INTEGRATED METADATA IN THE BROADCAST ENVIRONMENT

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In a modern broadcast environment, efficient and effective handling of metadata becomes more important every day. Much time and money can be wasted re-entering data that is already present in the digital domain. This money could be better spent on programme making. The authors will describe practical examples of how this can be achieved in a real broadcast environment using real products in use or in development.

INTRODUCTION

It is the objective of this paper to explore how broadcasters can achieve efficiencies by equipment manufacturers and solutions providers for different stages of the broadcast production chain sharing metadata. The integration of playout systems and production editors is key to the effective handling of metadata in the broadcast environment. Broadcasting is now entering its 9th decade and many of the systems established to report on the data associated with broadcasts are similarly archaic. The authors feel that the time is now ripe to rethink the role of metadata in broadcasting and provide a fully integrated solution to the issue.

1 EARLIER ATTEMPTS

Former attempts at this integration have not satisfied the current needs for tracking of media asset use and have often necessitated the retyping of information that already exists in a digital format.

To keep track of all media assets used during a production this information often had to be typed in manually.

Even with formats supporting some kind of metadata and edit information like AES31-3 or AAF the information is often not passed on to business processes outside the editing scope. Although AAF provides extensive information about the composition of media objects its main use in practise is the exchange of projects between AV editors. Only very few systems supporting business processes outside the editing scope can handle AAF and due to its complexity it is unlikely that this will change in the near future.

The systems we shall describe herein are the dira! Radio Playout System from VCS and the SADiE Digital Audio Editor.

1.1 The design goals of dira!

The dira! system has been designed as a networked playout system for concurrent and instant access of audio, database and schedules from the ground up. Even in its first version designed in 1993 the aim was to support the workflow of many people working on the same programme rather than building a separate playout application running on a single machine. As well as the strong concepts on the server side a large variety of tools have been created to support users to search, edit and schedule items, and to playout programmes. Amongst the major requirements for a system covering the whole process from editing and scheduling to playout and reporting was and still is reliability and redundancy. Whilst the implementation of a system of this scale provides enormous benefits to their workflow, a broadcaster can't afford such a system to be vulnerable. Thus, from the early days the dira! system was designed for maximum reliability while covering a very broad range of functions integrated into the system.

Over the years many customers with different workflows have used the system and with the benefit of their experience and work practices it has evolved to support a very wide range of different operations, from News to Music stations; from 24-hour networks to regional playout centres; from cultural programmes to classical music stations; etc.

As a natural development after the first step to digitise playout, interfaces to other business systems have grown over the years and now includes tools for

planning systems, music scheduling applications, reporting, archives, etc.

Due to the fact that one of the main functions of a playout system is digital audio editing, 3rd party editors have been built in from day one. These editors provided many journalists with desktop editing functions, which supported simple topping and tailing of audio on a single track. Over the last three years a lot of new "built-in" audio applications have been designed to enhance the workflow once more and to make it even more seamless. Amongst these functions are auditioning, recording, creating links and voice inserts for playout and multi-track editing. Unlike many production editors nowadays which have reached full maturity and support a vast number of special editing functions, the most recent application that has been added to the dira! playout system is a single-track editor that, by virtue of its simplicity, supports the very quick turnaround of audio in a news environment.

1.2 The design goals of SADiE

Design of the SADiE system began in 1992 and from the outset concentrated on the needs of the typical professional audio operator, especially in the broadcast environment. Initial implementation gave the user familiar tools, such as graphical representations of tape, using razor blades to “cut” the audio, etc., so as to ease the user into the world of audio editing on computer. Many of these early paradigms still persist in the software today.

The fundamental goals of the SADiE design have always been to ensure that the system accommodates the users needs, by honing the design from the users’ perspective, and ensuring that the speed of operation can always keep up with the editing decisions that the operator needs to make. Audio quality has always been a critical issue.

As the concepts of computer audio editing have become familiar and users have demanded more comprehensive editing and processing facilities, efforts have been made to ensure that the basic concepts of productivity have remained paramount in the product.

It is thus clear that for a playout system, the reliability of the database and reporting functions transcend all other design criteria whereas in the audio editor, speed and operator efficiency are core.

1.3 Best of Breed

Given the maturity and more than a decade of development effort it is unrealistic that one single product - either a production editor or a playout system - could combine all of the described benefits in one single product.

Thus, the only way to accommodate the users’ needs is to provide the best production tools and ensure a seamless workflow and integrated business process. This can only be achieved by integration of these two product categories.

The SADiE editor has never required a large database application and there is little justification on commercial grounds for creating the requirement within the organisation. The SADiE design team do not have experience in creating large metadata tracking systems in software, preferring instead to concentrate their efforts on more audio related features. However, in the modern broadcast environment, tracking the metadata associated with programme production becomes an increasingly time consuming part of the process and efforts must be made to reduce this workload.

Similarly, the dira! system contains a simple editing application but VCS have neither the desire nor the resources to design a full production editor into the dira! playout system.

There is, therefore, an incentive to concentrate each organisation’s design efforts on areas of existing core competency, maintaining the “best of breed” status that each product has earned in its own field.

Best of Breed integration follows the need to provide broadcast users with the best product for their requirements. This must still satisfy the developer organisation's desire to achieve the strategic goal to implement effective overall business processes.

Various aspects of application integration have to be considered to provide an overall solution leading to two main questions:

What data needs to be exchanged and how can the data be represented on an interface level?

How can the integration present itself as a seamless process to the user to improve the workflow?

2 TYPICAL WORKFLOW

To understand the true relevance of sharing this metadata we need to explore a typical workflow that might be used for producing, for example, a radio feature.

For this example we will take a short 30-minute documentary style feature on the life and times of a well-known musician.

2.1 Genealogy of source material

With this example we will have a narrator, a number of interviews with the musician, various friends and acquaintances, some pre-recorded music material (released and non-released) from the musician and from the musician's band, some other material from other artists that the musician refers to in his interview, etc.

The original interview material is relatively easy to keep track of, as the producer is most likely to have recorded these assets him or herself. Similarly the narrator will have been booked to provide the voiceover and consequently there will be easy audit trail for tracing any amounts owed. All the material from pre-recorded, released sources could be tracked through their respective ISRC numbers though this data is often not present in databases. Pre-recorded but previously unreleased material will be more difficult to track through the program production stages. One assumes that most of the other interviewees have signed release forms allowing the unimpeded broadcast of whatever was recorded.

Every process performed on this material must be tracked if an accurate report of the royalties due on the eventual broadcast program is to be easily made. Often this will occupy the time of the creative operator of the editing system, tracing which material from which copyright owner was used for which periods of time.

The authors assert that this mechanical tracking of usage should be handled entirely by the computer systems used to create the program rather than tying up the valuable time of the creative producer. This task is made much more complex by the use of different manufacturers' systems.

2.2 Asset Descriptors

The assets used during a production like the described feature can be distinguished by a number of different descriptors:

a) Origin
Has the asset been created in-house and intellectual property owned by the broadcaster, or has it been created in co-operation with, or by, a 3rd party?

b) Content Category
Is the asset a speech or music item or a trail? This may result in different parts of an organisation being responsible for negotiation of contracts and for billing.

c) Contracts
Is the usage of the asset already covered by individual contracts (e.g. with a 3rd party production company) or general contracts (e.g. with own personnel or the music industry)? Do different royalties apply for use on FM, DAB or the Internet?

d) Broadcast History
Has the asset already been broadcast and do different royalties apply if the asset is broadcast a second or subsequent time? Has the asset already been scheduled although not played out to air?

It is easy to see that today only very little of the information described above is passed on between production editors and playout systems and other asset repositories. This leaves a blank spot in the production process that very often requires manual re-entry of information or shutting one's eyes and worrying about it (and the relevant payment!) later.

With more and more areas in the broadcast operation becoming digital, it is natural to want to automate the tracking of asset use during production and playout.

2.3 Extreme Examples

Current playout systems and editing applications already support the tracking of playout information or the exchange of information about the composition of AV material and it would appear to "just" integrate them to create an automatic process for tracking of media assets used during production and playout. But the situation is more complex than this:

When recording interviews during a production it may be necessary to edit the recording numerous times to remove hesitations or 'ums', etc.. This may result in a huge number of very small clips from the same origin. This "micro asset usage" may cause significant performance issues in business systems that have not been designed very carefully on the interface level. Moreover, it may prove to be impracticable for a user to reconcile the metadata contained within this large number of clips.

Production editors provide a high level of processing functions and a source clip may not be recognised anymore after processing. Should the new clip be considered as sourced from the original or has the processing changed the source that to an extent that the new clip has its own new "identity"?

Imagine a famous celebrity is coughing in the background while a speaker is recording a report. While editing the report it may not be possible to cut out the background noise without altering the meaning of the report. Should the cough be considered as embodying intellectual property and should this be reported when the piece is played to air?

A similar quandary occurs with an interview that is recorded with copyright music playing over a PA system in the background.

Can a level threshold be defined under which a source clip can be considered to be inaudible if used in a new clip? Has a media asset to be tracked even if only one sample of it is used in a new clip?

Looking at some of these extreme examples of genealogy and intellectual property of media assets it becomes clear that the desire to fully automate the process of tracking media asset use during production will not be feasible. The decision whether or not the usage of a particular media asset is critical in many cases needs to be taken by individuals following their experience, the organisation's guidelines and existing contracts while relying on other individuals to fill out information on source material properly if known at all.

2.4 Finding and collecting metadata

For most productions a variety of source material is used. To find the source material producers may use any source of information: archives, newspapers, books, news agencies, Internet, documents, interviews, etc.

With the support of a production database this information could be collected or referenced to from a "production file". This container for all information relevant for production would naturally also contain information about already existing assets that may be used for production.

However, although such a "production file" would be of great benefit to the producers, the information collected in it will not follow a structure that may be processed by computers to create a report of all media assets used for a new media item.

Given that decisions on use of media assets are taken by individuals and the tracking of those assets cannot be fully automated it appears that the integration of applications can support the individuals by offering already existing information about media assets and allowing for easy input of information for new assets.

The integration of applications in the production environment should therefore support the cross-retrieval of metadata already existing in some electronic form to be able to:

a) find material that may be used for a production
b) support the reporting and tracking of media assets used

2.5 Editing decisions

As our fictitious programme begins to be crafted into the broadcast product, the level of complication increases. Have we included a 25 second segment of this particular song or, for reasons of editorial flow or overall programme length, have we had to cut it back to 15 seconds? Has the legal team got back to us with advice to remove a particular sentence from the interview with our subject's childhood friend for fear of attracting a lawsuit for false accusations?

These sorts of editorial decisions will often be made right up until the moment of broadcast and obviously can affect the royalties payable.

2.6 Programme re-use

Increasingly, programs are re-used and re-purposed or licensed to other broadcasters around the world to amortise the production costs. This can involve re-negotiations with copyright owners and will need a list of what material is present in the programme.

3 GENEALOGY

This brings us to another key point in the integration of workstations and radio automation systems: Genealogy. This term has come to describe the derivation and lineage of source material or assets that have been used to put together a particular programme.

3.1 Inspiration

Radio producers get their inspiration for programmes from numerous sources. A snippet of Martin Luther King's famous "I have a dream" speech might inspire a program on sleep disorders, or a small gobbet of Margaret Thatcher might provoke an idea for a programme on economics; similarly hearing a Tony Blair speech might provoke the idea of a series on the meaning of truth, or Michael Howard on "people's" pronunciation.

Regardless of where the inspiration for a broadcast originates, increasingly archive or pre-broadcast material will be used more and more extensively for making future programmes.

Now, taking the earlier example of our documentary on the musician, some of the material may be easier to access by sourcing it from a previous broadcast rather than going back to the original source assets. This would involve extracting the relevant sound bites from this secondary source and inserting them directly into the new production. This practice was not widely used before the advent of Digital Audio Workstations as the generation loss of analogue tape was often too great to allow such liberties.

3.2 Tracing the source

This "second-hand" material will in turn have its own list of copyright owners who may need to have their contributions recognised or recompensed. As this process continues to develop, future producers may not realise that a particular piece of audio they are purloining from a broadcast made in 2002 did not originate there but had in turn been lifted from an earlier programme from 1992.

One can envisage scenarios where a useful sound bite has been copied from source after source after source until it's origins are difficult to trace. A true genealogy system should allow broadcasters to trace the owner of the source material of anything that is put onto the airwaves. Figure [1] shows a potential complication.

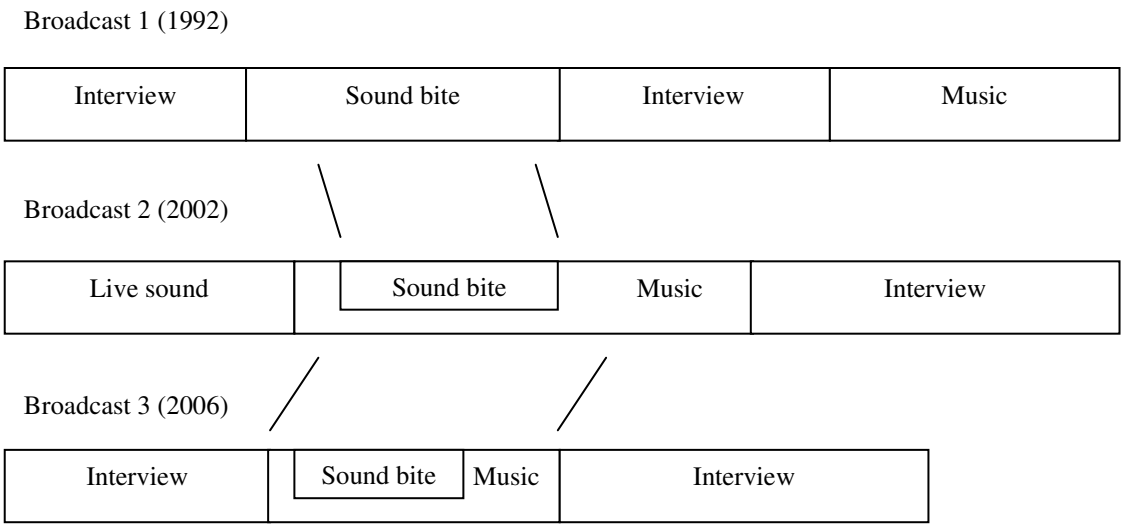

Figure [1]. An example of Genealogy

In Figure [1], an original sound bite was first broadcast in 1992 and subsequently used in another programme broadcast ten years later. However, during this second broadcast, the sound bite was superimposed onto a music bed. Consequently, when the sound bite is used for a third time in the 2006 broadcast, the same music bed must be used as it is now mixed into the source audio (unless the original source can be found). However, the reference for this music is no longer easily to hand – the producer of the third of these programmes may be unfamiliar with the works of Malodorous Punk – consequently it becomes a researcher's nightmare trying to trace who is due the royalty payments.

With a properly configured Genealogy system the metadata for every piece of audio can be traced back to its origin so this not-so-famous Jazz musician would still get his just royalties.

A correctly configured Genealogy system that allows the producer to easily trace the sources of the audio can be a significant benefit to the user and the employer. Utilising the expensive time of a producer or a researcher to trawl through databases when a computer system can perform the same operation much more cost effectively leaves much less time for the creative individual to exercise their true talents ensuring that the listener is properly entertained. Certainly for a public service broadcaster, reducing the administrative expense leaves more funds available for the creative processes, which are at the core of the PSB remit.

4 MULTIMEDIA ISSUES

As Digital Audio Broadcasting (DAB) becomes more prevalent and popular, the ability of the playout and production systems to share multimedia content becomes vital. The authors see metadata for DAB as a core issue in the future.

4.1 Multimedia playout

At present, much of the multimedia content on DAB is restricted to a brief synopsis of the broadcast's content and maybe a web site address that the listener can go to for further information. This hardly does justice to the possibilities that are available if we use this data space in the DAB bandwidth wisely. It is maybe doubtful that much use of the visual bandwidth of DAB will be made (Television would seem to fulfil this role admirably) but metadata broadcast at a specific time could be invaluable to the further adoption of DAB.

Magazine style programmes could place relevant telephone numbers or web sites into the DAB data stream tied to specific parts of the broadcast programme. Consequently, the telephone number appearing on the listener's DAB receiver 10 minutes into the program could belong to a consumer group whereas a later number could be for the medical research council. However, it should be remembered that magazine programmes are subject to legal advice up to the moment of broadcast and if an item has to be removed the associated metadata with that magazine item must be removed alongside it.

Another good example of metadata for DAB could be local language subtitles for foreign language opera broadcasts. This again requires the metadata to be tied to the timeline of the broadcast as such a subtitle would be fairly useless unless it coincides with the correct point in the music.

In both these examples it is imperative that the editing system and the playout system, and any production based server technology, understand and can interchange an agreed metadata structure and can place it on a timeline. Without the ability to share and interoperate with this metadata the producer does not have control over the total output of their editorial decision process. Due to the fast turnaround nature of these types of programmes, interchange is necessary to allow the best tool to be used to modify the production without destroying the metadata content or timing.

In addition to the information about the composition of an item, which is relevant for the tracking of media asset use, information for multimedia playout may be associated with audio segments, which effectively forms a second level of composition.

It is desirable that information about these audio segments can be exchanged between a production editor and a playout system to avoid unnecessary distraction of the workflow by splitting the audio production from the "authoring" of multimedia playout.

These aspects of integration can be expected to result in an improved workflow by:

a) assisting in the tracking of media asset use
b) automating genealogy where possible
c) supporting the authoring of multimedia playout in the same application that is used for production (cross media convergence)

4.2 Interoperability

Besides improved workflows, interoperability is another keyword in current attempts to optimise the business processes in a broadcast operation whilst making the best use of the exisiting digital systems and applications. It is therefore highly desirable to create a flow of metadata through the various business systems.

Given the individual strength of applications and tools it is impractical to store all metadata information in all systems redundantly. If the full set of data describing an asset and its use cannot be passed on between all applications, integration must be based on passing on external references to the information. In this way, all information relevant to a specific task can be displayed to the user by an application while identifiers create reference links to external data for additional information.

The more applications that are involved in the broadcast process the more complex this cross-referencing between the applications and their data repositories becomes.

In large broadcast organisations different applications may be used for long-term scheduling, resource planning, commissioning, playout, archiving, storage of production material and details, reporting, etc.

Given the complex task of tracking of media asset use it is advantageous to begin to collect metadata as early in the process as possible - maybe even before the programme has been fully commissioned. During the production process more information can be added by gleaning details from edit decision lists.

Some information about material may not have been cleared during the production process; for example, the origin and ownership of archived material may be unknown. Producers may still take the decision to use this material due to its relevance to the production.

While most information will normally exist when scheduling on-air playout, some items may have limitations in their on-air usage due to their unknown origin or limited rights to broadcast the item.

Although it would never be the aim of a broadcaster to clear rights and origin on material after it has been broadcast, this still happens in practise quite often, especially if the relevance of the material demands it. In these cases more information about the material is often added when reporting a programme.

Finally, when the material is archived full documentation should be made. This should result in the completion of all necessary information about the material, which can be then used subsequently when the material is requested for later productions.

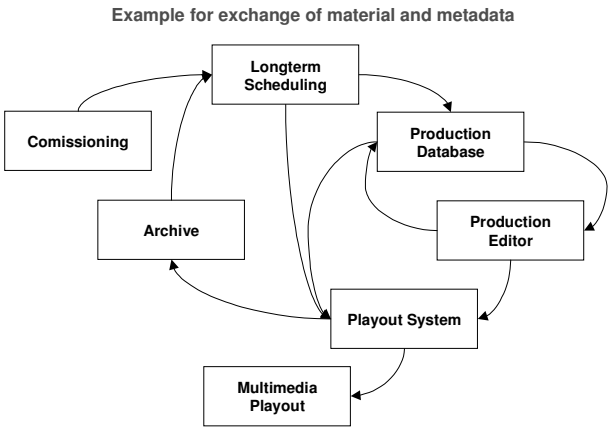

Figure [2].

5 TECHNOLOGIES

Various technologies exist to assist in the integration of metadata into the broadcast environment.

5.1 Physical

Physically, there are numerous networking solutions available although fast Ethernet is by far the most common method of connecting digital audio workstations in use today. Larger broadcasters may well use network backbone structures to handle the large volumes of data on their internal networks but solutions will normally be available to interface these with very cost-effective Ethernet.

It is common practice at present for broadcasters to have multiple removable drives carrying work in progress with dire consequences if the drive gets dropped and damaged. Once all work in progress can be stored on a central server or network of interconnected servers then a suitably robust backup scheme can be implemented, protecting these assets.

5.2 File Formats

For the simplest integration a common file format for the audio assets can be chosen, such as the AES/EBU specified Broadcast Wave Format, which will give some of the advantages referred to above.

Adopting a common file format, such as Broadcast Wave Format, can accommodate the most basic metadata integration providing originator reference and a UMID (Unique Material Identifier), which can act as the central database key. However, there may be advantages in transferring more data between the applications. For a properly integrated system that will provide real cost savings to the implementing broadcaster and real time savings to their staff a more comprehensive approach must be adopted.

5.3 Composition data

Further integration can be achieved by passing Edit Decision Lists between the workstation and the playout database and thus more accurately describe the composition of the audio in a particular broadcast. In this way the database can work out the composition of each item produced by the workstation and create its reports accordingly. A suitable Edit Decision List format could be AES31-3 or, in the fullness of time, the Edit Protocol of AAF (Advanced Authoring Format). AAF also leaves room for providing further metadata as the broadcaster's requirements change.

A potential weakness of AAF in terms of integration is the use of key-length-value (KLV) structures to describe the material. In comparison to XML based formats a large number of existing tools and interfaces cannot be used with AAF without pre-processing the information. However, the AAF Association is addressing this point by developing an XML variant of the AAF standard. Unfortunately this is not likely to be available for some time.

It will normally be necessary for the workstation to provide a consolidated playout file in any case as the playout system may be restricted to playing out single (stereo or multi-channel) files at any one time except during cross-fades.

This solution still does not provide a full solution to the requirements for DAB metadata and it is more cost effective for the implementing broadcaster to concentrate on solutions that are available rapidly rather than waiting for international committees to firm up standards.

Mpeg-7 is another metadata standard that may be taken into consideration for the envisaged integration as it allows the building up of a structure of audio segments over time. However, examples for the usage of Mpeg-7 often concentrate on the automatic or manual analysis of material (feature extraction) and not the actual tracking of asset use. Thus, the temporal structure of audio segments in Mpeg-7 may form a basis for information of the composition of a media asset as well as define time-related information for multimedia playout.

Mpeg-7 is based on XML and therefore allows easier processing and exchange with other applications and facilitates the search and transformation of the metadata, which is key to simple interoperability.

5.4 Towards full integration

By keeping all the relevant metadata online throughout the production process it becomes a much simpler task

to chase up any missing data at the time of creating the production.

If the workstation can access a database entry screen even while offline from the main database then a still closer integration is possible. Offline loading of music from CD for example can be done without access to the main music database providing that the ISRC numbers required for reporting are copied over to the main database and cross-referenced as necessary by the main database.

After discussing the requirements and obstacles of integration in the production scope it becomes evident that it is not sufficient to agree to the usage of a specific metadata format to achieve a full integration. The following levels of integration need to be harmonised to provide a solution that is future-proof:

a) definition and selection of data formats for exchange of metadata
b) interfacing applications to provide a seamless set of tools for users
c) alignment of metadata in various applications and systems
d) flexible processing and tranformation of metadata

5.5 Cost / Benefit Analysis

Although there may be costs involved in setting up and executing an integrated metadata approach within the broadcast environment, the benefits will rapidly outstrip these costs both in terms of cash flow and less tangible assets such as staff morale.

Most producers of radio broadcasts are by their very nature creative and, in the increasingly competitive market for listener figures, it is important to utilise these creative skills to the full. Tying up talented producers with tedious administrative tasks is not making the best use of these assets.

6 CONCLUSION

This paper has attempted to describe the benefits and the obstacles of integrating production editors, playout systems and other applications in the broadcast production process.

While an improved tracking of media asset use and the support of multimedia playout could be identified as benefits, the Authors have tried to show that the task is too complex to be completely automated. Accepting this fact it could be shown that integration in the production environment can support users in a domain that becomes increasingly significant for broadcast organisations - the genealogy of media assets.

Following a discussion of existing metadata standards it was shown that the agreement on a standard for metadata exchange does not automatically satisfy all challenges but must be followed by an analysis of the workflow and additional business systems involved, and by integration of applications at the user interface level.