still has to weigh these recommendations against the ampleness of the available resources. No matter the size and financial status of the institution, choices will have to be made, compromises are inevitable, and better solutions WILL come along.

The weighing becomes a jigsaw puzzle impacted by selection, format, size of the digital collection to be, storage space, safety, management and access. The curator of each audio collection has to weigh those decisions and make the best informed recommendation for the institution at that time.

And these guidelines are definitely a worthwhile investment in that process.

* * *

We will have with us a limited number of guidelines for purchase, alternatively, you can pick up a flyer with ordering instructions. Please do come over, browse and ask questions – we will be available throughout the conference.



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