

CHANGING SCENERIES CHANGING ROLES PART IX

GAME CHANGERS? FROM AUTOMATION TO CURATION – FUTUREPROOFING AV CONTENT



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SELECTED PAPERS FROM THE FIAT/IFTA MEDIA MANAGEMENT SEMINAR

CHANGING SCENERIES, CHANGING ROLES PART IX

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PREFACE

ON MAY 23RD AND 24TH 2019, the Media Management Commission of FIAT/IFTA presented Part 9 of its Media Management Seminar Series ‘Changing Sceneries, Changing Roles’ in Stockholm’s Garnisonen Conference Centre, hosted by SVT (Sveriges Television) and the National Library of Sweden (Kungliga Biblioteket). What follows is the proceedings of the seminar with some of the presentations enjoyed by the archiving community over the two days.

The domain of the Media Management Commission is ‘metadata’, ‘workflows’, ‘access’ and technology surrounding these topics. The primary task of the MMC is the dissemination and exchange of knowledge on (digital) AV-archiving. Key to achieving this task is the ‘Changing Sceneries, Changing Roles’ series of seminars which mean to inform and train media managers, documentalists, middle management and technical archive staff.

The focus of the seminars is the effect of changing technology on the daily work of media managers, archivists and documentalists. For each

seminar a specific theme or development is chosen, and speakers invited to present their ideas and projects. Essential to each MMC seminar are the discussion panels where archive staff can compare the possible impact of the presented developments with their jobs.

In 2019 we achieved a landmark – 20 years since we first came together to discuss this theme - and it continues to be pertinent in our community. For over 20 years the MMC Seminar has focused on change, new trends, and innovation. We have highlighted case studies of broadcasters and national institutions at the cutting edge of these changes, challenging us all and sparking creativity. The seminars demonstrate practical ways we can implement trends and innovation in our ways of working. To mark the anniversary, two legends in the FIAT community, Eva-Lis Green and Jacqui Gupta, reflected on the 20 year legacy of the MMC seminars and it is only fitting that their reflections form the first chapter of this publication.

The theme of this year’s seminar was what comes next? Titled “Game Changers? From Automation to Curation: Futureproofing AV Content”, the seminar showcased projects involving Artificial Intelligence, Data Mining and Machine Learning, automated data management, authentication, misinformation and disinformation, content security, and rights management. We also looked at some upcoming megatrends in broadcast archives from our community of contributors in broadcasting and its regulators. It was a professional treat for us all. It is our hope that in sharing these proceedings they continue to provoke thought and inspire us all to embrace the game changers coming our way.

Vicky Plaine

Chair FIAT/IFTA Media Management Commission

Glasgow, May 2019

ACKNOWLEDGEMENTS

AS CHAIR OF the Media Management Commission I want to thank all the contributors to the Seminar and this publication for sharing your knowledge and allowing us to reproduce your presentations here. I also want to thank our hosts SVT and the National Library of Sweden for your flawless organisation and hospitality, and our Seminar moderators who ensured the presentations ran smoothly. Thank you to Axel Green for his hard work on the design of this publication and to SVT Bild for the free use of stills. Last but not least, thank you to my colleagues in the Media Management Commission for all their hard work on both the Seminar and this publication, with particularly my commission co-chair, Elena Brodie-Kusa.

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**EVA-LIS GREEN
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Eva-Lis Green is Head of Digital Collections at the National Library of Sweden. Previously at SVT her roles included Media Quality Controller (Archives and Rights department), Head of Archives and Transmission and Head of Documentation. Eva-Lis is a specialist in media asset management archiving workflows and information systems. She is a member of the FIAT/IFTA Executive Council and was also Media Management Commission Chair.

Jacqui Gupta, Lead Technologist/Information Scientist, Automated Production & Media Management, BBC R&D has worked in various roles across production, news and archives thanks to her expertise in digital MAM, production and archive metadata, AV archives and digital preservation. Jacqui is Vice President of FIAT/IFTA, a member of the Executive Council and was Co-Chair of the Media Management Commission.

1 20 YEARS OF MMC SEMINARS

CHANGING SCENERIES, CHANGING ROLES 1998-2019

THE FIAT/IFTA Media Management Commission has produced a series of seminars entitled “Changing Sceneries, Changing Roles” for more than 20 years since 1998. The main purpose of the two day seminars was to provide a forum for AV archivists to network and learn, share ideas and experiences of media management, metadata, latest trends and technologies. It evolved into an international biennial event hosted by different members of the MMC in a variety of locations across Europe and beyond. The first Seminar was in 1998 hosted by the BBC in London followed by B&G Amsterdam 2004, ORF Vienna 2007, SVT Stockholm 2009, TFO Toronto 2011, NISV Hilversum 2013, BBC Scotland Glasgow 2015, RSI SSR SRG Lugano 2017 and finally KB and SVT Stockholm 2019.

The themes and trends have developed over the years with the advent of new and emerging technologies and media asset management systems

resulting in new workflows, processes and changing skillsets. However, looking back over the 20 years, surprisingly we are asking ourselves the same questions at each and every Seminar. How will the role of the traditional archivist change if the archive becomes an integral part of the production chain? Will automated indexing eventually replace professional manual annotation and cataloguing? What is the future job profile? New job titles and roles emerge with exciting, trendy names which could suggest a similar role elsewhere in the media industry. The role of the Media Manager is ubiquitous in the broadcast media industry with a variety of different meanings. Metadata is another buzz word which has evolved over the years – descriptive metadata, structural metadata, technical metadata, preservation metadata, user generated metadata, leading to Big Data and Linked Data and finally Artificial Intelligence and Machine Learning. Social Media has made a significant impact on AV archives in recent years amidst a great tide of digital content, more and more digital channels and stations resulting in a plethora of digital multi-platforms. Also, file based production created new digital workflows, using new innovative production and archive tools which impacted the workflows and processes of the archive leading to organisational and change management challenges.

So let's take a look at a few snapshots of the MMC journey throughout the years.

LONDON 1998

During the late nineties, we witnessed the birth of new digital workflows and technologies in broadcast production, news and archives. The early adopters of digital newsrooms were SVT (Sveriges Television) in Sweden and SWF (Sudwestrundfunk) in Germany followed by the BBC in the UK. At this time, digital production and archive systems were being developed

for News with innovative features and functionality such as visual thumbnails and key-frames displaying images of clips and scenes. This was a revolutionary approach at the time which introduced new expectations for browsing and search. The ENPS (Electronic News Production System) was implemented in a wide variety of digital newsrooms with an information retrieval system designed for journalists. News librarians had to adapt to new ways of working using digital production systems and online catalogues. “Metadata” was a new buzz word – another term for cataloguing and indexing. At this very first Seminar, Professor Tan of VU University, Amsterdam, predicted fully automated indexing would be 20 years from realisation! He reminded us that automated tools should be used to facilitate rather than replace human analysis.

AMSTERDAM 2004

File based production was becoming established in News and Production areas. This raised many questions amongst AV archivists about their roles and future job profiles. What are the consequences and effects of file based production on traditional archive processes? What is the added value of AV cataloguers in an environment of intelligent search engines and peer to peer networks and user annotation? How will the archive roles change? New roles were emerging – Media Manager managing content and metadata throughout the production process and maintaining standards; Ambassador of New Technology using expertise and knowledge to support digital systems, media processes and production staff; Media Editor repackaging archive content for new products and online; Content Specialist in preservation and access; and finally the new role of Trainer, educating programme makers on technology and information management. The seminar conclusions were positive. All agreed that AV archives using professional archival skills would be at the heart

of the production chain, with archival expertise to set standards, monitor metadata quality and implement selection and retention policies. We also saw the emergence of new user communities generating content and metadata (UGC and UGM).

VIENNA 2007

The Vienna Seminar continued the themes of new workflows, processes, technologies and changing roles with more searching questions. What is the goal of AV Archives? Does technology improve the workflow? Do we need to continue neutral cataloguing when targeting specific user groups? How do we train and prepare the archivist/media manager for their expanding roles? One of the real challenges was how to tag, catalogue, store and reuse assets in a rapidly changing digital technology environment. Novel technological advances in automated indexing resulted in pilot trials for scene change detection, camera movements, face and object detection, speech to text and auto generated description via subtitles/closed captioning. Please note this was happening over 12 years ago! New relationships were being developed between IT and broadcasting teams in order to understand these new challenges and requirements. A new role of ingest operator was created for digitisation processes including quality control and also another role of data/systems manager to manage the media and metadata in the new systems. And production staff started to enter metadata at the programme creation stage so that the role of the librarian changed to monitoring the quality of the metadata and setting standards and guidelines. A new concept of 360 Competencies was introduced as professional multi-skilling in a new multi-media environment required a new set of competencies.

STOCKHOLM 2009

Keeping your best content and metadata was the main theme of the Stockholm Seminar focusing on selection and retention policies. What is selection and retention? Keep it? Select it? Retain it? Not selecting before was deemed as destruction and not selecting now the content will still exist somewhere and be accessible. One question was raised - Quality before Quantity? It is better to keep 10 well documented clips rather than 20 badly documented with little metadata. The keynote speaker, Lev Manovitch, Professor of Computer Science, City University of New York, introduced a new data mining society with a new paradigm – keep everything and find and select later using new visualisation techniques. Today, we are immersed in a data driven society but 10 years ago it was a difficult concept to understand. So do we keep some garbage? Only 10 - 20 percent of what is kept is reused. Metadata was another continuing theme focusing on quality criteria and validation of authenticity. As more production staff were adding metadata early in the production process, it was important that validation of metadata authenticity remained in the hands of the archivist. New tools (speech to text and scene detection) and automated indexing technologies assisted in the creation of metadata but the technology was not perfect and would still require a lot of human interaction. It was acknowledged that there would be more metadata in the future and rich media navigation and search techniques would certainly increase discoverability and findability.

TORONTO 2011

This Seminar addressed new challenges in the audio-visual archiving domain including tagging, user generated metadata, social media, web archiving, new media and multi-platform publishing processes, linked data

and search. A new topic of cloud computing highlighted the challenges, practicalities and risks, control and ownership of data and archive content in the Cloud. But can we really trust the Cloud? At the time some broadcasters were starting to investigate different options including hybrid and private clouds. In the preservation domain, new open standards based approaches for video migration and preservation with new data tape formats were in the process of implementation. How can we maintain the technical quality of HD when archiving HD content through a life-cycle of tapeless capture, production, editing and distribution? New automated digital workflows at TFO in an HD tapeless broadcast station were demonstrated with automated direct links to Facebook, iTunes, YouTube and distribution to multi-platforms PVRs, Mobile and PDAs. Equally the “World is Turning” at TFO with web exclusive content. Also, CBC/Radio Canada News were beginning to use web exclusive footage in their bulletins. This created a new role for web archiving. Archivists were increasingly becoming production archivists and not just broadcast archivists working collaboratively with online and social media teams. Tagging was also a hot topic as NRK re-enacted a pilot workshop to identify all the benefits and pitfalls for tagging all new media content.

HILVERSUM 2013

Metadata, Big Data, Artificial Intelligence, Automated Annotation and Social Media were all reflected and debated in this seminar “Metadata at the cornerstone of digital archiving”. Audiences were becoming key actors in our news and programmes generating more and more content and metadata. Online videos on websites viewed via streaming or downloading methods anytime and anywhere. Big Data was a new concept using more and more metadata about programmes and audiences. Social media was driving many media stories globally through Facebook, Twitter, You-

Tube and numerous other social media sites. What a challenge for our archives! The proliferation of content in new interactive formats means more pro-active archiving!

Artificial Intelligence and machine learning techniques were being developed in universities. Cees Snoek (University of Amsterdam) described artificial learning whereby a computer is trained to automatically generate accurate sentence-level descriptions of video content derived from shapes contained in the video frame. In a few years, this could be a reality. So will there be a need for cataloguers in the future? A case study from BBC R&D described how a “mood classification” research prototype will help to find content based on Mood. Imagine searching for video clips and programmes that are happy, sad, serious, funny, fast or slow paced! Today, can you really search for a shot of someone looking sad? The Radiotelevisione Svizzera RSI Archive had implemented in house developed speech to text software to automatically tag television and radio content by means of speech to text computer audio analysis. A research pilot project was presented on the BBC World Service Archive that automatically tags radio content using linked data and crowdsourcing. The proliferation of content in new interactive formats means more pro-active archiving! A recurring question in our seminars - how can we ensure veracity, authenticity and integrity of all this additional content and metadata? Who is responsible for metadata input - archivists, cataloguers, production, users, viewers, listeners or machines? What is the archivist role of the future? The very same questions we are asking today in 2019.

GLASGOW 2015

Various case studies were presented on second generation MAM systems and metadata.

Most broadcast archives were in the process of implementing or developing second generation MAM systems. Roles inevitably changed due to new digital media workflows throughout the production and archive lifecycle. The role of the cataloguer changed to data file wrangler working with new formats and post-production systems. A new requirement arose for more automatic processes and for the media industry to understand archive requirements. One challenge was training staff in a file based world with a plethora of new MAM features and functionalities and also education in new social media activities. Journalists and production staff also needed to be trained in metadata input, search and ingest. What are the biggest challenges in changing digital workflows and processes? Change is constant and production and archive staff must embrace new technology and IT technology staff. MAM systems enable collaboration and as a result organisational and change management proved to be a challenge. Theo Mausli, SRG SSR, presented a 2020 Vision of the future with 6 Giant Steps over the next 5 years -selection of content, data flow, traceability, AI, Data Mining. Finally, the new archivist of the future will be a coach focused on teaching, training, correction, and maintenance of digital MAM systems. We asked the same question - What will be the tools and technologies of the future? AI and data mining will be prevalent as Jonas Engstrom of Mayam stated “Leave search to a competitive algorithm!”

LUGANO 2017

The seminar entitled “Embracing Automation, Enhancing Discoverability” covered the emerging trends and technologies of the day including integration and interoperability of cloud based systems, transformation to micro services, sports production archives and challenges of near-live logging and publishing on multi-platforms, automatic metadata generation, automagically archiving and discoverability projects. The conclusions were

encouraging and an acknowledgment that Archives are undergoing a massive change and building new skillsets and competencies fit for the future. Emanuele Balossino, Mediaset, Italy, implemented a re-engineering and evolution of roles in day to day activities and workflows. Journalists are searching and retrieving content with taxonomy training and archivists are becoming media managers providing technical support. The integration of new automation tools in MAM systems/flows provided more efficient processes and eliminated tedious activities enabling changing skillsets. The results of ASR pilot projects were positive but also confirmed a new role as machine teacher, quality assurer and curator of metadata. Yet we are still asking the same question – Will automation replace human work? There was a general acknowledgement that there will always be a need for archivists to manage AI and ML. Training algorithms need time and people to test and improve taxonomies with skilled knowledge of scenes and clips. Automation is not 100% perfect yet as it is not archive specific. It is not the technology but a human being system! Maybe media archivists could acquire the new skillsets of data analysis, coding and programming. In the future, archive staff will be free to be more creative and concentrate on data manipulation, curation and collection building.

WRAP UP

To conclude the discussion over the 20 years of MMC Seminars, we have observed and gained knowledge about the changes in the business as well as in the archivist role and the changes in our mind set.

Let's start with the Archive before digitisation. We had analogue physical collections, we could hold the carrier in our hands. We had old Card Catalogues and registers. We talked about cataloguing rules and classification. Of course these old archives are still around and we also need the old skills today. But the technology and workflow changed and the cata-

logue moved to a database instead of having the information on paper. In the 1980s databases became common and in the 1990s we started to transport information between databases. In the 2000 decade more and deeper system integration was implemented and now in the 2010 decade we are in the automation, big data, linked data and artificial intelligence era.

When the digital archive emerged about 20 years ago a whole set of new buzzwords appeared that we needed to understand the meaning of. A lot of new media and archiving terminology started to be frequently used like Archiving Process, Metadata, Video file formats, Taxonomies, Tagging, Media Management, Metadata models and templates and Exchange formats.

Alongside the digitisation, the metadata started to enter the databases in different ways. The new digital archiving processes implemented made it possible to input metadata from different sources. It could originate from production, internal users, viewers and listeners, machines, archivists or a combination of different inputs for different types of metadata.

This led to the MMC Seminars' major question: How will the changed scenery change the archive and archivist role? In broadcast archives the role and archive identity became unclear since the archiving process was no longer exclusively the archive's business. This issue is still a living debate whilst the archiving institutions are facing big challenges in what role they play in society. The archive's need for both Audio Visual Archivist Generalist and the deep knowledge Specialist became more obvious than before and the need to rethink the skillsets became inevitable.

In order to review what competences an archive generalist needs, the MMC Seminars found that the understanding of the new media landscape being non-linear is crucial. Also knowledge of the company and the institution's mission and processes is a must. Of course, a general understanding of users' needs and a familiarity with file based content and technology are also required competences.

Focussing on the metadata field, the metadata in a new context means to work with metadata models and structure, different metadata types, taxonomies/categories, controlled vocabulary, definition of terminology – tagging, keywords, authenticity and integrity. This requires a metadata specialist to be able to work as evaluator and quality controller of metadata input, information/metadata architect, educator and provider of rules and guidelines and crucially, mediator between users and IT technology.

Other specialist skills needed are Content Curator / Data Curator, specialist in digital archive logistics, file specialist and Media Manager and last but not least preservation and migration strategist.

And finally, we need to get ready for “the touch generation”.



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Patrick Aichroth worked as an IT freelancer and software developer, before becoming a researcher at Fraunhofer IDMT in 2003. Since 2006, he is head of the media distribution and security research group at Fraunhofer IDMT.

He has been involved in many industrial and publicly funded research projects, and is especially interested in applying technology within an interdisciplinary context to address trust and information overload problems, challenges related to systematic evaluation and trustworthy AI, integration and orchestration of A/V analysis technologies, and security/privacy aspects of audio-visual analysis and recommendation.

2 **DARK HORSE TECHNOLOGIES**

**AUDIO FORENSICS, PARTIAL MATCHING AND PHYLOGENY
ANALYSIS FOR MEDIA VERIFICATION AND MEDIA MANAGEMENT**

DISCUSSIONS ABOUT AUTOMATIC metadata extraction and AI often start with well-known tools such as face and object detection and recognition, speech and speaker recognition. However there are many other, lesser-known technologies which can provide substantial business benefits and unexpected problem solutions.

In this paper it will be argued that audio forensics, audio partial matching and audio phylogeny analysis represent such technologies. An explanation for how they work, and how they can be used for very different and sometimes unexpected purposes will be given. These purposes include media verification and tampering detection, reuse and duplicate detection, rights tracking, programme analysis and other applications.

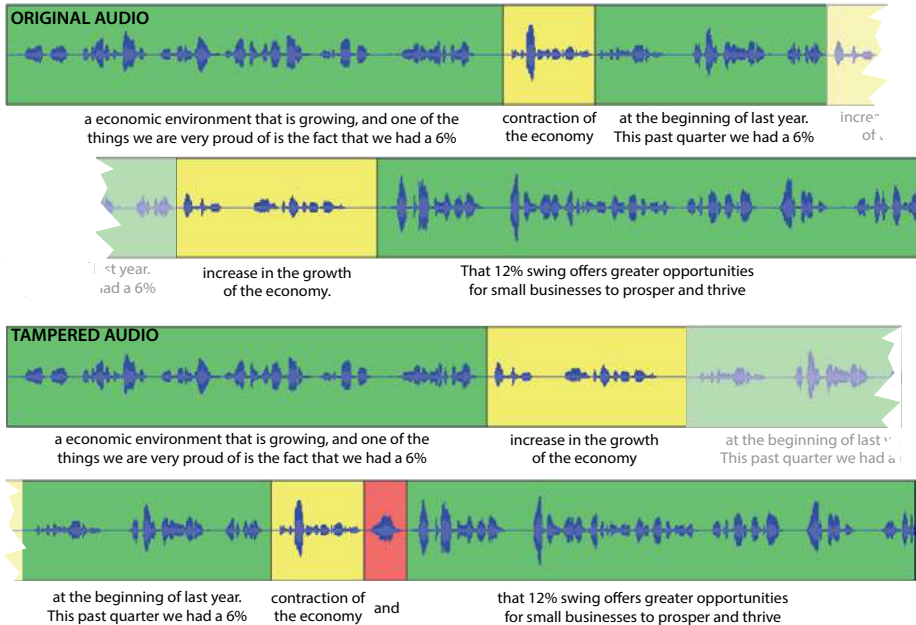


Fig 1: Tampered audio file

AUDIO VERIFICATION: PROBLEMS, APPROACHES AND CHALLENGES

AUDIO FAKES: YOU CANNOT ALWAYS TRUST YOUR EARS

Thanks to the availability of huge amounts of content, low-cost editing tools and almost limitless distribution possibilities, creation of fake audio has become fairly cheap and easy. One of the most effective and common means to create a fake is to use and edit existing material, thereby creating a new distorted context or modified message.

This especially goes for the case of audio. Speech is our main means of communication and information and represents a perfect target for manipulation. Consequently, audio editing is the most cost-effective means of creating fakes, possibly more effective and dangerous than the threat

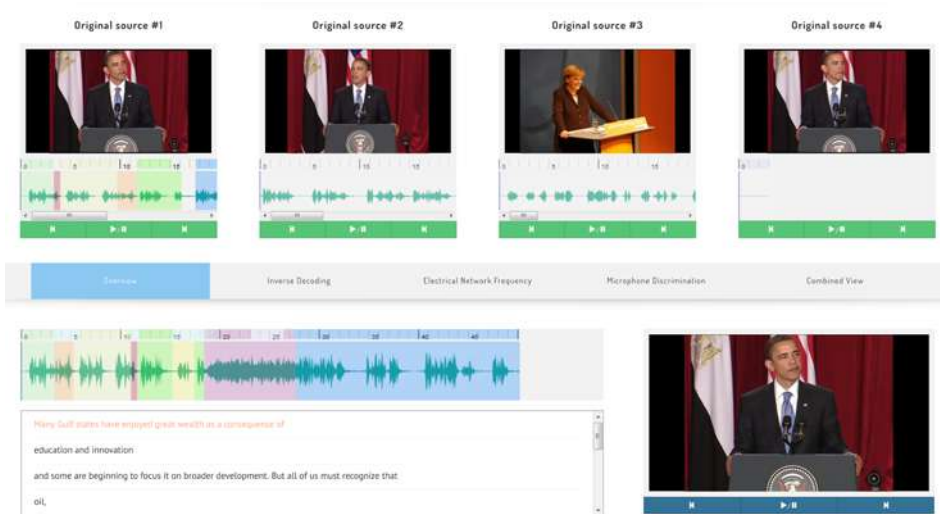


Fig 2: Corresponding video

of video manipulation. Copying, inserting or removing a few words or sentences from speech recordings can convey new and/or completely distorted meaning and cause significant harm. If it's done convincingly it is very difficult to detect.

Figure 1 shows an excerpt transcript of a tampered audio file based on this type of manipulation. This fake was created by copying and pasting material from speeches from former US president Obama and German Chancellor Angela Merkel. The manipulation of the audio was further camouflaged by partially using the corresponding video material (see Figure 2). Even though this example was created without much effort, and deliberately includes audible artifacts, most people do not recognise the fake.

Because of the ease of faking content it is not surprising that there has been an increase in related cases in journalism (e.g. recordings of polit

cians making controversial statements); fraud and other crimes (e.g. recordings from sales interviews via phone including a fake “yes” to confirm the transaction) and other examples within recent years.

These types of recordings need to be assessed to confirm if they are authentic and if they are consistent with the claimed context of the recording (e.g. time and place) and have not been edited afterwards.

DETECTING FAKES: AUTHENTICATION VS. TAMPERING DETECTION

In general, there are two very different approaches to “content verification”:

1. Content authentication, using cryptographic means, i.e. digital signatures
2. Tampering detection and localisation, i.e. detecting specific manipulations, typically using signal analysis and machine learning, statistical analysis, metadata analysis, etc.

Digital signatures (approach 1, see Figure 3) can be used to sign content at a defined “reference state” during the content lifecycle, e.g. during or right after recording, and they can then be validated to prove that the content was not altered afterwards. Any modification of the content will result in a failed validation.

Digital signatures seem to be the perfect solution for our problem but there are a number of drawbacks. One problem of such an approach is that verification will fail even for the slightest modifications and this is not always desirable. Some modifications such as format conversions, level changes or transcoding are common in processing workflows and do not

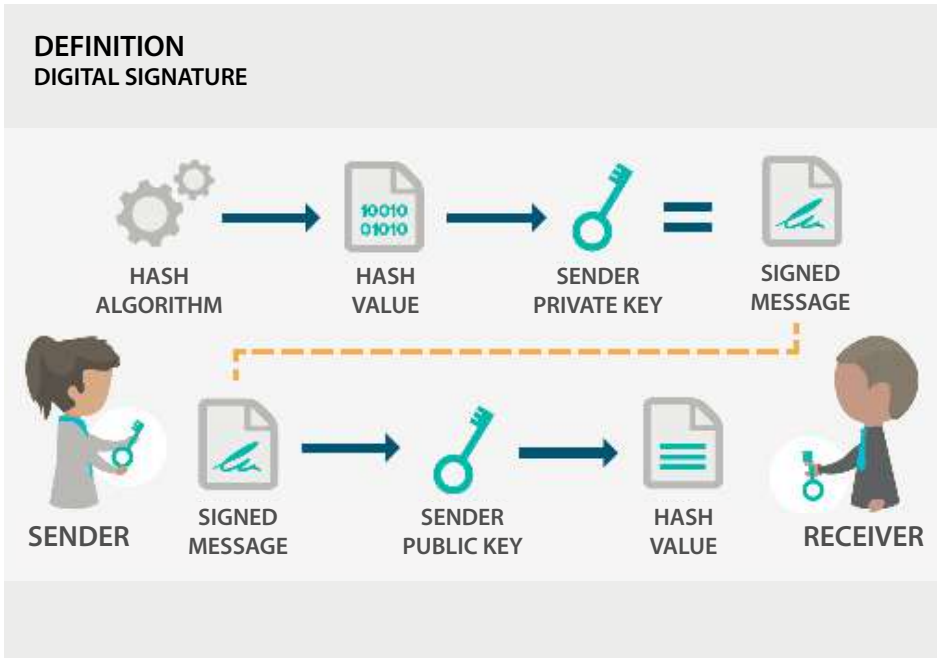


Fig 3: Digital signatures

alter the perception/meaning of a speech, while others do. We would like to differentiate between both categories. And indeed, it is possible to extend standard schemes for digital signatures to make them more “media-aware” and robust to ex-ante defined types of processing, e.g. using selective hashing and perceptual hashing (a technique that we will discuss later in this document).

However, there are two additional major problems: One is that authentication provides only a binary answer to the question “has this been tampered with?”, while in many cases, it is actually necessary to understand how content was modified and to assess ex-post how trustworthy and useful content is. Moreover, the approach requires modifications of recording devices, which result in non-trivial technical challenges and certain costs,

and has therefore never been able to reach the mass market.

We can derive that authentication based on digital signatures, possibly with media-specific modifications, can be a good solution for cases such as law enforcement, where recordings need to be made “tamper-proof” for later use and where a certain effort for device modifications is acceptable. For all other cases, however, we need to deal with the fact that digital signatures are not applied, and that we need tampering detection, i.e. tools that can detect and localise specific manipulations in material that do not require any specific prerequisites and can be applied to any content under question.

Tampering detection and localisation (approach 2) is based on the following concept: content processing steps leave characteristic traces or “footprints” within material (and often within related metadata). Such footprints can be individually detected using signal analysis, machine learning and statistical analysis. They can be analysed with respect to inconsistencies among them, inconsistencies between them and claims about the context of the content.

This is the domain of media forensics, which has led to the development of various footprint detectors for video, image, text and audio manipulation over recent years.

AUDIO FORENSICS TOOLS

Described below are three selected types of audio forensics techniques, which aim at detecting two different kinds of footprint:

- “Acquisition footprints” (see Figure 4) are traces of the acquisition setup and process, including the influence of the recording device, source encoding, etc. They are always present in authentic original recordings, and they can be detected

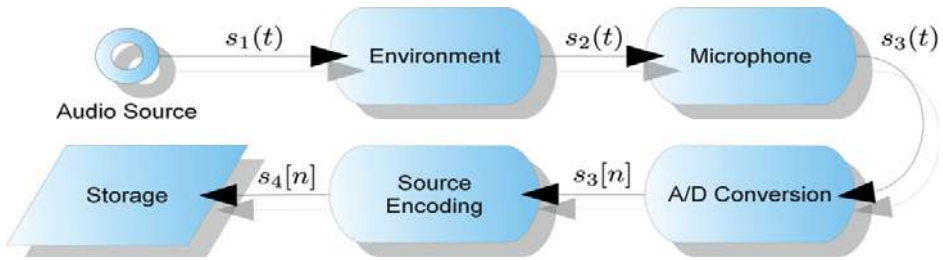
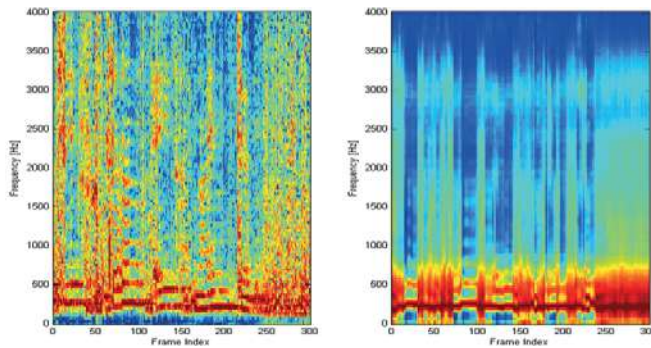


Fig 4: “Acquisition footprints”

and verified. For instance, it is possible to verify whether the identified traces are consistent with a certain recording set-up/device or a certain recording location and time.

- “Editing footprints”, in contrast, are traces of editing/processing, for example insertion and removal of segments, resampling, etc. Normally, they should not be present in authentic original recordings (except if the setup justifies that), and they can only be detected, not verified. In our case, editing footprints often manifest as inconsistencies of acquisition footprints, i.e. it is possible to identify different segments within the audio with different properties.



MICROPHONE RESPONSE

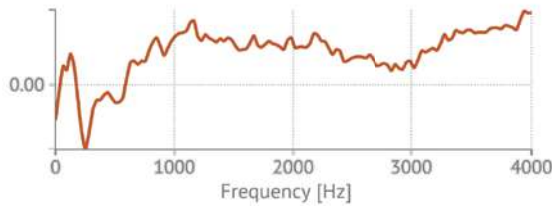


Fig 5-6: Microphone analysis

The first type of analysis is microphone classification and analysis. It aims to detect traces introduced by the recording device, with the microphone being the most important element therein. For this type of analysis, signal analysis and machine learning are used to estimate the original sound source behind a speech recording (see Figure 5) and to calculate the influence of the recording device, resulting in an estimation of the frequency response of the microphone used (see Figure 6). This technique can be applied to verify that a certain device was used for a recording, but also to detect inconsistencies, i.e. traces of more than one microphone within a supposedly authentic recording (which, except if explained otherwise, should not be present). The third example type of analysis is codec analysis. It aims to detect footprints left by lossy audio compression such as MP3, AAC, GSM or

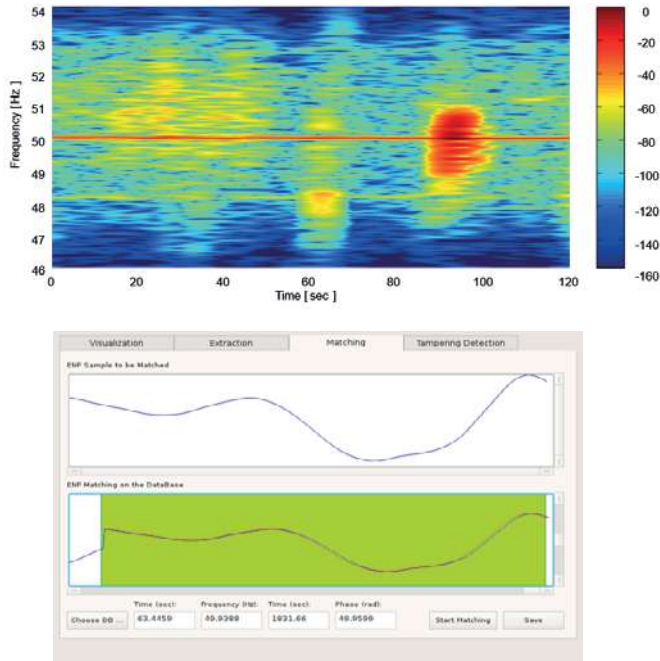


Fig 7-8: Electrical network frequency (ENF) analysis

other lossy codecs. The resulting information can be used (a) to detect and verify acquisition footprints, i.e. check whether the detected coding traces are consistent with the recording process and related claims; or (b) to detect editing footprints, i.e. traces of more than one coding process, or inconsistencies within the coding traces. Codec analysis technologies include machine-learning based approaches to detect multiple coding, and so-called “inverse decoders” which can reverse-engineer the coding process. Not only to detect traces of previous encoding and estimate the respective bitrate, but also to detect the original framing grids and possible inconsistencies introduced by subsequent insertion and removal of material.

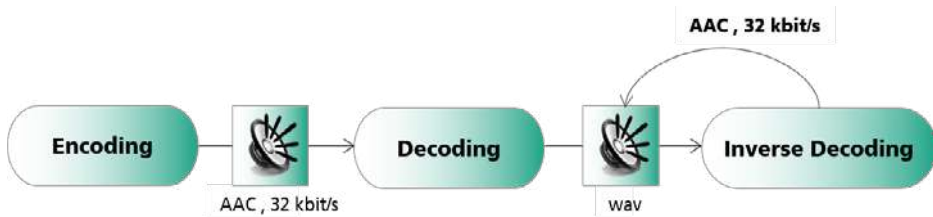


Fig 9: Inverse decoder

Of course, there are many more audio forensics approaches, and it makes a lot of sense to combine them. Depending on the circumstances and processing applied, only some traces are relevant, and the more traces can be detected and localised, the better. Moreover, the combination of detectors often results in a significantly improved overall detection accuracy.

PARTIAL AUDIO MATCHING AND PHYLOGENY ANALYSIS: DEALING WITH COPIES

Beyond the need to analyse individual items, content verification often needs to deal with copies and datasets. There are two reasons for this: the first reason, fakes are often created by reusing (copying and pasting) parts

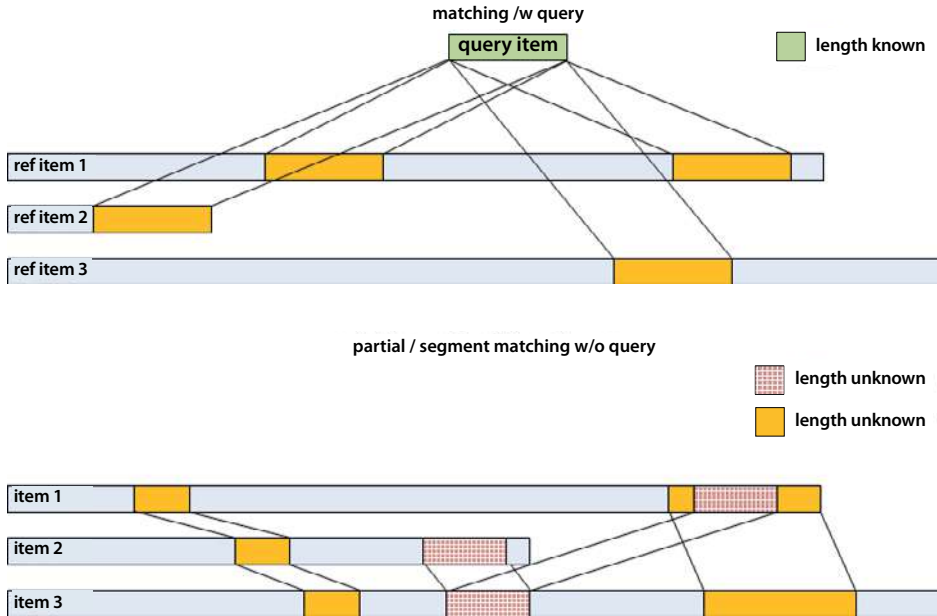


Fig 10-11: Audio matching techniques

of pre-existing material. The second, thanks to the abundance of possible distribution channels, it often happens that multiple copies exist of a content item to be investigated. It is often unclear how the copies differ from each other, and in which order they were created. Two types of technologies can be especially useful to address this type of problem: audio partial matching and audio phylogeny analysis.

Well-established classic audio matching techniques (see Figure 10) use fingerprints (which can be considered a compact representation of an item) to perform content-based queries, i.e. they use part of a content item to look it up within a database, often with the goal of identifying it. Audio partial matching (see Figure 11) also uses fingerprints, but it is different from classic matching approaches regarding both goals and the

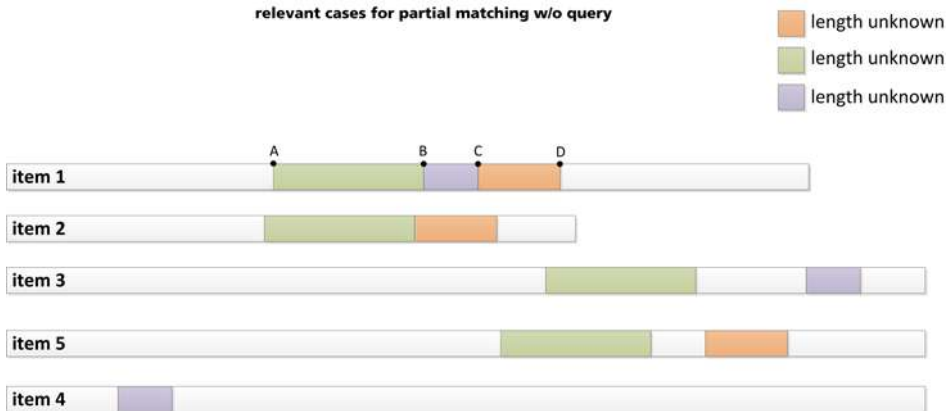


Fig 12: Audio partial analysis

applied algorithms. It aims to detect and localise partial reuse/duplicates (typically down to 3-4 sec length) within a dataset, the existence, location and duration of which is previously unknown.

Within the context of verification, audio partial matching can be used to efficiently identify partial reuse/copies within a set of items under investigation – a task which is difficult and costly to perform manually (especially with respect to accurate localisation of a partial copy). Moreover, a modified version of partial matching that can deal with very short segments (less than 150 ms) can be applied to detect so-called “copy-move-forgeries”. However, there is one problem that remains: among a set of copies or partial copies created (e.g. by coding/transcoding), how do you find out in which order they have been generated?

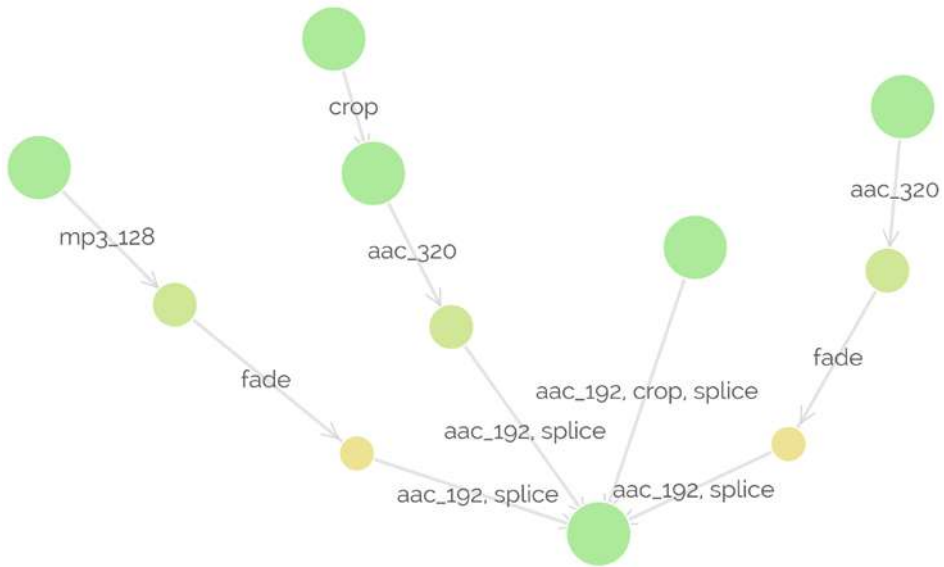


Fig 13: Audio phylogeny analysis

This is where phylogeny analysis comes in handy (Figure 13). Phylogeny analysis' aim is to automatically detect parent-child-relations within a set of near-duplicates, and it can estimate which transformations (e.g. AAC and MP3 coding, fading and trimming) were performed for each step. Hence, this is another important element for forensics analysis.

AUDIO FORENSICS: SUMMARY AND CHALLENGES

The aforementioned tools for audio tampering detection, partial matching and phylogeny analysis provide a useful toolbox to support content verification. The goal should be to integrate it into existing verification

workflows, thereby preparing for an increase in relevant cases. Of course, there are several challenges to be considered/addressed:

- As in some other domains, for every new or improved detector, new or improved attacks emerge, which trigger the development of new detectors again, etc. – forensics is a cat-and-mouse-game which frequently raises questions like “how much of the details on detectors can be published?” or “how to provide access to the technologies?” which are not always easy to answer.
- We need a “falsification culture” for media: the more information about the recording and provision context and process is provided with the content the more targets for falsification, and the better for verification. Currently this is not yet the default.
- As discussed, it is necessary to cover a broad range of tampering detectors. Much more R&D in this domain is required to achieve this goal, but commercial interests tend to underestimate the topic (as in other security domains, this might be due to free-rider problems), and public funding on this topic is somewhat limited.
- Interdisciplinary approaches to verification should be the default, but are rarely conducted, possibly due to their enormous complexity. Content verification should not only cover all data types (video, image, audio, text, meta-data), but also include other disciplines like linguistics, psychology, data analytics, etc.

- Automatic tools need to be adapted and cleverly integrated into practical workflows in order to provide benefit, especially in the domain of journalism. Users also need training and best practice guidelines to understand when to use automatic tools, how to use them and to interpret their results – e.g. users need to get used to probabilities instead of expecting certainties. Such challenges will be addressed in the Google DNI-funded project “Digger” , which includes integration of audio forensics tools into an existing collaboration platform for content verification, TrulyMedia .

Beyond these existing challenges, there is a big challenge in the making: a new generation of speech synthesis technologies based on Deep Learning/GANs allows for the creation of very realistic synthetic speech. This represents a big threat especially for the journalistic domain, but also for audio communication. At the moment, there are no detectors for this type of fake audio. Ideas for detection approaches do exist, but it remains to be seen whether suitable projects can be initiated and conducted early enough to meet this threat in time.

APPLICATIONS BEYOND CONTENT VERIFICATION

Apart from content verification, the described technologies can solve problems and provide benefits within several other applications.

METADATA AND RIGHTS TRACKING, AUDIT TRAILS

If content is produced involving external actors, importing from other systems, or using legacy software, it is often difficult and costly to

← Ancestors view

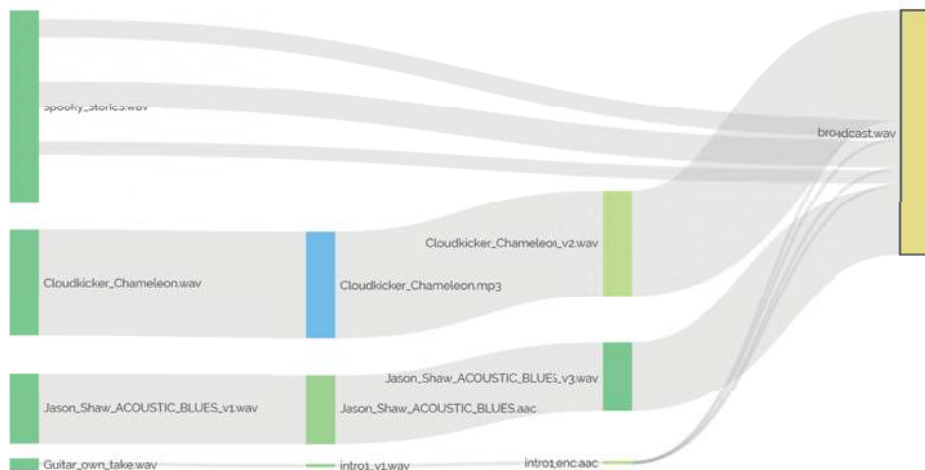


Fig 14: Metadata and rights tracking

prepare metadata and clear rights for the content produced. This is because the information about which parts of which original content went into a production needs to be manually annotated. Moreover, this often results in erroneous, incomplete and inconsistent metadata, and additional costs.

Partial matching can be used to perform this task automatically. Being provided with a set of items including the original material and the item under question, it can localise which “original material” was actually used in the production. This speeds up the task of providing metadata and clearing rights significantly, and supporting audit trails. Figure 14 provides a visualisation of a respective analysis to a given item “broadcast.wav”.

example visualisation of an analysed radio programme (segments with the same content have the same colour).

FURTHER APPLICATIONS

Reuse tracking and “news content history”

For an organisation it can be very important to measure where and how (much) of its own content is reused by others. Similarly, it is interesting to analyse the reuse of news footage across different stations/channels over time, to evaluate reporting habits of stations/channels, and to understand how news evolves (what was used, what was left out), as a means of measuring journalistic quality. How much delay occurred until the news was reported? Can certain clusters of news programmes be identified? What is the lifespan of news? Respective content can be aggregated, and then be analysed using partial matching to automatically derive such information.

Quality Control

For aggregation and import, it can be important to ensure that content does not enter with undocumented previous coding steps, causing unintended quality issues, for example by unintended transcoding from MP3 to AAC (which can result in nasty artifacts). However, previous coding steps can be detected using inverse decoding and codec analysis as outlined above.

Storage/de-duplication

Production processes can involve many partial copies, which can result in significant storage costs and issues related to metadata inconsistencies.

Partial matching can be used to identify partial duplicates, and “original” versus “derived” content can be distinguished by using phylogeny analysis, to prepare for the respective cleanup processes.

Synchronisation

If several A/V-recordings from the same event (e.g. captured from different camera perspectives) need to be found and synchronised, partial matching can be applied.

Cue-sheet creation

The aforementioned tools for tampering detection can also be used to detect and localise cuts created during the production process, and to automatically create respective cue sheets.

SUMMARY

Lesser-known technologies for content analysis do sometimes provide surprising business benefits and unexpected solutions to problems. Audio forensics tools, audio partial matching and audio phylogeny can support content verification, but these techniques can also be used for many other purposes.



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Elina Selkälä is the Head of Archives at Yle, Finnish Broadcasting Company. Yle Archives fosters and curates the archive collections of Yle, provides the company's personnel with information services and training, and publishes archive material on Yle Areena, Yle's online web service. As Head of Archives Elina is interested in exploring the potential of AI and machine learning in storing and preserving audiovisual content for future generations.

Kim Viljanen works as a concept designer in the development team of the Finnish Broadcasting Company's ondemand TV and Radio service Yle Areena. Kim is an expert in metadata technologies and develops solutions to address the increasing needs for metadata about the audio and video content to provide better and more personalised user experience for the Yle Areena's users.

3 IDENTIFYING THE BUSINESS CASES

AUTOMATIC METADATA IN THE FINNISH BROADCASTING COMPANY

Automatic metadata extraction technologies for audiovisual content such as speech recognition, face recognition and visual feature extraction promise new ways to address the broadcaster's ever-increasing demand for metadata in production, publishing and archiving. However, aligning the opportunities of the new technology with the business needs of a broadcasting company can be challenging due to limitations of the technology; different needs of different business cases; the need to change existing processes and systems; and the need for new skills. In this article we discuss the Finnish Broadcasting Company, Yle's learnings from several projects in identifying the right business cases and right methods for automatic metadata, especially the EU funded research project MeMAD and Yle's internal "Metadata machine" project.

THE NEED FOR METADATA IS INCREASING

Yle, the Finnish Broadcasting Company, produces, broadcasts and publishes online significant amounts of radio and television programmes and audio and video content every year. Audiovisual content needs rich, high-quality metadata so that it can be found, used and consumed, because searchability of the audiovisual material is largely based on textual, descriptive metadata. In addition to the audience, internal users have similar needs of finding audiovisual materials in production systems and the archive.

Currently the metadata about the audiovisual content is created manually during the planning and production processes of content creation.

In the recent years Yle has been transforming itself into a data driven public service company that provides a personalised service to all individual members of the audience. This requires more data and understanding about the audiences' content consumption habits but also more metadata and understanding about the content we create and publish.

One part of this transformation to a data driven company is enabled by the possibilities of artificial intelligence (AI) and machine learning (ML). The first use cases at Yle have been using these technologies in audience analytics and content recommender systems.

In this article we focus on using AI and ML technologies for creating content metadata automatically. For example, speech recognition, face recognition and optical character recognition technologies provide information about audiovisual content in a human readable format such as the transcript of what is spoken or list of names of the people in the footage.

Our goal is to create metadata which we define as a human-readable descriptive, textual or structural information about the content. In contrast, a machine learning model might also represent essential features of a media file, but the mathematical model is typically not understandable to a human and hence we don't consider it to be useful for our human readable data needs.

Automatic metadata extraction is the activity of using automatic technologies (currently typically based on AI and ML technologies) to analyse the content that is input to the analysis service. The output of such analysis should then be relevant, human understandable metadata that captures essential aspects of the content.

Yle has been conducting tests with automatic metadata technologies for at least a decade, the earliest test was with speech recognition ten years ago.

After many years of testing we realised that the time could be right for taking automatic metadata technologies into production at Yle. This is mainly to increase quality and availability of content analysis services (e.g. "cognitive services" provided by many cloud services but there are many other companies also offering relevant services). Another reason is the increasing need for metadata to enable the personalised public service of the future which can not be addressed properly with only manually created metadata.

STEERING YLE TO GOOD METADATA PRACTICES

Yle Archives has been heavily involved in the transformation of Yle to a data driven public service company. Some of the early-stage automated metadata generation projects carried out at Yle and Yle Archives were presented two years ago, at the 2017 Media Management seminar in Lugano. At that time we had studied, for example, how speech recognition methods and applications perform in Finnish language, and how we can use automatically created transliterations for describing audiovisual content. We also experimented with various image recognition methods available at the time, and evaluated the quality and accuracy of the metadata they produce. Two years ago the aim was to learn about AI, machine learning and automatic content analysis methods in theory and practice. We wanted to find out and define where automation could be used, where it would most benefit the metadata production processes, and find out

what kind of products and services were available. The pilot projects and their results are presented in more detail in the proceedings of the 2017 Lugano Media Management Seminar.¹

FURTHER STEPS TOWARDS AUTOMATION AT YLE ARCHIVES

The next step forward from studying the method was to explore the best ways to implement the methods in practice, to bring them closer to our own use cases and our everyday metadata work at the Archives. In the fall of 2018 two pilot projects were carried out.

The first pilot, a small scale speech recognition project, was conducted with a Finnish company, Ääni Company. Ääni Company provides automatic speech recognition services and offers real-time automatic speech recognition in English and Finnish. With Ääni Company's product, we wanted to study if a generic speech-to-text application could function as a fit-to-purpose tool, when and wherever the user has a need for speech recognition. The goal was to find out if an external analysis application, which “listens” to the media file turning it into a transcribed text, is a handy and helpful tool, and under which circumstances.

The application's tester group was composed of archivists whose task it is to create descriptive content metadata for radio programmes, and of archive journalists who search radio content from the archive database. The group of testers was instructed to use the application in real life use cases, for example when they came across archived audio content with poor metadata and wanted to find out what the content was about.

1. Heading for AI - The automated metadata generation projecta at Yle
<http://fiatifta.org/wp-content/uploads/2018/12/MMC-Seminar-Changing-Sceneries-Changing-Roles-VIII.pdf>

As a result we found out that this kind of “on-demand” speech-to-text application is a handy aid for producing descriptive metadata for audio content. An archivist can easily get an idea about the audio content from the transcribed text, and if the transcribed text is also automatically annotated, we can improve the quality of archived audio content metadata significantly. Due to the slowness of the speech recognition process such a general tool is not optimal for archive journalists who sometimes very quickly need to know if the audio content in question is what they are looking for.

In the fall of 2018 we also conducted another small pilot project in which we used the transcriptions and keywords that are automatically generated from Yle Areena’s audio and video content for recommendation purposes. The transcriptions and keywords were entered into our archive database, and our goal was to find out if this kind of metadata improves the findability of audio and video content from the database, and whether it is of help to archive users. In addition, the aim was to learn about ways to manage and organise metadata in our database, and how to present the automatically created metadata to archive users.

When evaluating the results, the most important finding was that it is important to be aware of the purpose for which the metadata is automatically generated. Keywords generated for content recommendation are usually aimed to “sell” the content to the audience, so they don’t necessarily describe the subject or the visual content well enough for archiving needs. Another important observation was the need to reconsider our information architecture and data models to better organise our metadata when entering automatically generated metadata into our databases. We also learned that we need to distinguish between metadata that was generated automatically and that which is created by archivists so that archive users can be aware of the difference.

DEFINING THE COMPANY WIDE SOLUTION FOR AUTOMATED METADATA

Yle is participating in an EU funded research project "MeMAD"² (2018-2020) where the goal is to research the opportunities of combining human effort with automation in the media business.

The project members have expertise in areas such as speech recognition, automatic translation, automatic visual analysis, metadata, linked data, manual content analysis, media production processes, media archives and media publishing. By combining the expertise of these different areas, the project aims to develop automatic tools and processes for media creation and publishing processes that go beyond the current state-of-the-art methodologies e.g. automatic translation and subtitling, automatic metadata generation for archiving purposes, and improved production processes for content creators.

Another current activity at Yle is the "Metadata Machine" pre-study project (spring and summer 2019) where we test currently available services in the market and try to identify the most relevant use cases. The vision of the "Metadata Machine" is that it could be better to invest in a centralised service, rather than a distributed service, where each department individually buys (potentially the same services) from different vendors.

The Metadata Machine project is conducted in cooperation with Graymeta³ using their Curio product, which is a metadata aggregator service. The idea of Curio is to integrate a wide variety of automatic metadata extractors in the market (including services from Google, AWS, Microsoft, Valossa, Speechmatics and others) and provide a uniform user interface and API to these services. This addressed Yle's needs to easily test different services in the market.

2. <http://www.memad.eu>

3. <http://www.graymeta.com>

The Metadata Machine project has invited all interested departments and individuals in Yle to test the automatic metadata technologies. The project is still ongoing, but we are currently considering the following use cases which have great potential based on our testing with different teams in Yle:

1. **Content creation:** For example video editors can locate relevant parts from the source material quicker if the content is first automatically indexed with face recognition, optical character recognition, speech recognition and other technologies.
2. **Archive:** For example, automatic metadata could be created for assets that do not currently contain any metadata. Automatic metadata could also provide new viewpoints to the material, for example optical character recognition would make all text inside the video image searchable. Also manual metadata creation could potentially be assisted with the help of automatic metadata.
3. **Media logistics and versioning:** For example, finding the timecodes for advertisement breaks, black frames, silent regions, start of end credits and segments containing burned in text elements in video images would be helpful for Yle's material logistics, translation, quality checking and publishing processes.
4. **Analytics and audience research:** With the help of automatic metadata, audience researchers could have access to much more detailed information about each programme. This could be used to find correlations between what is said or shown on screen, and how this affects the number of viewers.

5. **Rapid development.** As a part of the Metadata Machine project we have noticed that the availability of automatic metadata tools, such as speech recognition, face recognition, optical character recognition etc. makes it much more likely that such technologies are used in the company. By making the tools available, this in itself might increase the speed of innovation within the company.

For the Metadata Machine project we tested the above mentioned use cases in practice and the results are promising. However, we are not yet ready to publish final results or conclusions regarding individual use cases.

A few lessons learned from the Metadata Machine project include the following:

Identifying the exact business cases for the new technologies is difficult. This is due to the limitations of the technology, but also because new technologies require changes in thinking and existing processes before the full benefits can be achieved.

The metadata aggregator approach seems to be working well for Yle's purposes. The market of automatic metadata extractors is evolving fast and it makes sense to maintain the flexibility to change services as needed.

The quality of automatic metadata varies quite a lot and we are still working on what the exact quality requirements are for our different data purposes.

Different use cases typically require different user interfaces - the role of the user interface design is significant, otherwise the automation might not align well with the needs and daily work of the users.

Finally, we have noticed that for some people the errors in automatic metadata are annoying. Our message is that even if the data may contain errors, it could still be valuable. Consider accepting the imperfectness of the data and the technology – and see if it still could be valuable for your business and your daily needs! It is better to start now, because the technology (and quality of data) will most surely improve in future.

CONCLUSIONS AND NEXT STEPS

We have gained valuable knowledge and understanding of the field of AI and machine learning and automated metadata extraction from the pilots and experiments conducted in recent years. We have also learned about their possibilities and uses, as well as their limitations, both in theory and in practice. Additionally, we have identified various use cases where new technologies and methods could be used to identify and describe audiovisual content.

We have also had many discussions about the relationship between the machine and the human being (the information professional), so that we could dispel the fears and worries associated with AI. We have tried to find ways to co-exist with AI, and learn to make better use of the possibilities of AI. In order to gain better knowledge and understanding on AI, Yle Archives has urged employees to use some of their working time to complete the “Elements of AI” course offered by Helsinki University and Finnish tech strategy company Reaktor. Elements of AI is an online course open to anyone interested in learning what artificial intelligence is, what artificial intelligence allows us to do (and what it does not) and how artificial intelligence affects our lives. This free online course is also available in English at www.elementsofai.com.

Metadata and automatic metadata generation are currently the focus point of the entire company. High-quality, abundant metadata is a requirement for running a modern public broadcasting company. Metadata is required for audience insight, logging of content, on-demand publication, translation and versioning of content, production management as well as for the archive. At the moment Yle in its entirety is committed to finding a company-wide solution for automatic metadata production because the need for and importance of metadata is constantly increasing.

A company wide centralised solution does not necessarily mean that all use cases would be served by a single, company wide automatic metadata solution – there could be exceptions for specific use cases such as music

reporting, video editing or automatic translation where optimised solutions for that problem could address the needs better. However, if and when such specific solutions are in use, we stress the importance of making the data available and accessible. Any system that creates metadata should be integrated into the company wide metadata solution.

The goal later this year is to gather all of the experiences and knowledge gained so far, and to decide on the next steps towards a company wide metadata solution. Yle's ambitious goal is to find a universal, efficient solution – a centralised metadata service – that combines the various automatic content analysis methods into one solution.

Furthermore, we want to integrate the solution into Yle's production environment, into our planning, production and publication processes, and analyse all media content – raw material, acquired content, published and live content, as well as the archive collection in our possession. Ultimately, we want to make sure that the automatically produced metadata is available throughout the company for all our various metadata needs.



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AUTHOR:

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Léonard Bouchet, 41, is an expert in digital transformation and development. Since January 2016, he has been in charge of the Data and Archives department at RTS (French part of the Swiss Public Broadcaster), where he has been using the strengths of new modes of collaboration (agility and holacracy) and innovative technologies (artificial intelligence). From 2013 to 2016, he was head of RTS' digital production department. Developer and project manager in the public service since 2009, he also has 10 years of previous experience in the private sector.

Sébastien Ducret is an IT consultant at Kalyss and has been working for Radio Television Suisse (RTS) for several years. He recently joined the Archives department development team which works to open up the audiovisual archives to the public.

4 A VISUAL FEATURE EXTRACTION PIPELINE

...AND ITS APPLICATIONS FOR RADIO TÉLÉVISION SUISSE

ARTIFICIAL INTELLIGENCE IS bringing a technological revolution by minimising or drastically modifying the human effort needed to get outstanding value out of our archives. Here at Radio Télévision Suisse (RTS), we are working in the field of Artificial Intelligence (AI) and specific Machine Learning based solutions to tackle the huge amount of data we have within our content. In the course of research and development we have put into production a unique solution that we label as a Visual Feature Extraction Pipeline. This tool implements recognition capabilities using Machine Learning techniques to identify patterns within facial, object and landmark features. For faces, once these patterns are identified, the algorithm is able to precisely store each person's facial features in the form of mathematical data. No two faces can ever be the same. With the algorithms we use the pipeline can quantify each unique pattern to distinguish between the differences in each face.

Facial recognition has extreme value nowadays and to understand its importance, we must first analyse the rate of accuracy in identifying any person through facial features. Our solution follows a 5-step process in analysing facial data and has successfully identified and differentiated between faces taken from our archives. Facial recognition has the credibility to identify facial features with a high accuracy and success rate and makes it useful in a wide variety of practical applications. Of course, the visual feature extraction pipeline not only works with pictures but can also identify faces from a video. Here at RTS, we've already experimented very interesting opportunities with this solution and are pleased, as a broadcaster archive, to have the needed dataset to collaborate with others and explore even more in the future.

HOW IT WORKS

This pipeline takes as input an image or a video frame and outputs feature vectors for faces, objects and scenes, and landmarks unlike a classification pipeline which outputs classes' label and scores. A feature vector is an n-dimensional vector of numerical features that represent some object. Feature vectors are used to represent numeric or symbolic characteristics called features of an object in a mathematical easily analysable way. Once features are extracted, they can be used for many applications, such as to classify person, to search visually, to train custom classifiers to automatically categorise content like for example various sports.

A VISUAL FEATURE EXTRACTION PIPELINE

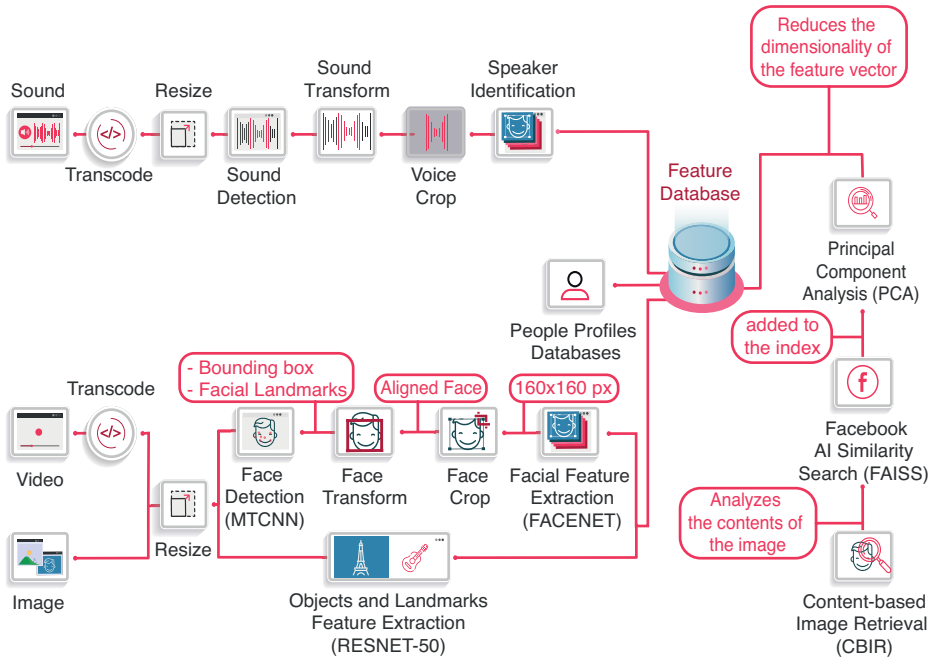


Fig 1: Visual Feature Extraction pipeline

STAGES OF VISUAL FEATURE EXTRACTION PIPELINE

The visual feature extraction pipeline consists of five stages:

1. Face Detection
2. Face Transform
3. Face Crop
4. Facial Feature Extraction
5. Object and Landmark Feature Extraction

Let us take a detailed look at each stage individually.

FACE DETECTION

The first and the most important stage of the extraction pipeline is detecting faces in an image. This stage takes an image or a video frame as input and outputs the bounding box and facial landmarks for the face(s) detected in the image. The bounding box is a rectangular box defined by x and y coordinates of the top left corner, height and width of the rectangle of the face region. There are five facial landmarks, including left eye, right eye, nose, left mouth corner, and right mouth corner. The system uses a deep learning algorithm called Multi-task Cascaded Convolutional Networks (MTCNN)¹ to detect faces. It is Multi-task because it does two tasks: bounding box regression and facial landmarks localisation, while it is Cascaded Convolutional Networks because it leverages an increasing resolution in a cascaded architecture with three stages of convolutional neural networks.

FACE TRANSFORM

The second stage of the extraction pipeline is face transform. This stage takes the bounding box and facial landmarks as input and outputs an image of the face aligned. The face is aligned to improve the accuracy of the algorithms. The system translates, rotates, and scales the face to align it.

FACE CROP

The third stage is face crop. Once the face is aligned, it is cropped to a 160x160 pixels image.

1. Joint Face Detection and Alignment using Multi-task Cascaded Convolutional Networks, https://kpzhang93.github.io/MTCNN_face_detection_alignment/index.html

FACIAL FEATURE EXTRACTION

The fourth stage of the extraction pipeline is facial feature extraction. This stage takes the image of the aligned and cropped face as input and outputs a facial feature vector. The system uses a deep learning algorithm called FaceNet [2] to extract a low-dimensional representation of any face. The FaceNet pre-train model uses an Inception-ResNet v1 architecture and is trained on the MS-Celeb-1M dataset and tested on the Labeled Face of the Wild dataset. It generates an embedding, 128 dimensional feature vector. The facial feature vector is then saved in a feature database.

OBJECT AND LANDMARK FEATURE EXTRACTION

The last stage of the extraction pipeline is object and landmark feature extraction. The system uses a deep learning algorithm called ResNet-50 to extract feature vectors of objects in an image. The ResNet-50 model with weights pre-trained on ImageNet is provided by Keras Applications. Deep learning algorithms learn from successive layers of representations. Both the input layer and the last max pooling layer are regarded as the feature extraction part of the model, while the rest of the network is regarded as the classification part of the model. A transfer learning approach has been used to enhance the performance on landmark feature extraction. It has then been retrained on the Google Landmarks dataset.³ The feature vectors extracted are then saved in a feature database.

2. FaceNet: A Unified Embedding for Face Recognition and Clustering, <https://arxiv.org/abs/1503.03832>

3. Google-Landmarks Dataset, <https://www.kaggle.com/google/google-landmarks-dataset>

FACE CLUSTERING

We have seen how facial feature vectors are extracted from an image. To extract vectors from a video, the process is the same, i.e. the system extracts the frames from the video and passes them through the extraction pipeline. A video has a frame rate of 25 frames per second but it is not necessary to process all frames. A frame rate of one frame per second is generally sufficient. However, at this rate, if a person's face appears for only a fraction of a second, it will not be detected. Since a person's face can appear on several frames, there will be several facial feature vectors of the same person's face. The system uses a hierarchical clustering algorithm to group the faces of the same person based on their similarity. It then computes the arithmetic mean of face features for each detected person.

APPLICATIONS

Face identification is the first application we made of the extraction pipeline.

PUBLIC FIGURES FACE DATABASE

In order to be able to identify a face we first need to have a database of known faces. Thus, our documentalists have built a face database of public figures and they regularly update it. We choose to limit ourselves to public figures for ethical and legal reasons. Our database currently consists of approximately 92,000 images of 5,500 people. Each time a face is added to our database, the system extracts a facial feature vector using the extraction pipeline and saves it.

FACE IDENTIFICATION

Once we have a face database we can identify a person by comparing their face with all the faces in the database. To compare two faces:

1. The system extracts the facial feature vector of the face to identify
2. The system computes the cosine similarity between facial feature vectors of both faces (Cosine similarity will range from -1 meaning exactly opposite to 1 meaning exactly the same)
3. The system compares the cosine similarity with a threshold above which the face is considered to be the same
4. We have empirically defined this threshold at .80

VIDEO SEGMENTATION

Face identification is used to create segments of people appearing on a video. The metadata of the created segments, i.e. person name, start timecode and end timecode are then exported.

VISUAL SEARCH

The second application we made of the extraction pipeline is visual search or Content-based Image Retrieval (CBIR). "Content-based" means that the search analyzes the contents of the image rather than the metadata such as

keywords, tags, or descriptions associated with the image. To be able to retrieve an image, we first need to build an index of feature vectors to optimise speed and performance as an exhaustive search would need considerable time and computing power. The trade-off is basically the accuracy. The system reduces the dimensionality of the feature vector, from 128 to 64 for facial feature vectors and from 2048 to 128 for object and landmark feature vectors, using an algorithm named Principal Component Analysis (PCA) and compress it with a lossy compression based on Product Quantizers (PQ). Searching is from memory. We used Facebook AI Similarity Search (FAISS)⁴ library which provides very efficient implementations of these algorithms. Once the feature vectors are extracted they are added to the index. Our index currently consists of approximately 65,000 videos containing 60,000 faces and 65,000 scenes.

To find visually and semantically similar images:

1. The user selects an example image
2. The system extracts a feature vector of the example image
3. The system computes Euclidean distance or L2 distance between the feature vector of the example image with feature vector index and outputs top N results

AUTOMATED CATEGORISATION

The third application is automated categorisation. Visual content can be automatically categorised using custom classifiers. Our documentalists can create a custom classifier and add images to represent various classes to it. For example, a “Sports” classifier, with “Tennis”, “Golf”, and “Ice Hockey”

4. Facebook AI Similarity Search (FAISS), <https://github.com/facebookresearch/faiss>

classes. Once the classifier has enough classes and images per class, it is trained and can be used to automatically categorise visual content.

CONCLUSION

To sum up the entire process, the visual feature extraction pipeline uses five unique steps to extract facial features from each face and further store the quantified data into a mathematical representation. The process in abstraction follows the method of taking a picture or a video frame as an input, outlining and identifying the face (if any) from within the input, aligning the facial features detected earlier, cropping the face to exclude any unnecessary features, and finally passing the data through our neural network algorithm.

As for the final information extracted and sent to the deep learning algorithm (known as FaceNet) through the visual feature extraction pipeline, the image is saved and can be used for any future purpose. The algorithm uses a mathematical model to distinguish between two different images, as the information is stored in a mathematical vector form. As for identifying facial features from videos, the algorithm only needs to take a single frame from a moving picture (say 24 fps) and use it as a basis to pass through the program as input.

Once the features are identified, they can be used for a wide variety of purposes such as enhancing textual search and performing visual searches. Here at RTS, we extracted the facial features of thousands of public figures from information taken from our archives and used machine learning to give direct access to relevant segments for our audience. By entering a person's name, the algorithm can thus identify each frame where the figure is present. We really think these solutions and the techniques we used open very interesting new fields and perspectives for Archives. As this is an extremely large and rapidly evolving field, we are eager to share and openly collaborate with all broadcasters interested in this domain.



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COMPANY: BAYERISCHER RUNDFUNK, GERMANY

Gabriele Wenger-Glemser studied political science, history and German studies at the Albert Ludwig University of Freiburg in Freiburg im Breisgau. She began her career at Bayerischer Rundfunk almost twenty years ago having volunteered as an Information Specialist. She progressed to Head of TV archives in 2001 and after fourteen years, moved on to become the Head of Documentation and Research Services where she can still be found today.

In her time at Bayerischer Rundfunk, she has been involved in numerous projects from the development of a strategy for securing archive stock on video tape and film carriers to the introduction of a content management system and AI-based procedures for indexing text, audio and video content.

5 SHAPING THE FUTURE

ARTIFICIAL INTELLIGENCE IN AV ARCHIVES

THE ARD IS short for the “Association of Public Broadcasting Corporations in the Federal Republic of Germany“ and was founded in 1950. Today it is an organisation jointly operated by nine regional public broadcasting corporations, Bayerischer Rundfunk (BR) being one of them. All corporations are independent from the state of government and publicly funded. Each corporation of the ARD is an independent institution and has its own legal basis, but their mission is very similar. It is to provide information, educational, service, arts and entertainment programmes. All ARD members contribute to the nation-wide television programme “Das Erste“ and to four other common channels.

In addition to “Das Erste“ there are seven regional public television programmes in Germany. BR operates the regional television programme BR Fernsehen, the educational channel “ARD-alpha“ and ten radio stations. Our radio and TV programmes are available nationwide, mostly

Europe-wide and can be accessed over the internet from almost anywhere in the world.

Each of the ARD broadcasters holds their own comprehensive archives and the ARD archives in particular have a long tradition of working together. For example, we develop, use and maintain common software, have joint rules and standards for the documentation of our media and we organise the exchange of archive programmes between the ARD broadcasters.

So it makes sense for the archives tackle the huge challenge of the so called digital transformation together. The video mining task force was established by the conference of the archives in 2017. The goal was not to have an academic discussion on video mining, but to identify possibilities and create use cases for the introduction of AI-tools and methods in day-to-day business and in our infrastructure.

There is an ARD strategy paper on optimisation in the digital age from September 2017 that provides a general framework for our group. One of the described projects and intentions is cost reduction and staff savings in the archives.

The project “Media Data Hub” will establish a common cross-media data system. We want to use state-of-the-art technologies that enable significant increases in the efficiency and accessibility of media content. With the support of intelligent search functions editors gain better access to all archived programmes of the ARD.

One key aspect is using new technologies to simplify and automate indexing and metadata enrichment for all kinds of content, regardless of whether it is derived from TV, radio or internet. To a large extent, AI should replace the intellectual and manual documentation of media.

As a public-service broadcaster ARD’s and BR’s mission is to provide programmes aimed at society as a whole. For the introduction of AI methods it is important to know that our programmes are going to cover very different issues and domains. Each of our Third Television

Channels and most of the radio programmes are characterised by an individual regional profile and a high degree of regional focus throughout its programmes. This is an important issue for the introduction of AI methods in our archives because they have to work for each type of content which includes international, national or regional focused themes, objects or persons.

AI – ARCHIVES GO AHEAD

Our task force is absolutely convinced of the potential of machine and deep learning for our media companies. When I talk about AI in my presentation, I always mean Weak AI based on machine and deep learning. In the following, I use AI as a term for methods, tools and algorithms based on machine and deep learning.

AI can help to increase the efficiency of media production, to redesign processes, and to manage the increasing daily ingest, throughput and output. With AI we will achieve the goal : no essence without metadata.

Cognitive Services are our only chance to get more suitable metadata for different and new platforms, different users, personalisation and user-centric recommendations despite decreasing personnel resources. Even today we can no longer index each piece of content comprehensively and deeply. For many decades the archives have provided great efforts to enrich metadata. However, all our efforts are not enough to supply the required and needed metadata for all of our content in consistent quality and quantity, required time and speed, and requested granularity suitable for all users, use cases and usage scenarios.

AI presents a great opportunity to increase not only the quantity and quality of metadata, but also the accessibility, availability and usability of valuable archived content. Some people in the archives may fear losing their job because of this development. However, I think it will be an ad-

vantage to have more capacity for new tasks, new archive services for our programmes and digital transformation in our media companies.

The challenge for AI tools is that we do not only need more metadata but the right metadata for different use cases. We need metadata in valid and consistent quality, suitable for all users and usage scenarios, no longer media-specific, but user-oriented. Even for all hierarchical levels of AV content (e.g. a singular frame or shot, as well as for scenes, contributions, or the whole programme) and in different depths (low-level features as well as syntactic and high-level semantic information).

AI-based tools and techniques for metadata extraction like speech to text, face recognition, object and concept detection will be used in different areas, for archiving as well as editing and publishing, not only for historical content, but for ongoing ingest and for new footage.

We archives go ahead: we have lots of interesting content which is of interest for training.

We have the required knowledge and experience about AV content and metadata, and know which metadata is needed for which use case. We can develop methods and procedures and when tried and tested and operational in the archives, they can be transferred to other application scenarios. With our testing and training of new technologies we can support the whole broadcasting company.

AI and its impacts present a great opportunity for the archives but we have to accept the challenge and be prepared for change.

ARTICULATE YOUR NEEDS – USER-CENTRIC APPROACH

The starting point of our considerations and our activities in the expert group were the following five key questions:

- In which areas is AI operational and how can we get good and reliable products?
- How can we find a starting point for the integration, earn low-hanging fruits and create concrete added value?
- How can we filter out suitable material for training from our rich archive content?
- How can we automate necessary training? This is because we do not want to replace the manual effort for intellectual indexing with the effort for the necessary training for face recognition and identification, for example.
- How do we train our employees and how can we become a learning department?

We cannot blame the industry for only highlighting the bright sides of their services, and concealing their weaknesses. So it is our duty to emphasise both: the possibilities as well as the limits. Most of the time there is a big difference between a showcase and the requirements in real life. To make sure that we buy trustworthy AI and will achieve good results, we chose a user-centric approach to the issue. We collect and describe user stories from the perspective of the archives and the editorial staff. User stories as short descriptions of functionality from the perspective of a user are very helpful. The focus is on the experience of the customers and their needs. A user story is supposed to define what the product should do and what benefit should be achieved, but not the specific approach of how it is done.

able. I am sure, in our user stories we did not always succeed. Writing user stories requires some practice and in any case it is necessary to discuss the stories with the developer and the product owner. The stories are a good basis for the conversation with them: As a user you articulate your needs, not technical aspects. As an IT specialist you learn what the user really needs and what they want to do with the application. If it turns out that the story is incomprehensible or useless, you can delete, reformulate or add more details without much effort. And of course at any time it is possible to add new ones. For this user-centric approach and for writing good user stories you also have to describe the different user groups. You need so-called personas, short descriptions of typical users and their needs.

In our expert group we collected about 250 stories that we clustered, covering video, audio and text mining. The stories include lots of aspects concerning training and quality management, as well as non-functional requirements like data protection and data sovereignty. We carried out a rating of each story to show the added value for archives and journalists, as well as the savings potential.

There are four areas that have great potential and added value. Face recognition, object recognition, speech to text and fingerprinting.

Face detection is already a sophisticated and well-developed technology, with high potential for the whole lifecycle of a video. The biggest challenge is the training of the system concerning people of regional or local relevance who are not international or national celebrities.

Object recognition also offers great potential. However, due to the additional need of training, we have not found a practical entry scenario yet. Moreover, we do not want to have too many concepts but only adequate ones.

We have used speech to text since last year and it is indispensable in daily operations in the archives and editing departments. It is absolutely fundamental for our whole company, even though we do not have any solution for the detection of South German dialects.

Since 2011 we have used fingerprinting at BR to manage different versions of a video. Last year we did a proof of concept to use fingerprint technology to create an edit decision list automatically after production for rights management. The results were so good that we are going to integrate this service in our infrastructure and our day-to-day business this year.

OUR VISION: NO CONTENT WITHOUT METADATA

To enrich all content with metadata we need a mining platform with different cognitive services for the multimodal analysis of any content during the whole lifecycle of a media production, preferably in real time. The aim is to have comprehensive metadata for content creation and distribution and to share content with suitable metadata inside the company and between broadcasters.

In the future we may use services on premise as well as services in the cloud. Currently, we prefer on premise solutions to avoid high costs for the upload because of the huge amount of material. Perhaps this point will play a minor role in the future.

For our different use cases we definitely need the possibility to combine several services, maybe using them in consecutive order. The extracted metadata has to be filtered, enriched and aggregated for further use.

Customised training and quality management will play a central role. For machine learning, we need applications which support manual as well as automated training to train with our own content, as well as for training with generally available content.

At BR we intensively discuss the necessary infrastructure for the integration of different mining services. This is a very important task. To prevent us from making interfaces to the mining platform for every internally used system, we need a uniform interface to internal and external mining

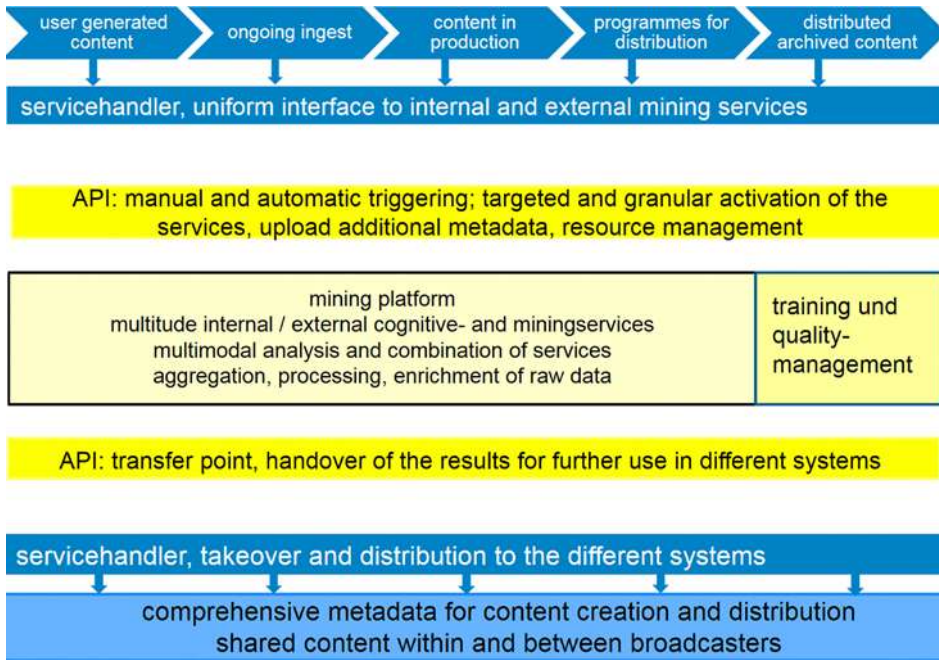


Fig 2: Integration Workflow for Mining Services

services and a central API. It must be possible to trigger the mining services to activate only specific services or analysis tools, as well as to trigger a complex analysis workflow to manage resources and scheduling jobs and also to upload additional metadata. Further, we need a central transfer point and layer for the acquisition of the results and to forward them to the requesting user system.

THINK BIG, START SMALL

There exists no off the shelf product that exists to meet all of these functional and non-functional requirements.. The success or failure of a particular product or service is barely predictable at the beginning of a plan-

ning or design phase. We are sure we have to train and adapt products to our content and our application cases. Therefore, we have to invest a lot to develop tailor-made solutions for our needs together with different providers. The great question is, how can we get good products?

Whether a product or service is a significant improvement, or if the quality is sufficient, cannot be predicted at the beginning. We have to thoroughly examine if the results of a service meet our expectations.

Only application and testing allow reliable statements about the quality and the results, the applicability and the potential in the media company, and about the effort for integration in our technical infrastructure and day-to-day business.

We consider automation and integration of AI a longer process. And we recommend to think big, but start small. Through proof of concepts and minimal viable products we have to train our staff, provide greater security and confidence in lighthouse projects, and gain first practical experience. What we need are specialised AI tools for our specific needs.

It is essential for us to be as independent as possible from vendors and to be able to exchange services in the future. It is imperative that high standards of data protection, data sovereignty and data integrity are complied.

The market for AI is flourishing. There are numerous research facilities with interesting research projects, but they often do not offer any products themselves. Further, many companies in the traditional broadcasting sector are increasingly integrating AI-based methods for enriching and managing content, e.g. products for video editing. But we cannot train several tools. From our experience, working with small start ups is very rewarding. They are very responsive to the wishes of the customer, they are generally more focused on specialist fields, develop on premise solutions and allow customers to participate in the development of the products. The results are often more adapted to the needs and the content of the customer. The disadvantage however is that for the different needs, we have to cooperate with multiple companies.

By contrast, the global players and tech giants offer complete solutions from a single source. They have integrated multiple AI services into their solutions, which are typically cloud-based. This in part has serious repercussions on the costs, which are often extremely high due to the vast amount of material. The billing of algorithm services on an hourly basis or quantities is very problematic for us because the costs are not plannable.

Benchmarking between the different and singular available services is very difficult. We need new Key Performance Indicators (KPIs).

Our expert group has identified 12 points that play an important role in the comparison of providers and their products: business model of the vendor, data protection and integrity, references and experience, training possibilities, accuracy of results, usability, support structures and communication, customising, scalability, technical integration, modularity and finally potential for further development.

We are going to describe these aspects in more detail . As a result, we have a comprehensive grid for comparison and for discussion with the various providers.

TRAINING – THE MOST IMPORTANT TASK FOR ARCHIVISTS IN THE FUTURE

The training of the deep neural networks and machine learning from data is fundamental for good results of AI tools. For the training of algorithms a huge, suitable and clean training dataset is necessary. Because machines learn directly from data, the training dataset is fundamental to good results.

AI has to learn from real-life examples and is almost always lost in unfamiliar and novel situations. New objects or new persons in our content cannot be detected without training. Yet, in our media companies, issues, themes and persons can change every day. Furthermore it is very important for us to recognise regional or local objects like buildings, events or

content-based training improves quality BR

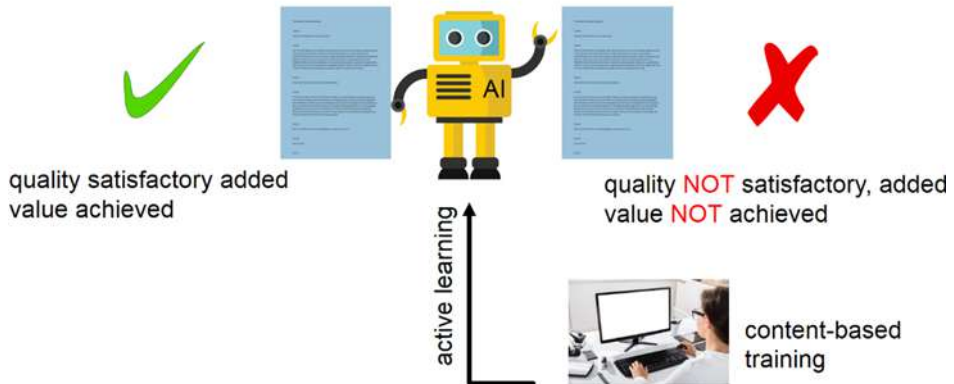


Fig 3: Content-based training improves quality

locations. It is necessary that the mayor of a small town is also recognised – not only international or national celebrities.

The more specific needs to be learned, the more effort is required for training. General concepts (like cat, night, house) can be trained from general data. Specific concepts, like the tradition and the event of the so called Schäfflertanz (Barrel-makers dance) in Munich, or the special building of the Bavarian parliament, the so called Maximilianeum, have to be trained by oneself. We think this is a task for archivists in the future.

By contrast, the global players and tech giants offer complete solutions from a single source. They have integrated multiple AI services into their solutions, which are typically cloud-based. This in part has serious repercussions on the costs, which are often extremely high. In any test or proof of concept with AI services we learned the following:

The quality of the service was not satisfactory. The pretrained models can only be the basis for special training by the customer. For higher output accuracy or for more added value, content based training is essential. For example speech to text is included in different products, but the results are not suitable to generate subtitles or to distribute the manuscript on our platforms. At BR, we need a speech model for the dialects in South Germany. We have to train our own language model and we are going to start a new proof of concept at BR to try this with our video content and the associated subtitles. We want to develop a model that is owned by us. If we switch to another AI-service in the future, we hope that customised training with the previously trained model and dataset will be possible.

However, learning algorithms must be continuously optimised, trained, and the results have to be monitored. For example, if your neural network learns new faces permanently, you have to check that the results remain the same for already trained individuals and do not worsen.

To automate the metadata enrichment process we need content-based training. To reduce manual efforts for training, we search methods to automate the training process, and to use our own rich content.

POC – AUTOMATICALLY GENERATED TRAINING DATASET FOR FACE RECOGNITION

To identify a real person in a video, a suitable training dataset (stills or video) for this person is necessary. For this reason, we have carried out a proof of concept at BR to clarify two principal questions:

First, whether it is possible to generate a training set for a face recognition algorithm automatically. Second, how suitable is the training material to recognise relevant persons in videos of BR. To answer these questions, we restored and extracted suitable and labelled content from our BR video portfolio.

We created a list of relevant people onto the lower thirds of television news programmes within one year. This list was the foundation for a deep learning service to cut out faces in video scenes and link these with the associated name extracted from the lower third by OCR. So whenever a person with lower third was in the video, the face together with the name has been archived in a training data store. Even if a wrong match between face and name appeared, a clustering method filtered them out. In this way we have created about 1,000 identities with hundreds of pictures that show the current person in different positions and locations. Therefore, the necessary variance of the examples was given.

Afterwards, the generated training set was used to train a neural network for face recognition. With unknown video material we checked if the trained people were recognised. Of course, untrained people in this example show as unknowns. But the trained people are recognised with an accuracy of more than 90%. So the proof of concept was really successful and we integrated this service in our infrastructure.

OUR LEARNINGS

Of course in future operations, we will not be able to manually correct each wrongly extracted result. However, as editor or journalist in the creative process, archival content cannot be verified again due to time constraints. Named people in the archive database must be 100% correct. The necessary quality of the results of AI tools depends on the use case, so the required quality may vary.

Training and quality management are very important. We have to monitor the results and we need information automatically if results worsen. We have to establish training workflows and quality assurance routines. Face detection algorithms especially have to be optimised and adapted continuously by an up-to-date training data set for new relevant people in media.

In a pre-test of a face detection service we had a really interesting example. In spite of the correct lower third, the cognitive service mistakenly recognised the person depicted. Parameterisation is very important, and we learned: rather than having wrong metadata, less metadata is preferred.

Humans and machines have to cooperate in the future. Machines will not replace archivists, but the archivist's job description will change fundamentally. Therefore we need new skills, and even more resources in our IT departments.

The collected user stories and the suggestions of the task force for video mining are used for POCs and testing and also for the development of the new Media Data Hub. To get good and trustworthy AI to enrich our content with metadata, we have to work out appropriate solutions. To make first experiences on the basis of concrete projects, we established a laboratory for digital transformation at BR. It is high time to build up expertise and to achieve first presentable and visible results. Of course, we will not be able to get the full added value from the beginning. We must evaluate initial results, improve and optimise procedures, adapt existing services to our needs and our content. It is also not clear whether all requirements and use cases will be met in the best possible way using the same algorithms and methods or whether we will need different ones for similar tasks.

Let us shape our future actively!



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Graeme Phillipson works in BBC Research & Development on the AI in production project. He is part of a team investigating how to use techniques from AI, Machine Learning, and Computer Vision to tackle some of the problems found in television production. The team includes Stephen Jolly, Craig Wright, Graeme Phillipson, Michael Evans, Violeta Menendez Gonzalez, and Benjamin Maxwell all of whom contributed to this paper.

Previously Graeme has worked on several projects involved in the running of iPlayer such as a system which automatically keeps track of what music has been played on TV & Radio so that audiences can find music they have heard. Prior to working at the BBC he studied neuroscience at Edinburgh University, and worked on a 3D motion capture system used in clinical gait analysis.

6 LEARNING FROM ARCHIVES

USING HISTORICAL CONTENT TO ENGINEER NEW TOOLS

THE PURPOSE OF archives has been to find new ways to use old content. So far this has meant recycling clips or entire shows previously produced in the production of new content, both to save cost on production and to provide access to shots that would otherwise now be impossible to reproduce. In this article we will suggest that the challenges facing public service broadcasters in competing in a new online market will mean that new radically different methods of content production will be required. In particular we suggest that methods from A.I. and machine learning could be extremely valuable. Furthermore, the application of these methods critically requires large amounts of data, and accessing and identifying the correct data for these methods suggests that over the coming years the role of archives and archivists will change, from being a source of old material to be reused, to being a source data from which insights into content production can be derived. This could mean that

archives will become increasingly important as their role changes from being just a source of clips, to also being the “robot educators” of the future.

As media production moves more towards an online future the amount of content production has increased dramatically. In order to compete with this, traditional broadcasters will need to likewise increase the amount of content that they produce. Fortunately, there are many opportunities to find culturally significant events that we could cover, which currently we do not. Across the UK there are many festivals, public lectures, local theatre, political processes that currently do not have access to the coverage they perhaps deserve. The Edinburgh Festival is one of the largest cultural events in the UK with approximately 50,000 shows across 500 stages. What if we could cover this festival at the same scale that we cover the Olympics? This would greatly help us in our mission to reflect the cultural activities of the UK.

However, there are great challenges in achieving this goal. Outside broadcasts are an expensive way to produce television. They require a large team, and outside broadcast truck, and a satellite link, and the expense of this limits the scale of the coverage. This was not a problem in the area of broadcast-only production, as there would only be a limited amount of time in the broadcast schedule to accommodate the content. Now that we can produce online only content we could make much more available, if we can find a way to lower the cost of production.

Previous work in R&D has looked at lowering the cost of the equipment required for such a production. A project called SOMA used fixed locked off 4k cameras with wide shots of a stage in which crops of HD footage could be made (see Figure 1).

This was operated over standard IP based networking, rather than traditional broadcast hardware, and allowed a single operator to manage the framing of four cameras and perform vision mixing at the same time. This dramatically lowers the cost of an outside broadcast and has been used for



Fig 1: The SOMA tool allows a single operator to control several cameras and perform vision mixing using commodity hardware.

live content production in circumstances where it would otherwise be impossible. While this does increase the capacity for production, the number of stages and events at the Edinburgh Festival would suggest that we could still improve things by lowering costs even further.

To address this issue the AI in Media Production team has been working on a system called “Ed”. This aims to be a system which could automatically frame and sequence video in a multi camera production of a live event, using low cost hardware. The idea would be that the hardware could be installed in a venue at the start of the festival, and then left to automatically produce new content whenever a show then takes place at that venue, without any operator needing to be present. This kind of automation is what would be required to produce content at the very large scales which could radically transform our offering to the public. Initially we

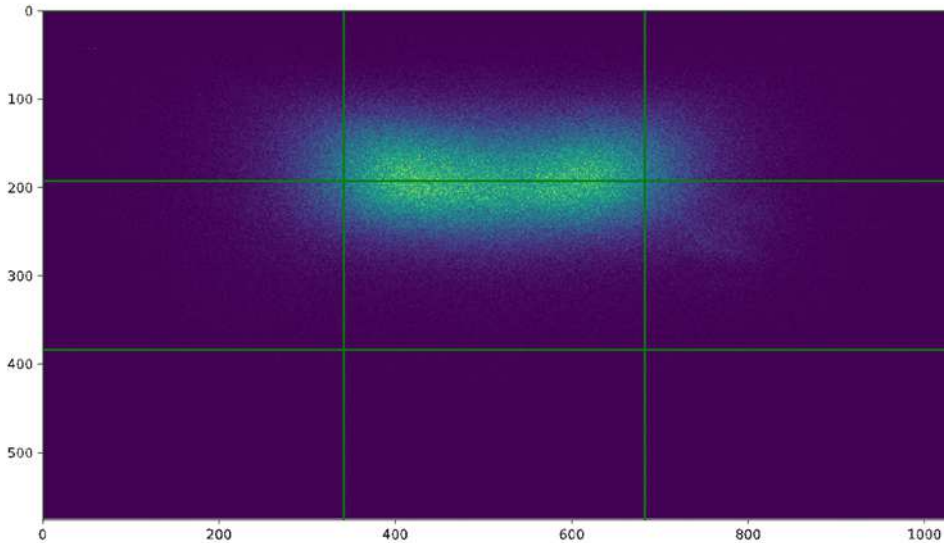


Fig 2: Framing of faces in BBC Drama in one-shots from an automated analysis of 8,273 hours of video (3.6e6 detected faces).¹

have focused on comedy panel quizzes, a common format in the UK, and one that poses enough challenges to require an understanding of cinematography to work, whilst at the same time having strong enough conventions of filming that it is plausible that a machine could indeed produce this output.

In order to do this, we started by trying to learn “rules of cinematography” by interviewing creative professionals and reviewing the academic literature on the subject. We use this derived insight to produce an engineering prototype. With this prototype we can then perform user evaluations to see if the quality of the output is adequate for real use, and to further refine the rules.

Having derived some rules the Ed system runs the raw footage through a series of AI systems which can extract features such as face locations,

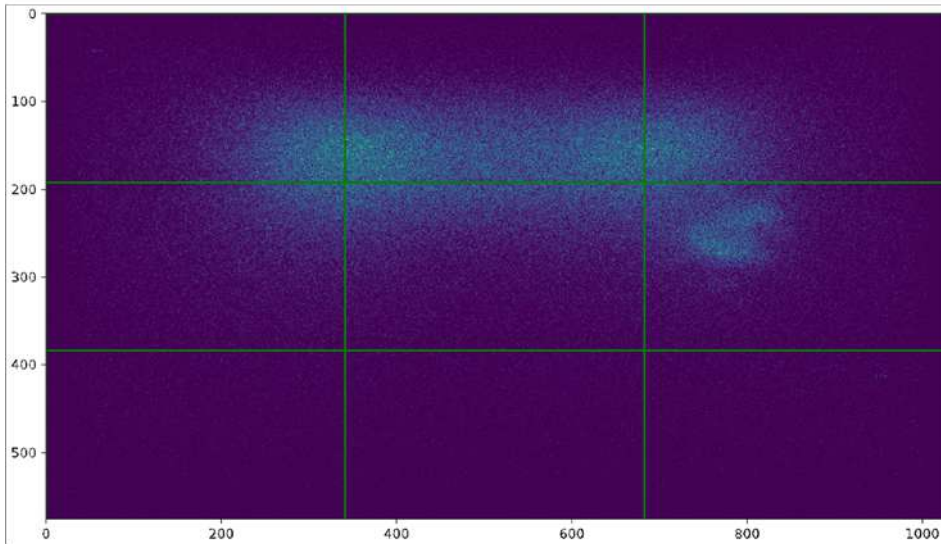


Fig 3: Framing of faces in BBC Drama in two-shots from an automated analysis of 8,273 hours of video (3.6e6 detected faces).¹

looking directions, and when people are speaking (see Figure 2-3). Then the rules which the system has learnt can be used to produce crops and sequence and cut between these crops so that the resulting mix follows the conventions of cinematography as closely as possible.

In addition to interviewing professionals and surveying literature to produce didactic rules, there is an additional source of information we can use in the form of the large archives that we have access to. These archives represent decades of the best professional work in this area and so will implicitly contain the “rules of cinematography” if we can find a way to

1. Phillipson et al, “Automated analysis of the framing of faces in a large video archive” WICED 2018

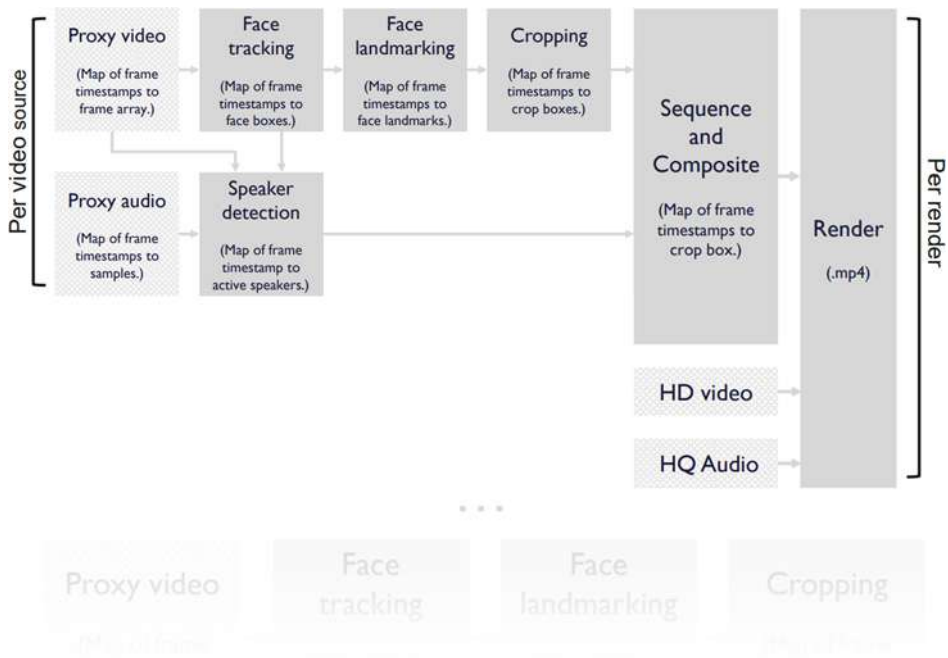


Fig 4: Simplified block diagram of the “Ed” systems flow of data when producing automated output.

extract them. This may have advantages of the didactic and literature approach for two reasons. Firstly, when interviewing professionals, it can be difficult for them to express exactly what they have learnt. They may be able to frame a shot so that audiences will appreciate it without explicitly having produced a list of rules, relying instead on their intuition. Also, academic research in this area is often performed by people who do not have access to very large archives, and so focuses largely on popular film, where the conventions may be quite different from the use cases we are examining.

In order to start processing archives at a very large scale we need a combination of human and machine effort. We use a small amount of hand labelled data to verify the accuracy of automatic methods which can then go on to process data at a scale that no human could ever do. It is important

that we verify automatic methods on our own content, as many publicly available datasets for feature extraction, such as face detection, rely on publicly available data which is often amateur footage such as YouTube or Flickr. This is typically very different in terms of lighting, style, etc and so the best performing algorithm on public datasets may not be the best performing one on broadcast footage.

In 2018 BBC R&D performed an evaluation exercise on 20x10min videos (10x news, 5x drama, 5x factual), from which ground truth labelled data generated by a professional transcriber at 1fps. We examined SeetaFace, Dlib, OpenCV, and other major commercial providers. We found SeetaFace to be amongst the best performers with approximately 70% of faces detected, with a very low false-positive rate. With this we were then able to process 8273 hours of footage of drama shows automatically producing probability density functions of face locations for different kinds of shots (see Figure 4). This can then be used in the design of the Ed system to improve the quality of the output.

Producing the human labelled data which is then used to bootstrap the automated process is a particularly important step. Any bias or incorrect data will lead to those same biases being represented in the automated analysis on a larger scale. We should not make any assumptions about familiarity with media production on the part of the people producing the labelling, and so should avoid media specific jargon. Good Human-Computer Interaction design is important here, to make sure that the “ground truth” labelled data really is that.

We have been working on the design of a tool to help label shots with the number of people in them, where their faces are, which way the people are looking, and what the shot type is. In order to make sure that the labelling is accurate we have designed special UIs for the looking direction and shot type. For the looking direction when moving a scroll bar to select this the user receives feedback in the form of an animated character, where they can match that character’s face to the face on the screen.

For the shot type we avoid the terminology of “medium shot”, “close up” etc, and instead ask the labeller to mark where on the body the bottom of the screen crosses. Again, as the user makes the selection they are given feedback in the form of an animated character who is shown in a shot of the same type that they have selected.

There are some features that inform directorial choices which we believe will be extremely hard to detect. One such feature is humour, it would be very hard for a machine to understand when the words being said are funny or not. However, we have feedback from editorial professionals which tells us that this is an important factor. In particular we have a hypothesis that when the current dialogue is funny the cutting pace is faster. While it would be very difficult to produce a machine that can detect humour, we can look for ways around this problem. In particular since this system is not intended to run as a real-time live system, we can allow the system to look ahead in the content to see what happens next. We could look to see if there is laughter from the audience happening soon, and therefore deduce that the current moment is funny. In order to do this, we need to empirically validate our hypothesis, and quantitatively assess exactly how much faster the cutting pace should be when the current moment is funny. Therefore, we want to run an analysis of a large archive of comedy shows to answer these questions.

There are of course, a great many factors which affect the pacing of shots. Here again the large scale of the archive matters a great deal, given a large enough dataset we can assume that all these other factors combine in so many ways that they can be treated as a single confusing “noise” variable which will average out over the whole archive. In order to do this we ran a non-verbal noise detection system over a large quantity of comedy panel quiz shows. We examined the results to find the onset of laughter in these shows, then aligned all the timelines of shot changes to be relative to the onset of laughter. We were able to examine the pacing of the shots and how this compares to before and after the onset of laughter.

Our preliminary results agree with the hypothesis, the cutting pace does seem to be faster in the moments leading up to a moment of laughter. Importantly this also informs us of just how much faster, which of course the system needs to know in quantitative terms.

Here we have presented several methods by which the analysis of archive content can be used in the production of new content, in ways which go beyond the traditional re-use of old material. As broadcasters continue to try to compete in a highly competitive online market the use of Machine Learning for content production, whether in full automated systems such as “Ed” or semi-automated systems, seems likely to only increase. In a future where Machine Learning plays a central role in content production, archives and archivists will play a critical role in providing the kind of data that is required for these systems to work.



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Nicolas Hervé, Senior Researcher at INA, joined the Research department 8 years ago. Previously he worked as an engineer in IT services before obtaining his PhD, working on automatic image annotations and multimedia indexing in the Imedia Lab at INRIA. Whilst at Institut Pasteur he worked on biomedical image analysis and contributed to Icy open-source software.

He is involved in research software architecture design such as DigInpix (visual entities detection in video), amalia.js (open-source metadata enriched HTML5 video player) and OTMedia (research platform for news monitoring). Currently his research is focused on digital humanities and, more specifically, the news ecosystem. He recently co-authored a book on this subject: “L’information à tout prix”

7 OTMEDIA

THE FRENCH TRANSMEDIA NEWS OBSERVATORY

THE INFORMATION INDUSTRY is going through a digital revolution. Its practices of production, diffusion, consumption and its economic models are upset, bringing new possibilities, new constraints, but also blurring the roles of the actors.

How does news spread today? What is the Internet's or Twitter's role compared with that of traditional players such as television, radio and the press? Who starts a media "buzz"? Who are the players involved? What place do images occupy in the media? Which is the most frequently broadcast image of the week?

All these questions have arisen with the numerous developments in the news and information sector in recent years and the Transmedia Observatory has attempted to answer them by inviting researchers in IT and social sciences to work together.

OTMedia is a software platform dedicated to research projects that can analyse vast quantities of diverse, multimodal, transmedia data (television, radio, Web, press agencies, Twitter feeds) linked to French and French-language news. The main purpose is to achieve quantitative transdisciplinary research between Human and Social Science and Computer Science¹.

OTMedia permanently collects, processes and indexes thousands of streams from television, radio, the Web, the press, news agencies and Twitter. The volume and diversity of its collection and performance of its modules make OTMedia a unique platform that incorporates transcription, visual, text and linguistic analysis and cutting-edge data mining software components in order to quantify a number of phenomena such as the spread of information, the importance of copy-pasting in the media, or the links between traditional media and social networks.

Although it has already been the subject of very interesting studies in the digital humanities and social sciences, its potential for exploitation has barely begun.

OBJECTIVES

The OTMedia project started in 2010. One of its main challenges was to start from the analysis needs expressed by Human Sciences researchers and information stakeholders, and to collaborate throughout the developments to create new concepts, models and tools dedicated to the analysis of the information landscape. This collaboration allowed the creation of a first prototype after two years. The discussions focused on the collection scope, the definition of analysis criteria, use tests (evaluation of results and ergonomics) and the analysis of system biases.

1. Hervé et al. 2017

The technological challenge of the project lies not only in the volume, but also in the diversity of the sources of information taken into consideration. In this sense, media corpora have interesting properties for automatic analysis approaches. It was necessary to be able to identify for each piece of information, whatever its original format (image, sound, text), descriptive data, making it possible to identify its properties, its source, but also its coverage in the form of copies (integral or partial) or strong proximity from one medium to another (same subject, same theme...). It is then necessary to carry out different phases of data mining on these automatically enriched, potentially noisy and incomplete data. One of the major concerns of the project (and one of the most complex ones!) lies in the estimation of the cumulative biases produced by all the operations of a task.

THE PRELIMINARY STEPS: DATA ENRICHMENT AND INDEXING

We have implemented several algorithms for automatic data enrichment. Some are generic and well established, others are more specific and developed as needs arise for some studies. The degree of integration of these algorithms into the platform depends mainly on their maturity and the need to be able to benefit from the results in real time. The complexity of the approaches, and the computational capacity of the servers, also play a role in determining whether an analysis is automatically performed on all the content captured or simply on some corpora for specific studies.

The main tools available are as follows: For audio data (from television, radio and online videos) a transcription is made. We have two speech-to-text software available, allowing us to quantify potential biases in analyses that are related to transcription errors. For images (still images from online sites, social networks or extracted from videos) we use several approaches to index and make queries by similarity. Our indexing engine, developed

in-house, allows us to efficiently manage several million images without any problems and thus allows us to search corpora on the scale of all the images produced by the media ecosystem. Finally, many natural language processing methods are used: extraction of named entities, categorization, salient word extraction, quote detection, plagiarism. More specific algorithms are also implemented such as the detection of referencing of a media as a source of information.

TOWARDS INTERACTIVE DATA MINING

Data mining, or knowledge extraction from data, aims to extract knowledge from large amounts of data, by automatic or semi-automatic methods. In OTMedia, data mining is used to bring out groups, trends, structures or movements from the mass of information available.

The prototype is a dedicated search engine: the user types a simple query, using the standard search bar, or complex, using the widgets to help formulate queries and filters. The documents are displayed in a list, each item in the list being clickable to access the source or its enriched metadata, so that the user can validate its content. In addition to the chronological distribution, summary tables of the results allow the user to have a feedback on the results of the query: number of results per medium, or for the twenty most represented media, number of occurrences of the most salient words, personalities, acronyms or places. These interactive tables allow you to read the entire result, detect anomalies or refine queries. Functionalities for creating, deleting, merging, intersecting and visualising user corpora are also available.

Visual searches are performed via an interface activated when an image is selected. An enlarged version of the image is presented to the user, who requests all or part of the selected image with the mouse. The engine finds copies of images or partially similar images. The association of a set of

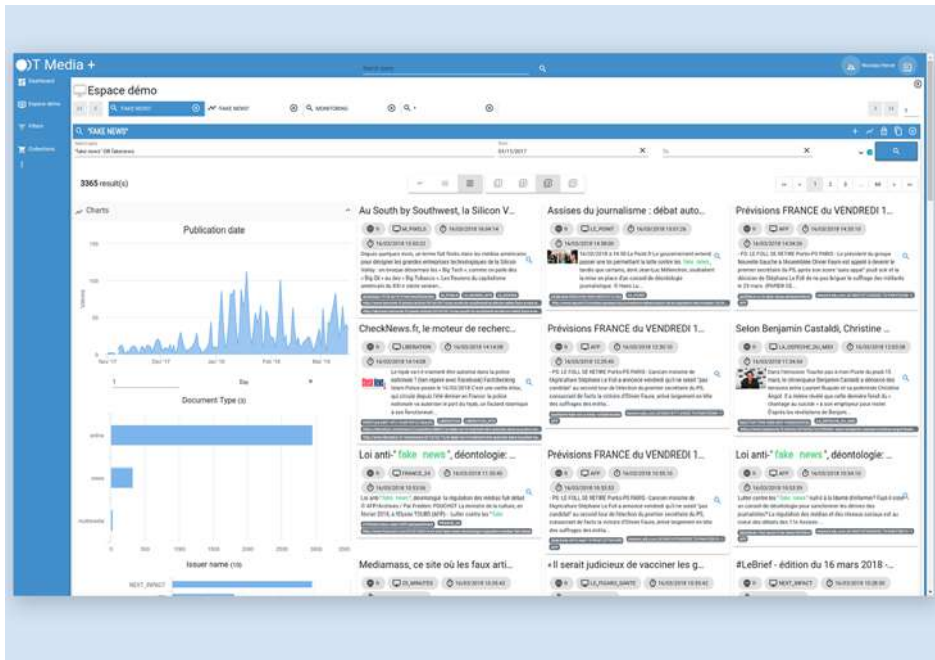


Fig 1: OTMedia search engine

visual copies with the source documents from which they originate makes it possible to study the distribution of a specific image in the media: when and by whom was it used? The selection of small objects such as logos, allows us to group all the images of the same cultural or sporting event with a "covering" (such as the Venice Mostra, the US Open...).

For each query, based on terms, people, media, themes or structuring fields, the interface produces comparative chronologies of occurrences in all the results relating to the global query. For example, the global education query, coupled with the names of presidential candidates, will display the number of times each candidate's name is associated with the term education during the campaign. If candidates are replaced by the media, then the question can potentially be answered: does a media actor more often than others cite the issue of education ?

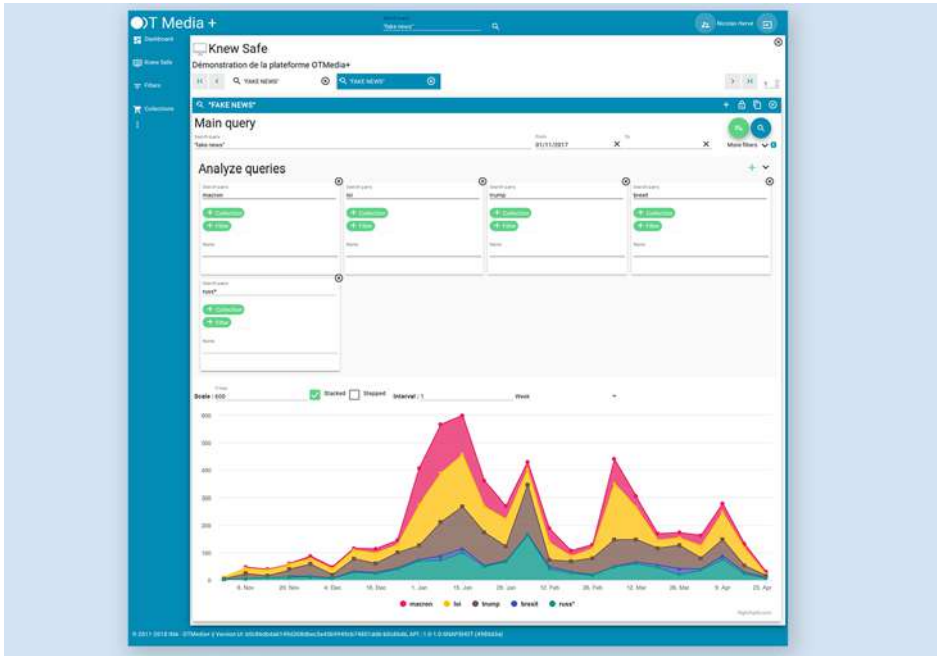


Fig 2: Temporal distribution of documents

OBJECT EMERGENCE: DETECTION OF TEXTUAL AND VISUAL EVENTS

One of the fundamental tasks of data mining is to group and label sets of "close" items in order to bring out "higher level" objects. The underlying idea is to reduce the volume of data by classifying and prioritising it in an attempt to perceive its content. Indeed, if the search engine answers the question, "does the database contain elements related to my request ?", the data mining attempts to answer the question: "What is in this database ?". In the context of the project, we studied two types of specific aggregates corresponding mainly to groups of objects with similarities in textual and visual modalities.

To address visual data mining problems, it is important to rely on a powerful visual engine. Research in this area aims to establish strategies

The detection of media events from textual documents is carried out in several phases. The most important one is to assess the semantic similarity between documents. From an analysis of the salient words in the documents, we create aggregates that are then merged over time. We also take into account the disparity of the textual elements at our disposal: press articles, audio transcripts, teletext, documentary notes and tweets. The results have been thoroughly evaluated as the “media event” and this is the central object of most of our further studies.

ECONOMIC STUDY OF THE FRENCH NEWS ECOSYSTEM

Using OTMedia, we try to answer a simple question from an economical point of view: “Is there still a ‘commercial value’ of news in this online world?” In a recent working paper, we document the extent of copying online and estimate the returns to originality in online news production².

We use a unique dataset covering the entire news content provided online by the universe of French news media during an entire year (2013). Our dataset covers 87 general information media outlets in France: two news agencies, 59 newspapers, ten pure online media, nine television channels, and seven radio stations. We tracked every piece of content these outlets produced online in 2013. Our dataset contains 2.5 million documents.

Using the content produced by news media, we perform a topic detection algorithm to construct the set of news stories. Each document is placed within the most appropriate cluster, i.e. the one that discusses the same event-based story. We obtain a total number of 25,000 stories, comprised of 850,000 documents (about 35 documents per news story). Near-

2. Cagé et al. 2017.

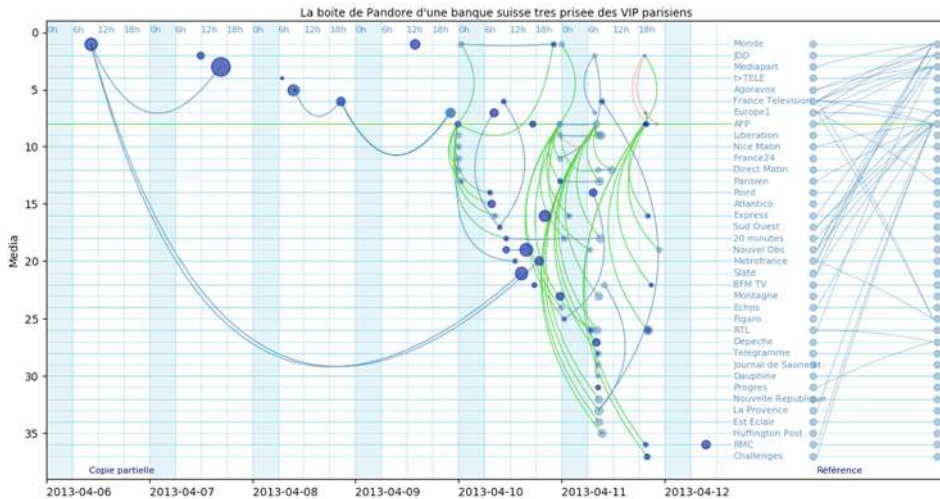


Fig 4. A single media event with all its documents, plagiarism and source mentions

ly one third of the news events are about politics, 30% about the economy and less than one quarter about crime, law, and justice. We then study the timeline of each story. In particular, for each story, we determine first the media outlet that breaks the story, and then analyse the propagation of the story, second by second. We investigate the speed of news dissemination and the length of the stories, depending on the topic and other story characteristics.

We show that, on average, news is delivered to readers of different media outlets 172 minutes after having been published first on the website of the news breaker – but in less than 224 seconds in 25% of the cases. The reaction time is shortest when the news breaker is a news agency, and longest when it is a pure online media, most likely because of the need for verification.

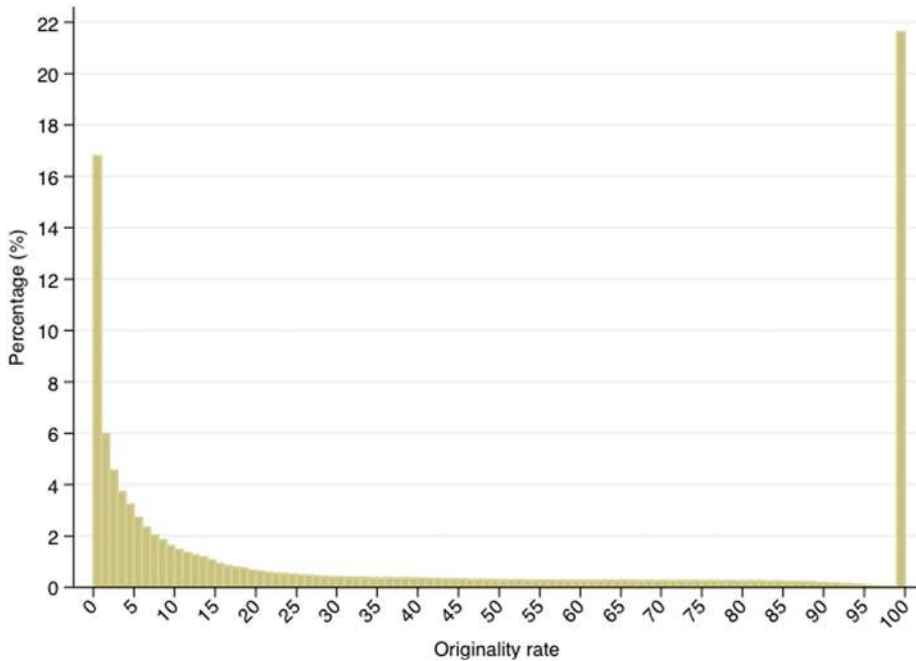


Fig 5. Distribution of the originality rate

High reactivity comes with verbatim copying. We develop a state-of-the-art plagiarism detection algorithm and find that only 32.6% of the online content is original. The distribution is bimodal, with one peak for the article with less than 1% original content (nearly 17% of the documents) and one peak for the 100% original articles (nearly 22% of the documents). The median is 14%. In other words, with the exception of the documents that are entirely original, the articles published within events consist mainly of verbatim copying – more than 55% of the articles classified in events have less than 20% originality.

Obviously, copy can take different forms. First of all, we distinguish external (copying from another media outlet) from internal (copying from a previous article you published) copy. Secondly, we distinguish content copied from the news agencies and content copied from other

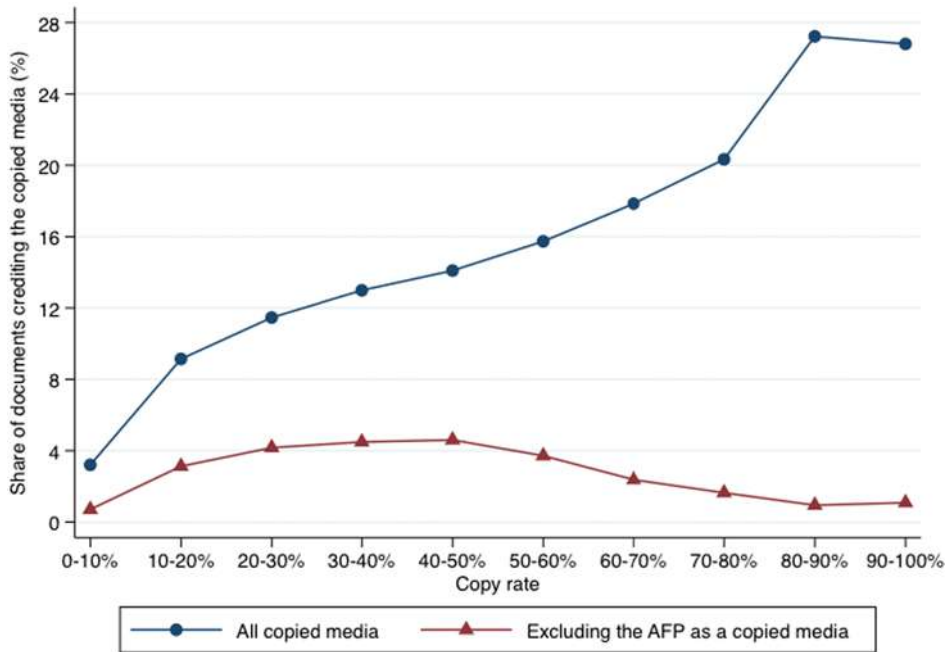


Fig 6. Share of documents crediting the copied media

media outlets. All the media outlets that are clients of a news agency are indeed allowed to reproduce its content in its entirety, and the business model of the news agency is based on the reproduction of its content by other media outlets.

But in effect, every time an original piece of content is published on the Internet, it is actually published three times – once by the original producer, and twice by media outlets who simply copy-and-paste this original content. (Obviously, in practice, we often observe large numbers of media outlets copying part of the content of an original article. But in terms of numbers of original characters copied, this is equivalent to a situation where each piece of original content is published three times.) Moreover, despite the substantiality of copying, media outlets hardly name the sources they copy. Once we exclude copy from the news

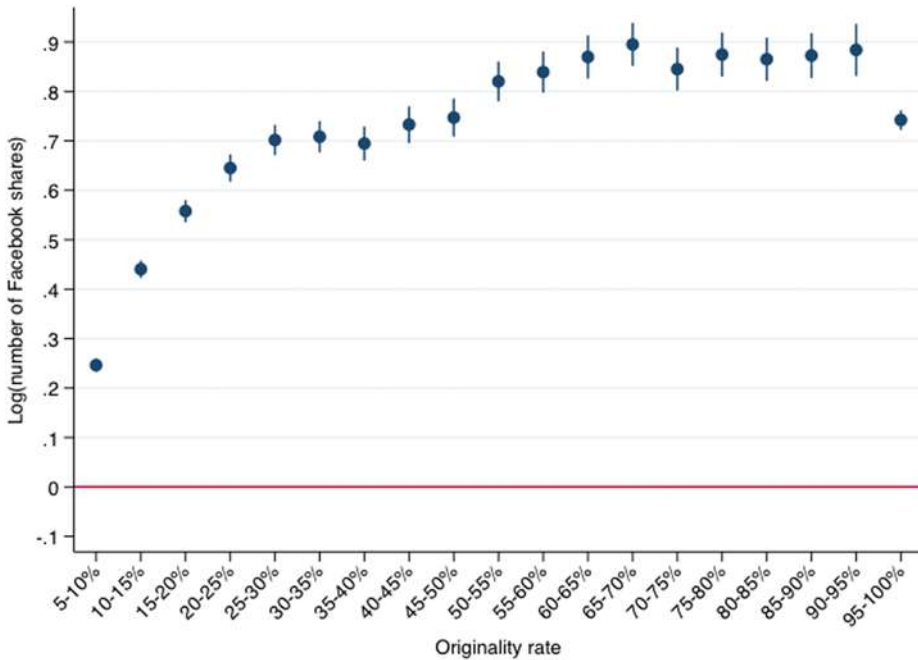


Fig 7. Facebook shares depending on originality rate of documents

agency, we show that only 3.5% of the documents mention competing news organisations they copy as the source of the information.

Do original news producers nonetheless benefit from their investment in news gathering? In instances where the online audience was distributed randomly across the different websites, and regardless of the originality of the articles, our results would imply that the original news producer captures only 33% of the audience and of the economic returns to original news production (which, as a first approximation, can be assumed to be proportional to the audience, for example via online advertising revenues). However, we show that reputation mechanisms and the behaviour of internet viewers allows the mitigation of a significant part of this copyright violation problem.

First, using article-level variations (with event, day, and media fixed

effects), we show that a 50% increase in the originality rate of an article leads to a 35% increase in the number of times it is shared on Facebook. This finding is illustrated in the following figure, which plots the estimates of the coefficients from the estimation of the number of times an article is shared on Facebook, as a function of the originality of the article.

Second, by using media-level daily audience data and article-level Facebook shares, we investigate to what extent readers ‘reward’ originality. To do so, we compute audience-weighted measures of the importance of originality. As a first ‘naïve’ approach, we assume that all the articles published on the website of an outlet on a given day are ‘equally successful’. Doing so, we find that the average audience-weighted original content is above 46%. This reflects the fact that media outlets with a larger fraction of original content tend to receive more audience.

More importantly, if we weight content by media-level audience shares and article-level Facebook shares, we show that the original content represents up to 58% of online news consumption, i.e. much more than its relative production (33%). This means that within a given media outlet, the articles that get more views (as approximated by the number of Facebook shares) are those with more original content. In effect, reputation mechanisms actually appear to solve about 40% of the copyright violation problem, as long as the media outlets realise this and allocate their effort and journalist time accordingly. The observed collapse in the number of journalists in all developed countries may reflect the fact that some outlets have not.

Of course, greater intellectual property protection could also play a role in solving the copyright violation problem and raising the incentives for original news production, and we certainly do not mean to downplay the extent of this problem. Other factors may help rationalise the observed drop in the number of journalists, the decline of advertising revenues, and the increasing use of ad-blockers to begin with. However, our results suggest

that in order to effectively address this issue, it is important to study reputation effects and how viewers react to the newsgathering investment strategies of media outlets.

CONCLUSION

The collaboration between computer researchers and Human Sciences researchers, which is at the heart of this project, is very rich, even if it sometimes leads to misunderstandings on both sides. First, complex Human Sciences concepts are rarely directly modelable by sets of criteria or measures that can be manipulated by algorithms. Thus, the concept of a "media event" remained a topic of discussion between the partners for much of the project! Nevertheless, the consideration of the multiple dimensions of analysis required in the social sciences and humanities has been productive because it has led to linguistic and visual processing sequences not foreseen at the outset of the project. The evaluation examined the utility and usability of the system: recommendations were collected from users for each version of the prototype. Several functionalities have been added such as managing corpus of results, exporting data, tracking quotations or detecting partial text copies (when a sentence or expression, for example, is transferred from one medium to another). The analysis of the validity of the results made it possible to make a qualitative improvement of some modules of the system. Finally, the users' recommendations on the handling of the prototype have changed the interface: some data has become interactive, the interfaces have been linked together to logically link the operations linked to an analysis task. The user tests made it possible to study the balance between technological automation and the control that must be left to the user.

Finally, the use of the prototype by expert users highlighted the two types of bias in the OTMedia system: bias due to technological processing

and bias related to media editorial practices such as, for example, backdating sources or non-compliance with the duty to quote. One of the fundamental aspects of the project with regard to the use of data mining technologies was their validation in well-managed settings in order to measure the biases generated by the tools. Indeed, analysis systems can generate biases at all levels, from description to final visualisation, and thus distort the interpretation of results. This is why, in addition to technological innovation, it is the whole methodology of use, in relation to practices, that is the subject of research and experimentation in the implementation of the second phase of the project, currently under development at Ina.

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Marjolein Steeman is a data management specialist and has worked with the Netherlands Institute for Sound and Vision on several projects. She helped develop a framework for a Preservation Metadata Dictionary, based on international PREMIS standards. Her focus is on enhancing the sustainability of the archive by creating practical solutions for data governance. She is a member of the PREMIS Editorial Committee.

8 NISV'S IPR FLOWCHART

...AND HOW TO STORE RIGHTS METADATA IN THE MAM

SOUND AND VISION is one of the largest archives in the world and we store different types of media, including radio and television programmes, photo's, video games, written print media, political cartoons, GIFs, websites and objects. In 2017 we started a project called Rights metadata, combining our knowledge of metadata and legal issues. This project was very special because our goals on preservation on one hand and on giving access to our assets on the other turned out to be mutually compatible and strengthened each other.

STRUCTURING YOUR DATA IS VITAL

Preservation metadata is defined as the metadata that is needed to ensure long-term usability of content. This implies a normative set of data that

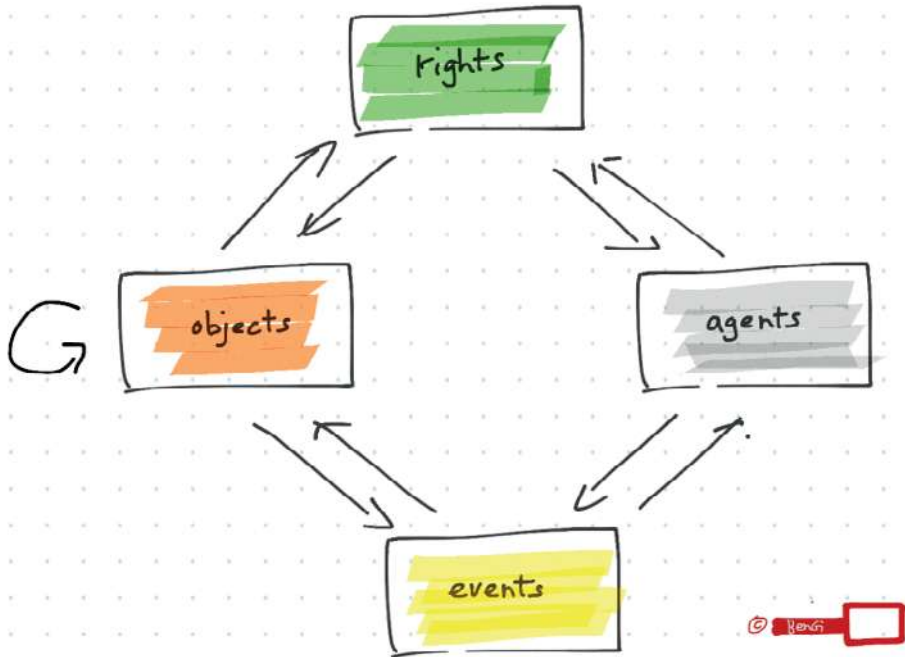


Fig 1: Entities of PREMIS

must be in place. From the perspective of preservation we must ascertain that a defined set of metadata is actually recorded in our system. We often assume metadata is entered automatically at ingest or by hand after any research on demand. But where is it stored precisely? And how can we ‘prove’ it is there?

At Sound and Vision we use the International metadata standard PREMIS to define what metadata must be present. For us PREMIS offers a roadmap to structure the metadata as it comes to the archive in any disorderly setting.

The schema in figure 1 shows the basic PREMIS information model. It consists of four entities. The main entity is the one on objects. Objects can be described at different levels, differentiating from the physical level of files and bitstreams to more abstract concepts of what we aim to preserve.

This may be the actual set of files needed to render the object, called the representation level. Or the level of the intellectual item that describes the object as the actual experience we want to preserve.

The next entity in green covers the rights. This entity holds the assertion of one or more rights or permissions pertaining to the Object. It tells us what acts we are allowed to perform on the object. In yellow there is an entity for events. This entity holds the actual audit trail of the file, which is important to verify its authenticity. Both rights and events can have connections with agents. For instance the author who is the owner of a copyright. Or specific software that has performed a certain event.

The first question we tried to answer during our project was: why is rights-metadata important in terms of preservation?

The right of exploitation of any work is defined by intellectual property law. This is generally known as "copyright". The primary author's copyrights are described by the Berne convention. They are the exclusive rights of: translation, reproduction, public performance, broadcast or public recitation of the work. Of these exclusive rights, the right of reproduction is the one that is directly of interest for preservation, since all digitally archived materials, by their nature, will be copies. The very act of entering an item into an archive is the making of a copy. So by merely preserving the material we may infringe on the author's rights. The PREMIS model takes this as a guiding principle. The first attribute of the Rights Entity therefore is the actual copyright status.

The next attribute will be how can we perform the needed actions, without infringement of these rights. This is possible in two ways: by law or by explicit permission. In The Netherlands this is regulated by law: basic copying of files to prevent deterioration is allowed for institutions that have a public duty of preservation. So for preservation in a strict sense we do not need to document copyright for each individual program.

But our institute has a much wider mission. To illustrate this, see the two quotes below from our current mission statement:

1. In 2025, Sound and Vision will be the guardian of and leading institute for journalistic and media archiving and interpretation.
2. To this end, Sound and Vision will actively promote its extensive collection and open it up as much as possible, for everyone – from professionals to individuals.

So we definitely want to enable acts like viewing and re-use. The regulation by law will not cover this; we will need explicit permission from the author or perhaps from the current rightholder. For the metadata in PREMIS this means we must document the IPR status with the agent that owns this right, and data that define the expiration date. A complicating factor is that one programme might touch multiple Intellectual Properties, because of footage that is used or for instance music that is played.

On a whole, this mission opens up a lot more variables that need to be structured. Apart from the copyright, other issues might be at stake, like neighbouring rights, privacy or ethical concerns. This is exactly why rights are often very complex to put in a metadata structure. We tackled this by taking a practical approach and asked ourselves this key question: how do we go through the complex decision of whether we may publish a programme online? This approach combined preservation objectives and the mission of opening up our archive.

THE FLOWCHART ONLINE PUBLICATION

In order to decide if material may be published online, the Flowchart Online Publication (figure 2) is a useful instrument. This flowchart was created by Sound and Vision in 2017 and is available on its website. It was also published on the FIAT/IFTA website¹. The VUC, the Value, Use and Copy-

FLOWCHART ONLINE PUBLICATION



A Analyse the work's components



B For each component, assess what kind of author is involved



1 — independent person



2 — organisation



3 — unknown

C Document who the rightsholders are



date of death > 70 years
= copyright expired



publication date > 70 years
= copyright expired



impossible to find out?
don't publish (possible diligent search)

D Assess the rights status



1 — all copyrights expired



2 — Sound and Vision is rightsholder



3 — copyright clearance



Public domain



CC-BY-SA



Licensing agreement

E Document license result



F Check three more things before publication:



1 — is it a recent recording or broadcast of an existing work? (neighbouring rights)



2 — does it include performance? (neighbouring rights)



3 — no ethical concerns?

G Document all outcomes. If allowed: publish in accordance with determined rights status



Fig 2: Flowchart version 1.0

right Commission of FIAT/IFTA, has translated it into several languages, with explanations checked by lawyers of the relevant countries.

Below is a short guidance of the steps to take according to the flowchart.

STEP A

First, we analyse the different components of a copyright-protected work. An audiovisual work often consists of several components. It is made up of several layers of copyright coming together to make the final product. The components of a filmwork are for example moving images, music, script, etc. Each component needs its own assessment.

STEP B TO C

Then for each component it is important to find out what kind of author created it, to determine the term of copyright protection. Based on this information it is possible to determine in advance how promising the research for online publication will be.

According to Dutch copyright law, copyright expires 70 years after the author's death, on January 1st of the following year. When the author is an organisation and no individual creator is mentioned on the work, copyright expires 70 years after the work's first publication, on January 1st of the following year. On the occasion that the creator is unknown, it is possible to label it as an 'orphan work', but only after extensive research ('diligent search'), after which you can publish a work under certain conditions.²

1. <http://fiatifta.org/index.php/media/flowchart-online-publication>

STEP D

When all copyrights have expired, the work is in the public domain. Sometimes, Sound and Vision itself is rightsholder of the material. If so, Sound and Vision makes material available online under a creative commons license (at this moment under a cc-by-sa license model). In all other cases a tailor made copyright clearance is needed with the author or current rightsholder.

STEP E

The outcome of all steps of the research are well documented. Regardless of the outcome of the research so far.

STEP F

Before making the material available online, three more things are to be checked:

1. Is the work a recent recording or broadcast of an existing work? If so, the work could still be protected by neighboring rights in favour of record producers, broadcasting companies or film producers.
2. Does the work contain any performances? If so, the work could still be protected by neighboring rights in favour of the performers.

2. <http://diligentsearch.eu/>

3. Finally, check for ‘ethical concerns’. Assess the occurrence of portrait rights, privacy law and consider whether the work is suitable for online publication at all.

STEP G

Again the importance of documenting is stressed: document and capture all outcomes. It makes all decisions transparent and offers a chance for retrospection at any moment. Even when an investigation fails or the outcome shows that the work cannot be published, this is noted. By the passage of time or by new knowledge or insights, the research can possibly be picked up later.

PROJECT ONLINE PUBLICATION

Parallel to the design of the flowchart, colleagues identified some collections that had a good chance of being in the public domain. Indeed our goal is to publish material and give open access. The selection of promising material would make the result weigh up against the extra chores of registration and documenting. We anticipated that we would find ways to alleviate the administrative burden later on in the process.

For each of these collections two parallel actions were taken. First: research of contracts, to establish the overall rightholder(s) of the selected material. How, by whom and when was this collection created, and how was it transferred to the archive? This research produced much information on the overall terms for copyright.

Second: research on the images themselves. Each programme has been viewed individually. A list of all programmes that were selected was created and all information was added regarding the criteria relevant for IPR or other rights related issues. Also findings from the actual viewing were added. Here we put special effort into formalising our notation.

The image shows a video player interface. On the left, a video frame displays the following text: "Film vervaardigd door de N.V. ORION-FILMFABRIEK Pletterijkade 10-11 DEN HAAG" with a logo below. The video title bar at the top left reads "ORION_voortitels_NEDERLANDSCHE.FHD002025KR.mp4". On the right, a metadata panel is visible with the following fields:

ProgramID	...
Titel	NEDERLANDSCHE PAPIERFABRIEK
Publication date	1920s
Producer	Orion Filmfabriek
Crew	
Asset Rights	
• License	License Free; public domain
• Terms	
• Note	uitkomst onderzoek: Publiek Domein op basis van publicatiedatum op aftiteling Ethisch bezwaar: nee
• Determination date:	3-6-17

Fig 3: Example “Orion Filmfabriek”

The credits shown in figure 4 are of a film made by the “Orion Filmfactory”. This company produced films in the twenties. This is an example of a film which was created by an organisation without mentioning any individual person on the work. And since it was also published more than 70 years ago, this film is in the public domain. Because there were no neighbouring rights or ethical issues, it could be published online.

On the right side of the figure the fields are listed that were recorded in the research documentation for this film. Marked yellow are some attributes of the Programme. In PREMIS these would be attributes of the Object. Based on these facts the actual right status (License) will be registered. The License field is a controlled list with values on whether permission is still needed for re-use.

Possible values are:

- License free; public domain
- License free; released by the rightsholder: he or she has given explicit permission
- No permission: the material is blocked
- Request: permission must be asked for on each request for re-use
- Check: permission might be automatically given based on agreements among broadcasters, this needs to be checked

The Note is important to put down the summary of the research. In this case:

- how the assessment was made to determine public domain: on the basis of publication date on the credits page. It is relevant to know whether a credits page is available because it is strong evidence of who is the maker, and possibly date information
- the explicit check whether there are complications like: work within work, neighbouring rights, privacy or ethical issues. In this case no issues have been detected

The actual Determination date is recorded also.

The screenshot shows a video player interface with a metadata panel on the right. The video player displays the following text:

Haghe_Willy_Mullens_vermelding_DE_THEE_VAN_FHD00201YVM.mp4

Opgenomen door
WILLY MULLENS,
Directeur der
HAGHE-FILM-FABRIEK,
Den Haag.

2

The metadata panel on the right contains the following information:

- ProgramID: ...
- Titel: DE THEE, VAN PLANTAGE TOT HET PAKJE
- Publication date: 1928
- Producer: Haghefilm
- Crew: Mullens, Willy (camera, director)

Asset Rights

- License: **required license**
- Terms:
- Note: Publiek Domein per: 1-1-2023
Afloop auteursrecht berekend obv sterfdatum
Ethisch bezwaar: nee
- Determination date: **3-6-19**

IPR

- Makername: **Mullens, Willy**
- Maker: organisation or person **person**
- Current rightsholder: **heirs Mullens**
- Terms for re-use: **required license**

Fig 4: Credits of a film made by the Haghe Filmfabriek/ Willy Mullens

Figure 4 is an example of a film which was created by an organisation (Haghe Film) and mentions an individual person on the work: Willy Mullens as cameraman, who died in 1952.

In this case, the film is not in the public domain and therefore not published online yet, because 70 years should pass after the death date of Willy Mullens before it can be published.

On the right the fields that were recorded for this film. Marked yellow, Willy Mullens is added as a crew-member, being the cameraman and director. Here the death date of the author is important. The outcome ends up in the note: only in 2023 the film will be public domain. Until then the status is Required license.

Marked in green the current rightsholder, being the heirs of Willy Mullens, is documented. These fields refer to the Rights and Rights-Agent entity.

The terms for re-use for this rightsholder are made explicit. The green marked fields are repeatable to cover multiple works within the programme, or multiple rights-issues, other than copyright.

DOCUMENTATION

These examples show that for each programme specific metadata must be added to the programme list. Along the way procedures were worked out to create a normalised set of data that could be added to the MAM-system in a batch edit. Special attention was needed for the notation of exceptions. For instance: what to do when ethical issues were identified? Or an additional work within work was identified. The notation in the list was temporary and focussed on the next step: the check performed by our legal and privacy officers.

Once all research for a particular collection had been done, this final check was performed. Given the complex risks involved, this step is very important. Only after this step is completed the selection of programmes that are in the public domain would be gathered in a structured file with metadata. This file is then used to create a batch edit in the MAM.

The exceptions, those that are not in the public domain yet, or have other specific issues, will still have to be processed by hand. Here we need people that really like tidying up. The researchers are motivated by publishing online as much as possible, but our metadata managers are only satisfied when the MAM system is completely updated with all results from rights investigations.

Following this workflow we were able to publish a considerable amount of programmes in a very controlled way. Also, we were able to refine our MAM-system with new requirements to even better document rights. Especially on the additional rights issues, other than copyrights (IPR).

FINALLY

This article provides insight into how Sound and Vision deals with (copy) right and its aim to publish audiovisual material openly, online as much as possible. Behind the scenes, Sound and Vision works with the flow-chart a lot. It is an important tool when assessing whether archive material can be made available online, with the aim to stimulate easy reuse on a large scale.

We enjoyed doing this project and we are confident that we have a much more structured way of collecting and documenting rights metadata. When Sound and Vision publishes material online, decent research is done and the results of that research are findable for anyone and for evermore.



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COMPANY: **FINA, POLAND**

Joanna Kaliszewska is Chief Metadata Specialist of the FINA Digital Repository in the National Film Archive Audio-visual Institute in Poland.

She is a graduate in Cultural Anthropology and Communication Studies, and has previously worked as a website project developer and specialises in UX and UI design with experience in cross-media project development.

Currently, she is in charge of FINA's MAM database which aggregates metadata and digital resources for film, TV and radio productions. She also specialises in standardisation and implementation of metadata norms, is responsible for migration projects and supports archival cataloguing workflow.

9 TAMING THE FINA ARCHIVE DRAGON

RIGHTS MANAGEMENT IN FINA'S DIGITAL ARCHIVE

MOST AUDIOVISUAL ARCHIVES are challenged to create effective digital archive systems with data structures that can store all types of information. Films, television programmes and radio broadcasts have various distinctive characteristics, which makes them difficult to describe in one uniform way which is valid for the different purposes of archival preservation. Existing metadata standards are helpful in structuring digital archives, but most of them are dedicated only to a few audiovisual types, for example - the FIAF moving image catalogue manual for film data or EBU norms for television content.

In 2017 the National Film Archive, the biggest film archive in Poland, was merged with the National Audiovisual Institute, an institution dedicated to supporting and preserving television and radio broadcast productions. Suddenly two independent institutions faced the task of unifying their operating systems.

CHANGING THE VIEW

The Polish National Film Archive was the biggest film archive in the country. It owned over 600,000 analog and digital film carriers with a large amount of additional production materials. The National Audiovisual Institute was a mercenary institution, that co-produced and digitised rich audiovisual resources.

Both institutions had their own digital preservation systems. The characteristics of stored data were different, with only a few similar standardisation solutions. The idea of creating FINA's new archival digital database came along. After the fusion, complete audiovisual resources became congeneric.

At the moment they consists of:

- films and additional materials connected with film production for example. posters, scenarios, costumes and scenography projects
- all kinds of television production (reports, TV news, programs, magazines, etc.)
- live theatre recordings
- collection of video-arts or other modern art audiovisual works
- radio broadcasts
- collection of music albums or single music productions
- unused production footage and other audiovisual works

During the resource analysis we unveiled similar elements in all cinematographic and audiovisual works description. The characteristics of audio resources also had common parts in their source metadata description. We decided to base metadata description in our digital database on the CEN EN 15907 norm and FIAF standard, but we wanted to supply them with elements from other standards. For example EBU television standard or museum description norms used in the biggest polish museums such as Polish National Museum and Zachęta Gallery.

Building the digital catalogue based on FRBR norm was motivated by its elastic structure. Dividing the data by the subject matter of the audiovisual work “life” is handy and effective. But creating coherent archival description wasn’t our only task. We wanted to build a database useful for outside users, for sharing information with websites and for educational purposes. Also, we needed our system to be a capable Media Asset Manager, with safe digital resource archiving capabilities.

STANDARDISATION PROS AND CONS

The way we incorporate the description standard is determined by the institution’s work line – it can be centered around cinematographic production or archival workflow. During the design process, it is also important to be cautious about the flow and usage of information, because they determine how we can exploit the data.

Adapting several elements from other audiovisual description standards into an already established database was relatively easy in terms of integration, because of the three level hierarchy determined in the FRBR standard. The biggest advantage of structured data is that the resources are described in spatial structure – this gives us the ability to migrate data separately for each level.

Choosing the metadata structure helps in organising data and – what is even more important from a UX point of view – makes it possible to personalise user workflow. It also helps with adjusting the data from the source database to the website, managing structures for accessibility purposes of the archive.

On the other hand, adapting a specialised standard is very demanding for users. They need to have essential understanding of cinematographic and archival technical and theoretical knowledge.

In FINA's case, standardisation consisted of a three-leveled hierarchical metadata description: the level of **WORK** (basic and neutral metadata about artistic work), the **MANIFESTATION** of the work and the **ITEM** (with recorded manifestation). There are also additional elements, such as events (for digitisation, conservation, etc.) or agents (for personal information or institution register). Data structures for every part of metadata hierarchy are entirely designed and administered by FINA's staff.

THE DIFFICULT SITUATION OF RIGHTS MANAGEMENT IN FINA

After learning about the variety of the FINA's collection and the characteristics of its standardised metadata, we can now look into rights management and licensing.

The National Film Archive had a statutory responsibility to preserve and store Polish cinematographic heritage. In reality, it was translated as receiving an obligatory safety copy of every Polish cinematographic production with all additional content created during the filmmaking process. The National Film Archive stored the carriers with a safety copy for every title, but didn't receive any property rights (only distribution ones).

On the other side, for many years, film production studios were gradually conveying film carriers from their archives to the National Film Archive, without passing on the property rights. Some of those companies (but not all) had been bankrupted, so after some time the rights were

also conveyed to FINA because FINA held the original negatives of the selected titles.

It gets even more complicated for the pre-war film collection. Most Polish silent films were destroyed during World War II. It is estimated that only 15% of Polish silent film production survived. Today, only a few titles are in the public domain. As for the pre-war sound films, they are the most problematic. Film documentation was almost completely destroyed during the War. That has made finding the owner of the rights extremely difficult, especially in 21st century (finding the rights owner location was even more challenging, mostly because of the war and communist emigration). The majority of these resources are qualified as orphan works, but their legal status is unstable at the moment.

Another interesting group within the audiovisual heritage are productions and co-productions made by the late National Audiovisual Institute. A large part of the collection consists of multi-genre TV and radio materials. They have individually established property and distribution rights, described in detail in their contracts. There are no permanent arrangements with contracts, so to know how to interpret the rights for a title, you need to check it in one or even a few contracts (because some of the titles were produced in batches).

There are also cross-rights materials, created during the digitisation and restoration programmes financed through EU subventions. These titles have complicated rights interpretations because of the many generations of the manifested versions with different legal approaches. Also, as an archive, we need to be cautious of the information provided by other productions. FINA has the responsibility of checking every stored title and list all quoted video and audio source materials, because their contracts have very detailed licensing fields.

The long history of receiving analog and digital carriers is another reason for various distribution fields which carriers can be used for. There are situations in our archive where we have three or four identical copies

for one title, but each carrier has come to us from different sources and, because of that, it has different distribution fields.

DIFFICULT, RIGHT?

Navigating the complicated structures of the property and distribution rights is a challenge even for people who have excellent knowledge about FINA's resources. But if we think about it in the wider perspective of 200,000 titles and over 1.5 million analog and digital carriers (the numbers grow bigger day by day), even excellent knowledge can be only moderately helpful in finding rights information about the rights without assistance. During the reorganisation of FINA's digital archive, we had in mind that we needed to find a new solution, dedicated to characterising all the rights management data for every title of our collection.

HOW TO TAME A DRAGON?

Designing new data structures requires combining different conditions and characterising all the data previously accumulated over the years of describing the audiovisual content. The most important part of the design process is to determine the main group of users and find a proper structure for prepared metadata.

In our case, we were not able to limit the spectrum of our users to only one group. Additionally, the range of data we wanted to present hadn't had the same level of importance.

As the first step of designing new solutions, we selected three types of access to the rights data, depending on the level of information the user wanted to receive:

1. DISTRIBUTION GROUP

Group of users from sales and law departments, mostly concentrated on sharing and publishing content. They need very detailed and complex information about the rights and licensing possibilities. Their work should be quick, and they need to find data in a complete set.

2. PROGRAMMING GROUP

These users are mostly focused on programming cinemas and creating event schedules. This group needs information not only about the rights, but also about the availability of the carriers. As for the rights data – they need clear and quick info in a simple form.

3. EDITORIAL / SPECIALISTS GROUP

For the specialists, rights information is one of the many aspects of the editorial work of describing resources in the archive. Knowledge about the rights is crucial in their workflows, especially when they want to create a detailed description of a title.

SUBHEADING?

The second part of the design phase was dedicated to gathering all possible cases of rights metadata we already had in our digital database.

Data analysis helps in finding connections and relations between metadata. Knowledge about relations determines the way data structures can be designed. It can also be the deciding factor for locating newly implemented

structures in the form of an object. For FINA's case the most useful solution was keeping the rights data connected with the level of Work, as a separate event.

Description standards for audiovisual archives define similar systems of placing data in cataloguing structures. We decided to stay faithful to the standardised conceptions. But during the implementation we found a need to extend the connections and virtualisation of our data.

Also, because of the internal needs of our employees, we decided to parse the data into new fields of already established data structures for every level of our digital catalogue. For example – some distributional information is placed only on the analog or digital carriers and the data about quotes in chosen titles is located on the level of title description.

NO HUMANS WERE HARMED IN THE UX DESIGN PROCESS

Having characterised user groups, analysed content and prepared location for the data structures with established connections to other data objects, there was one important issue left. How to design the data structures with impressive numbers of elements to make them usable and easy to control for our users?

Past experiences with data structures showed us that perfect descriptions are practically impossible to be presented in a user-friendly way, because of the excessive amount of information. Extended databases deal with problems of too advanced data and the overprovision of structures. Building effective metadata description should always prioritise quality and users' competences.

The perfect solution would be to create the design with the functionality to support comprehensive description for all possible scenarios for property rights and licensing conditions. Unfortunately, for a large number of titles, that kind of solution would be unusable, because of the huge

amount of terms and data fields. The description would be complete, but difficult to fill and slow in terms of usability in user's daily work. As UX designers we didn't want to force our users to de-code professional terms and dig in the metadata to find selected information about the title.

We concluded that the most helpful way of improving our model was to personalise permissions, assigned to the data fields. We decided to create a new rights & licences object connected directly to the work level. Basic information was automatically visualised on the other data objects connected with the title. The user permissions were configured in a way, which graded the level of access to the information by defined user-groups. We also left basic rights information connected only to the carriers on the third level (item), because of their similarities.

At the moment rights are described in FINA's digital catalogue as an independent object, connected with the title (work level). Data structures are built with specialised sections – for property and distribution rights, and have a separate tab for license information. Data fields are connected with controlled vocabularies for person and institution agents. They are directly linked to the fields dedicated to the percentage of the rights each owner has. We have also included information about the name and number of the contract and its detailed arrangements (with dates or duration of the license). Rights transferring history is stored in a separate tab within the object. 80% of data fields are limited with defined content such as thesauri or controlled vocabularies.

Chosen information is automatically transferred to the virtual fields placed on different data objects. The selected data is used by normal users for informational purposes.

Divided metadata and limited access gave us the opportunity to create a detailed description of rights for all of our users. Thanks to this new functionalities metadata is not overwhelmed with details and technical language. Completing the description can be gradually made by various groups of users, and so their work has become easier.

We periodically consulted with departments that have crucial knowledge about the usage of the rights data in our Institution. We have organised workshops to analyse the ideas and structures for rights description. Thanks to these workshops we were able to limit the dictionary entries and design useful data structures. During our discussions we compared law and sales department workflows to our primary arrangements and selected the most important elements of newly built data objects. To our surprise, some parts we thought of as being crucial were totally unusable for interpreting the data.

Another interesting topic was creating the connections between data objects. Our digital catalogue is heavily constructed on the links between data, objects and content. Automatic virtualisation of data from the rights & licenses object to different levels of description had a good impact for users with minor interest in the rights. Additionally, personalisation of data fields emphasised by the users with specialised knowledge gave them the possibility to improve on the already established internal rights description standard.

IN CONCLUSION

Creating user friendly constructions of data is a demanding task. Rights and licenses are one of the most high-maintenance data sets in audiovisual archives. We can characterise them as highly specialised, repeatedly changing and used in potentially many valuable areas of work.

Designing a solution that properly describes the data and makes it usable requires a deep understanding of existing metadata and continuous communication with marketing and law departments. Finding the usable answer should be taken as a priority, if we want the digital catalogue to be frequently used by employees in their daily workflow.

Sometimes, not creating a perfect solution but one that is easier to use is more acceptable than the original 'perfect' idea. Without understanding

the weight of data structures we are designing, there can be no positive ending. Without cooperation with users and in-depth knowledge about the characteristics of our data, UX designers can only produce a vision. The real work starts when the usability of designed functionalities is tested and reviewed by system users. And to achieve a positive impact there is only one way: to gain knowledge about resources and abilities of people who work with your collection.



AUTHOR: **GERHARD STANZ**
COMPANY: **ORF, AUSTRIA**

Gerhard Stanz has worked for the ORF since 1991. Technology implementations – mainly in the area of archive preview – and broadcast related European research projects led him to his current position as “systems developer” in the multimedia archive.

With focus on content management and metadata, he was involved in several ORF projects including newsroom modernisation, the introduction of digital production and the implementation of the new television archive system.

Gerhard is an active member of FIAT/IFTA's Media Management Commission and participates in ISO working groups on Standards in digital archiving. His current main activity is the continuous operational adaptation and improvement of the digital archive in its relation to the file-based workflows of his company.

10 ORF'S RIGHTS CODE SYSTEMS

IN THE ORF, metadata on licensing and the rights of video content are maintained in four interrelated systems.

One of the systems is “Teleplan”, which is the rundown planning system for our TV channels. For integral programmes it contains a section where the films and series department can manage consumed transmissions of purchased programmes. This is a simple form of license and rights management.

Closer to the subject matter of “Rights Codes” are the other three systems. These are more integrated into the whole process of media production and support all kinds of content valorisation beyond “simple” channel playout.

Our license and rights database “ORFEUS” is a fully-fledged contracts database capable of systematically representing all the layers of individual contracts and restrictions that together constitute the legitimate options

of using audiovisual content in today's common ways (from linear transmission to nonlinear on- and offline use). ORFEUS separately represents integral and partial use options as well as geographical or technical constraints set in contracts.

The rights codes that we use in our MAM-Systems are derived from "ORFEUS" and represent simplified uniform subsets of the wide spectrum that is representable there.

It is here that systems hold and manage video files and rights codes come into play. The data models of MAM-Systems are not designed to manage rights information in all its complexity. The understandable wish to still have rights information represented in the place where the actual files are managed, has led to the introduction of rights codes into MAM-Systems.

If we follow the course of video material from ingest to production, archiving, repetitive de-archiving and re-use – which is the typical lifecycle of video material – all starts at our production MAM "P-CMS" (Production Content-Management-System – "Viz Ardome")

The Production MAM contains two rights code systems, one is a "traffic light system" that rules the options for all content as long as it is untransmitted (a traditionally peculiar stage of production where a lot of sensibilities apply).

The P-CMS's traffic light system uses four colours with the following meanings:

- green – may be used
- yellow – check with material responsible
- orange – visible exclusively for an editorial group
- red – visible exclusively for material responsible

After archiving, the rights situation is translated into a more complex system of about 15 rights codes which indicate the scope for further re-use and valorisation.

These rights codes are maintained in our Archive-MAM “Fesad” but they are, in a simple form, also integrated into the P-CMS.

There are about 14 rights codes in FESAD. The number varies over time as it is a dynamic system under constant adaptation to new constellations. The rights codes are:

- 0 Rights documented in License Database “ORFEUS“
- 1 Full Copyright – own Production
- 2 Fully Usable in ORF Productions but not beyond (applies e.g. for EBU/EVN)
- 6-9 Agencies (APTN, CNN, Reuters, SNTV)
- 11 Full copyright / commissioned service production
- 77 Mixed sources (individually listed)
- 87 Restricted, only for an editor or group of editors
- 88 Absolutely restricted (type “lawsuit pending“)
- 98 Mixed rights, take care for personal or license rights – in case of doubt consult license department
- 99. Restricted – consult the respective editorial department

The rights codes are representations of a certain temporal, geographical and technical extent of optional public use. Rights code “1” stands for the broadest spectrum of that kind. The options for this material are in

principle unlimited. Further on down the line of rights codes more typical restrictions apply according to contracts that must be taken into consideration.

Above all, the constraints set by art copyright and personality protection must be represented. A typical rights code indicating that sort of constraint would be our code “98”. Another rights code that applies to mixed cases would be “77” which just indicates that there are mixed sources (which are listed in the comments of the rights code as it is derived automatically from a planning database). In case of discontinuation of an agency contract, one could thereby identify the relevant material.

The most restricted case in our system is the code “88”. According to the hierarchical logic of going from most to least usable rights codes it should be “99” but it was introduced later and the latter code was already in use. I mention this just to point out the dynamically changing character of the system.

It is important to understand that the rights codes in the archive-MAM are not just represented as figures, but also with the full textual metadata describing all respective temporal, geographical and factual constraints in words. This is achieved by text macros of FESAD, which are applied during annotation. Archive personnel chooses a rights code, and the text macro fills all the necessary fields that go with it with meaningful text.

This metadata than can be exploited by combining rights options with other search words in the database. A search for scenes of Nepal for which we have online rights for instance, immediately comes up with 1.171 results. We can then narrow this down further by adding additional terms to the search statement.

The distribution of rights codes in our Database clearly fulfills our aim to provide content that journalists can use easily.

The 2.1 million items with rights codes represent almost 50 % of all items. We apply rights codes backwards as we digitise our holdings. In the last 10 years 70% of all items have been given a rights code.

Distribution of Rights Codes:

- 70 % are “type green“ and indicate that the material can be used immediately
- only 15 % indicate mixed cases, where a bit more research is necessary before use
- another 15 % are indeed prohibitive and discourage the use of material that would have negative consequences for the company – in most cases financially

We have harnessed our system of rights codes also as the key factor to facilitate self-service downloads again to point journalists to the most easy to use material.

We see the merits of our system mainly in the easy access that it provides to the huge amount of “green material”. Also, that the rights codes are searchable in boolean connections with descriptive metadata is a great advantage.

We are aware that such distributed systems are partly inconsistent and mixed rights situations are still unintuitively represented to users. Therefore, our future plans lie in the documentation of all sources and the application on sequence level, for which we already have productive prototypes in place.



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COMPANY: DR, DENMARK

Johanne Worsaae Nielsen is Head of Data Management (and Program QC) at the Danish Broadcasting Corporation. Her team oversees the data flows and registrations in the digital MAM, making sure content is archived with relevant metadata and rights information.

She has a background in publishing, where for 8 years she worked with digital production and digital distribution, both on the ground for a larger Danish publishing house and as a member of international metadata standards steering committees.

In 2018 she left the world of books to begin her journey in the magical broadcasting sphere. And she's happy to be there.

11 FUTURE PROOFING

RIGHTS MANAGEMENT AT DR

WE USED TO believe we knew the future. We believed that what we concluded in the present, would also be the correct answer in the future. Things developed slowly, and linear TV and radio was broadcasting. It shocked the world when a second Danish TV channel began transmitting. Also, organisations changed more slowly. Once you entered the doors of DR, you hardly ever left the place again.

What has this got to do with right codes and daily practices? Well, the view of the world as a static well-known place affects the way we work. Thus, it leads to rights codes and rights information texts such as: “Call me if you want to use a sequence from this program. /Klaus”. If you could find the phone number of Klaus, and called him, he most likely would say: “Sure you can use a sequence. Lars, the musician, agreed that we could show it on TV as we saw it fit.”

Klaus believes that he will always work at DR, and that TV will always be the same. Neither one nor the other is true.

Therefore, we need to make a shift from concluding on the future use of our content to neutrally describing our content and its third party elements. Because the world is not static, and what is true today might be false tomorrow. Rights agreements do change, and broadcasting is evolving more rapidly than ever. We have to stop calling Klaus.

RIGHTS CODES IN WHATS'ON, PLANNING SYSTEM

So, what do we do today at DR? Have we moved out of this sphere of knowledge-belief? Not really, no. We do our very best to register our own rights and third party rights in order to foresee future use, but it's still hard to move out of the present. In our planning system we register rights related to reruns, streaming and other aspects of digital distribution. In our MAM we register rights related to future sequence use.

In Whats'On we register information required for planning linear distribution and digital distribution:

- Linear: Number of allowed reruns
- Streaming rights: number of days online
- Downloadable: Yes/ No
- Georestrictions: Yes/No

This is the structured data. We also have:

- An empty field for notes about third party materials, that are relevant if content is to be re-bought, and rights need to be cleared

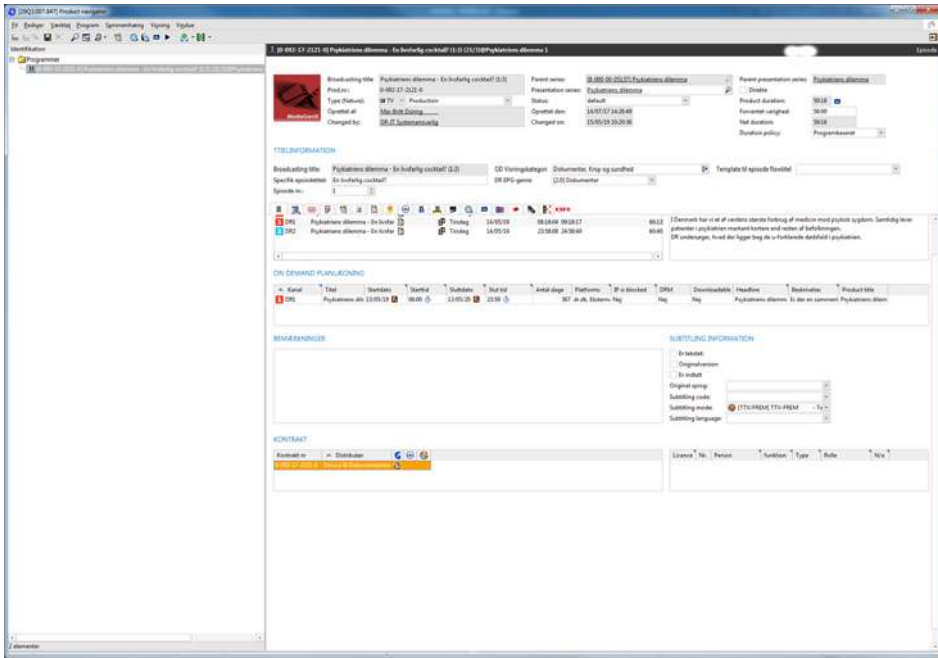


Fig 1: Rights registrations in Whats'On – the planning system of DR

And here comes a question for the audience: “Do you think that this unstructured optional field always holds the required information?” You’re right! It obviously doesn’t. Because these notes are not necessary today. And “the rights for the programme are cleared – so why do I have to register them?” Very often our minds are still in the age of “just call Klaus”. We must continue to insist, that our content needs a full rights description.

RIGHTS CODES IN DR MEDIA ARCHIVE – MAM

Now, let’s move from planning the distribution of our content and on to our Media Archive. Here, our audio and video content is stored.

The screenshot shows a user interface for managing rights information. It features two main sections: 'Rettighedsniveau' (Rights level) and 'Klausuleringstekst' (Disclaimer text).

Rettighedsniveau is represented by a traffic light with four colored circles and corresponding text:

- Kan genudsendes og genanvendes (i uddrag) efter god skik og brug
- Genudsendelse og genanvendelse forudsætter særlig betaling udover KGF
- Genudsendelse og genanvendelse kræver særlig tilladelse
- (Rettigheder ikke udfyldt)

Klausuleringstekst is a text input field containing the text: "Må først anvendes efter udsendelsesdato".

Fig 2: Screenshot showing the traffic light of the MAM at DR

Our MAM contains different kinds of content:

- Published content that DR has produced/ bought
- Raw material e.g. press conferences
- Subscription materials e.g. AP
- Metadata-only posts for non-digitised content

Our rights codes must handle all of these different kinds of content. In our MAM, our rights information consists of the well-known traffic light and a rights information text field.

For our in-house produced content, it's the programme team who fills out the traffic light and rights information. The archive team helps them when there is doubt and checks that everything is OK.

When it comes to external productions, that DR has ordered, then it's the archive team who fills out the traffic light and rights information based on the actual contract between DR and the production company. When do we use which code?

GREEN:

- DR content with only third-party materials covered by collective agreements (music and visual arts)*
- Bureau/AP material
- Raw material from DR photographers
- Information about which music/visual arts that have been used must then be reported to the rights organisations, who handle the collective agreements.

YELLOW:

Content is marked as yellow, when you can use the content, but you'll have to pay a fee to third parties such as actors, instructors or live musicians. These rights do not have to be cleared; you just have to pay an agreed amount.

RED:

If a programme does contain rights that must be cleared if the content is to be reused, the traffic light should be red. We use red for:

- DR content containing third party materials for which rights have to be specifically cleared (as opposed to those under a reporting agreement)
- DR content containing ethically controversial sequences
- NON-DR content (this is not archived but stored temporarily)

“If a programme is marked with a red light, then I cannot use anything from it”, you might conclude. But no, that is not necessarily the case. A programme is marked red if it contains third party materials, but it’s often perfectly fine to use sequences from other parts of the programme.

So, our simple traffic light unfortunately doesn’t make our rights codes simple and easily decodable. And we have more challenges with in the MAM.

1. Legacy registrations – even if the registrations are of good quality, then principals for rights registrations have changed over the years making it hard to fully understand the meaning of a yellow traffic light.
2. “Just call me. /Klaus”: remember him?
3. When rights agreements change. E.g. we used to have an agreement with Reuters. We paid an annual fee and could use their content free of charge (or something similar). Then the agreement was not renewed, and all Reuters content and DR content containing Reuters content was wrongly classified. Since we had no structured information on where Reuters content was used – we had no structured

description of our content – we could only do so much to correct the rights information. And of course, there were hiccups. Similarly, when the format rights for “X-Factor” were taken over by our competitor TV2, we corrected – manually – the rights info on 100 programmes.

TO SUM UP – CHALLENGES IN RIGHTS REGISTRATIONS

So, what are the challenges in today’s rights registrations at DR? Let’s try to sum it up:

- We don’t know what the future brings - what we conclude today might be wrong tomorrow
- We don’t know how materials will be used
- Rights agreements change
- Format rights might change hands

We have a common need across planning and production to have our content properly described in order to use it to its full extent. And in order to not use it when we’re not allowed. When you want to re-run a programme, you must know which rights need to be cleared in order to do so.

When you come to the Research department and ask if a sequence from an old programme can be used, they have to be able to find the answer. So, they call Klaus. And if Klaus doesn’t pick up, they will have to say “no”.

We need to describe our content – not making conclusions on the basis of current use cases. Because only then can Klaus’ productions live on, long after he has walked out the doors of DR.



AUTHOR: **MAJA WETTMARK**
COMPANY: **NRK, NORWAY**

Maja Wettmark is the Head of Metadata Processes at the Norwegian Broadcasting Corporation (NRK), working in the Technology department. She holds a bachelor's degree in library and information science and has been with the NRK for 14 years.

Maja is working with the different aspects of metadata at NRK to make the content searchable and accessible for publishing and reuse. This includes how to handle digital manuscripts, subtitles and superimposes as well as descriptions, categories, information regarding target audience etc. The information is created by the producers of the content in their own production systems and automatically transferred to NRK's public net players and the internal archives. The motivation is to make use of the metadata in creating the best experience for the public – in presentation, search and recommendations.

12 KNOW YOUR RIGHTS!

A BETTER UX DESIGN

THE NORWEGIAN BROADCASTER NRK holds almost 3 million audio and video items in the media archives, dating back to the 1930s. We want the archive to inspire producers of new content and we're encouraging them to reuse material from it in new contexts. But even if we have the media files and descriptions available, it doesn't necessarily mean we can do whatever we want with the material, someone else might own the rights and we need to contact them before we publish it again.

CHANGING THE TV MAM SYSTEM

We are in the process of changing the MAM (Media Asset Management) system for our TV production.

TRAFFIC LIGHTS

In the old MAM, which is twelve years old, traffic lights indicate to what degree the content can be reused without a new agreement with the rights holder. Green is supposed to mean that NRK holds all the rights and the content can be reused freely in new NRK productions. Red is supposed to mean that someone else owns the rights to the material. Yellow is something in between, or that the rights holder is unknown. The children's channel also use yellow to express that the video contains children and can't be reused without consideration.

The traffic light system is problematic in many ways. Red doesn't mean STOP - you can often make a new agreement, or pay a fee, to reuse the material. Yellow doesn't mean anything, if you don't have additional information. And a big disadvantage with green and red displayed on a timeline is that some colour-blind people can't see the difference.

NEW TV MAM

The biggest change with our new MAM is that we're now developing some parts of it in-house, instead of buying the whole package from a supplier. With the new MAM we are in total control of the metadata structure and the user interfaces.

NEW SYMBOLS

We couldn't change the user interface in our old MAM so we had to live with the frustration over the traffic lights for many years. That gave us some time to consider other options and discuss them with different stakeholders. Metadata experts developed the different copyright

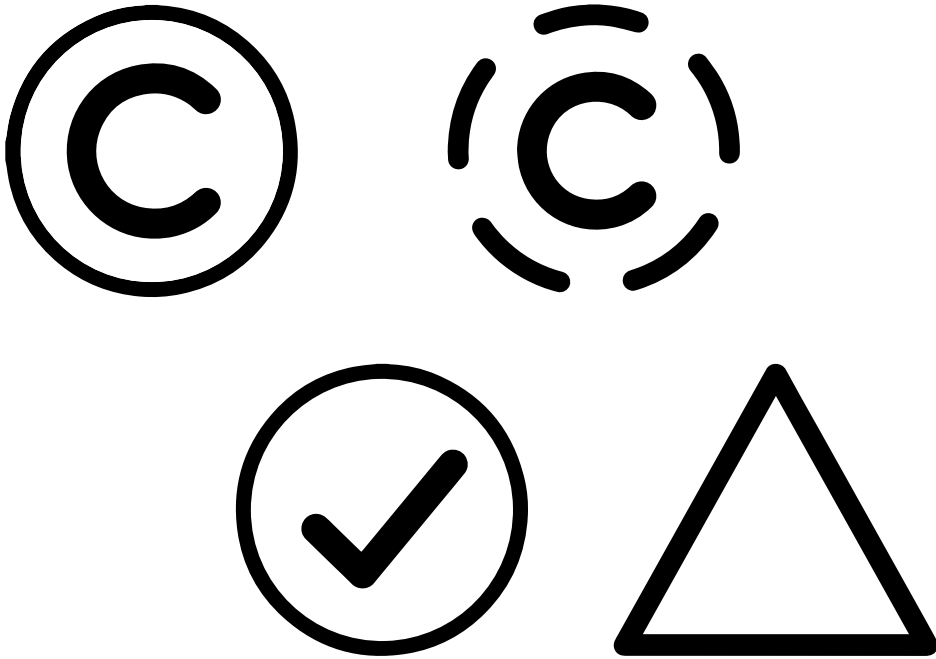


Fig 1: Copyright concepts as symbols

concepts we needed in the NRK context and a UX designer sketched symbols for them. To make the symbols understandable we borrowed the copyright C, which most people recognise. We ran these by the editorial units and the legal department to make sure they were intuitive and covered what we wanted to express. Figure 1 shows the symbols we developed.

Both "Copyright" and "Sensitive" require a comment in free text, or a contact person, to point the next person in the direction of what to do before reusing the material. The "C" with a dotted line can be found on overall descriptions of programs, to indicate that it contains both copyrighted and free-to-use material. If the content is marked with "Sensitive" and "Free reuse" it is most likely an NRK production containing children or people in vulnerable situations. If someone wants to use it in a new pro-

duction, they may have to talk to a parent or consider if the new context is appropriate.

We will not try to map the traffic lights to the new symbols, that would be an impossible task. We will have to let the legacy colours live side by side with the new symbols.

WORKFLOW

Given the amount of content we produce and acquire every day, it is crucial that the staff closest to the content mark it and write the comments in the systems they use. This is the main reason we wanted to develop symbols and workflows as simple and intuitive as possible, even though the copyright universe is very complex and sophisticated. There is always room for misunderstanding, and we may have underestimated the different requirements for expressing rights issues. However, we believe that the simplification of the workflow will result in more staff thinking about and marking-up rights in a hectic production situation.

TIMELINES

Our new MAM provides users with a genealogy timeline, giving them the opportunity to follow the source of the content. If the people closest to the material mark it with correct rights symbols, they make the work a lot easier for the next person using the same material. Figure 2 is an illustration of a timeline with descriptive metadata, rights information, sensitive material, internal comments and genealogy.

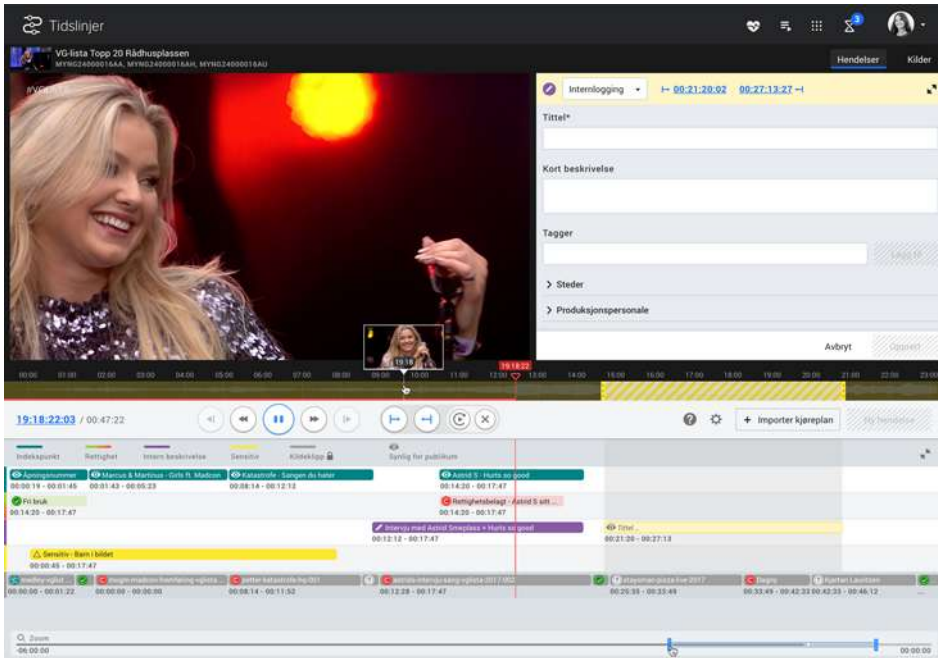


Fig 2: Genealogy Timeline

OTHER SITUATIONS

As a publisher we deal with rights in many different situations.

NRK TV STREAMING SERVICE AND VOD RIGHTS

We have our own streaming service for video called NRK TV. With this platform we are competing with Netflix, among others. We work hard and pay a lot of money to obtain lengthy Video on demand (VOD) rights, in order to make NRK TV a buffet of delicious and interesting content. To keep track of VOD rights we use our planning system, What's On. The

commissioning unit interprets contracts and fills out the specific fields in What's On to create patterns for web publishing and keep track of linear publishing. The web publishing patterns include start/end time and geo-blocking.

In the licencing period of specific purchased content we can produce promotional material for broadcast with no extra cost.

THE RIGHT TO QUOTE

In the editorial process we always look for the best ways to illustrate the story we are telling. The quotation right gives us an opportunity to use copyrighted material freely if it is within a reasonable length and is clearly marked. It requires context where the quoted material enriches the story or is necessary for understanding it.

REPORTS TO THE RIGHTS ORGANISATIONS

We use the planning system (What's On) to generate reports of the music used. We send the reports to the rights organisations with whom we have a standing agreement and pay a yearly fee.

TO SUMMARISE

Our focus is on simplifying the rights mark-up workflow in our TV MAM, since it is performed by every editorial unit producing content, and not just use rights experts. We have left traffic lights behind; we find them problematic in different ways and have developed our own symbols with three different values to cover the rights issues we deal with in everyday

situations. We also added an additional symbol to express that the content contains sensitive material.

Digital publishing is in constant transformation. We don't have time to investigate unclear rights issues if we want to publish the best content quickly. With a simple and intuitive mark-up workflow, we expect that even more of our archived content will have correct rights information. This will hopefully lead to an increased use of the archives in new content. The copyright universe is changing as well, and we need to follow these changes in archive development.



AUTHOR: **DAVID KLEE**
COMPANY: **A+E NETWORKS, USA**

David Klee is Vice President of Media Infrastructure at A+E Networks, a global entertainment and media company with cable television channels including A&E, History, FYI, Viceland, and Lifetime. He is leading a new engineering team in New York City focused on technical strategy for media supply chains, working to leverage the cloud to drive agile transformations.

Prior to joining A+E, Klee worked in various media management, live production, creative and operational roles before moving into technology. He then built new engineering teams at NBC News in New York and Univision Communications in Miami (the largest Spanish-language media company in the U.S.), both focused on software development for media workflows and archiving.

Klee holds a Master of Science in Information Management from Arizona State University and is an AWS Certified Solutions Architect.

13 ARCHIVING IN THE CLOUD

THE WORLD OF cloud computing is changing fast, particularly when it comes to media. Even just a few years ago, archival storage in the cloud was still too expensive for most organisations to consider for large media files like broadcast-quality masters of television programmes and movies. But since late 2017, the cost of the lowest-price, cloud-based storage has been cut in half¹ – twice² – and the trend is certain to continue.

Things are changing so fast that it is difficult to keep up with the details, to say nothing of building a long-term strategy to leverage the power of the cloud. Pricing models and levers change quickly, and because cloud computing is usually considered a “service” that gets paid as a monthly bill, those changes more directly impact most organisations financially.

2019 may well be the year we look back at as the tipping point in cloud computing use for more traditional media companies that have historically

focused on equipment inside their facilities to support broadcast and cable channels. Due to a confluence of factors - better internet connectivity, lower storage costs, and even the innovations brought by artificial intelligence and machine learning - cloud computing can now be seen as a very viable option for many media and entertainment workflows, including television archives.

But in order to embrace the power of the cloud, we must first understand how it works - at least at a high level. This paper will explore how cloud storage providers generally structure their products today, how archival storage in the cloud tends to work, and what it costs. Though any actual numbers in this paper will surely be out of date by publication (along with many of the associated product names and functional details), the goal here is to broadly outline how archival storage in the cloud can be used today and what strategies are beginning to emerge for the future.

THE MEDIA SUPPLY CHAIN EVOLUTION

Before fully embracing storage technology in the cloud, it is important to understand how moving into the cloud starts to present new paradigms for media workflows in broadcast and cable-focused organisations. In the past, these organisations were able to receive finished television shows and movies from suppliers on video tapes, films, or other physical media. In the last decade, those deliveries have moved to high-quality video files, but only recently have they started to come through the internet or through other network-connected computer systems.

Similarly, broadcast and cable organisations have historically focused on only one major destination for their finished television programmes and movies: linear broadcast and cable channels. The advent of internet-based streaming platforms like Netflix, Hulu, iTunes and a myriad of other video-on-demand (VOD) services has forced these broadcast and cable

organisations to think about completely new kinds of video file delivery at the end of their processes. These deliveries, too, have begun to move to and through the internet.

These new internet-based bookends to media supply chains have created an entirely new paradigm for broadcast and cable content companies. Television programme distribution no longer happens by sending files to servers and systems exclusively within an organisation's physical walls. Now, a significant portion of the distribution process goes through the internet: crossing outside an organisation's physical boundaries.

This requires a new approach to broadcast archives. The archive systems that maintain television programmes and movies can no longer be thought of as a disconnected vault to keep content safe for eternity. It is now critical to think of the archive as an integrated part of the modern television workflow; accepting new programmes and making them available to an increasing number of systems with minimal delay. Archives need to be connected at many different points in the media supply chain: not just at the end. And much of this new media supply chain flows through the internet.

There is a danger, then, that the broadcast archive can be left behind: disconnected from the internet, and therefore, disconnected from the rapidly evolving supply chain of television programming. However, in this new world of internet streaming, the archive has new value; it can be a new enabler of growth for an organisation looking to monetise and reuse its content library. Connecting the archive to the internet -- and to these new media supply chains moving through the cloud -- is critical to meet growing content demands.

USING A PUBLIC CLOUD

While it is imperative to connect modern television archives to the internet, there are many approaches to doing so. One way is to leverage "public

cloud” service providers such as Amazon Web Services (AWS), Microsoft Azure, and the Google Cloud Platform (GCP).

These providers are not “public” in the sense that your data will be shared with the world (unless desired), but rather “public” in the sense that the servers, storage, and technology to make these services work are all hosted in shared data centers that customers access through the Internet (rather than accessing servers and systems physically residing within space and networks directly controlled by the organisation, itself). Microsoft defines the public cloud as, “...computing services offered by third-party providers over the public Internet, making them available to anyone who wants to use or purchase them.”³ Essentially, public cloud providers will manage all the actual computers and infrastructure for you, and rent you virtual servers, storage, and other computing services as you need them.

There are many public cloud providers that offer a variety of services, but as it currently stands at this time of writing, AWS, Azure and GCP are generally the top three in market share for storage.⁴ There are a lot of similarities between the three in terms of their cloud-based archive storage offerings, so they will generally be the focus of this paper.

ARCHIVE STORAGE IN THE CLOUD

In some ways, you can think of cloud storage as a somewhat limitless hard drive in the internet; you can connect to it from almost anywhere and upload and download whatever you want to store there. Popular services like Dropbox and Google Drive have paved the way for this concept at the consumer level. On a commercial level, the offerings are similar but usually much larger and with many more capabilities. But, in a very simplistic way, cloud storage can look like a hard drive or server that just never gets full.

However, there's a bit more complication under the hood to explore when looking at the kinds of cloud storage that big companies tend to use for important corporate data. Each of these big, public cloud providers have many different types of storage to offer that are each good for different purposes.

When it comes to archiving, each major public cloud provider has an archive class of storage to offer: storage that is best used for content that does not need to be accessed regularly. For AWS, their Simple Storage Service (often just called "S3") has two different archival storage offerings⁵: one is called "Glacier," and the newest (and cheapest) is called "Glacier Deep Archive." Microsoft Azure offers Azure Blob Storage with an "Archive" tier⁶ and within GCP, Google Cloud Storage has a tier called "Coldline."⁷

Each of these cloud providers are able to offer increasingly cheaper archival storage, but there are some trade-offs to consider. For one, archive storage in the cloud is usually not immediately available for use; archive storage is often called "cold" storage. In this way, archive storage in the cloud is less like a hard drive and more like a video tape, CD-ROM, or LTO data tape that needs to be retrieved from a shelf and put into a reader before the content can be accessed.

This "retrieval" or "restore" process brings content back to an "online" tier (which is often called "hot" storage) so it can be used again, kind of like putting a CD-ROM into your computer. That restore can take time, and the amount of time can vary widely between each cloud storage product: from a few milliseconds on the short end (almost no wait at all) to a couple of days on the long end. In most cases today, the wait is a few hours.

The benefit of putting up with this wait time is that archive storage can cost only a fraction of the storage costs that are always available to use immediately; in the most extreme cases, archive, or "cold" storage, can be less than 1/10th the cost of "hot" storage that is always available⁸. That difference leads to a second big consideration to using archival storage in the cloud – cost – and the different types of cost that can be expected.

CLOUD EXPENSE

Costs and strategy tend to be much more tightly correlated when shifting to public cloud-based storage. This is partly because the actual cost to store any individual piece of content becomes much more apparent when a monthly bill arrives telling you how much to pay.

Historically, it has been extremely difficult to calculate a total cost of ownership (TCO) for content stored in a broadcast archive. It has been necessary to total a variety of costs including LTO data tapes; the cabinets, robots, drives, and servers that make the LTO archive system work; the nearline disk storage and network connectivity that makes the system available; the power and cooling for the data center the system sits in; the management software and servers that index the content to make it searchable and available to users; and many others. Answering what seems like a relatively simple question – “How much does it cost to store a single master?” – can be surprisingly complex.

In the cloud, many of these same systems, technologies and costs still exist, but they become the responsibility of your chosen cloud provider; and the cloud provider distills them down into a bill sent out each month. When the bill arrives for the storage infrastructure service (often called Infrastructure as a Service, or “IaaS”), it becomes very clear how much it costs to store each piece of content. Similarly, a monthly bill may arrive for the management software that helps organise, catalogue and manage content in the cloud (usually in the form of Software as a Service, or “SaaS”). Regardless if there is one bill, two, or more, when the bills begin to arrive, it becomes very clear what each piece of content costs to store and manage.

These costs are also a fundamentally different type of expense than most organisations have historically used to fund archive systems. Archive systems have often been funded as major projects or multi-year initiatives by an organisation; typically with a budget of capital expenditures (often

called “capex”) that are made for investing in equipment that will be used over a relatively long period of time.

In the cloud, costs shift to a monthly subscription that typically comes from a different budget category: operational expense (often called “opex”). Opex budgets are the same budgets that organisations use to pay for ongoing operations to keep a business running: things like salaries, benefits, rent, and support contracts (among others). Depending on how an organisation measures its financial health and success, expanding opex budgets can make an organisation seem less healthy than spending capex to finance big projects. Capex projects can be seen as positive signs of expansion: an investment in the business. Opex costs can be seen simply as the ongoing costs of keeping the business running: costs that should be minimised.

There are some benefits of shifting archive expenses to opex budgets, however. For one, the higher level of transparency showing how much it costs to store each individual piece of content in the cloud can help inform better business decisions; being able to make quick calculations about potential actions (like using a number of assets in a new content distribution deal) based on actual numbers can bring a tremendous amount of insight to new initiatives.

In addition, treating archival storage as a service to subscribe to (rather than as a physical system to build and maintain) actually transfers much of the responsibility for these systems to another organisation: a cloud storage provider that specialises in computing infrastructure. Trying to keep up with maintaining the technology behind a large archive system can be quite difficult; while LTO tapes might be made to last 30-years or more, in reality, the functional life of an LTO tape might be only a few years before the technology used to read and write the data is completely obsolete⁹. This can lead to large capital investments every few years to rebuild an archive system in an organisation: updating technology and migrating data before the storage itself becomes outdated.

By subscribing to storage as a service, expenses become more predictable. Each organisation no longer needs to put together large amounts of money every few years to rebuild the archive. Instead, each organisation pays a relatively steady, monthly fee. Behind the scenes, each cloud storage provider must keep up with many of the same concerns around technology obsolescence, but this is arguably one of the core competencies that the cloud provider must maintain to stay effective. This approach also allows media companies to be more adaptable and agile when new technologies come into the market; rather than investing in capital projects every few years to find the best archive technology, opex expenditures can keep an organisation more flexible to shift to new storage types more quickly, and use different types of storage for different types of content where appropriate.

CLOUD ARCHIVE COSTS

While understanding the shift from capex to opex in the cloud is important, it is equally important to understand what kinds of opex charges to expect; what individual items and actions actually lead to an increased bill at the end of each month. When it comes to using cloud-based archive storage, there are four main categories to understand: the amount of storage being used, operations, restoring content from archive storage back to “online” or “hot” storage, and egressing or downloading the content out of the cloud.

When it comes to “operations,” these are charges for accessing and manipulating data regularly that might come into play on frequently accessed files: busy websites and large data sets, for example. While these charges can be expected for cloud-based archives, they are usually not significant enough to have an impact on use cases and strategies: perhaps a few dollars a month, depending on the size of an archive and the systems it talks to. We will not focus on them here.

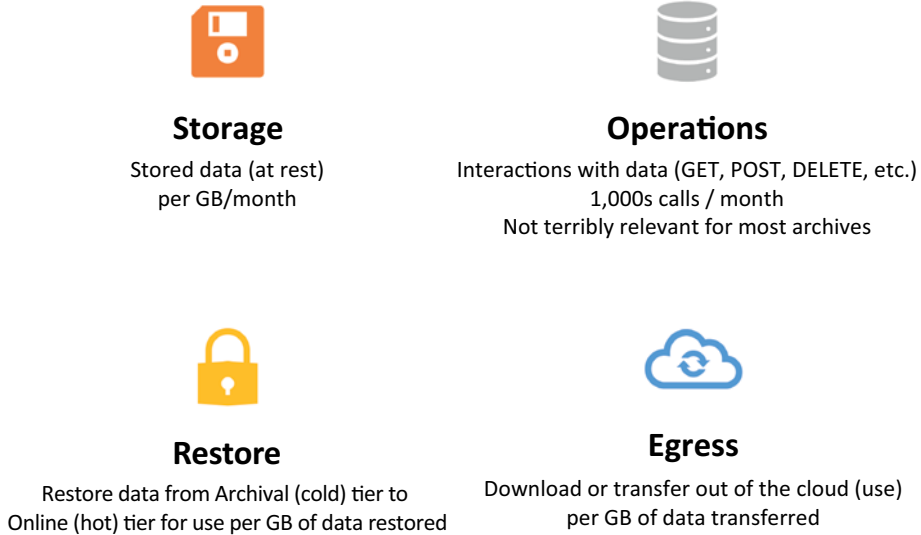


Fig 1. The four different categories of charges for storage in the cloud

THE COST OF STORAGE

The cost for the storage space, itself, is the first category to understand in the cloud. This is often charged in a number of GigaBytes (GB) being used each month, and all major cloud providers charge (at the time of this writing) half a penny (\$0.005) or less¹¹⁻¹³ for each GB of storage used in their archival tiers each month.

THE COST OF RESTORE

The second source of charges when using cloud storage is the cost of restoring content from archival storage back to “online” or “hot” storage so

content can be used. As discussed previously, archive storage in the cloud is often not available immediately; in order to download or access archived files, a “restore” or “retrieval” process must be initiated first. This restore is charged based on the size of the file, and is usually expressed in terms of a cost-per-GigaByte (GB) retrieved.

The cost of retrieving files in the major cloud providers is (as of this writing) a few pennies (\$0.01 - \$0.05) per GB¹³⁻¹⁵, which means that the cost to retrieve a file from the archive back to an “online” tier for use a single time is more than the cost of storing the file for the month. This retrieval cost helps reinforce that archival storage in the cloud is most effective today for content that is not regularly accessed.

THE COST OF DOWNLOADS

The third source of cost only comes into play when content is used outside of the cloud; the cost to download, or egress, content out from the cloud provider to another location (either on “Earth” or another cloud provider, or sometimes even another region with the same provider in the cloud). While none of the major cloud providers have a special charge to transfer data in to their cloud storage locations, there is a special charge to transfer that data out or download that content. This is most often called “egress,” and is usually significantly more than other storage and restore charges.

As of this writing, the cost of egress hovers around \$0.10 per GB for most of the major cloud providers¹⁶⁻¹⁸. That means that egressing a file out of the cloud is approximately 2-10X more expensive than restoring it from an archival tier of storage, and roughly 20-100X more expensive than storing that file for a single month. The cost of egressing content can significantly shift the economics of the cloud for a particular use case, reinforcing that archival storage in the cloud is best for content that is rarely

ONE MONTH OF STORAGE, ONE RESTORE, ONE EGRESS (1GB)

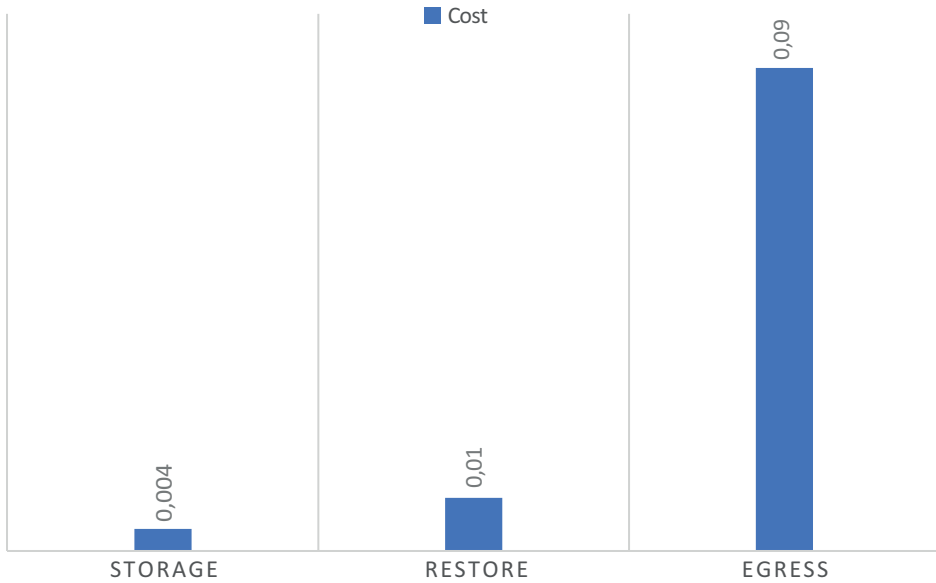


Fig 2. The proportions of cost spent on one month of storage, one restore, and one download (egress) for Amazon Glacier storage (example pricing will not apply to all situations).

needed outside of the cloud, and also helping build the case that any content stored in the cloud is best transcoded, quality checked, or otherwise processed in place in the cloud (without downloading it) to be the most cost effective moving forward.

COST EXAMPLES AND STRATEGY

While the numbers above will certainly change in short order (if they have not already), their general categories and rough proportions should be slightly more durable. Those proportions are represented in figure 2.

As the chart shows, by comparing the cost of one month of archive storage to the cost of one restore and the cost of one download (or “egress”), it

ONE YEAR OF AWS S3 GLACIER DEEP ARCHIVE VS. ONE LTO7 TAPE

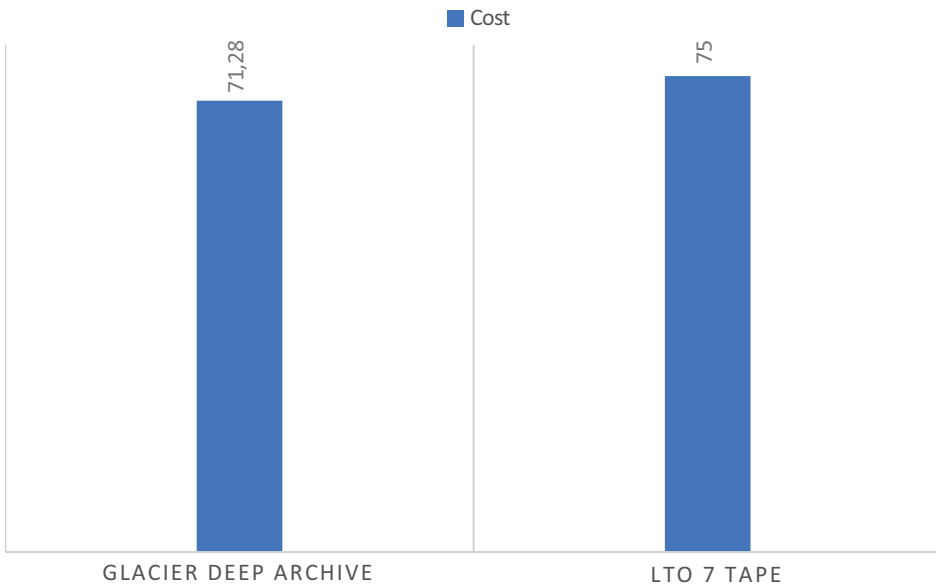


Fig 3. The cost of one year of AWS Glacier Deep Archive storage versus the cost of one LTO-7 tape, each holding 6TB of data (example pricing will not apply to all situations).

is clear that egress accounts for a huge proportion of the cost. In fact, if all three of these things happened in the same month, storage would account for only 4% of the actual cloud provider bill for the month, 10% would be to restore the content from archive once, and the other 86% would be the cost to download the content a single time.

It is a slightly more fair comparison to look at the cost of an entire year of storage in a cloud archive compared to the cost of restoring and downloading the content once (since files in cloud-based archival storage are not really intended for use every month). Still, if every piece of content in an archive was restored one time in a year (but stored for a full 12-months), on average roughly one-third of a yearly bill would be for storage alone, while the other two-thirds would be for the cost to restore and download all the content a single time.

Regardless of the actual numbers and specific situation, the overall message is consistent and clear: storing content in the cloud can be relatively inexpensive if it is not used. But, even given that, we may be approaching an interesting tipping point on the cost of archival storage in the cloud.

As Figure 3 shows, we are approaching the point where a year of storage in the cheapest available cloud archive storage tier (at the time of this writing AWS S3 Glacier Deep Archive¹⁹) is now, in many cases, cheaper than purchasing that amount of storage on an LTO7 tape.

Now this may not be a completely fair comparison; this is only one year of cloud-based storage against the relatively long-term storage medium of an LTO tape. But keep in mind the total cost of ownership truly behind large-scale LTO archive systems; the myriad of costs associated with hardware, software, facilities and personnel to maintain these systems and migrate data over a long period of time. In addition, the above chart only includes the cost of purchasing a single copy of an LTO tape. Most large-scale archiving systems would store the content on at least two or three redundant LTO tapes to maintain durability over a long period of time and protect against failures, but the cost of most archival storage in the cloud includes these extra copies. (In order to maintain high ratings of durability over a long period of time, most cloud storage providers automatically create and manage multiple, redundant copies of data behind the scenes included in the storage cost). The comparison of a single LTO tape to a single year of cloud archive storage may be more fair than it appears at first glance.

It is at this point that cloud-based archive storage can truly become compelling for certain use cases: when the cost of the cloud storage becomes as cheap or cheaper than the cost of the equivalent number of archive LTO tapes by themselves.

CLOUD ARCHIVING USE CASES AND STRATEGY

The above cost structures and current pricing lead to a fairly natural use case to begin archiving in the cloud: disaster recovery. If content is relatively inexpensive to archive in the cloud as long as it is not used, and if storage costs in the cloud are beginning to rival the cost of the storage media (LTO) alone, archiving backup copies of content to the cloud can be a sound strategy. The hope is that these backup copies are not accessed regularly (if at all), and the completely separate storage location and method from an on-site LTO library can be a solid part of an overall backup and recovery strategy.

But backup copies in the cloud can quickly become primary copies. As media processing and media supply chains continue to move to cloud-based processing in major public cloud providers like AWS, Azure and GCP, cloud-based copies of content can help facilitate new cloud-based workflows. This is quickly becoming a viable option, as processing content in the cloud and transcoding derivative copies of assets can be done in many cases without incurring egress or download charges; taking a full-quality master video file in cloud storage and transcoding a relatively low bitrate derivative for distribution to a new Over-the-Top (OTT) video service, for example, can mean only the smaller (and cheaper) file exits the cloud and incurs the download fee.

To facilitate workflows like these, a whole new class of tools is emerging in the cloud to enable highly elastic and scalable media processing. Some of these tools can process content in place; your organisation can continue to manage your own cloud-based storage locations, give a software provider in the cloud temporary access to your storage in the cloud, and your content can be processed without incurring egress or download fees. There is tremendous power in these new tools that can process large amounts of content in parallel with nearly limitless elasticity, but they can only be used if content has first been extracted from slow, onsite storage

archives that include LTO and even legacy video tapes. In short, it is only possible to leverage these new tools in the cloud if you have an archive connected to the cloud.

OTHER CONSIDERATIONS FOR CLOUD ARCHIVING

In addition to the emerging use cases for disaster recovery and media supply chains in the cloud, there are several other reasons to consider cloud archiving. Let us consider some of the use cases relevant to a global content organisation like A+E Networks.

A+E Networks is primarily based in the United States with three of the most viewed cable networks (A&E, History and Lifetime), but also has a large business distributing content around the world with 80-channel feeds in roughly 200 territories displaying its content, which is translated into a total of 41 languages.²⁰ However, A+E, and global media companies like it, do not necessarily maintain large offices with technical systems and staff in every country or territory.

As content works its way around the world and is translated into different languages in different regions, there can be tremendous value in preserving these translated, derivative copies for reuse on both linear and digital platforms. But how should a global company effectively manage large volumes of files around the world without maintaining cumbersome and expensive archive systems in many different locations? Enter the cloud; with the ability to centrally manage content but to also keep the content stored in a region of the globe where it will still be relatively close to the places where it will be used.

By managing content in the cloud, companies with multiple locations can more easily connect to each other by simply using the internet. The immediate advantage from a technical perspective is less physical hardware to support. But there are additional benefits of this approach.

As discussed earlier, content stored in the cloud can be reused and re-processed elastically and leverage the growing ecosystem of media supply chain tools, as well as keeping ahead of technology generational challenges like constantly migrating content from aging archive systems to new ones.

And the biggest benefits of all may yet to be fully unlocked; leveraging all the new innovation being driven by machine learning and artificial intelligence in the cloud to better manage large volumes of content. While there is a lot of hype around these new technologies right now, if the reality even begins to meet the potential of being the most revolutionary change to human existence since commercial electricity,²¹ it will be worthwhile to have our content systems prepared to take advantage. At the very least, it seems clear that the cloud will continue to serve as a “supernova” for innovation and new technologies²² over the coming decades, and those who are prepared to leverage it will put themselves ahead.

MOVING FORWARD BY MOVING UPWARD

With decreases in cloud-based storage pricing and the continued innovation being driven by cloud computing, there are, today, use cases and workflows that make sense for broadcasters and cable companies in the cloud. One of those is cloud based disaster-recovery; extra backup copies of content in a diverse location with a somewhat diverse set of technologies compared to on-site LTO libraries. In addition, keeping archive systems connected to the cloud positions broadcasters to take advantage of the next generation of media supply chain tools, as well as the newest innovations in computing, including machine learning and artificial intelligence.

But moving to the cloud is not without challenges. First, pricing models can be downright confusing. It can be difficult to understand exactly what charges will be for a particular block of storage or a particular group

of services until the bill arrives; simultaneously, it becomes increasingly important to understand these cost structures because a bill is arriving in short order that must be paid out of an operational budget. This causes a huge tension in cloud migrations; costs become more tightly coupled with strategy yet more difficult to understand at the same time. However, there is also tremendous power in understanding these structures and being able to more directly tie each individual piece of content or processing action to a real, quantifiable cost. With this kind of transparency and correlation between content and technology costs, organisations can build better metrics, and ultimately, drive better business decisions.

In addition, the cloud does not magically alleviate the need for strong content management practices. These practices will change significantly in the cloud because of new technologies and paradigms, but the processes and policies that have helped enable good cataloging and preservation of content in the past are even more valuable in the cloud as the infrastructure of content storage becomes unbound by most conventional constraints. Most of the big public cloud providers offer Infrastructure as a Service (IaaS) - the storage alone. This is the place to put bits of data. Good data management tools and media management software platforms that allow for cataloging and organising the bits of data are still needed in the cloud, and they often come in the form of Software as a Service (SaaS) providers. That means that many organisations will end up with at least two bills each month – one for the storage provider, and another for the management software service – but these two bills are often necessary to effectively manage content at scale.

Finally, the cloud does not alleviate the need for good project management and change management practices. In fact, the extreme amounts of change that can be driven by these completely new tools and technologies brings a new focus to these disciplines; they become even more critical for success in the cloud. But the right approaches are needed to these critical topics when using technologies that can decrease build times from months

and years to days and weeks. It doesn't make sense to take weeks to build a project charter for a project that might only take two days to complete. It doesn't make sense to build a multi-year project timeline before beginning implementation when half of the technologies planned to be used could be outdated before the project is even halfway complete.

More agile approaches are required. More focus on the user is required. More compartmentalised, target projects must be scoped to be successful. Those building media processing and storage roadmaps for the cloud cannot afford to plan a multi-year, skyscraper-scale initiative, and instead need to focus on building thousands of rooms, one room at a time. The projects need to be short, focused, and meaningful to users. The projects need to build on each other with quick wins that demonstrate success and build momentum. Major initiatives need to be approached as a series of small projects. The key is to have a strategic goal, and implement it one tiny piece at a time. We cannot expect to plan every step of the marathon in advance.

It will take agile practices, incremental change, and constant collaboration to be successful as the pace of technological change continues to accelerate, particularly when it comes to the future of "television" technology. But by working together to share ideas and build on successes both inside and outside our organisations, we can all hope to build new systems and processes that will enable the next generation of media organisation to thrive.

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14 WHAT GOOD ARE IDENTIFIERS ANYWAY?

WHAT IS AN identifier? An identifier is just a name we use to call something. People have been thinking about this for a long time. The denizens of the cave in Plato’s Republic named the things that they saw. In Genesis 2:20, “Adam gave names to all cattle, and to the fowl of the air, and to every beast of the field.”¹ Things were simpler then: since nothing had a name yet, there could be no confusion. Explorers who come to a new (to them) land name things as well, sometimes using a name that exists locally, and sometimes making up a new one.

This gets us to the real problem with this kind of name – names given by people: they multiply and change, which can cause both ambiguity and confusion – not a bad thing when carefully used by a poet, but not helpful for a computer. For instance, in *The Iliad*, the Greeks are variously called Argives, Danaans, and Achaians; while “son of Atreus” can mean Menelaus or Agamemnon. The most extreme case is found in Old Norse literature.² All of

the gods have name after name. Odin is All-father, One-eyed, Hanged God, High One, Longbeard, Wolf-foe, Wanderer, and Truth-Guesser. Everyday (to the Vikings, anyway) objects and activities can be described with kennings, figurative circumlocutions in the place of an ordinary noun: battle is spear-din, blood is battle-sweat, ravens are the swans of battle, a fishing line is a bait-gallows, etc. They can then cascade almost indefinitely: the heather of the field of cod is seaweed, mead of the swans of battle is blood (again), and the brewer of the mead of the swans of battle is a weapon.³

WHAT MAKES A GOOD IDENTIFIER?

In the non-digital world, several domains have notably successful solutions, including the binomial system for biological naming (e.g. *corvis corax* for raven⁴) and standard bibliographical references for scholarly publications. Both of these venerable systems are making the transition to the digitally-connected world. For a general overview, see Henry Thompson's "Understanding URI ecosystems". For domain-specific approaches, see Richard W. Kroon, et al.'s "The Power and Promise of Identification" and David Patterson, et al.'s "Challenges with using names to link digital biodiversity information".

In our case, we want names that unambiguously identify audio-visual works.⁵ We call this an identifier, and the identified thing is that identifier's referent. For machine-to-machine communication and automation, we can add some further details:⁶

THE IDENTIFIER IS UNIQUE WITHIN ITS CONTEXT

The identifier must be the only identifier for the referent within the context of the identification system. If a referent has two identifiers, they're

no longer useful for determining the sameness of two things. The context is also important. All identifiers exist in a particular domain or scope, and an identifier that means one thing in one domain may mean something else entirely in another. This is especially true for identifiers that are just numbers. “42” is the identifier for *When Harry Met Sally* (1989) in a particular product catalogue, and *Love and Death* (1975) at the Česko-Slovenská filmová database. Identifying the context and domain of the system is critically important. As an historical example, Roman Imperial Coinage⁷ covers coins of the Roman emperors issued by the Roman state; it explicitly excludes provincial coinage.

THE IDENTIFIER HAS THE RIGHT GRANULARITY

This really is a set of decisions about what “the same” means. For example, *Zootropolis* (2016) was released as *Zootopia* in some countries, with only the title changed. People usually think of them as the same movie. However, a marketing manager will think of them as different things. The further away from production something travels, the more likely this is to happen, and to matter. The usual example is *Blade Runner* (1982), which exists as the underlying work itself – the basic intellectual property – and as multiple very different versions: the original theatrical cut, the director’s cut, and the final cut. In broadcast TV, it is not uncommon for the same show to exist with different music because of local licensing issues. The identifier system must either be able to cope with this, or say explicitly that the problem is out of scope. ISBN covers specific editions of books and book-like products; it says nothing about whether the contents of a hard-back edition and a paperback edition are the same or not.⁸ Plato makes the case that the cave-dwellers are naming the shadows, not the objects casting them, which is at its core a granularity problem.

THE IDENTIFIER IS RESOLVABLE

It's all well and good to say "trust the identifier". This happens all the time in retail stores, where shoppers tend not to ask if the barcode on the package of noodles really is the barcode for the package of noodles. However, the retailer almost certainly has a way of getting back to that information, as shown when "package of noodles" is printed on the customer's receipt. Resolving an identifier is how someone gets to the underlying identifying information and metadata for that identifier. Furthermore, the identifier should be resolvable by anyone. (The barcode on the package of noodles can only be resolved by some people.) Since there is no way of knowing how an identifier will show up in the world at large, anyone who finds one should be able to learn what it is identifying. Until recently, this was done with books and printed catalogues, e.g. Linnaeus' *Species Plantarum* and its many successors for botany, or Gifford's *The British Film Catalogue* for British film before 1994. Nowadays, we use the Internet.

THE IDENTIFIER SHOULD LINK TO OTHER IDENTIFIERS

In an ideal world, such an identifier would be the only name we ever needed. We don't live in that kind of world. Films and TV shows already have multiple names (titles, as we saw with *Zootopia*) and identifiers (as we saw with ID 42.) Therefore, a good identifier not only identifies a work unambiguously, but should connect it to other identifier systems as well. This allows discovery of other information, and allows people and systems that use those identifiers to find not just the underlying identifier, but everything that it links to. Not all identifiers are resolvable (many studio and broadcast IDs are not) but they're still useful. Since systems differ in granularity, the linked identifiers should indicate some kind of relationship is possible: "is same as" where the referent really is the same, "is derived

from” or “contains all of” where one referent is clearly not the same as the other but has a close connection, etc. In the non-digital world, people just provided alternate names. The simplest example is a dictionary, saying, e.g. that Livorno (Italian), Legorno (old Italian), Leghorn (archaic English), Liburnus (Latin) are all the same place in Italy.¹

IS THAT ENOUGH?

At a high level, yes. Uniqueness and granularity address Plato’s and Adam’s problem of giving things a name at the right level: the shadow of a horse is not a horse; tigers are different from lions, but they’re both cats; cygnets are baby swans, but still swans. Resolvability and linked identifiers solve the kenning problem of finding the referent and discovering other names: Báleygr, “Flaming-eyed”, is Odin, who is also Blindi, “the blind one”. What then remains is implementing a technical solution based on these ideas.

THE EIDR IDENTIFICATION SYSTEM

EIDR⁹ is a curated, globally-unique identifier system for audio-visual content and content delivery services, operated as part of the Digital Object Identifier^{II} (DOI) family of identifiers (ISO 26324).¹⁰ The EIDR ID registries are, and always have been, read-for-free. Anyone can go to

I. For example, the standard work in Latin place names is J G Th Grässe’s *Orbis Latinus* (1861, most recent revision 1972.) Although this may seem obscure, it is very helpful when reading Medieval sources or deciphering the place of publication of early printed books. It is now available online through the Bavarian State Library.

II. DOIs are digital identifiers of objects, not just identifiers of digital objects. They apply to digital works, but they also apply to abstractions and physical products. If it can be conceived of, it can be identified by a suitable DOI.

the DOI Web site^{III} to resolve an EIDR ID (returning its full descriptive metadata record) or go to the EIDR Web UI^{IV} to search for an EIDR ID based on the associated work’s descriptive metadata.^V EIDR members can also use the EIDR HTTP API, Java SDK, or .NET SDK to integrate their in-house systems with the EIDR Registry for fully-automated workflows. No other global audio-visual identifier system offers this same level of service.

There are two primary types of EIDR IDs (or ID Registries): the EIDR Content ID and the EIDR Video Service ID. The IDs themselves are “opaque” or “dumb” identifiers (e.g., 10.5240/0E8E-C250-E484-9794-A9F2-0 or 10.5239/509E-5F41) – you cannot derive the meaning of an EIDR ID from inspection other than to identify its Registry (ID type) from the included DOI prefix (the ID preamble up to the forward slash “/”).

Each EIDR Registry associates a unique identifier with a record containing metadata to describe the referent object. It would be impossible to collect all descriptive information related to an identified object in one place – there are simply too many data elements and points of view. What is important in one context is distracting in another. Even something as basic as the top billed actors may change with territory and over time as actor popularity waxes and wanes. EIDR’s focus is on identification, not metadata aggregation, so EIDR records contain sufficient descriptive metadata for discovery and determining uniqueness, but no more. Instead, EIDR users can use the associated alternate identifiers to link to disparate data sources to meet their needs, or use the EIDR ID as a key to third party data systems and workflows.^{VI}

III. Or just place “https://doi.org/” in front of a DOI: e.g., converting “10.1000/182” to “https://doi.org/10.1000/182”.

IV. See <https://ui.eidr.org/>.

V. Satisfying Identifier Precept 3: The identifier is resolvable.

VI. See, for example, the EIDR entry for *The Polar Express* (2004).

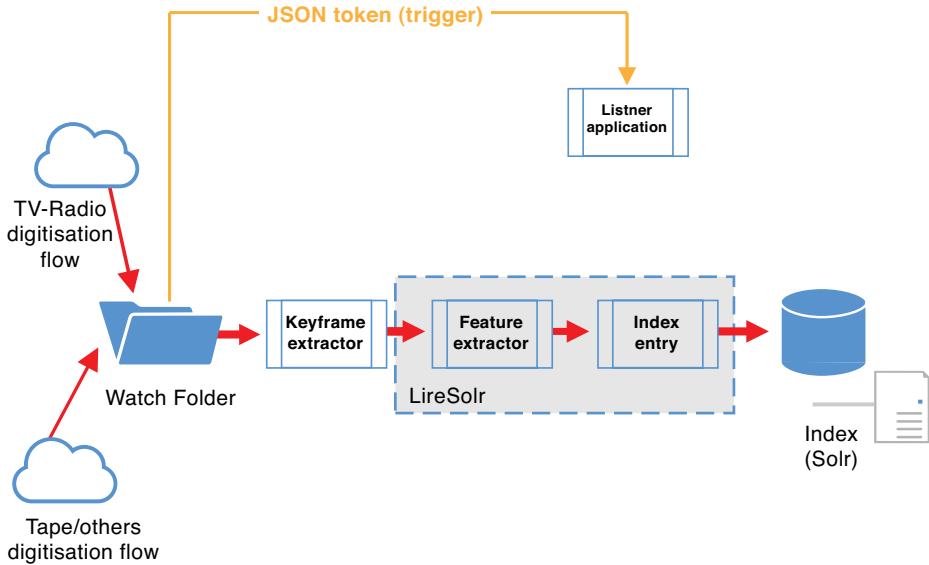


Fig 1. EDR Hierarchical Structure

EIDR CONTENT ID

EIDR Content IDs apply to audio-visual works and related assets. EIDR IDs are to movies, TV programmes, and other audio-visual content much as ISBNs are to books or UPC/EANs are to consumer products. This includes feature films and short subjects, television series and specials, industrials, actualities, first-person historical accounts, educational programmes, and value-added materials (VAM) such as behind-the-scenes featurettes, outtakes, and trailers – all dating back to 1878 and reaching out into the future for works currently in development or production.

Within the EIDR Registry, Content ID records are arranged in a hierarchical “tree” structure starting with an ID for the work in the abstract (sometimes called a “title” record). This Abstraction can have any

number of associated Edit records, each representing a different version or creative cut. Each Edit, in turn, can have any number of child Manifestation records, each representing a different encoding or instantiation of the version (Edit) of the work (Abstraction). EIDR records can also be collected into Compilations, which represent groupings of other records, and associated via Lightweight Relationships, which link related content from different registration trees (e.g., linking a trailer to the film it promotes).^{VII}

For example, Fritz Lang’s *Metropolis* (1927) is identified by the EIDR Content ID 10.5240/B158-B2CA-62BE-C5EF-50DC-2. This represents the work in general. It currently has three Edits, including 10.5240/B4CE-C185-B8A1-6DB4-13A1-H (the original theatrical release), 10.5240/6559-52BC-6A31-29F8-6391-I (Giorgio Moroder’s 1984 restoration), and 10.5240/B727-2847-6C83-0ADA-3202-F (Kino Lorber’s 2010 restoration, billed as “The Complete *Metropolis*” with 25-minutes of previously missing footage). For its part, the Giorgio Moroder Edit has three child Manifestations representing VHS, DVD, and Blu-ray encodings.

Currently, there are more than 2.1 million records in the EIDR Content ID Registry and it is growing with an average of 44 thousand new records each month. The Registry also processes well over 200 million transactions per year, including 60 million metadata queries and more than 100 million EIDR ID resolutions.

In addition to the EIDR Content IDs themselves, the Registry also includes alternate identifiers – third party identifiers associated with the same referent object. There are well over 4 million Alternate IDs in the EIDR Content ID Registry, with some records having more than 50 each.^{VIII} These link to other parties, including the work’s producers or distribu-

VII. Satisfying Identifier Precept 2: The identifier has the right granularity.

VIII. Satisfying Identifier Precept 4: The identifier should link to other identifiers.

tors (using house IDs), data aggregators (IMDb, AlloCiné, etc.), streaming services (Netflix, Google Play, etc.), hard good retailers (Amazon, etc.) and archives (American Film Institute, British Film Institute, Svenska Filminstitutet, Technische Informationsbibliothek, etc.). In most cases, the referent of the alternate identifier is the same as that of the EIDR ID itself, but in other cases, the relationship may not be direct or one-to-one. For these cases, EIDR offers an optional ID Relation to explicitly state how the referents of the two identifiers are related. If the alternate IDs are resolvable on the Internet, then EIDR provides a hyperlink directly to the associated service. For example, the EIDR record for *Fanny and Alexander* (1982) links to (among other things) the Swedish Film Institute's Svensk Filmdata-bas page for that film.^{IX}

To help ensure uniqueness within the EIDR Content ID domain, every update to the EIDR Registry – new record addition or existing record modification – goes through an automated fuzzy match de-duplication review based on the descriptive metadata and alternate identifiers in the EIDR Registry. In cases where the automated service cannot make a definitive determination, the transaction is referred to EIDR Operations for manual review before the final result is returned to the client.^X

EIDR VIDEO SERVICE ID

EIDR Video Service IDs apply to video delivery services, such as traditional linear TV (terrestrial, satellite, or cable TV channels), VOD services, Internet streaming services, etc. These IDs can be used to identify the delivery source for a presentation of a particular piece of content.

IX. See <http://www.svenskfilmdatabas.se/sv/item/?type=film&itemid=5922>.

X. Satisfying Identifier Precept 1: The identifier is unique within its context.

For example, *The Great British Bake Off* (2010—) originally appeared on BBC Two (10.5239/D6B6-4A19) before moving to BBC One (10.5239/A8F1-4A83). When it appears in syndication in the US, it is broadcast by stations in the PBS network (10.5239/66E9-D91F).

EIDR GOVERNANCE

EIDR is a non-profit association with members spanning the globe.^{XI} Commercial members pay annual dues on a sliding scale indexed to their gross revenue, so larger companies pay more than smaller ones. Non-profits, such as universities, archives, and museums, qualify for free EIDR membership under an EIDR outreach program for non-commercial interests.^{XII} All members can use all EIDR services, including unlimited ID registration, without additional charge. Smaller, for-profit companies who do not have sufficient annual output to warrant full EIDR membership can obtain EIDR IDs individually via an EIDR retail registration agency, paying only a transaction fee rather than annual membership dues, so there is an option for every type and size of organization to obtain the EIDR identification services they need.

USING EIDR IDENTIFIERS

The FIAT/IFTA 2017 MAM Survey¹¹ indicates that there was relatively little adoption of globally unique identifiers - less than 10% at the time of the survey, “probably due to the fact that many television archives choose to focus their preservation and access efforts on unique content.” Even

XI. See <http://eidr.org/uam>.

XII. See <https://titleregistrar.com>.

when the content is unique, it is more interesting, more useful, and more relevant when it connects to the world outside the archive.

Very, very few audio-visual works exist entirely in their own silos, isolated from the rest of the world.^{XIII} They may enter into commerce through various channels, in which case using a resolvable unique identifier provides for far more efficient communication than using a title or a non-resolvable private identifier. Metadata can come from external sources either because it already exists or because it is generated by an external process, in which case it needs to be tied back to a particular work or instance – shared identifiers streamline that process.

Identifiers are pointless if they're not used. They're meant to connect people, machines, and processes. As the world grows increasingly connected, this cross-party communication becomes more and more important. Here are some examples of EIDR identifiers as they are used today.

CATALOGUING, ARCHIVES, AND CONNECTIVITY

The most obvious way to use identifiers is as a catalogue index. All institutions already have their own catalogue numbers, so is there any benefit to adding another?

The simple fact of registering things with EIDR provides a different look at your own data. Many registrants discover duplicates in their own systems, misidentified items, and items that are variants on the same work rather than actually being the same. Adding local identifiers to the EIDR record lets others know that you have the work or information

XIII. See Richard W. Kroon's "The Secret to Automating Multi-Party Asset Workflows" for an overview of the limitations of siloed archives and "The Power and Promise of Identifiers", which makes the case for networking archives to deliver universal search.

about the work, even if that identifier is not resolvable, though of course it's better if it is.

For example, the US Library of Congress (LOC) catalogued its holding related to the Watergate hearings under the title Senate Hearings on Campaign Activities – the correct title – with Watergate Hearings as an alternate title, since that's what most people call the events in question. Individual episodes of that Series all have LOC reference numbers as alternate identifiers, connecting them to LOC's in-depth information.

The Library of Congress registered the PBS coverage of the Watergate hearings as part of their mission to make the information they hold more widely available, but broadcasters often register their own works directly. Commercial broadcasters who register their archives often discover that past licensees have already registered the works. Since episodic TV is frequently reordered when it is redistributed, this can cause some confusion, but EIDR allows multiple episodic numbering schemes, each with an identifying domain. *The Adventures of Black Beauty* (1972–1974) is a UK television classic, originally produced by London Weekend Television and broadcast by ITV. It was licensed to Sony Pictures, who registered it with EIDR. ITV later discovered that Sony had reordered some of the episodes. The episodes now have ITV's original episodic numbering and Sony's alternate numbering, with identifiers from both parties. Each episode also has an identifier from the British Film Institute (BFI), which also has information on the show.

Other participants beyond broadcasters, broadcast archives, and national archives can be added into the mix as well. *This Modern Age* (1946–1954) was The Rank Organisation's British-oriented answer to *The March of Time* (1935–1951) from Time, Inc. At the simplest level, identifying it with just the title runs the risk of confusing it with *This Modern Age* (1931), an MGM feature film of the same name. ITV owns most of the Rank catalogue, and registered the episodes that were in its archive. The BFI had data on more episodes, and a more complete record of the

episodic numbering. Finally, the Complete Index to World Film (CITWF)^{XIV} had information on some of the episodes, which it had in its own database as theatrical shorts. Combining the data from all three sources has produced better overall information than any one source had, and opens the way to possible collaboration in the future, for example by re-releasing it with supplemental material from the BFI or CITWF.^{XV}

In all of these cases, having a unique identifier from EIDR makes it possible to identify the works unambiguously and get fuller information.

OBID AND TAXI

The Coalition for Innovative Media Measurement (CIMM) TAXI (Trackable Asset Cross-Platform Identification) initiative began in 2013 with the goal of providing an open, vendor-neutral, universally applicable and economical method for audio-visual audience measurement.¹² That goal was realized in 2018 with the publication of two SMPTE (Society of Motion Picture and Television Engineers) international standards: OBID and OBID-TLC.¹³

OBID

The SMPTE OBID (Open Binding of Identifiers) standard specifies an audio watermark that can be added to audio-visual content to carry an EIDR Content ID^{XVI} in a format that cannot be detected by humans, does

XIV. See <https://www.citwf.com>.

XV. Showing that people's interests change slowly, alongside "Fabrics of the Future" and "The British: Are They Artistic?" you will also find "Will Europe Unite", "Europe's Fisheries in Danger", "Palestine", and "The Future of Scotland."

XVI. Advertisements carry an Ad-ID. See <http://www.ad-id.org>.

not interfere with other watermarks (Nielsen, ATSC 3.0, anti-piracy, etc.), and can be read by a machine in real time – either directly from a video feed or acoustically using a microphone to record the programme’s audio as it plays live. Multiple OBID watermarks can be added to and extracted from the same piece of content. For example, the producer could identify the work originally (with an EIDR Abstraction ID), the distributor could identify a particular version (with an EIDR Edit ID), and the broadcaster or streaming service can identify a particular encoding (with an EIDR Manifestation ID) – all of which can be extracted in about five seconds from the programme as it plays.

OBID-TLC

The SMPTE OBID-TLC (OBID-Time Labels to Content) standard specifies a separate audio watermark that can carry time/date stamps and the EIDR Video Service ID of the presenting channel or playout service. OBID-TLC watermarks are added live during playout. In addition to the original audience measurement applications, there are additional content management, anti-piracy, and process automation use cases enabled by the OBID and OBID-TLC watermarks.

DIGITAL DISTRIBUTION

Automating digital distribution workflows is essential for supply chain efficiency. Identifiers are clearly a part of this – exchanging information based on titles is slow and error-prone and can result in lost sales and unhappy customers (both distributors and consumers.) The publishing industry uses ONIX to represent and communicate product information in the book trade.¹⁴ The music industry uses DDEX, which automates the distri-

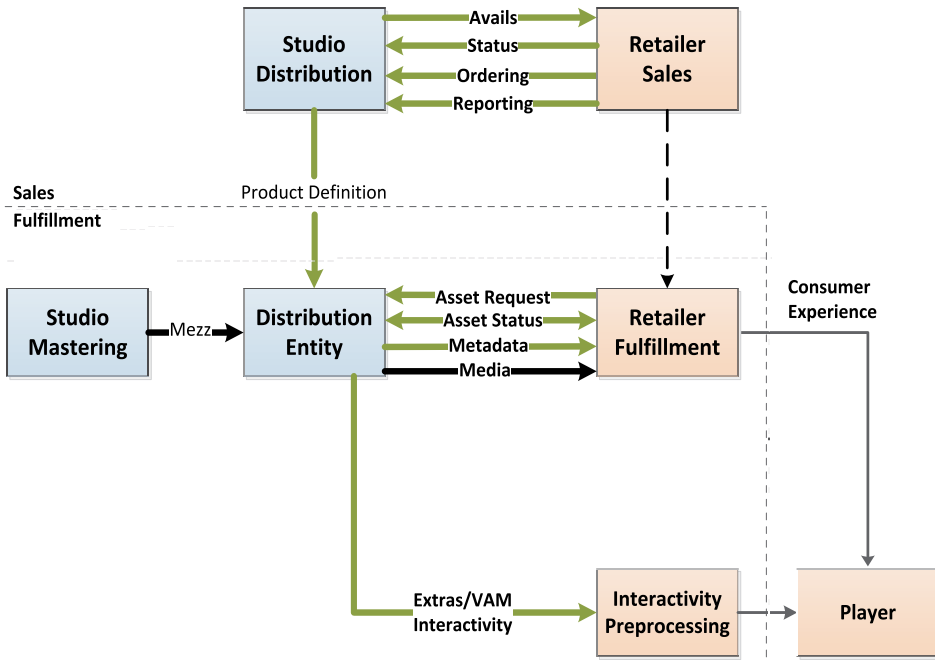


Fig 2. MDDF Ecosystem (Green: MDDF defined; Black: MDDF supported)

bution and reporting of recorded music, making use of the ISRC recording identifier.¹⁵ MovieLabs has developed the MDDF (MovieLabs Digital Distribution Framework) suite of standards to solve the same problems in the film and television industry.¹⁶ It offers unique identification at levels of granularity appropriate to each part of the process (using EIDR), scalable and localisable metadata (based on Common Metadata), precise communication of licensing data, efficient delivery, and support for digital extras. All of these are tied together with appropriate identifiers, with EIDR for the underlying content. It also provides a framework for quality control and a common representation for content ratings in over one hundred different jurisdictions.

Digital distribution is a complex workflow and can only function well with reliable identification and identifiers at all stages of the process.

MDDF has been adopted by large and small content producers and rights holders and by global retailers and digital service providers.^{XVII}

LINKED OPEN DATA AND ONTOLOGIES

Once a network of linked resolvable identifiers exists, it becomes possible to share and discover data across multiple sources. This is commonly called Linked Data (or Linked Open Data, if the data is freely readable and usable by anyone). The formal definition of Linked Open Data (from Tim Berners-Lee) is:¹⁷

1. Use URIs as names [identifiers] for things
2. Use HTTP URIs so that people can look up [resolve] those names.
3. When someone looks up a URI, provide useful information, using standards (RDF, SPARQL)^{XVIII}
4. Include links to other URIs [cross references], so that [people and machines] can discover more things.

This seems like a lot, but it essentially says, “Use resolvable linked identifiers with structured data.” EIDR (and DOI more generally) make most of this relatively straightforward.¹⁸

XVII. See <https://www.citwf.com>.

XVIII. RDF: Resource Description Framework; SPARQL: SPARQL Protocol and RDF Query Language. XVI. Advertisements carry an Ad-ID. See <http://www.ad-id.org>.

1. An EIDR ID is an identifier, and is trivially converted to a URI by prefixing it with “https://doi.org/”
2. EIDR IDs are inherently resolvable
3. Resolving an EIDR ID returns metadata about the underlying referent in human readable and machine readable forms.¹⁹
4. External identifiers can be represented both as a bare identifier and a resolvable one, e.g. 150779587 and <http://collections-search.bfi.org.uk/web/Details/ChoiceFilm-Works/150779587> (if you follow the link, you’ll see that the BFI metadata also includes the EIDR ID.)

What Sir Tim left unsaid is that the data that is returned has to be in some known structure for it to be useful. There are several technical ways to do this, such as an XSD schema for XML data or a JSON schema for JSON data. However, the current best practice is to define an ontology using RDF. An ontology is just a way of structuring types of things, the properties of those things, and the relationships among those things. A simple example would be:

ID XXX is a TV episode
ID XXX is an episode of ID YYY
ID YYY is a Series
ID XXX has director ID ZZZ
ID ZZZ directed ID XXX
ID ZZZ directed ID XYZZY
ID XXX was produced in country ID AAA

The referents of those IDs will themselves have more properties and relationships. RDF is the W3C specification for structuring these definitional frameworks.²⁰

The most complex part of defining an ontology is deciding what things really matter and so must be included, and defining exactly what the terms mean. If the first question is answered too broadly, the over-generality adds complexity that can prevent the use of the ontology. If the second question is answered without great precision, different users of the ontology will have different notions of what the items mean. For instance, in the simple skeletal example given above. “Series” means different things in the US and the UK.^{XIX}

There is significant interest in ontologies in the audio-visual space, from both production companies and archives.²¹ MovieLabs has, with its member studios and their parent companies, developed an ontology for film and television works.²² The starting point was EIDR, for the identifiers and links to other systems, and the data model covers metadata from multiple stages of a work’s lifetime – contributors, revenue, external works the audio-visual work is based on (books, games, etc.), ratings, rankings, and a great deal more. One of the most important features is that the ontology allows every piece of data to be attributed to a source, which starts to address some of the questions of trust, authority, and quality that fully general linked data systems raise.

There have been several implementations using different technologies, but they all use EIDR IDs and the linked identifiers they provide to aggregate data from multiple sources. An early application of this linked data source analysed the difference in genre assignments in different sources, including regional predilections, and used machine learning to find “implied genres” based on explicitly stated ones.

XIX. In the US, the Episodes of a Series are grouped into presentation Seasons (traditionally, one per year starting in the fall and running through the spring of the following year). A US Season is equivalent to a UK Series, giving “series” to entirely different meanings in each territory.

UK COPYRIGHT HUB

The UK Copyright Hub is a non-profit agency that connects rights holders with people who use their content.²³ The underlying mechanism to connect works with rights information is based on projects from the Linked Content Coalition (LCC), EU ARDITO project, and mEDRA (a DOI Registration Agency).²⁴ The content can be identified using an embedded identifier or other means, such as fingerprinting or watermarking. Most of the work has been done with publishers and image libraries, but the technology is sector-agnostic and available to individuals as well as corporate bodies.

A rights statement does not have to imply a monetary transaction. For example, a current project provides an appropriate rights statement for films that are in the public domain; the films are currently identified with an EIDR ID, with support in progress for video signature technology from The Media Institute at UCL.²⁵ Because EIDR IDs contain references to other identifiers, these rights statements can be discovered through those linked identifiers (ISAN, IMDb, and Wikidata, for example).

The same underlying mechanism can be used to direct users of clips to sources for the full content.

LUCID

Most audio-visual content is not cleared for redistribution because determining rights in a work is currently complex and labour intensive. To make more content “rights ready”, the LUCID Rights project uses automation, AI, and machine learning, based on earlier projects, to construct decision trees for determining rights information.²⁶ Among other things, this depends on secure identification of the work and having adequate metadata. EIDR provides the certain identification, and metadata is collected from an implementation of the MovieLabs Creative Works

Ontology that focuses on aggregating contributor data from the external sources referred to in the EIDR records.

ACADEMIC CITATION AND CROSS-REFERENCE

Proper source citation is “the connective tissue of scholarship.” This applies to audio-visual source materials as much as it does to traditional print media. A particular institution may have the only extant copy of a work, but others will view and later cite that work in their own writings and derivative works. This requires proper, unambiguous citation. According to Crossref, a DOI agency that issues identifiers for journal articles, “Citation is not just about credit and rights, but is about pointing at evidence and, increasingly, about ensuring that research is reproducible. In this latter case, it is becoming even more important that the resolution of the citation identifier be precise and machine actionable.”²⁸

For example, the thesis “Celluloid love: audiences and representations of romantic love in late capitalism” by Benjamin de la Pava Velez includes over 100 DOI-based citations from two different ID Registries: Crossref for academic papers and EIDR for motion pictures.²⁹ By including DOIs in the citations, readers can immediately reference the source material in a way not possible before. Crossref also offers a “cited-by” service that reports the number of times an article has been referenced by other authors, which can be used to measure the impact and reach of a piece of scholarship.³⁰

EIDR IDs can also be used to associate an audio-visual work with its related assets, so a movie can be tied to viewable copies of the work, its screenplay, production artefacts, advertising ephemera, reviews, etc. Institutions can include EIDR IDs in their catalogues for assets held in their collections or those that are no longer extant. This can lead to inter-archive universal search, allowing users to locate the objects they require re-

EIDR AND THE FOUR PRINCIPLES OF IDENTIFICATION				
	Uniqueness	Granularity	Resolvability	Linked identifiers
Cataloguing, Archives and Connectivity	Required Required	Required	Required	Required
Audience Measurement	Required	Required	Required for auditability	Simplifies integration with other systems
Digital Distribution	Required	Required	Required for auditability	Simplifies integration with other systems
Linked Data and Ontologies	Required	Required	Required	Required
Rights Declaration	Required	Required	Required	Extends capabilities
Rights Determination	Required	Required	Required	Required
Citation and Cross-Reference	Required	Required	Required	Extends capabilities

Fig 3. EIDR and the four principles of identification

ardless of where they may be held. As an example, the BFI holds material related to *A Christmas Carol* (1984), including the script, and *I, Claudius* (1976) including the 2" quad master and original and retrospective reviews of the series, all of which can be discovered by following the linked BFI identifier in EIDR.

CONCLUSION

EIDR provides a technical solution to the four principles of identification for the audio-visual sector. The applications above rely on its adherence to the first three principles, and rely on or gain significant benefits from its implementation of the fourth.

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WHAT GOOD ARE IDENTIFIERS ANYWAY?



AUTHOR: **HENRIK JOHANSSON**
COMPANY: **SVT, SWEDEN**

Henrik Johansson has been working at SVT (Sveriges Television AB) since late 2017. Upon joining SVT, his first role was as a metadata strategist and team manager. In 2018 he became the Head of the Archive and Rights department. 2018 also saw the development of one particular project, "A Searchable SVT", which would enable the audience to navigate through SVT's online material and Henrik has been heavily involved in the project.

Before SVT, Henrik was Director of Copyright Operations at ICE (International Copyright Enterprise), a company that serves several copyright organisations within the music business with database and metadata administration.

15 A SEARCHABLE SVT

SVT IS THE Swedish Public Service Broadcaster and its archive department was established in 1958. Since then SVT has seen many projects and changes. 2018 saw the development of one particular project, "A Searchable SVT", the name of which refers to the possibilities of navigating through SVTs online material from the perspective of the audience.

The project group was put together by two senior business developers and consisted of four individuals representing the Archive, SVT Play (our main online platform), IT and a project manager. The task, "do something to improve how we work on metadata", was quite vague and unclear in the beginning. The state of confusion was probably increased because three of the project members, including myself, had more or less just started at SVT. The plan from the business developers was that they wanted to grasp the moment when new people started in key roles to get them together

working with metadata. So, without much further instruction, it was up to us to find something useful to do with the project. We already knew by now that there was no budget for this project, we couldn't do any big technical changes and definitely not build anything new. From the beginning we had to focus on developing and optimizing our processes.

CAST AND CREW

We started to study old use cases and also collecting a lot of new ones while talking to people from all around SVT. We got stuck on two main things. The first was that when publishing our productions on our online platforms we were often missing out on information about cast and crew, which of course has a negative impact on searchability. At the same time, one of the big unions for film and television employees in Sweden was putting pressure on SVT to improve the way their members were credited online. If these two matters were not enough incitement, we were also aware of some complaints about how the recommendation engine at SVT Play worked and we understood that its lack of performance was due to the lack of metadata (like cast and crew).

Regarding SVT's own productions, we have always stored information about cast and crew in our archive system, but not for acquisitions. In a broadcast world there was less use for metadata when we didn't have the long-term rights.

We started to look into the situation with our own productions to see how we could use the information from the archive system to fill the needs for the online platforms. We soon understood that the technical part of it was quite easy, e.g. we could do it without asking for money. The problem was that these metadata processes have only been used in archive purposes for the last 60 years and were based on data being added after a production is broadcast/published. The SVT process looks like this

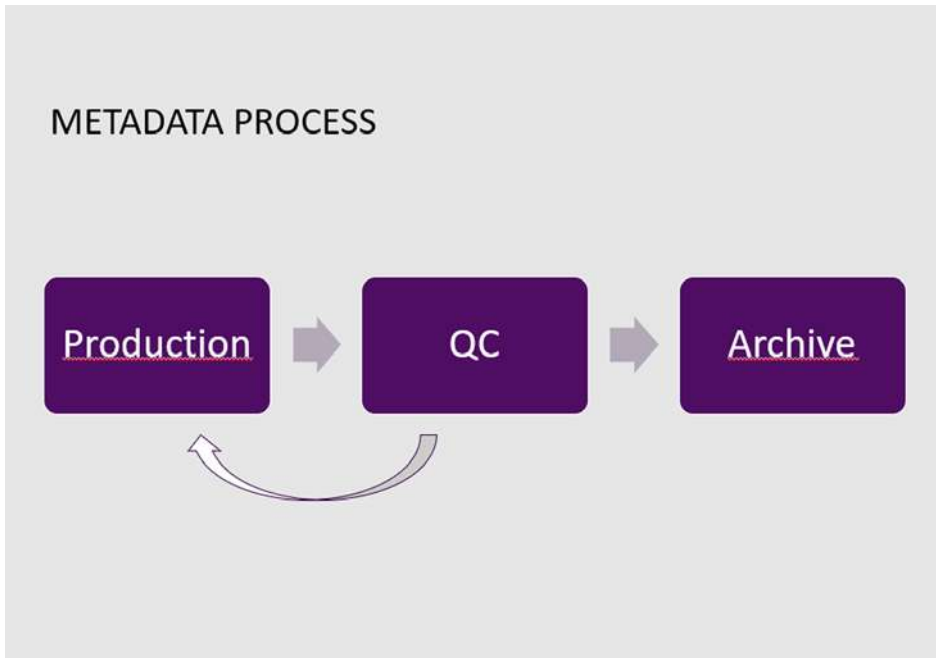


Fig 1. The production themselves are responsible for adding metadata. A group at the archive department carries out quality checks.

To be able to obtain this metadata before publishing, we had to change the process. For acquisitions this would be a completely new task. One of our project members was the Head of the SVT Play publishing team so she started to talk to a selection of productions (drama and fiction) and acquisitions and tried to convince them about the benefits of inputting metadata earlier in the production chain. I had just been at SVT for 6-10 months by this time and had heard stories from my department, the archive, that there were examples of metadata requests dating back ten years with no reply, so I was more than surprised when it turned out that everybody was really keen to deliver this data. The difference in engagement and a willingness to provide publishing metadata versus archiving metadata was significant. When it is about reaching a larger audience, the productions immediately prioritised these tasks and the accompanying process change went really smoothly.

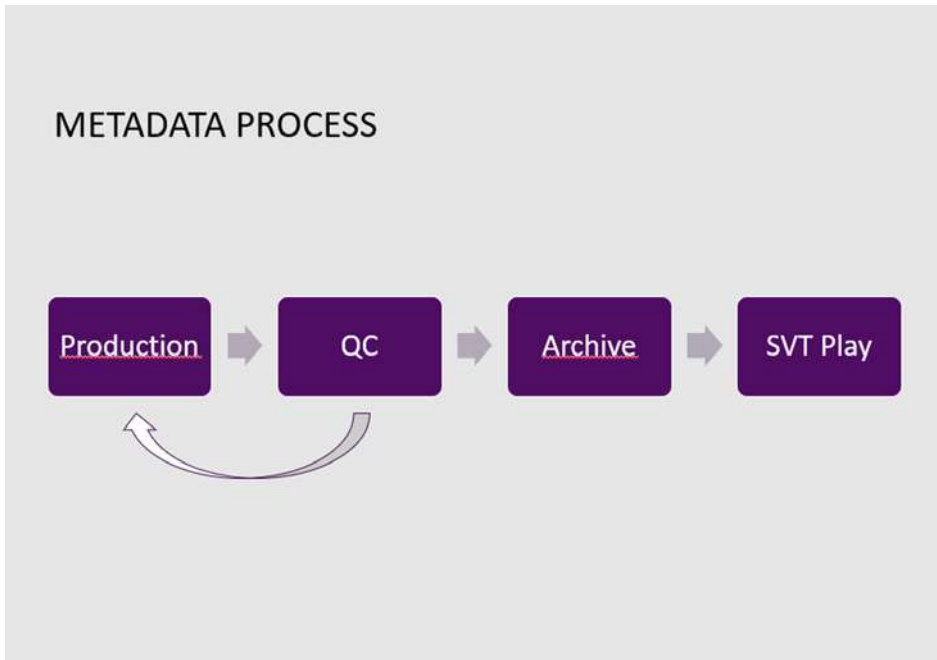


Fig 2. The archive is taking place in the production chain.

The small technical changes and the quite large process changes that were carried out involved around twenty different teams and functions, covering everything from production, publishing, archive, legal, I.T. etc. Due to the number of people involved, all using the same metadata, it took quite a long time to implement this, but it was a very useful insight into how many people are affected by the flows of metadata. It became very clear for everybody involved that this is not something that only concerns the archive. Figure 2 shows how the metadata flow now looks for the productions involved in the project.

For older productions and re-runs we also had to check the quality because these metadata fields were never intended to be used for publishing. Unfortunately the field for middle name had been used for notes like “deceased” and ”hard to work with” and that had to be removed before publishing.

It's also worth mentioning that all cast and crew is not displayed on the online platforms. It's only the ones considered out of "public interest" (a tick box in the archive system) and for now it's only when you look at the specific shows through a browser.

DESCRIPTION TEXT

As part of the project we also investigated the description texts. These texts are created by our communication departments and if needed, depending on time, are amended by the SVT Play department. The reason for this is that the communication department are the main receivers of the newspapers, TV-guides and similar online sites and the needs for online publishing sometimes differs. For example, a TV-guide description often starts with episode number and title and sometimes even consists of information about re-run dates. On our online platform, episode and title information is placed in a separate field which makes the same information in the text redundant. Also, information about re-runs may not be suitable or even relevant for an online publication.

What we did here was to put people from the communications department in the same room as the ones working with online publishing and together with the administrator for the planning system where this meta-data lives, we could apply a simple update to the system. Now they can put in one description for the traditional TV-guide/broadcast version and another description without episode, titles and other irrelevant information to be used for the online platforms.

The lesson learned here is that we should talk more to each other across the different departments. This was a quick fix that had been waiting to happen for many years.

SIDE EFFECTS

Due to the change in timeline for metadata, further development also needs to take place. We are now about to start to implement a CMS for the Program Reception that manages quality control of metadata. Right now, everybody in the group has their own productions that they control and their individual work plans in an excel sheet. When we need to take deadlines into consideration we must be more transparent and less dependent on the individual. Metadata for publication can't wait if somebody is sick or on holiday, which has often been the case for archiving.

Another system that has already been developed and implemented as a result of the project is something we call "The Cred". This is an application that makes it easier to apply cast and crew to the archive system. The application was developed for the program acquisition department, but there are already plans to develop it further.

The interest for different forms of metadata tags are really on the rise at SVT right now and actually have been for quite some time. Right now, there is a new project looking into what kind of metadata we need for publishing purposes and what data we could use that already exists in the archive.

SUMMARY

To summarise, I would say that we already knew that there was a lot of potential to improve how we use metadata for publishing purposes, but both during and after the project we constantly perceived new opportunities, both internal and external, around areas such as navigation and automation. The best, and the worst thing with this is that we also learned how many teams and functions at our company are involved with, and directly affected by, the same metadata flow. The benefit of this is that we

have learned to collaborate more, and it also minimises the risk of getting something right in one end, but wrong in the other. The downside of it is that it's quite complicated and time-consuming. It is always easier if there is just one owner who can provide the solution and changes themselves. .

Even though there will be a lot of new processes and requirements for metadata with online publishing, it's also a very good opportunity for the archive not only to get better data, but to get it faster as well. The status of metadata is, as all of you already know, on the rise, and it's our responsibility to grasp the moment and make sure that the archives also benefit from it.



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COMPANY: **NHK, JAPAN**

Hirokazu Arai is an Engineer and part of the System Planning Group of NHK Archives. He joined NHK in 1999 after graduating in electronics. From 2003 to 2014 he worked in the Engineering Administration Department where he oversaw the development of the news production equipment and content delivery infrastructure.

Hirokazu joined NHK Archives in 2014 and as NHK Archives have continued to evolve he has been heavily involved in planning the future archive system to ensure the safekeeping of over 1 million hours of video and audio assets which have been produced over the last 90 years.

16 SOPHISTICATED 4K AND 8K WORKFLOW

ESTABLISHING WORKFLOW – THROUGH THE CASES OF NHK

NHK STARTED 8K test broadcasting in August 2016, and practical 4K and 8K broadcasting in December 2018. And we also plan to broadcast the Tokyo Olympic games in 4K and 8K. To address these issues, we have been working to preserve 4K and 8K from the start of test broadcasting. At the beginning the priority was given to preservation, footages were recorded in the LTO and stored on shelves as a temporary measure.

More recently, we have been considering the system requirements and solutions for preserving 4K and 8K online in the MAM. It turns out that there are other challenges besides extremely large file sizes. The actual online preservation of 4K and 8K in the MAM is scheduled to start this October. In this document, I will explain these issues and how NHK plans to solve them.

OVERVIEW OF NHK'S 4K AND 8K BROADCASTING

After 2 years of trial broadcasting since 2016, NHK started practical broadcasting of BS4K and BS8K last December. BS4K broadcasts 18 hours from 6 AM to 12 PM, and BS8K broadcasts 12 hours from 10 AM to 10 PM. More than 90% of the broadcasting time on BS4K channel is with 4K, which do not include programmes upconverted from 2K, and more than 60% of the broadcasting time on BS8K channel is with 8K quality programmes. Currently 700,000 receivers were shipped to Japanese market and NHK also broadcast a 30-minute live news programme once a week. As the real-time contribution network for 4K and 8K has not yet been introduced, this programme focuses on studio commentary and in-depth reports rather than breaking news.

DIFFERENCE BETWEEN 4K, 8K AND 2K WORKFLOWS.

In the 2K era, including the tape and file-based era, camera recording, studio recording, editing, and playout were basically operated in the same format and media. However, the workflow for 4k and 8k is very different.

4K AND 8K WORKFLOWS (SHOOTING AND RECORDING)

As master files for playout, we use files with much higher bit rates than 2K, such as AVC-I 1800Mbps for 8K and XAVC 600Mbps for 4K.

COLOUR GRADING

However, in 4K and 8K, it is common to perform colour grading to take

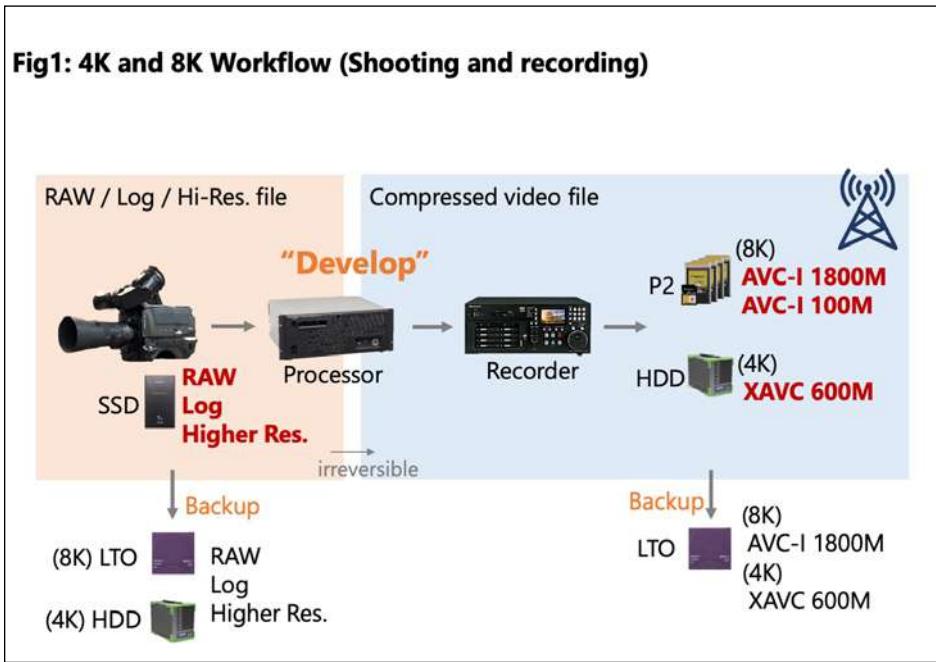


Fig 1. 4K and 8K Workflow (Shooting and recording)

advantage of the highest quality, which is 4K and 8K’s most important feature, and to realise various image expressions. Colour grading was common in the field of film but has rarely been made in the field of broadcasting. Given that we do colour grading, even these bit rates are not sufficient. Therefore, to perform advanced editing, it is important to secure files such as RAW and log files that can hold a lot of information during shooting and enable various image expressions.

HIGH RESOLUTION FILE FORMATS

RAW is a format in which the camera retains the quantized information, resulting in a larger file size. RAW files must be converted to video files at

some stage for editing via a process called "development". This process is irreversible.

Because these high-resolution files have very high bit rates, they require semiconductor memory, such as SSD, for fast transfer speeds, as the camera's storage media. However, because these are very expensive, it is not practical to preserve on these for a long time. In fact, on location, after we finish our shooting and return to the hotel, the video engineer works through the night to backup to other media such as LTO.

WHY WE NEED RAW AND LOG FILES: COLOUR GAMUT

In figure 2 the coloured palette indicates the range of colors that can be perceived by the human eye, but while 2K TV covers the triangle labeled Rec. 709, 4K and 8K TV can use the triangle colour gamut labeled Rec. 2020 in addition to Rec. 709.

This makes it possible to reproduce vivid colours in 4K and 8K that are closer to the way humans see and feel nature than in 2K.

HDR (HIGH DYNAMIC RESOLUTION)

HDR can express brightness several times higher than SDR (Standard Dynamic Range), and adds a new attraction to image expression, for example, it can express shades of white clouds floating in the blue sky.

RAW AND LOG FILES

To fully present such expressive power in broadcasting, it is important to have a file such as RAW that holds the information captured by the cam-

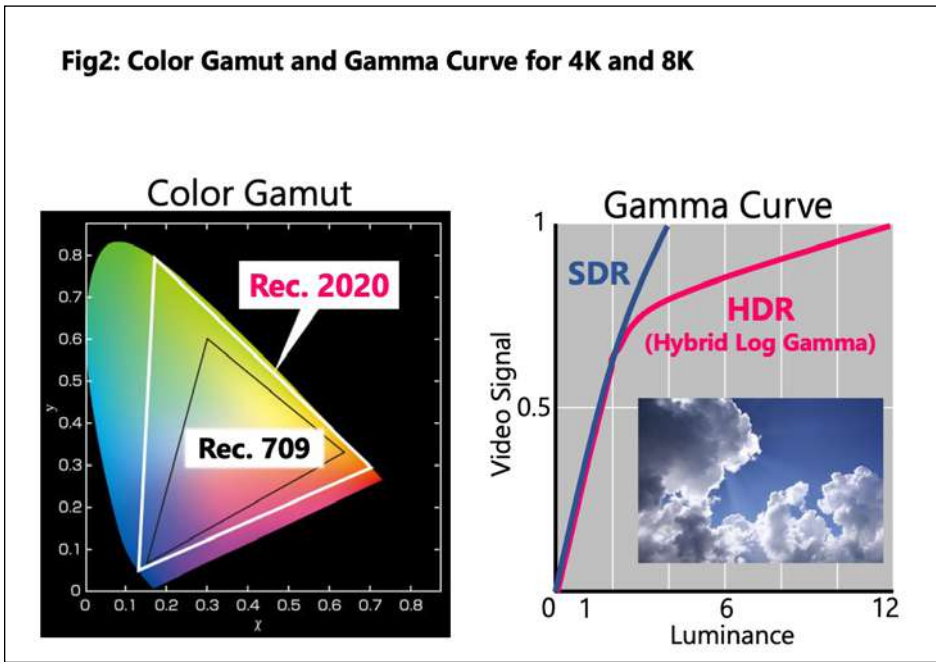


Fig 2. Color Gamut and Gamma Curve for 4K and 8K

era. But that doesn't mean we can blindly increase the number of quantization bits. To express a wider colour gamut or luminance range with a limited number of bits, quantization must be performed efficiently. For this reason, it is common to use gamma curves such as these logarithms rather than linear ones, which finely quantize dark areas where the human eye is sensitive and coarsely quantized bright areas.

To maximize the camera's capabilities, a video file recorded based on a certain gamma curve is called a log file. Since these log files greatly influence the characteristics of the camera, there are various formats such as Sony's S-log and Canon's C-log, each of which has its own unique colour expression. Even today, the number of formats is increasing. These advances are so rapid that some formats may no longer be available.

One of the HDR's standardised methods, the HLG (Hybrid Log Gam-

Fig3: 4K & 8K compatibility with 2K in various standards

	Rec.2020	Rec.709
HDR	×	×
SDR	×	✓

4K NEWS

Fig 3. 4K & 8K compatibility with 2K in various standards

ma) method, was jointly developed by BBC and NHK.

INTERCHANGEABILITY PROBLEM IN 4K, 8K AND 2K

4K and 8K can handle four standards for production and delivery, for luminance, and colour representation (see Figure 3). In 2K only Rec. 709 and SDR is available. For this reason, 4K and 8K is attractive because it offers more freedom in image expression than 2K. On the other hand, new tasks such as colour management and brightness management are added, and editing takes more time and costs.

LUT (LOOK UP TABLE)

To convert this variety of colour information and luminance, for example, to simply convert from HDR to SDR, or to give footage a special representation, we can use a table called a LUT.

However, these transformations are not without question. This means that conversions from HDR to SDR and from Rec. 2020 to Rec. 709 cannot be performed with mechanically uniform parameters.

For example, if we convert an image with a colour gamut of Rec. 2020 to Rec. 709, a simple conversion will not achieve the intended effects of the producer, such as making the natural scenery look more vivid or making the human skin colour look richer. The same is true when converting HDR to SDR.

It is difficult to mechanically produce 2K images of Rec. 709, SDR if they are produced in Rec. 2020 and/or HDR standards, so experts who can manage colour need to do this conversion.

For log files recorded with the camera, colour management specialists called colourists perform colour grading work on each cut to create a colour representation that matches the program concept.

Because of these conversion issues, NHK shoots 4K news in Rec. 709 and SDR format which is the same as 2K. This allows for a mechanical, uniform conversion between 2K and 4K. (By improving the camera's performance, we can feel the beauty of the image even when we watch them on 2K.)

CURRENT EDITING WORKFLOW IN 4K

Normally, a 4K video file is brought to the editing room on a hard disk. Today, there are many editors that support 4K online editing. Editing is generally carried out in a higher quality file format than the playout format to take advantage of its high quality. After editing, the video is exported to the hard disk

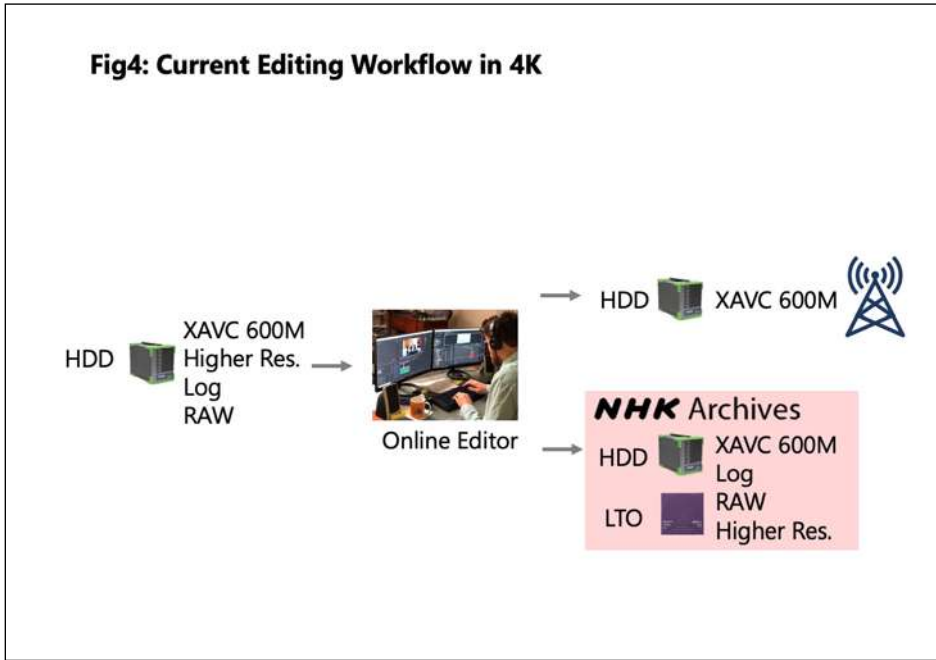


Fig 4. Current Editing Workflow in 4K

for playout, or to the hard disk or LTO for archiving. If necessary, we export clip files such as log, RAW, or higher resolution files for re-editing. NHK has a policy to usually keep XAVC 600M along with any kind of higher resolution files, to improve the convenience of handling in the archives.

CURRENT EDITING WORKFLOW IN 8K

In 8K editing, the high-resolution image output from the camera is processed and exported to the P2 card as AVC-I 1800M and AVC-I 100M ("development"). The AVC-I 100M file is identical to the 2K preservation format but is also used as an 8K proxy file. And, if the LTO contains 8K files due to backup or archiving, we have to export them to a P2 card for playback or editing.



Fig 5. Current Editing Workflow in 8K

We perform 8K editing by online or offline editing and write out to AVC-I 1800 M file on P2 card for playout. We also write AVC-I 1800 M and AVC-I 100 M to LTO for archiving. Currently we don't have appropriate media for 8K and MAM cannot reasonably afford its file size, so for the time being we record the contents on P2 cards in the LTO and store them on shelves. A major problem with 8K is that it takes a lot of time to export to other media and mount files on the editing machine.

WHICH MEDIA AND FORMAT SHOULD BE PRESERVED?

Silicon storage, such as P2 cards, has enough transfer speed to read and write 4K and 8K files, but it is not suitable for long term storage because

Fig6: Which media and format should be preserved?






		Semiconductor memory Expensive, not suitable for storage
	RAW Log Higher Res.	Essential for advanced editing Large file size Not universal
	AVC-I 1800M	8K playout format Not suitable for advanced editing
	XAVC 600M	4K playout format Not suitable for advanced editing
	AVC-I 100M	Proxy file 2K preservation format Used for archives and offline editor

Fig 6. Which media and format should be preserved?

it costs several thousand dollars for a set. Therefore, it should be written to LTO or HDD.

Log, RAW, and higher resolution files are required for advanced editing, but they are still too large to be preserved in the MAM. Also, because there are various formats depending on the camera, it is hard to say that it is universal, and it cannot be played immediately. New formats are being created every day.

AVC-I 1800M and XAVC 600M are 8K and 4K playout formats. NHK aims to preserve the playout file without superimpositions. We call it a “clean” picture, in these formats.

The AVC-I 100M is both a 2K preservation format and a proxy file. We need this file for archive systems and offline editing.

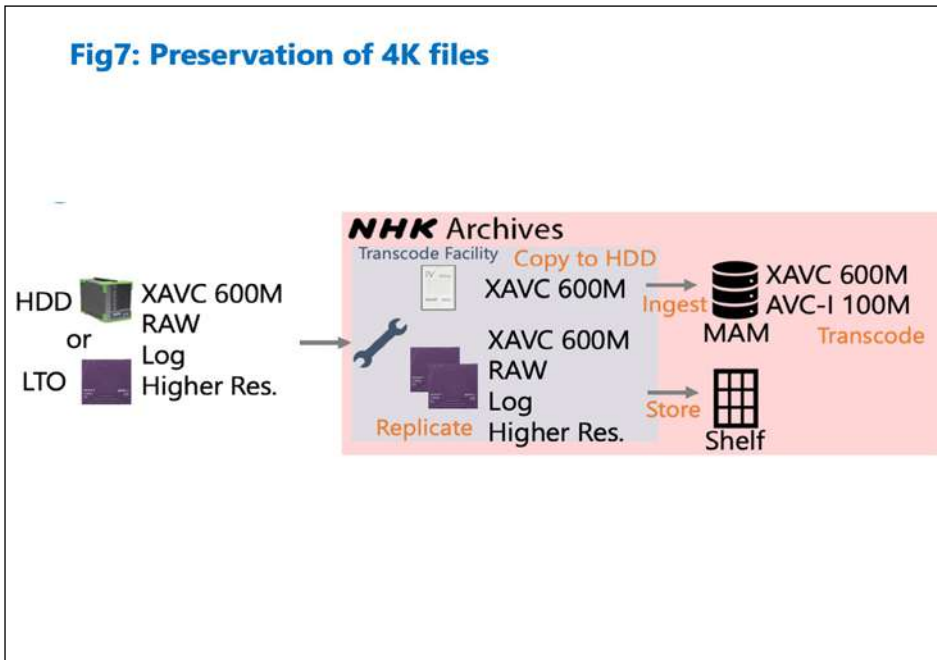


Fig 7. Preservation of 4K files

REQUIREMENTS SET:

How we should preserve and provide 4K and 8K contents

- If possible, we want to preserve them online.
- We must preserve playout and “clean” files.
- We must also preserve unedited materials if needed.
- We need to preserve higher quality files for re-editing.
- We have to provide them without taking too much time.
- We need to be able to provide downconverted 2K files.
- We should be able to watch 8K content with proxy video.
- We want to manage and use metadata on the same platform as 2K.

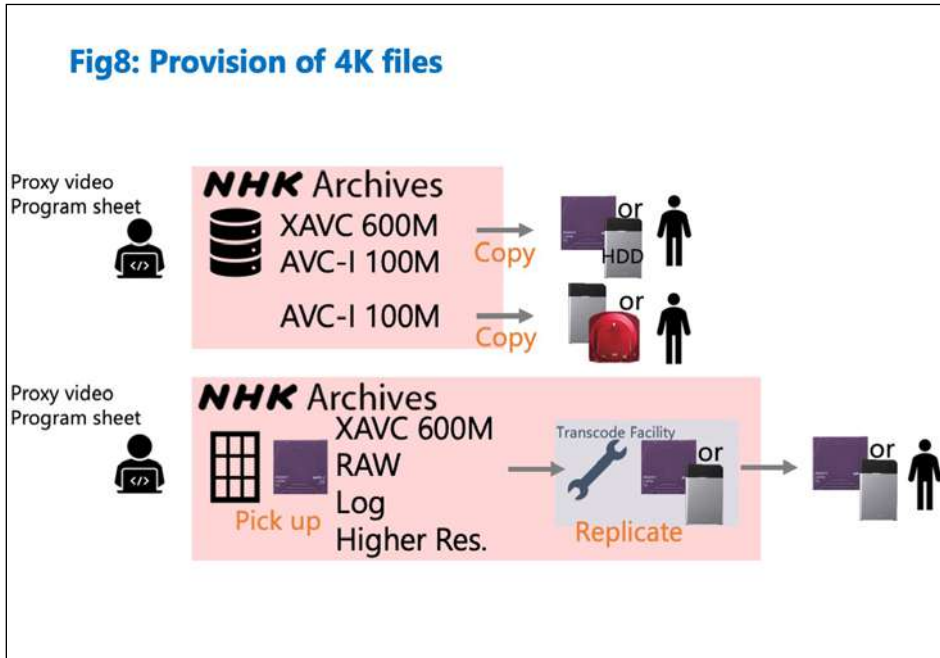


Fig 8. Provision of 4K files

NHK'S DECISION: PRESERVATION AND PROVISION OF 4K CONTENTS

Layout, Clean, and unedited files will be stored on HDD or LTO with XAVC 600M and brought to NHK Archives. They are copied once to HDD and ingested into the MAM. XAVC 600M files are transcoded in the MAM to produce AVC-I 100M files. This allows 4K content to be managed on the same platform as 2K, including video playback, programme sheets, rights management, and so on.

RAW, log, and other higher resolution files have larger file sizes, will be used less frequently as they are not universal files, so we decided to continue copying them to the primary and secondary LTOs and storing them on shelves.

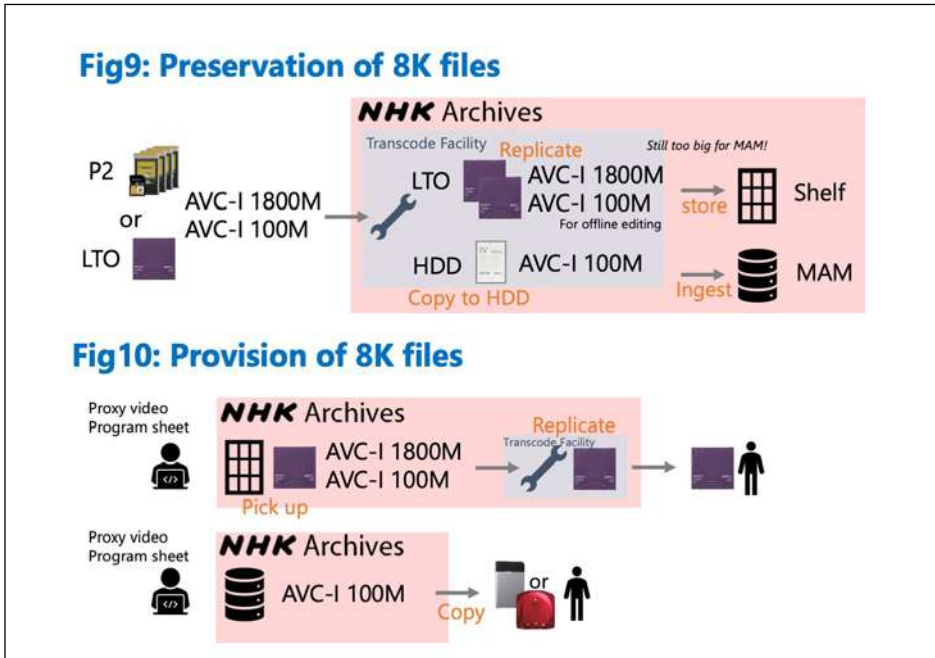


Fig 9-10. Preservation and provision of 8K files

NHK’S DECISION: PRESERVATION AND PROVISION OF 8K CONTENTS

Regarding how to preserve and provide 8K files, we think that 8K video files are still too large to be preserved online in the MAM and take too long to provide. That's why we decided to copy the media to the primary and secondary LTOs. However, it is necessary to be able to watch the contents with the video. So, we ask users to bring AVC-I 1800M and AVC-I 100M on their P2 cards or LTOs and we copy both files to the duplicate LTOs for offline editing. The MAM preserves only the AVC-I 100M, and that allows 8K to be managed on the same platform as 2K content.

We can order 8K contents after watching the proxy file and after replication we can receive the LTO. And we can also order downconverted 2K video file.

FRAME RATE DIFFERENCE

The 4K8K has a larger screen with better resolution, and a shorter viewing distance designed to enhance the viewer's immersive experience. So, we need to make the movement of the object appear smoother. Therefore, BS4K supports frame rates of 30P and 60P, and BS8K supports frame rates of 120P in addition to these.

As we designed the workflow to handle 4K and 8K content on a 2K platform, we needed to absorb these frame-rate differences, for example in programme sheets and in connection with newsrooms creating 4K news with 60P.

SHOULD WE BE READY FOR IMF (INTEROPERABLE MASTERING FORMAT)?

Recently, the IMF (Interoperable Mastering Format) has become a hot topic. The IMF is a standardised format that aims to make it easy and efficient for broadcasters, studios, and distributors to exchange contents. Netflix is the best known service to acquire with this format.

Large international studios often produce more than 30 versions including multilingual versions and sometimes for multiple devices. It is time-consuming to complete each version, so they think they can handle this more efficiently by reconfiguring it in the form of "Parts" and "design drawing". If we adopt IMF, we may be able to preserve fewer files and improve efficiency and convenience.

In the case of NHK, there are not many cases in which multiple versions are produced, so we will have to keep a close eye on whether it is necessary to create a system where we can exchange IMF or whether we should preserve these kind of files.

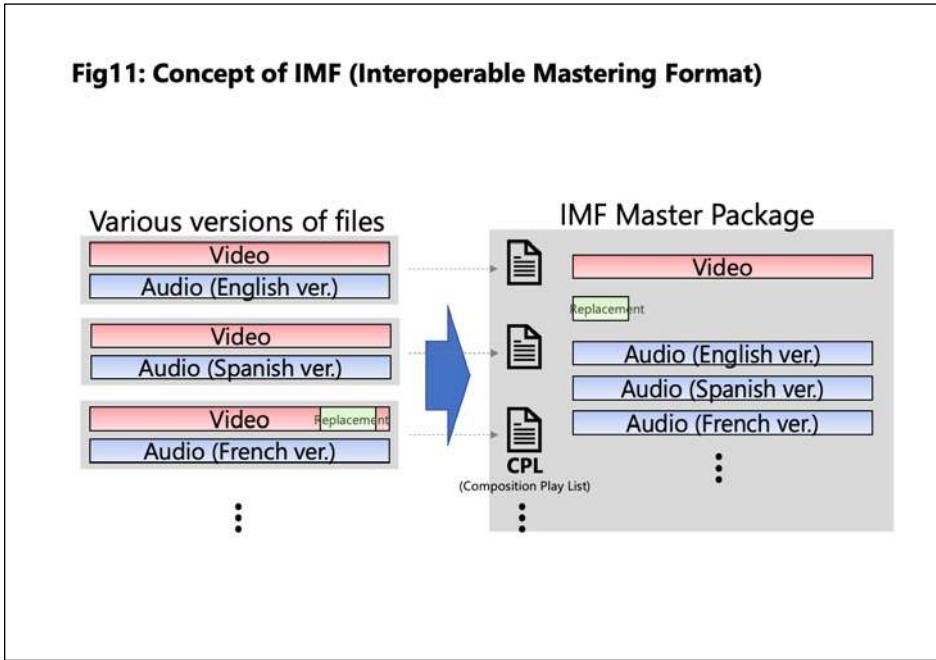


Fig 11. Concept of IMF (Interoperable Mastering Format)

CONCLUSION

As we have seen, the production style is quite different between 4K, 8K and 2K. It may be due to the difference in expressiveness as well as the current technical limitations. In these workflows, we also have to use different media based on the nature of the media. I hope there will be a medium like XDCAM that will be reasonable, fast in transfer rate and can work through all workflows.

Although 4K and 8K are in a transitional situation, they are expected to spread in the near future. We need to keep a close eye on future trends.



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17 AVMSD CHALLENGES AND OPPORTUNITIES

WHAT ARE THE TECHNICAL CONSEQUENCES OF THE NEW EU AUDIOVISUAL MEDIA SERVICES DIRECTIVE ON AV ARCHIVES?

IN THE PAST decade, the audiovisual market faced tremendous transformation in the creation, distribution and consumption of content, technical developments, services and user experience. Bringing the legal framework up-to-date was necessary to catch up with market developments, to ensure adequate consumer protection and a level playing field between new and traditional stakeholders. The revision of the Directive was announced as one of the priorities in the European Digital Single Market¹ strategy. The revised version was finalised in late 2018 and will have to be transposed into national laws of the Member states within 21 months.

The Commission set a series of goals while adapting the legal framework for the 21st century. Thus, the main changes in the Audiovisual Media Service directive address the following issues:

1. <https://ec.europa.eu/digital-single-market/en/policies/shaping-digital-single-marketX>

- providing rules to shape technological developments
- creating a level playing field for emerging audiovisual media
- preserving cultural diversity
- protecting children and consumers
- safeguarding media pluralism
- combating racial and religious hatred
- guaranteeing the independence of national media regulators

This article will offer an overview of the evolution in the European regulatory framework presenting a particular interest for archive content, resulting from the core modifications of the AVMS directive.

HISTORY AND CONTEXT

Through the 1980's Europe has seen important developments in broadcast technology allowing for a cross-country reception, leading to an increased number of commercial broadcasters in the Union. Council Directive 89/552/EEC, known as the Television without Frontiers Directive (TWF) was adopted in 1989, as a common standard in audiovisual media regulation was required. The goal of the European Union (European Community back in the day) was to ensure minimum harmonisation of broadcasting regulations through Europe that would permit free circulation through the union of television services and content, with the aim of achieving a single market in the broadcasting sector. Nevertheless, minimum harmonisation entails the possibility for a member state to impose stricter rules if deemed necessary in national context. The directive was amended in 1997 to adapt the regulatory framework to developments in the audiovisual industry (inclusion, for instance of practices such as tele-shopping, stronger rules for the protection of minors and promotion of European works). This first revision established the Country of Origin

principle, a cornerstone of the directive to this day: the country of reception cannot prevent the transmission of content nor impose its own rules if the broadcaster targeting its territory complies with the legislation of the country of establishment.

In the beginning of the 21st century, technological developments brought additional significant transformations to the audiovisual market, notably the increasing competition of on-demand services. The second review of the TWF directive was launched in 2003 to adjust the regulatory framework to the new technological environment in transmission of content. This revision resulted in the Audiovisual Media Service directive in 2007, codified in 2010. To ensure a level playing field for all services, in accordance with the principle of technological neutrality, the scope of the 2007 directive was extended to on-demand services. Nevertheless, those services were subject to a “light-touch” regulatory framework, considering their emergent status at the time, and the stronger degree of control by the user. On-demand services were to comply with a minimum set of rules, including requirements regarding promotion of European content. Article 13 of the directive introduced the obligation to ensure, "where practicable and by appropriate means, the production and access to European works"², by contributing financially to production or rights acquisition of those works and guaranteeing a share and/or prominence of those works in their catalogues.

The past decade has seen an even stronger convergence between television and the internet, and the impact of on-demand services grew considerably. Consumer behaviour has drastically evolved with the development of OTT services and video-sharing platforms. The regulatory framework had to be adapted again. The European Commission initiated the third revision of the directive in 2013, and the final version of the revised AVMS

2. <https://ec.europa.eu/digital-single-market/en/policies/shaping-digital-single-marketX>

Directive was formally adopted on November 14th, 2018. It was officially enforced on December 18th, 2018 and must be transposed into national law by Member States by September 18th, 2021.

THE 2018 REVISION: THE SCOPE

The revised version of the directive preserves the core principles: minimum harmonisation, country of origin (with a twist), and technological neutrality. Considering the degree of choice and user control over services, the AVMSD still makes a distinction between linear (television broadcasts) and non-linear (on-demand) services. However, the latter are now subject to stricter rules in order to improve the level-playing field. Another important evolution in the framework is the inclusion in the scope of the directive of video-sharing platforms. Strengthened obligations regarding accessibility of services to people with a visual or hearing disability, protection of minors and a revision to a certain extent of rules of commercial communication are further key modifications in the directive.

The directive slightly amends the definition of Audiovisual Media Services. While including both linear and non-linear services, the changes now allow the possibility for a catalogue of programmes that is part of a different service to qualify as an audiovisual media service provided that it fulfills the following criteria: an economic service in the meaning of Art 56 and 57 of the Treaty on the Functioning of the European Union, “where the principal purpose of the service or a dissociable section thereof is devoted to providing programmes, under the editorial responsibility of a media service provider, to the general public, in order to inform, entertain or educate, by means of electronic communications networks”. A catalogue of news video on newspaper sites, for instance, may be subject to the directive if they fulfill the rest of the criteria.

VIDEO-SHARING PLATFORMS

For the first time, video-sharing platforms are covered to a certain extent by the revised directive. The definition given in the directive is that of a services or a dissociable section of a service whose “essential functionality is devoted to providing programmes, user generated videos, or both, to the general public, for which the video-sharing platform provider does not have editorial responsibility, in order to inform, entertain or educate, by means of electronic communications networks.” The necessity of the inclusion of social media used to share audiovisual content is mentioned in the recitals of the directive, as they “compete for the same audiences and revenues as audiovisual media services”³. The audiovisual content shared on those platforms may thus be included in the scope of the directive.

The Commission will issue guidelines on detailed definition and practical implementation of the criterion of essential functionality. The text does recognise the lack of editorial responsibility on behalf of the platforms, while acknowledging the organisation of content, including by automated means such as algorithms.

The platforms will be required to respect obligations regarding protection of minors from content “that could impair their physical, mental or moral development” and protect all audiences from violent content and incitement to hatred on grounds that are referred to in the Art 21 of the Charter of Fundamental Rights of the EU⁴. Content that constitutes criminal activity under the EU Law, such as incitement to commit terrorist acts is equally the type of content that all citizens will be protected from under the revised directive.

3. Directive 2018/1808

4. sex, race, color, ethnic or social origin, genetic features, language, religion or belief, political or any other opinion, membership of a national minority, property, birth, disability, age or sexual orientation, nationality

The appropriate measures shall be determined in light of context, potential harm and type of viewers to protect, and must be practicable and proportionate to the size and nature of the platform. They cannot take the form of a filtering-type measure. A list of 10 measures is listed in the directive for providers to implement in order to meet the requirements, such as parental control, transparent or user-friendly reporting mechanism or age-verification systems.

Another set of rules Video-sharing platforms are equally obliged to conform to are requirements related to commercial communication rules set out in the Directive. Regarding platforms' own advertisement, the providers are to comply with qualitative rules listed in the directive and must take appropriate measures to ensure that users comply with the same rules. Viewers must be informed about advertisements contained in User generated content and programmes.

COMMERCIAL COMMUNICATION

On-demand services and video-sharing platforms have to comply with certain rules laid out in the Directive for linear services regarding commercial communication and advertisement, in particularly the strengthened provisions regarding the protection of minors from the advertising for alcoholic beverages and unhealthy foods. On the other hand, broadcasters will be given more flexibility regarding total advertising time in linear services: this time is limited to 20% of transmission time during the day (06.00 - 18.00) and 20% during prime time (18.00 - 24.00) In general, advertisements must be clearly identified as such to the viewers, on the video-sharing platforms as well. Fostering of the self-regulation and co-regulation codes for the advertising industry developed with the regulation authorities should be encouraged.

STRENGTHENED PROVISIONS ON ACCESSIBILITY

The Directive 2010/13 stated that Member states shall encourage gradual accessibility of audiovisual media services to people with visual or hearing disabilities in its Art 7. The new version strengthens those provisions by positioning continuous and progressive development of accessibility of programmes as a requirement. Member states have the possibility to decide on proportionate measures, with examples given in the recitals such as subtitling and audio description, or sign language or spoken subtitles. The directive does nevertheless state in the recitals that practical and unavoidable constraints that could prevent full accessibility must be taken into account. Additionally, service providers are to be encouraged to develop accessibility action plans that must be communicated to regulatory authorities and ensure the availability of accessible emergency information. Currently, seven member states⁵ impose stricter obligations on Public Service Broadcasters, and five have implemented general requirements for on-demand services⁶.

PROVISIONS ON PROMOTION OF EUROPEAN WORK

The directive pays particular attention to safeguarding cultural diversity and guaranteeing competitiveness of the European audiovisual industry. These objectives are materialised through the general provisions on the promotion of EU works laid out in Articles 16, 17 and 13. Broadcasters have to reserve a majority of their transmission time on linear services

5. HR, ES, FR, IE, IT, SE, FI. French Community of Belgium adopted in 2018 a new set of rules regarding accessibility including a specific set rules goals for the public service broadcaster that are stricter than for the private sector providers.

6. FR, IE, IT, PL, UK.

for European Works⁷ and 10% of that transmission time to recent⁸ works produced by independent producers.

The obligations for on-demand services were introduced in the 2010/13 Audiovisual Media Services Directive as a general requirement for member states to "promote the production of, and access to European works."

The directive suggests three main instruments to implement the objective of promotion of European cultural content:

- financial contribution by on-demand services to the production and rights acquisition of European works
- the share of European works in the catalogue
- prominence of European works in the catalogue

The revised directive brings substantial modifications to the obligations regarding financial contribution and the share of European works by strengthening the provisions of Article 13, with a potential impact on linear service providers as well.

In a twist on displaying a deviation from the country of origin principle, the new §2 of Article 13 allows Member states to extend the obligation of financial contribution to the services targeting but not established in the particular state. The provision, that originally was destined to on-demand services equally applies to linear ones in the final version. It is important to mention that the service must be EU-established, and that video-sharing platform are not targeted by the obligation.

7. Excluding the time appointed to news, sports, events, games, advertising, teletext and teleshopping

8. Produced in the five years before transmission

The modification that will potentially have the most impact on European content providers is the obligation of a 30% share of European works in the catalogues of on-demand services. The works in question must correspondingly be given sufficient prominence. The notion of prominence is not defined as such in the directive, however quite extensive examples are given in the recitals: use of modern marketing techniques, a share reserved for European works in the promotion of the catalogue, as well as "the labelling in metadata of audiovisual content that" qualifies as European with the availability of the relevant metadata to media service providers.

Regarding the implementation of the Directive 2010/13, while certain member states implemented a general obligation by transposing the exact text of the directive, most member states did include specific and detailed measures with regards to the obligations of Article 13 when transposing the directive into national law.

The share obligation was implemented in quite a large scale. Indeed, nearly 70 % of the member states⁹ implemented a share of catalogue, either as a standalone obligation or in combination with alternative requirements. While specific height of the obligation varies from 10 to 60%¹⁰, only Spain, Italy and France implemented a share of 30% or more. Consequently, the majority of member states will have to either increase the share of European works currently in place or develop a new legislative framework imposing the relevant share on the catalogues of VOD providers. Since nine countries currently have no share obligation in their national law, the impact for content providers will be quite significant.

A few important methodological questions arise from the mandatory share obligation. What is the most relevant technique to calculate the

9. 16 countries in total (AT, CZ, DK, ES, FR, HR, HU, IT, NO, PL, PT, RO, SI, SK, GR, NL).

10. 10 % (CZ), 20 % (PL, RO, SK, HR), 25 % (HU), 30 % (ES, IT - from 2019) and 60 % (FR – 50% for the first three years of existence of the service).

share – number of titles or number of hours? Should certain types of programmes be considered for the share calculation? Should the calculation be made per catalogue/service or over all services if the providers offer more than one catalogue? Most member states¹¹ do not currently provide for exemptions, while in others content such as news, sport events, games, advertising, teleshopping, teletext, entertainment or current events were excluded from the share¹². Currently, no single methodology regarding share calculation is prevailing amongst the member states. Regarding the last issue, the Commission shall provide more guidance, since the paragraph 5a of Article 13 specifies that "the Commission shall issue guidelines regarding the calculation of the share of European works."

The directive does foresee a possibility of exemptions for media service providers with an eventual low turnover or low audience and an option to waive the obligations in case they are "impracticable or unjustified by reason of the nature or theme of the audiovisual media services." Consistent with the Commission's approach of a two-tiered regulation for new entrants and new markets, the goal is, according to the recital 25, to "not undermine market development and to allow for the entry of new players in the market where companies with no significant presence on the market should not be subject to such requirements." The recital provides at the same time for more detail on these concepts that are otherwise not defined. "Low audience can be determined for instance on the basis of a viewing time or sales, depending on the nature of the service while the determination of low turnover should take into account the different sizes of audiovisual markets in the Member states."

11. 9 (AT, CZ, DK, ES, FR, HU, IT, PL, RO)

12. 6 in the case of news, 5 sport events, 5 games, 4 advertising, 2 teleshopping, 2 teletext services, 1 entertainment and 1 current affairs programmes.

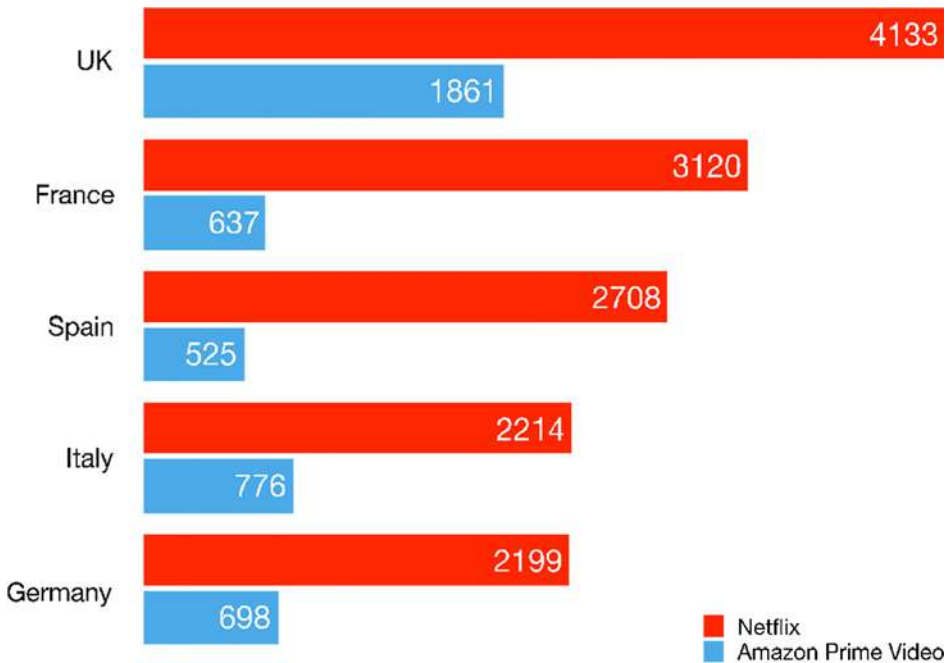


Fig 1. Volume of hours required to reach a 30% quota in each market.

OPPORTUNITIES FOR AUDIOVISUAL ARCHIVES

The imposition of a mandatory share of European works in on-demand services’ catalogues will profoundly impact the audiovisual content market in the short term. While most local or state-backed initiatives already offer a significant share of EU-originated content within their online audiovisual offer, most of the international players are lagging behind in terms of content diversity.

According to a study published in October 2018 by UK-based Ampere Analysis¹³, the largest international (US-based) VOD providers are lagging

13. Alex Varatharajah, 19/09/2018, Euro content bonanza: SVoD giants face adding hundreds of titles to meet EU quotas, Ampere Analysis, retrieved from <https://www.ampereanalysis.com/blog/053ea646-5856-4298-8fd6-f5c09a296a51>.

behind local players in terms of the share of European works available in local catalogues across the old continent. The exact deficit varies from market to market as depicted in Figure 1 on the previous page, charting the volume of hours required to reach a share of 30% of European content in the largest member states. The actual share requirement could even become higher in some markets depending on the final terms of implementation of the obligation in local law for each member state, as it is currently the case in France, for example, meaning that the gap in EU-originated content could be even higher than suggested by the directive alone.

This creates an interesting market opportunity for all audiovisual content owners with European works in their collections, as the VOD giants will possibly be racing to fill this gap in order to comply with the upcoming legal requirements. Local audiovisual archives appear as obvious partners, as they constitute a one-stop-shopping source for locally produced content. Amazon has already made deals with local broadcasters, which are reflected in the chart above when compared with Netflix.

This emerging market opportunity created by the new AVMS directive may be mutually beneficial for VOD platforms and content owners, enabling the former to comply with the new law and the latter to make their content available to a larger audience, while generating more revenue. Yet there are a few challenges in the way for most would-be content suppliers:

1. Content curation: identifying the content suitable for online VOD platforms
2. Rights clearing requires a clear knowledge of the rights associated with the content selected above,
3. Metadata needs to be rich and accurate in order to feed online platforms

4. Accessibility of the content requires even more metadata.
5. Delivery needs to be organised on a massive scale.

The sheer volume of the upcoming content exchange transactions will be an issue for most AV archives as thousands of hours of content will be at stake. The amount of treatment required for each of the steps could easily overwhelm organisations that are already stretched rather thin for daily operations alone. This opportunity probably comes at a good time to advocate for more investment in technology, to help with some of the challenges.

Choosing the content will already require a good knowledge of the rights associated with the content, in order to pick those that fit the definition of European works. Furthermore, content rights might need some renegotiation as the new publication context might not have been envisioned at the time the original contracts were signed, be it in terms of platform, geography, medium, etc. The updated directive also requires more transparency regarding the use of product placement in audiovisual production, which might not have been identified previously.

Online VOD platforms set the bar very high for metadata sets and require a complete set of publication-quality features, including still images, series logo, summaries of different lengths (for series, seasons and episodes), age restrictions, original airing date, genre categorisation, cast, etc. In some cases, the metadata set will have to be available in multiple languages. In the case of Amazon, having time-based metadata to feed the X-Ray layer is a definite plus.

At the crossroads between metadata and accessibility, multilingual audio tracks, subtitles and audio description are also high on the list of requirements prior to publication, and even more so given the additional legal constraints. This is an important issue because multilingualism has always been an afterthought for most locally-produced content. However, international subtitles make the content accessible to an international au-

dience, so they are probably low hanging fruit in terms of generating more revenues from a much larger potential audience.

The logistical nightmare of repurposing thousands of hours of content and their associated metadata in the correct destination format can reliably be automated, yet this requires a good understanding of the underlying standards and knowledge of the issues that can arise during such processes at industrial scale. Many institutions focus on a single audiovisual format and a single metadata standard, making the transcoding issues entirely foreign to them.

Most of these issues can be solved with the help of technology, or with a combination of technology and human validation, concentrating on the human contribution where it has the most added value. For instance, automated processes like speech-to-text extraction, subtitling generation and translation, or video-based face recognition are coming of age at the time of writing and could be used to treat more content in less time or with less resources.

CONCLUSION

We have retraced the steps leading to the current revision of the Audiovisual Media Services directive, focusing on the aspects that will have the most impact on audiovisual archives. The new text takes into account the emergence of video-sharing platforms and transfers the spirit of the previous directives to this new context, most notably by setting a minimum share for European oeuvres in online catalogues and ensuring their visibility. It also includes provisions for a stricter control of the following aspects: commercial communication, protection of minors and accessibility.

This new legal backdrop creates a huge opportunity for owners of European audiovisual content and the associated archives as the largest

online VOD platforms will be shopping for thousands of hours of such content. The sheer scale of the enterprise will create challenges for AV archives, but these challenges and the underlying commercial opportunity might accelerate their digital transition by liberating a much-needed flow of investment in technology.

OBSERVATIONS

MORE THAN 3 YEARS ON from the Stockholm MMC Seminar, everyone has endured the most challenging times in both life and work through an unprecedented pandemic. Media archives continued to operate under the most difficult of circumstances to provide an invaluable service to their organisations. In some ways, the impact of Covid-19 during this period will be viewed as an accelerator of innovation, technology, new remote workflows and roles in media production and archives.

All the use case studies, projects, and trials discussed in this Seminar imparted a wealth of knowledge and understanding, challenges and lessons learned across many topics including AI, ML, data mining, automated data management, training and quality control, misinformation and disinformation, authentication and verification, content security, rights management and archiving in the Cloud.

Some broadcast archives were experimenting with new AI tools and technologies as proof of concepts and pilots to determine the feasibility of implementation in archive operations. There is no commercial off the shelf product that will cater to all the requirements and needs of archives so testing, training and evaluation of results were key to concrete assessments and further development of new tools and systems. Gaining practical experience of face recognition, object recognition, speech to text and finger printing helped archivists to understand how these new automated tools could be a valuable aid to archive operational workflows and not a replacement for staff. Also, research developers in a broadcast archive focused on face detection algorithms and machine learning to help cataloguers create a face database of public figures for visual and textual search. Updating, training and quality assurance is paramount to building more accurate results. Automated categorisation is to be developed further in research projects catering to unique user requirements.

The relationship between humans (the information professional) and machines was explored in several presentations. Archives must find new ways of co-existence with AI and learn to use the potential to develop new ways of working. Metadata and automatic metadata generation is becoming the focus of broadcast companies in order to learn about possibilities as well as limitations both in practice and theory. The goal of many is to find one universal centralised metadata solution for the entire production and archive process. Will this be the holy-grail? In the future, implementation and integration of such a long awaited solution will be the next step.

Lesser known technologies were presented for media verification and tampering detection, rights tracking and programme analysis. The creation of fake audio through manipulating speech is on the rise with low cost audio editing systems. A variety of tampering detection tools and audio forensic tools are being developed in the domain of media forensics using partial audio matching and phylogeny analysis. Automatic tools need

to be adapted and integrated into practical workflows to provide benefits to journalists dealing with fake news.

New media supply chains and internet streaming is providing an opportunity for media archives to gain new value in monetising and reuse of content with cloud archiving. A decrease in cloud based storage costs and new innovation in cloud computing including artificial intelligence and machine learning is enabling sensible options for new use cases and workflows in media content archives. The advice is small steps and agile approaches in collaborative short projects to build new cloud archiving systems for the future.

Several discussions focussed on rights management and the development of professional rights guides including the flowchart online publication for media archives. Simple intuitive rights codes and traffic light systems were used by all broadcast archives as part of their rights management systems. The main challenges were that rights agreements and format rights are constantly changing, how will the content be used in which context and how can you predict future use? New symbols and workflows are being designed to replace the old traffic light system for copyright content. Digital publishing is in constant transformation as is the copyright universe so simple intuitive workflows to mark up with correct rights information is ever more imperative. New user friendly datasets are also being developed with standardised data structures for rights and licenses.

The opening presentation of the Seminar charted the history of past Media Management Seminars highlighting the current and future trends, innovative technologies and impact on the changing roles of the media archivist. Over the years, new roles were established or emerging in a constantly changing business and digital technological landscape of AI and ML; media manager, metadata specialist (coach, trainer, quality assurance) information architect, content/data curator, preservation and migration strategist and even robot educator! It seems that a combination of archive

staff in new roles (humans) and new AI/ML technologies (machines) are the Game Changers towards future proofing AV content.

Today, there is a perceived shift of acknowledgement. A Media Archive must be at the centre of the digital transformation providing archive management and broadcast content for reuse and retransmission in an era of rapidly growing competitive digital channels – archives are the “jewel in the crown”, “golden assets”. Ironically, the pandemic has accelerated a realisation in top management that the real value of any broadcaster is in its archive assets.

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