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Abstract

At each step in the production process the metadata, to be collected and used, has different characteristics. Metadata processing is listed for the major steps in TV production with an indication of the benefits and overheads at each point. Some of the metadata formats that are suitable and optimised for broadcasting are briefly described, with the key technologies of XML, MXF and AAF being identified. A table of the production process is used to show how we can store and use the metadata at each stage.

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METADATA IN TV PRODUCTION: ASSOCIATING THE TV PRODUCTION PROCESS WITH RELEVANT TECHNOLOGIES

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ABSTRACT

At each step in the production process the metadata, to be collected and used, has different characteristics. Metadata processing is listed for the major steps in TV production with an indication of the benefits and overheads at each point. Some of the metadata formats that are suitable and optimised for broadcasting are briefly described, with the key technologies of XML, MXF and AAF being identified. A table of the production process is used to show how we can store and use the metadata at each stage.

INTRODUCTION

In the process of TV production, information is collected, processed, presented and disseminated by both TV systems and information systems. This information, now known as metadata, requires efficient management to become an important contributor to saving time, cost and effort. This can be particularly important where productions are now being re-authored and output to more distribution channels than in the past. Metadata can cover a wide range of use so it is helpful to divide it into categories depending on its application:

Technical or Essential metadata describes the technical characteristics of the essence itself and examples are the 'picture width' and 'video sampling rate'. This information is usually embedded directly in the essence (video and audio) itself and has been processed in this way for decades. It is not the main subject of this paper, as we are experienced in processing this both in files (like MPEG) and streams (like SDI).

Compositional metadata describes how the various parts of a programme come together to form the completed output. The best example is the EDL or Edit Decision List.

Production or Descriptive metadata is business information about the programme, which for example describes the artists, scripts, staffing and rights. At present, this metadata is only informally collected by most broadcasters and an efficient 'joined up' process in the future has the biggest potential for cost savings.

STEPPING THROUGH THE PROGRAMME MAKING PROCESS

At each step in the production process we can collect, and possibly re-use metadata. We can treat each collection point as an overhead, and this must be implemented as painlessly as possible for production staff. Each re-use point is a saving, as we have removed a data re-entry requirement, probably reduced errors and given producers more information to help their task.

Commissioning

A commission occurs when the producer persuades the TV company to finance the conversion of an idea into a real programme. The commission is very important for production metadata collection as it gathers some key information like the 'working' title, producer's identity, and programme genre, and possibly contributor's names and initial scripts. It could well have financial and rights descriptions, which subsequently apply to the rest of the programme making process.

In a production department the recording and development of such ideas rarely uses a single technology, and often pen and paper is effective. However we could conceive of some parts of the programme ideas being presented to commissioners for a decision in a standard format. If this is the case the best format for metadata handling is using standard IT techniques like web technologies or it could be proprietary word processing packages. In our quest for metadata capture we need to import the metadata from these and store it in a processable form.

The *metadata collection goal* is to put together a document reflecting the commission in a clear and unambiguous way. Ultimately, as a long-term goal, this can have the status of a legal document, and the metadata coding techniques must have the characteristics required, like security and signing.

Planning

When a commission has been accepted, and before shooting, a plan is put together. There is often already proprietary software to help with this. The plan encompasses the staffing, resources and also the creation of the artistic description in the form of a storyboard and script.

The *metadata collection goal* is to take this planning data, probably from a number of sources and software packages, and encapsulate this into a single database or document folder. We do not require all the software to interoperate fully, but we do require it to export the collected data in a defined and standard form that can be re-used.

The *metadata use goal* is to make the full commissioning information available to the production team for their reference.

Capture

The obvious capture device is the camera, but equally, sound effects, graphics, stills, captions and music may all be added. At all points in capture there is an opportunity for metadata collection, and as we have physical devices to collect the material we can program them to collect much metadata automatically. An example is the GPS¹ position in the world that can then be used to identify shots by location. Other metadata, like producer's comments and annotation, can only be captured by direct entry at the time of shooting. We should allow producers to add metadata afterwards should they wish.

The *metadata collection goal* is to automate as much metadata capture as possible in the capture device. Secondly there should be facilities to add metadata from other sources, like PCs, mobile phones, PDAs and other devices. We would expect all this metadata to be

¹ GPS – Global Positioning System

either embedded directly on the tapes or referenced from tape to another data structure, held alongside in a computer of some sort. The metadata at this point in the chain should be viewed as 'portable', carried along with the essence, because a link directly to a central database is not regarded as practical during a shoot.

The *metadata use goal* could be very important here as it can help considerably with a shoot. We already have the commission document and planning document folder and so we need a way of taking these documents to the shoot for reference during the shoot. As before it is important that this data is in a standard format so that it can be read by a third party application, and possibly embedded in the essence delivered from the camera.

Ingest

During ingest we take all the tapes and other content collected during a shoot, as well as new metadata, and transfer it into the editing environment. We assume that the planning and commissioning metadata is already in the system. More metadata can be generated at ingest and this can either be directly entered, for example by an operator marking technically poor sections, or regions for special processing, or it can be extracted automatically. One of the most useful metadata items to extract at this stage is the shot change, which can greatly help later in organisation and editing. The potential for the future here in automated metadata capture is enormous, as we can apply the full power of computer recognition to mark up and label the content.

The *metadata collection goal* is to capture metadata describing ingest, like the tape labels and contents, both from the operator and automatically from the ingested material. All metadata captured on the shoot that is already embedded or associated with the material should be captured here as well. At or just after ingest, metadata can be captured directly by analysing the material using computer pattern recognition algorithms.

The *metadata use goal* is to view the tape labels so that the operator knows exactly and unambiguously what is being ingested. The software can also check the tape contents automatically for consistency and completeness. The programme planning metadata can be used to automatically organise the material ready for the post-production.

Logging

Logging is where the producers review what they have, and mark down its possible use. It is expected that all the metadata capture that has taken place up until this stage will greatly reduce this overhead. Our long-term goal is to remove the need for a separate logging process altogether.

The *metadata capture goal* is to allow the producers to review and add metadata about what has already been shot.

The *metadata use goal* is to provide enough previously captured metadata, so that the logging process is significantly quicker, simpler and more informative.

Edit

There is very little capture of *production* metadata during edit, as the whole editing process concentrates on capturing the *composition* metadata. We hope that all metadata associated with the shot and with individual clips is preserved during the editing process in a transparent way. In some cases when cutting and inserting this is not possible to do unambiguously and

there is a debate about how metadata in this circumstance can be usefully preserved.

The *metadata capture goal* is to produce enough *composition* metadata (an Edit Decision List) to accurately represent the artistic composition of the programme from its constituents.

The *metadata use goal* is to present any information, derived from previously captured metadata, to producers that can help with the creative editing process.

Archive

Archiving is a prime candidate for metadata re-use, as the metadata is the basis for a comprehensive search. The capture of metadata not only enhances the search, but also removes some of the overhead and uncertainty that archivists can have in cataloguing the material.

The *metadata use goal* is to make searching and re-use of archive material simple and effective.

Playout

Metadata is already used a lot in playout as all productions are required to produce 'paperwork' describing their transmission details, rights and payments information. While this is already automated, the collection of the data is not, and so the ability to feed the vast majority of the data from earlier stages in the production will save effort and errors.

The *metadata collection goal* is to start to build up a record of when and where the material has been used.

The *metadata use goal* is to take existing business metadata to populate the required documents for the administration of playout. Future distribution formats could make use of the metadata directly, for example synopsis, scripts and actor details form the basis of a web site, and parts of the metadata describing the production can be broadcast for TV Anytime transmissions.

METADATA FORMAT POSSIBILITIES

Good computer systems are built using a layered structure and so in this discussion we should not need to consider lower levels like networks and transport which are expected to be standard. There are a number of techniques used to represent metadata, and the ones that are of most interest are XML², the UMID³, MXF⁴ and AAF⁵.

The UMID, MXF and AAF are designed for, and by, the broadcast industry and are optimised for our application. XML is a general purpose IT technique for representing data, and has been further exploited in the MPEG7 and MPEG21 standards to describe media, but not presently in a way that is optimised for or suitable for broadcast metadata. In theory it would be possible to use MPEG7 and MPEG21 to convey data through the broadcast

² XML – eXtensible Markup Language

³ UMID – Unique Material Identifier

⁴ MXF – Material Exchange Format

⁵ AAF – Advanced Authoring Format

chain but additional work is required if we are to fully represent the broadcast metadata sets that describe our business.

XML

XML is a standard that allows us to represent data in a form that is easily exchanged in files or through the web. The parties to the exchange still have to agree what the data is and a data model, so XML only solves the coding and formatting, not the design and agreement problem. Any number of XML tools are available to software writers and web developers that can perform the coding and processing. The big advantages of XML are that it is relatively simple, open and well supported. The disadvantage is that it is verbose and inefficient in bandwidth and storage space. There is a binary format called BiM which XML documents can be converted to, which can solve some of the efficiency problems.

The UMID

The UMID, or Unique Material Identifier is a standardised label for the essence. The idea is that rather than interleaving the metadata directly with the essence, the UMID acts as a lookup ID number (essentially a pointer via a database) for the metadata. The advantage is that there is no need, and there may not be space, to hold the metadata directly on a tape or in a data stream. The disadvantage is that relatively sophisticated database software is required to be operational at many points in the broadcast chain if we are to use UMIDs. It is not clear yet if this type of sophisticated database is a practical possibility in a real complete broadcast chain, and the UMID may be better exploited initially within smaller subsystems like 'capture to ingest'.

The MXF File and Stream Format

MXF is Material eXchange Format and is a way of combining metadata with essence directly in a simple file. MXF is also designed so that it can be streamed. The big advantage is that the completed work, metadata with essence, can be conveyed as a whole through and between systems as either files or streams. It can also be transferred with FTP⁶, in fact any existing known file-handling technique can carry MXF. It is probable that MXF will become a key technology in our business.

The AAF File Format

AAF is Advanced Authoring Format. It describes work in progress as a composition and can link together many different intermediate essence tracks with a rich description of metadata. Its main use is to convey a full, possibly as yet uncompleted, composition between editors and other devices.

The Data Model

The sets and entities that make up the metadata need to be fully described, as well as any relationships and processing rules. This is the function of the data model. It is abstract in

⁶ FTP – File Transfer Protocol

that it describes the data, but does not specify how this description is implemented. A dictionary that defines the individual attributes and labels for the values, like XML tags, often accompanies the data model for a particular implementation.

Do we store Values or References?

The values of the metadata can be put directly into a file or document. Alternatively a reference (the UMID is an example) can be inserted so that the decoder has to decode the reference and look up the result using another database system. The advantages of the value are that it is complete and direct as no other database is required to find the result. The advantages of a reference are that it allows the value to be administered, checked and corrected at one central point. For example if someone's name and address were included as metadata in files, and they subsequently moved house then the reference would keep it up to date, whereas the value would not. It is important when designing a system to be clear that this behaviour is correct for the application under consideration.

Complexity and Islands of Metadata

Metadata becomes very effective when it is used to pass information between production steps as described earlier. It is sometimes suggested that all broadcast processes should talk to each other through a common network and a common database to achieve this. This in many cases is not practical, because an all-encompassing database would be so complex that it is hard to manage. This is particularly so where the metadata collection is remote from a studio centre such as a shoot, but also in a large broadcast organisation with many premises that should be designed to be able to work in an autonomous self contained manner. This is why, in many cases, we have suggested that the metadata is wrapped into a package like MXF and transported directly with the essence to the next step in the process. Such simplicity of concept is important if we are to introduce complex data handling into a complex organisation.

THE METADATA REPRESENTATION AT EACH PRODUCTION STEP

The table shows how metadata can be described at each step in the production process.

Production step	Metadata to be captured	Metadata set described by	Can be coded or stored using
Commissioning	Commission Document	Commission data model	XML
Planning	Plan of the programme composition, with associated metadata like actors, locations and staffing	Programme Plan data model of a composition (based on the AAF or MXF models)	Either AAF or XML
	Plan of the resources used	Resources data model	Document storage system or XML

Production step	Metadata to be captured	Metadata set described by	Can be coded or stored using
	Scripts	Text, but marked up with instructions according to a script data model	Document storage system or XML
Capture	Label for the essence	UMID Specification	Basic UMID
	Camera metadata generated automatically	UMID specification	Extended UMID
	Other metadata that can be captured with a camera or imported to the camera	Metadata Dictionary	MXF
	Other metadata that can be captured with a camera and exported to a PDA but associated at the time of capture.	Camera Capture Data Model	XML
	Metadata that can be associated at the time of capture. The essence is captured in the camera and the metadata captured on a PDA, but associated at the time of capture.	Programme Plan and Programme Shooting Metadata	XML, linked to the camera UMID
Ingest	Metadata generated at ingest, like shot changes and other automated capture	Data Model of Essence with events on a timeline	XML or directly into a database
	Metadata generated by an Ingest Operator	Logging Data Model	XML or directly to database
Logging	Metadata generated by a producer doing a review after ingest	Logging Data Model	XML or directly to database
Edit	Metadata describing the edits to the composition	Models of Edit Decision Lists (EDLs) based on AAF or MXF	AAF, MXF,XML (proprietary EDL formats are also likely)

Production step	Metadata to be captured	Metadata set described by	Can be coded or stored using
Archive	Metadata describing re-use of material	Metadata exported to a search engine	MXF and copies of metadata items to be searched in a database
Playout	Metadata describing playout information	Playout Data Model	XML or MXF

CONCLUSIONS

We have listed the types of metadata that can be collected at each point in the production chain, and given an example of how this can be coded in a standard and open system way. At some places metadata is stored directly (by value) and at others there is a reference, or pointer, to the metadata, which has to be looked up in a table or database. The main metadata formats for the broadcast application have been identified as XML, MXF and AAF.