# White Paper on UMID and its Applications[1]

Yoshiaki Shibata* and Jim Wilkinson**

*BSNC B&P Company **B&P Research Laboratories

Sony Corporation

* yoshiaki.shibata@jp.sony.com ** jhw@adv.sonybpe.com

The UMID is an international SMPTE standard with the purpose of providing a globally unique identifier for audio-visual material. While this is a key component for digital media asset management systems, it also provides a unique feature that allows it to be effectively used even in the traditional production environment. The UMID is designed as a component that allows traditional production methods to evolve seamlessly to the fully networked digital systems of the future. This paper explains the UMID data format and how it can be used in real applications with various examples for those who are not familiar with the concepts. Some detailed technical aspects of UMID operations are also discussed separately in the Annex.

## Table of Contents



---

[1] This is original text of the technology brochure distributed at Sony Booth in NAB 2002

# 1 Introduction

This paper introduces the UMID and its applications. The UMID is a Unique Material IDentifier internationally standardized by the Society of Motion Picture and Television Engineers (SMPTE [1]). At the time of writing, the publicly available specifications are [2] and [3], where the former specifies the UMID format, *i.e.*, the syntax of the UMID together with the semantics of each component, and the latter describes how to use the UMID in practical situations.

The UMID format specification was defined some two years ago. Since then, an active discussion has developed among experts in SMPTE regarding extensions to the format, the recommended guidelines of UMID operations and the development of use-case scenarios (some of which is reflected in this paper) in order to improve the quality of the current documents.

This paper is composed of four sections and one annex. This first section introduces the topic of the UMID. Section 2 gives an outline of the UMID specification based on [2], together with some of latest information. In Section 3, some UMID applications [3] are demonstrated together with some specific examples[2]. Conclusions follow in Section 4. The body of this paper is intended as a primer mainly for those who are not familiar with the subject. For those interested, Annex A summarizes some technical aspects of the UMID operations in the style of a FAQ.

# 2 Overview of the UMID Specification

## 2.1 What is the UMID?

In the future integrated networked production environment, any audio-visual materials stored in networked equipment will be readily available on-line. For reliable access to each item of audio-visual material, unambiguous identification is required. Until now, a video clip has been identified by, for example, using the tape number and time code. In the integrated networked environment, however, traditional methods cannot work efficiently, because the specific storage mechanism is hidden for the purpose of unified material management.

Another requirement for a unique material identifier is the need to support efficient meta-data operations. Meta-data that provides additional information about a specific item of audio-visual material is expected to

[2] UMID applications presented in this paper are for example only, in order to forecast the industry's trend and to provoke further discussion. Note that none of the examples are based on the actual systems/products supplied by Sony.

play an increasingly crucial role not only in the production workflow but also for enabling new broadcast services such as advanced interactive TV. While a small amount of meta-data can be directly embedded in the material itself, most meta-data will be separately stored and managed in dedicated databases. In this case, a linking tool that uniquely associates audio-visual material with its meta-data is a necessity. In order that the audio-visual material and its associated meta-data can be exported from the local network, it is essential that the identifier is globally unique to avoid the potential duplication that would arise from a locally unique identifier.

The Unique Material IDentifier or UMID has been designed to meet these requirements. While there exist other identifiers for audio-visual material and/or content such as ISAN/V-ISAN (ISO) [4, 5], CRID (TV Anytime Forum) [6] and CID (Content ID Forum) [7], the UMID identifies the material and not its editorial content. The UMID offers the following features:

- It is a globally unique identifier, which means no more than one material has the same UMID on the earth, resulting in global exchange of material and associated meta-data,
- It identifies any level of material granularity, including from a single frame to a completed final package,
- It can be automatically and locally issued, which means that access to neither a central database nor a registration authority is needed,
- It can optionally deliver fundamental meta-data, *i.e.*, when, where, and who creates each material unit[3] such as an audio AES3 frame or a video frame.
- It may be used in different applications, *i.e.*, not only as a global material identifier but also as a local identifier with some specific local applications.

## 2.2 Introduction of UMID Specifications

### 2.2.1 UMID Format

The UMID is a byte string whose length is either 32 or 64 bytes. The shorter UMID is called the “Basic UMID”, which is the core component of the identifier. The longer UMID is called the “Extended UMID” and is composed of two parts as shown in Figure 1. The first 32 bytes are the Basic UMID and the following 32 bytes, called the Source Pack[4], are provided to accommodate the fundamental meta-data providing the when/where/who of the material creation.

[3] This used to be called content unit in [2], and will be renamed in the updated document.

[4] This used to be called Signature metadata in [2], and will be renamed in the updated document.

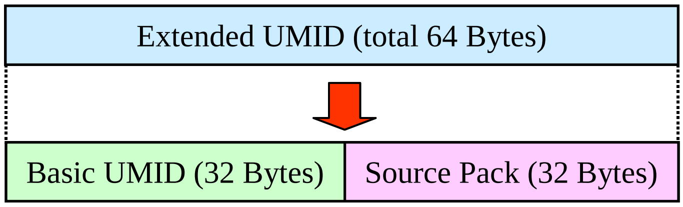


**Figure 1: Top-level structure of UMID**

The UMID may be used either as the 32-byte Basic UMID only or as the 64-byte Extended UMID. When used as the Basic UMID, it identifies any kind of audio-visual material, *i.e.*, picture material (whether compressed or uncompressed), sound material (as an audio data stream, compressed or uncompressed, multiple channels or single channel), or auxiliary data material (also known as data essence and including sub-titling data, carousel data). It also identifies certain groups of material such as picture material together with its synchronized sound.

In the case of picture data, for example, the Basic UMID may be assigned to any kind of audio-visual material from a video clip comprising a single frame up to an editorially complete production package.

The Extended UMID is provided for the identification of an individual unit of the audio-visual material, potentially including every frame of a clip or of a completed production package.

With the Extended UMID, each individual material unit (*i.e.*, a quantum duration of material such as an audio frame or video frame) can be uniquely identified where the time (when) component contained in the Source Pack varies with each material unit (See Q 1:  in Annex A for more details).

### 2.2.2 Basic UMID

The Basic UMID can be treated simply as a single 32-byte entity. In order to provide the global uniqueness, this 32 bytes string is composed of four components as shown in Figure 2 below:

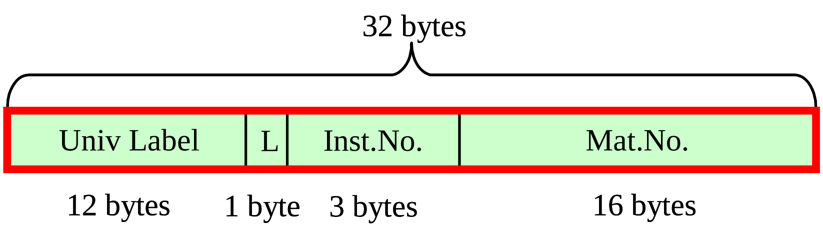


**Figure 2: Structure of Basic UMID**

- **Universal Label** (Univ Label): The universal label uniquely identifies that this entity is a UMID. The first 10 bytes are defined values based on a registered ISO label administered by SMPTE [8]. The 11-th and 12-th bytes define the type of material this UMID identifies and the creation methods of values in the components that follow this label, respectively. For example, when UMID is given to a video clip, its label might have the values of $06_h$ $0A_h$ $2B_h$ $34_h$ $01_h$ $01_h$ $01_h$ $01_h$ $01_h$ $01_h$ $01_h$ $12_h$ in hexadecimal.

- **Length** (L): This 1 byte component specifies the length of following byte string. Since 19 bytes follow in the case of Basic UMID, this component is fixed as $13_h$.[5].

- **Material Number** (Mat.No.): This 16 byte component accommodates a globally unique value, which makes the UMID a globally unique identifier. Several creation methods of the value in this component are specified in the UMID specification document [2], among which an example is given by the combination of MAC (Media Access Control) address of a device that processes a material together with the time snap at which the material is created. Because any network device (and/or network port) can be globally uniquely identified by the MAC address and only one material is to be processed and exported at a certain time snap, a material with UMID having this combination can be also globally uniquely identified. This method of creating a globally unique number is in common use in information technology systems.

- **Instance Number** (Inst.No.): This 3 byte component specifies whether the Material Number is newly created or it is inherited from the UMID of the input material. When audio-visual material is created, then its UMID needs also to be created with a new Material Number and the Instance Number with a value of $00_h$ $00_h$ $00_h$. When the audio-visual material is processed, the UMID of any exported audio-visual material has two choices: the first to be newly created as though the audio-visual material itself is something new, the second to inherit the Material Number of the UMID of the input while changing the Instance Number to be a non-zero value. In the latter case, a link between the input and the output materials is established by sharing the Material Number. This feature opens various UMID applications as discussed later in Section 3.3. The UMID specification [2] defines several methods for creating this component. One of the examples uses a central database that locally allocates a unique value of Instance Number for the UMID of each related output material.

### 2.2.3 Extended UMID

When a quantum duration of material, such as an AES3 audio frame or a video frame, needs to be uniquely identified in a material, an additional component that uniquely identifies each material unit can be added. This is achieved with the Source Pack[4] that forms the second half of the Extended UMID.

Figure 3 shows the structure of an Extended UMID with the following components:

- **"When" Component** (Date/Time): This 8-byte component specifies the date and time stamp at which a target material unit is initially created. The timing granularity for this component may be smaller than a video frame so that the value of this component can vary for each material unit in sequence[6].

---

[5] In the case of Extended UMID, this value shall be fixed as $33_h$ because of Source Pack of 32 byte long that additionally follows.

- **"Where" Component** (Alt./Lat./Long.): This 12-byte component specifies the spatial co-ordinate information associated with a target material unit. While it basically specifies the place at which a target material unit is initially created, another use of this component is to specify the position of the visual object captured by the material unit.  This component is decomposed into three parts: Altitude, Latitude and Longitude, each of which is 4 bytes long.

- **"Who" Component** (Country/Organization/User): This 12-byte component specifies who initially created the target material unit as a string of pre-registered text. This field comprises three parts, each 4 bytes long: Country, Organization and User code. The Country code component defines the country of the creator's organization based on ISO 3166-1 [9], *e.g.*, `us` (USA), `jp` (Japan), `uk` (United Kingdom), `de` (Germany), `kr` (Korea), and so on. The Organization component is an alphanumeric string that identifies the affiliation of the creator within the country defined by the country code. The UMID specification [2] encourages an organization to obtain a registered alphanumeric string from the SMPTE Registration Authority [10]. Finally the User code uniquely specifies the creator within the organization and the assignment of this local User code is left up to the organization. The standard also specifies how values for freelance users can be registered.

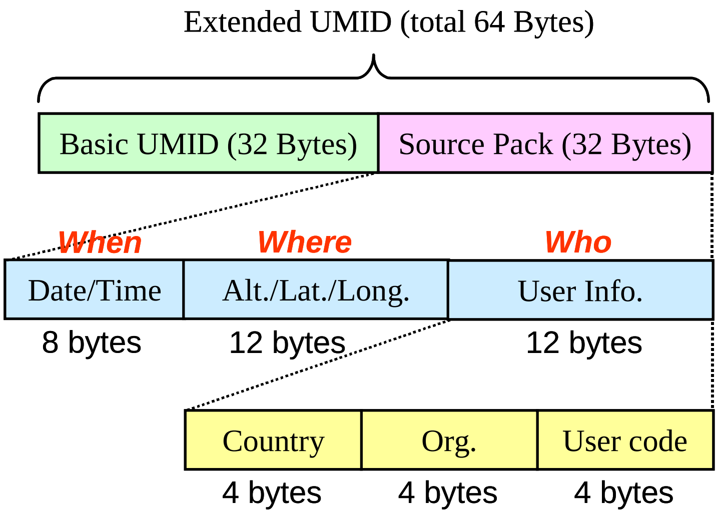


**Figure 3: Structure of Extended UMID**

While the original intention of the Extended UMID was to identify each material unit within an item of audio-visual material, it also accommodates fundamental information about the creation of each material unit that is preserved throughout the processes of the production chain. For further discussion, see Section 3.4.

[6] The specification of this component for a system having the frame rate of more than 30 fps, such as the 1080 60p system, is currently under discussion.

# 3 UMID Applications

## 3.1 Two distinct uses of UMID

In order to uniquely identify all materials produced through the production chain, the UMID needs to be *updated* at every operation step. There are two basic methods to *update* the UMID, which are associated with two distinct UMID applications as briefly discussed in Section 2.2.2.

- The first method of updating the UMID is to assign a completely new UMID, *i.e.*, one which defines a new Material Number and a zero Instance Number. Since the Material Number is a key factor that makes the UMID globally unique, the uniqueness of this UMID is guaranteed for all operations. This is the primary usage of the UMID, *i.e.*, UMID as a globally unique identifier.

- The second method of updating the UMID is to maintain the Material number value while assigning a non-zero value to the Instance Number. In this case, different instances of materials (*e.g.* copies) have UMIDs that share the same Material Number, but differ in their Instance Number. It should be noted that careful control of Instance Number updating is required so that the UMID remains sufficiently unique. In general, the uniqueness is only within a predefined controlled domain. Nevertheless, there are many cases where this method can be effectively exploited, for example, even in the traditional production environment. This method can be easily used to gather related copies of material without resource to a central database.

In the following section, some concrete application examples are given for each UMID application.

## 3.2 Application 1: UMID as a globally unique identifier

### 3.2.1 Media asset management systems

In the near future, all equipment in the production environment may be networked, allowing most processes involved in the creation and distribution of multimedia material and/or content to access audio-visual material directly through the network. An overview example of such a media asset management systems is shown in Figure 4.

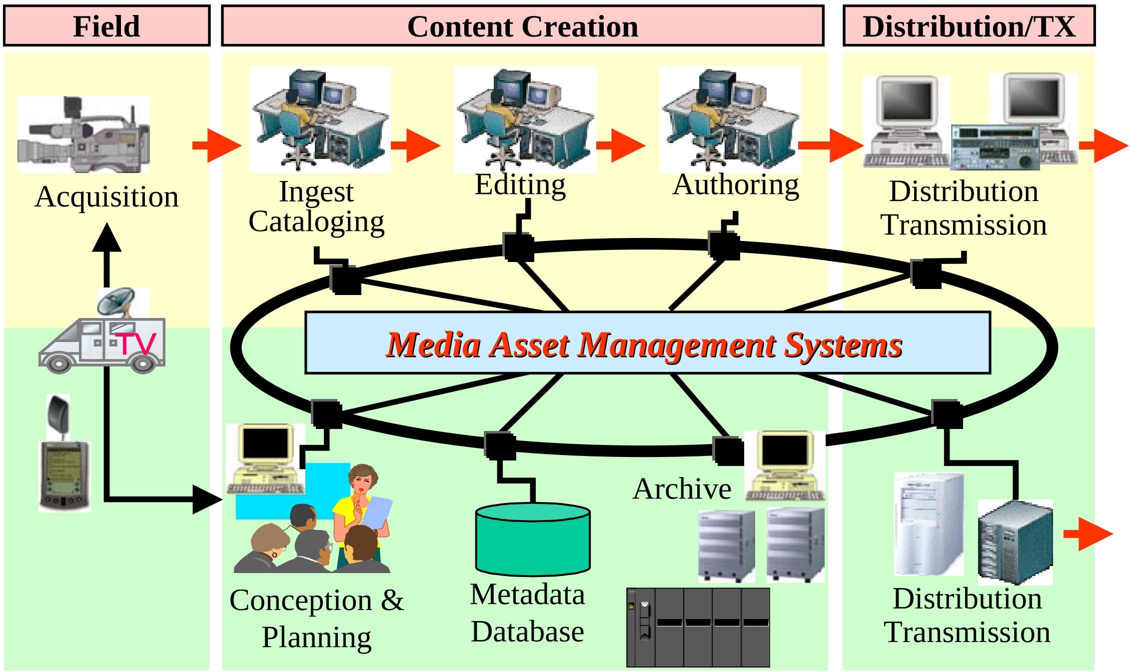


**Figure 4: Overview of future media asset management systems**

In this kind of environment, both the audio-visual material and its associated meta-data can be easily accessed on-line. While some compact, fundamental meta-data will be directly embedded into the audio-visual material data stream, most meta-data will be separately collected and managed in meta-databases so that material searches are conducted as a query to the meta-databases. This meta-data of audio-visual material may include multimodal meta-data[7] (*i.e.*, not only including textual keywords but also including non-textual data such as hand-writing, shape, movement of a visual object, human voice recognition and even semantic and/or conceptual information on objects or events captured in the material).

When audio-visual material and meta-data are managed in separate or composite systems, the material search will take two steps to finally reach a desired material. The first step will be to access the unique material identifier from a meta-database, leading to the second step of using the identifier to query for, and access, the audio-visual material from the archive or library. This is the primary purpose of the UMID.

In Figure 4, it should be noted that though all the system components seem to be located in one place, there is no inherent geographical limitation. For example, the Ingest/Cataloging may be made immediately after the acquisition in the same place, *e.g.*, in Japan. The audio-visual material and associated meta-data are then stored once in a database, *e.g.*, in USA, which is retrieved for post production, *e.g.*, in Europe. Furthermore, the system may be shared by several organizations, as all audio-visual material is uniquely identified without ambiguity through the use of the UMID.

[7] To achieve this sort of material search in an interoperable fashion, “Multimedia Content Description Interface” or MPEG-7 has been recently standardized by ISO/IEC (ISO/IEC 15938).

### 3.2.2 Field acquisitions

Another example of the association of audio-visual material and meta-data can be observed in field acquisition. Field acquisition (*Field* in Figure 4) is a first step for the creation of audio-visual material. Various valuable items of meta-data and additional auxiliary data can be also created at this step. For example, a camera person may want to judge material as good or bad by attaching the simple '*quality flag*' meta-data to key points during or immediately after the acquisition. Furthermore, it would be useful if a planning description such as a scene script or an assignment description can be immediately associated with the relevant audio-visual material during or after acquisition. Because it is the source audio-visual material that will be most frequently accessed in subsequent production steps, the capture of meta-data is vital at this step to enhance accessibility of the source material.

It should be noted that even in currently available equipment, some meta-data creation has already been implemented. The problem is that their creation in current systems is anarchic and thus reusability is very limited. Therefore it is much more preferable if these kinds of meta-data are created electronically. Furthermore, given meta-data in electronic form, an automatic association of meta-data with the captured material can be achieved with a higher degree of accuracy.

Provided with an appropriate subsystem, new acquisition work styles that enable such meta-data creation and maintenance will become rapidly popular. Figure 5 below shows one of possible such new work styles:

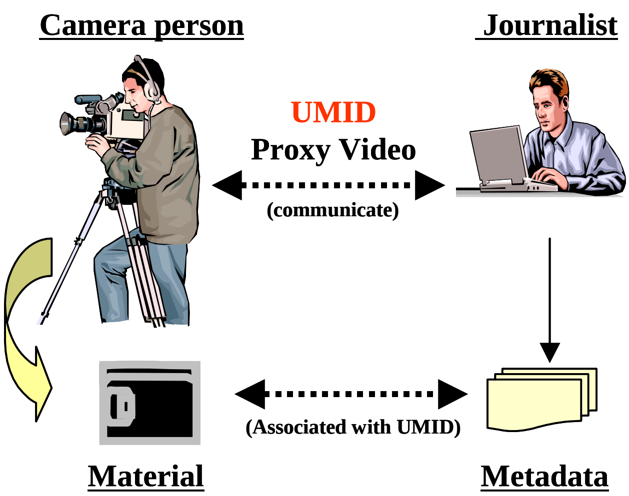


**Figure 5: Example of acquisition subsystem**

In Figure 5, a camera person is capturing audio-visual material accompanied by a journalist. In this example, a portable computer that can communicate with the camcorder is operated by a journalist to create meta-data during acquisition, and the UMID generated at the camcorder is transferred back to the portable computer. The portable computer is used, not only to create meta-data during acquisition, but also to associate the captured material with information provided before acquisition such as a scene script or an assignment description. To assist the timely insertion of meta-data such as text annotation, the camcorder may also transfer a low resolution proxy video to the portable computer in real time, so that the journalist can browse the captured video and sound at the same time as capture.

The audio-visual materials obtained in acquisition are usually stored on a tape. The associated meta-data is either stored on the tape, embedded with the audio-visual material, or stored on the portable computer. It should be noted that, even though the audio-visual material and its associated meta-data are separately stored, they are tightly linked to each other via the UMID, *i.e.*, the meta-data stored in the portable computer references to the target audio-visual material on the tape by specifying the UMID of the material. If the acquisition environment allows, meta-data, including the proxy video stored in the portable computer, may be used for further logging, and/or immediately transferred to the station for in-house operations so that the review of logging can be finished before the actual material on the tape arrives.

### 3.2.3 Traditional device migration to media asset management system

In future media asset management systems that exploit state-of-the-art network technology, server-based storage devices are expected to play a major role. However, even a traditional storage device, such as a VTR, can participate in the media asset management systems when it appropriately supports the UMID operation. A possible subsystem example is given by Figure 6 below.

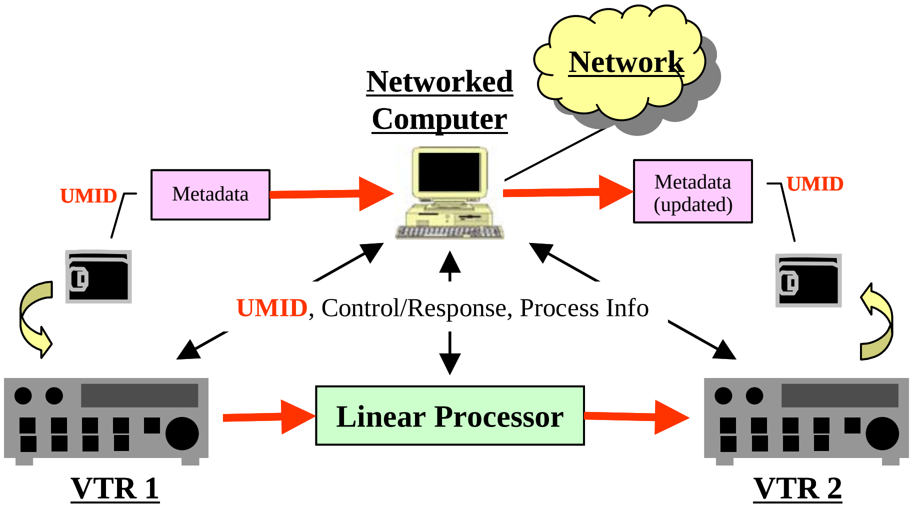


**Figure 6: Example of linear processing subsystem**

In Figure 6, two VTRs are connected via a certain linear processing device, all controlled by a networked computer. By exchanging the UMID between the VTRs and the computer, the meta-data of input audio-visual material in VTR1 will be updated to reflect information accumulated during processing and the result is then associated with the output material in VTR2.

## 3.3 Application 2: UMID as a locally unique identifier plus additional features

### 3.3.1 When should the UMID be used in this way?

In the traditional production environment with neither networked devices nor meta-data databases, the usefulness of the UMID as a simple global identifier would be limited.

As discussed in Section 2.2.2, the UMID specification [2] defines the second method of operation of the UMID, where the Instance Number is updated while preserving the Material Number. This method establishes a link between two items of audio-visual material before and after the processing through the common Material Number.

In the following sub-sections, some possible applications are demonstrated. Note that all the examples can be realized by introducing only the UMID, *i.e.*, no additional meta-data is required to achieve these applications.

It should be also stressed that "UMID ready" devices, if appropriately implemented, will support both methods of UMID operation, ether of which may be selected by, for example, a pre-set menu selector. Therefore the migration of traditional production equipment into future systems should be seamless with such devices.

### 3.3.2 For materials of the same content but different representations

In order to publish audio-visual material to various media such as terrestrial, satellite and the Internet, the material may be coded in different forms as necessary. In an environment where various formats co-exist, the format conversion will result in signals with the same audio-visual content but coded with different formats. In these situations, it would be natural to treat them as a closely related group of materials.

Figure 7 schematically show the use of UMID to meet such a demand.

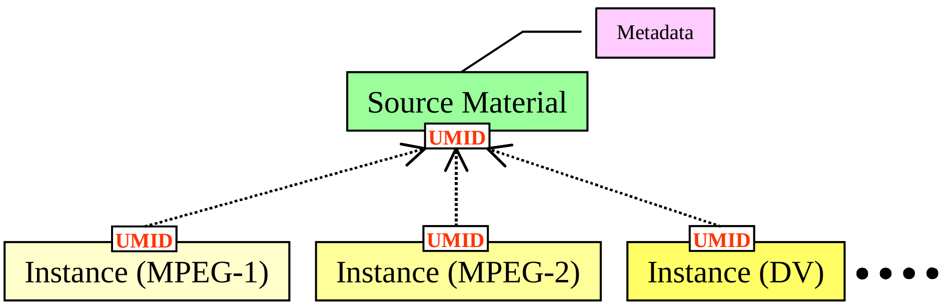


**Figure 7: UMID for grouping instances of different video format**

The UMID of the source material is closely associated with the UMID of material with different instances of video coding. This is achieved by sharing the UMID Material Number between the source material and the instances, *i.e.*, an instance of a certain video cording can be easily related to its source as well as other instances with the same audio-visual content but differently coded. Furthermore, meta-data associated with the source material can be also referenced to by the instances, which is useful especially when meta-data describes the content of source material that is shared for all instances.

### 3.3.3 For grouped and individual materials

When audio-visual material comprises data of one picture and one or more synchronized audio components, it is convenient to treat it as a single material group with one UMID. This is achieved by using a UMID whose identification type is a group of materials. In editing the material, on the other hand, it often happens that the individual components contained in the material are separated, processed independently, and then merged as the updated material. While the individual components are also required to have their own UMID as an independently accessible material, it is useful to have an association retained between the audio-visual material and its individual components.

In Figure 8, the use of UMID for this request is schematically demonstrated.

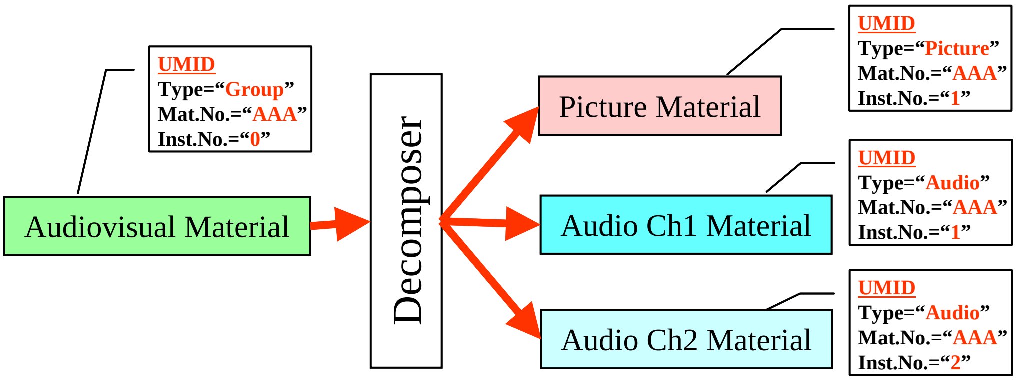


**Figure 8: UMID for audiovisual material and its inner components**

In this figure, an audio-visual material with UMID that identifies an essence group is separated into the individual components of picture or audio. In this case, the Material Numbers can be maintained, but their type identifier modified to the type of the individual component, together with the non-zero Instance Number. Since the Material Number ( "AAA" in this example) is shared by the combined material and its components, it is easy to relate components of the same combined material.

## 3.4 Applications of Extended UMID

### 3.4.1 Introduction

As discussed in Section 2.2.3, the UMID provides a placeholder to accommodate the fundamental meta-data of when/where/who originally creates the material, which is called Source Pack. While its primary intention is to uniquely identify each material unit in a sequence of material units, it can also be used for other attractive applications because once the Source Pack is created, it should be preserved throughout the processes of the production chain. A couple of particular application examples is discussed in this section.

It should be stressed that since the Source Pack is a part of the UMID specification, only the introduction of UMID itself enables those applications as demonstrated below with the "UMID ready" devices that also support the Extended UMID handling.

### 3.4.2 Efficient material search and browsing

The first example demonstrates the use of the Extended UMID for efficient material search and browsing during the content creation process.

Figure 9 shows a possible use of material browsing when the Extended UMID is embedded in the audio-visual material. The time and place information at which the material was acquired appears on the monitor. Note that since the Extended UMID is associated with every material unit, *e.g.*, a frame of material in this example, the information is continuously updated during the video play.


**Figure 9: Browsing a material with Extended UMID**

When the information in the Source Pack is utilized for material searching and retrieval, such an interface as shown in Figure 10 may be also possible.

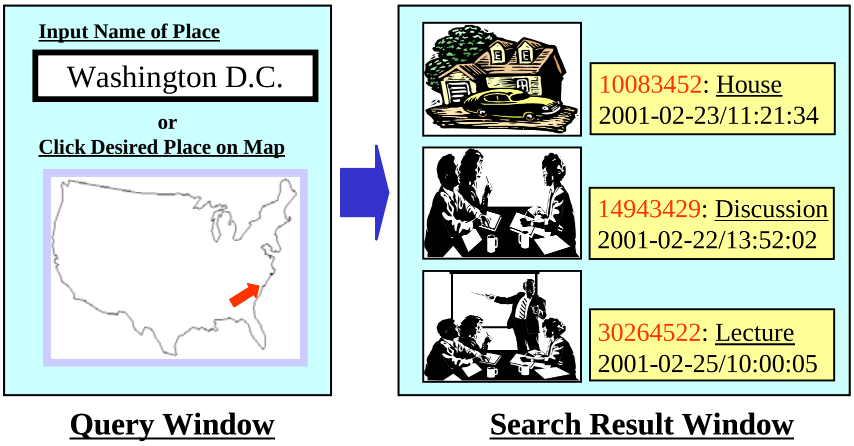


**Figure 10: Search and retrieval a material with Extended UMID**

In this application, materials are queried by inputting the desired acquisition place with either its name or the clicked position on the map as shown in the Query Window, the materials found by the query then appear as their thumbnail pictures together with their UMID, creation time, and possibly keywords if provided[8], as shown in the right side of Figure 10.

Note that, in general, the Source Pack meta-data can be automatically created and embedded into the audio-visual material during acquisition when an appropriate device such as a camcorder with a built-in GPS (Global Positioning System) unit is used.

### 3.4.3 Source material tracking

Because the information of Source Pack should be transferred *as is* through the production chain regardless of the UMID update at every step, the source information of each material unit can be obtained from any materials in the chain. Therefore, in the case of editing, an application shown in Figure 11 may be realized.

---

[8] Accommodation of textual keywords in a material is out of scope of UMID.

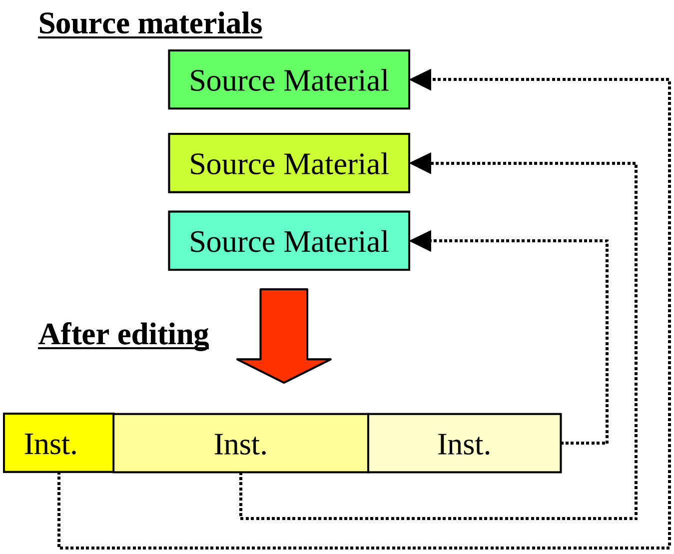


**Figure 11: UMID for tracking source materials**

In this application, three source materials are concatenated into an output package. The resulting material can be regarded as a concatenation of instances, each of which derives from its source material by a simple process such as a cut. By preserving the Source Pack in the Extended UMID through to the output, any part of the resulting material after editing may reference to its source information. Furthermore, if the UMIDs of instances comprising the resulting material and the corresponding source materials share the Material Number, any part of material after editing may also reference back to its original material unit in the corresponding source material.

For the treatment of the UMID in an editing process that combines two or more source signals into a single output such as occurs, for example, in a cross-fade, see Q 7: (i) for more discussion.

## 4 Conclusions

The UMID is a unique audio-visual material identifier internationally standardized by SMPTE as SMPTE 330M. The UMID is primarily intended to identify any audio-visual materials generated in the production chain with a globally unique number. It will operate not only as a key component in future networked media/material asset management systems to separately identify each item of audio-visual material, but also as a data management tool to associate any item of audio-visual material with its related meta-data. Additionally, the UMID has a number of unique capabilities that differentiate it from other material/content identifiers. By exploiting its capability to link related materials, various interesting applications beneficial even to the traditional production environment can be realized.

While there are two distinct operational uses of the UMID, “UMID ready” devices that should support both uses, either of which may be selected by, for example, a pre-set menu selector, will play a key role in enabling the seamless migration of the traditional non-networked production environment to fully networked future asset management systems.

Although various unique identifiers have been used in some asset management systems, one key property of the UMID is that it also uniquely identifies itself by using the Universal Label in order to separate it from any other identifier. Furthermore, it is internationally standardized to provide a globally unique identifier that can be used both to manage audio-visual material within any one system and to exchange audio-visual material, together with its UMID and any associated meta-data, between systems on a global scale while maintaining globally unique identification of the audio-visual material and its associated meta-data.

## Acknowledgements

The authors would like to thank Mr. Mike Cox (Mirador Techniques, UK) for his valuable assistance in the preparation of this paper.

## References

1 http://www.smpte.org

2 SMPTE Standard 330M-2000 for Television – Unique Material Identifier (UMID)

3 SMPTE Recommended Practice RP 205-2000 – Application of Unique Material Identifiers in Production and Broadcast Environments

4 ISO 15706: Information and documentation – International Standard Audiovisual Number (ISAN)

5 ISO/PWI 20925: Information and documentation – Identifier for versions of audiovisual works (V-ISAN)

6 http://www.tv-anytime.org/

7 http://www.cidf.org

8 ANSI/SMPTE Standard 298M-1997 for Television – Universal Labels for Unique Identification of Digital Data

9 ISO 3166-1:1997, Codes for the Representation of Names of Countries and Their Subdivisions – Part 1: Country Codes

10 http://www.smpte-ra.org/

# Annex A – Technical aspect of the UMID operations

In this annex, some technical aspects of UMID operations are discussed in the style of a FAQ.

**Q 1: What do the Basic and Extended UMID identify, *i.e.*, what is the scope of each identifier?**

As is discussed in Section 2.2, the Basic UMID identifies a single item of audio-visual material, *e.g.*, a video clip of any duration, while the Extended UMID identifies each material unit in the audio-visual material, *e.g.*, an audio AES3 frame or a video frame. This is schematically illustrated in Figure A-1 below:

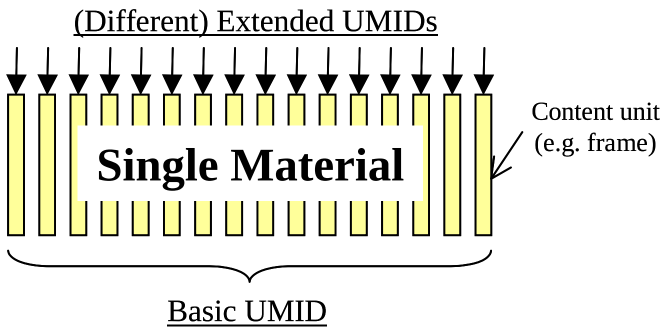


**Figure A-1: Material to be identified by UMID**

As shown in Figure 1, the Extended UMID is composed of the Basic UMID and a Source Pack, the latter is introduced to identify audio-visual material at finer granularity, *i.e.*, the material unit. In other words, there is a double layered structure: the first layer to identify a material as a whole and the second layer an individual material unit through its Source Pack. Based on this design policy, a constraint is introduced that, for any audio-visual material in which the Extended UMID is attached to each material unit, the Basic UMID contained in all of the Extended UMIDs in the audio-visual material should be the same value so that it can identify the material as a whole without ambiguity.

**Q 2: How to deliver UMID during material transfer?**

SMPTE standard documents provide the data transports for both the Basic UMID and the Extended UMID.

For the SDI (Serial Digital Interface), the UMID is one of the KLV (Key-Length-Value [A1]) encoded meta-data items that can be packed into SMPTE 291M Ancillary Data packets [A2]. These packets may be located in the horizontal blanking area of the SDI (known as H-ANC), or the vertical blanking lines (know as V-ANC).

In the case of SDTI-CP (Serial Data Transfer Interface – Content Package [A3]), the SMPTE standard [A4] specifies that the UMID be packed in the System area with the Type identifier value of $83_h$. The UMID may be placed either in the Package meta-data block when it is the UMID for all Items in the Content package, or it may be placed in the Picture, Sound or Auxiliary meta-data blocks when it is associated with only one essence element (*e.g.*, the video only).

In the case of MXF (Material Exchange Format [A5]), the UMID is a fundamental part of the specification and is contained in the Header meta-data as part of the structural meta-data. The UMID may also be contained in the System Item of each Content Package in the Generic Container in the same way as defined for SDTI-CP.

### Q 3: When to update the UMID?

In principle, the UMID needs to be updated at every operational step to distinguish all material items generated through the production chain. Updating the UMID depends on the application as discussed in Section 3.

More specifically, as shown in Figure A-2, it is the responsibility of each device to transfer audio-visual material with the updated UMID to the subsequent device.

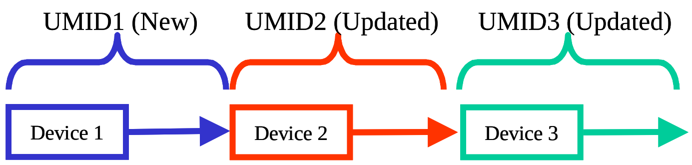


**Figure A-2: When to update UMID**

In each case of recording, the recording device should update the UMID of a material *before* recording, *i.e.*, it is a material with the updated UMID which is to be stored on media, and it is transferred *as is* when played. Based on this UMID operation, the UMID collision can be avoided even when a material is transferred and recorded simultaneously by more than one device via a router.

### Q 4: What happens to the UMID when only a small portion of the material is modified ?

This is a controversial issue but there are a couple of possible solutions. One is to update the UMID of, not only the partially modified part, but the entire clip. Another solution is to retain the old UMID even for those parts that are modified.

While the first solution seems like a good working principle, there are many cases when this is unrealistic. In particular, when the Extended UMID is embedded in a data stream, *e.g.*, at every frame. In this case, modification of only one frame results in updating the UMID of all the remaining frames contained in the material, as shown in Figure A-3. This is obviously hard to achieve especially for the traditional linear recording devices such as a VTR.

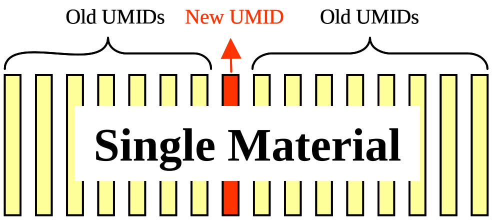


**Figure A-3: UMID update when partially modified by overwriting**

While the second solution might look strange, it does make sense when a clip is either already associated with many external entities over a system or not referenced at all. This may be understood by the analogy to a computer file system:

In most computer file systems, when a new file is created, a file node with a structural system component are dynamically created to uniquely identify a file and to manage its attributes in the system. The file node is preserved as is as long as the file exists no matter how the file content is modified by overwriting, though most of file attributes contained in the file node will be updated to reflect the modification. This is done in order to improve performance. Suppose, however, that the file node needs to be recreated even when only a small part of file content is modified. This would degrade the system performance by unnecessarily releasing and reallocating memory for the file node. Furthermore, when a certain item in the file node is referenced to by other parts of an operating system, the reference also needs to be updated in order to keep the system consistency. In other words, the operating system should always manage all the references to the file nodes.

If the UMID and its material are respectively regarded as the file node and the file content, the solution to retain the old UMID would be effective, especially in any environment without a database that manages the association between any material and its external meta-data.

**Q 5: Can the UMID be only applicable to a new material created by the "UMID ready" capturing device?**

No. Any legacy materials without a UMID can be introduced into "the UMID world" when it is processed with the "UMID ready" devices. As discussed in Q 3: the UMID needs to be updated before a material is recorded. This is interpreted that a material without UMID will be attached with a newly created UMID before its being recorded. The source pack may be also created and attached before the recording (when applying the Extended UMID) though it would contain the information regarding the initial introduction of the material to the UMID world rather than the information on when/where/who originally creates the material.

**Q 6: What happens when a material is backed up, or stored in media archive?**

In principle, the UMID needs to be updated even when a material is fully duplicated. However, this does not need to be applied to the backed up materials and/or materials stored in media archive. In other words, an identical material including UMID may be stored in the backed up storage and/or archive.

The consistency of UMID operations is maintained when the backed up materials are regarded out of scope of the UMID based management domain. Note that, since the UMID needs to be updated before being recorded, a material retrieved from the backed up storage and/or archive should have the updated UMID, which is different from the UMID of a stored material. Furthermore, by storing meta-data associated with any material to be archived into the meta-data database *as is*, the association between the stored material ant its meta-data may be also preserved, which enables the two-step media archive systems discussed in Section 3.2.1.

### Q 7: What is an overview of UMID behavior in the production chain?

Figure A-4 schematically illustrates the UMID behavior in the production chain.

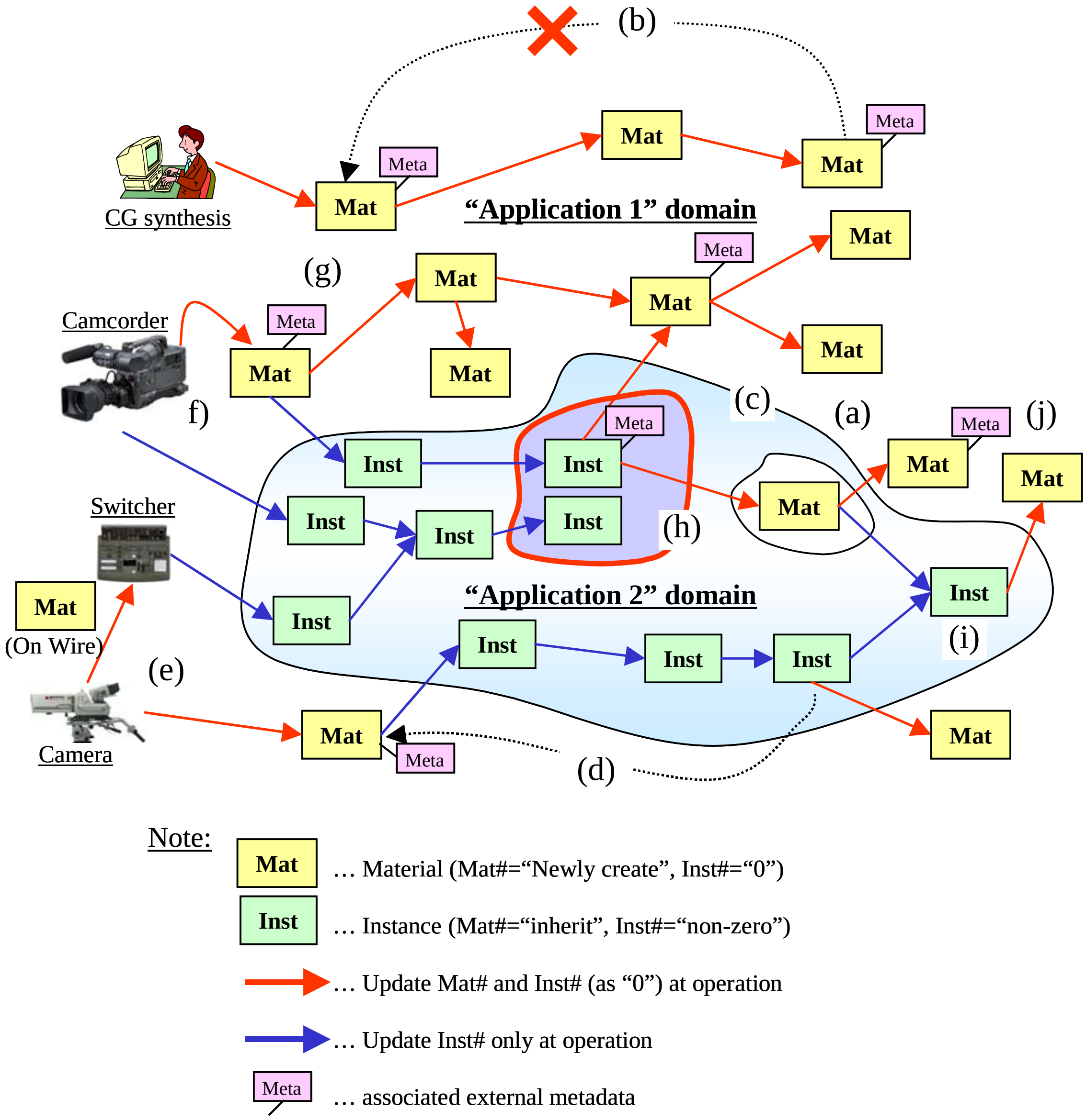


**Figure A-4: UMID operation in the production chain**

In the figure, the Material (yellow box with "Mat") represents an item of material with a UMID having a new Material Number while the Instance (green box with "Inst") represents the case of inheriting the Material Number. The red and blue arrows in the figure indicate the UMID updates at certain operations for Application 1 and Application 2, respectively. Note also that some materials are associated with external meta-data, which is represented with the attached purple box with "Meta" label.

The alphanumerical labels inserted in Figure A-4 indicate as follows:

(a) Application 1 is applicable anywhere, including even within Application 2 domain (See (c) below), because it guarantees all the Materials in the domain to be globally uniquely identified,

(b) No link to a source material is established in Application 1, which should be compensated by other method if desired,

(c) Application 2 is applicable to a certain closed domain in which the local uniqueness of UMID for the Instances is appropriately managed,

(d) A link to a source material is always established for the Instances in Application 2,

(e) A material just created by a camera and exists on the wire cannot be the Instance because of no Material Number to be inherited, while it will be recorded either as the Material or the Instance depending on applications,

(f) It depends on the UMID application whether a material recorded by a camcorder is regarded as the Material or the Instance though in most cases its being regarded as the Material will work without breaking the system consistency,

(g) A material regarded as the Material can be associated with meta-data that exists anywhere in the world,

(h) A material regarded as the Instance can be associated with meta-data that exists within a controlled domain where the local uniqueness of the UMID for the Instances is appropriately managed. On the other hand, meta-data associated with a source material may be also associated with the Instance that derives from the source material (See (d) above),

(i) In Application 2, even a material synthesized based on more than one source material may be regarded as the Instance that inherits the Material Number of one of the source materials according to, *e.g.*, their contributions in data size, etc. Furthermore the one composed of more than one concatenated materials is regarded not as a single material but as a concatenation of the Instances of source materials. The treatment of the Source Pack may also follow the same policy (See Section 3.4.3),

(j) Application 2 is only applicable to a certain closed domain, which indicates that a material to be exported from the domain should be made as the Material, *i.e.*, to assign a UMID with a new Material Number to the material in order to guarantee its global uniqueness out of the domain.

**Q 8: What happens to UMID in the Live environment?**

The UMID behavior demonstrated in Figure A-4 is applicable even to the Live environment, which means, in principle, the UMID needs to be updated at every operation.

However, since it would not be so useful for a material only temporally existing on the wire to be either globally uniquely identified or associated with external meta-data, an appropriate simplification of UMID operation may be allowed for live devices such as a switcher as long as the consistency is kept for the UMID of the resulting persistent materials on recording media. While it would depend on the overall system design, a live device that let UMID pass through without destruction is expected to satisfy most of the requirements of UMID handling.

## References

A1 SMPTE Standard 336M for Television – Data Encoding Protocol using Key-Length-Value.

A2 SMPTE Recommended Practice RP xxx – Packing KLV Encoded Meta-data and data Essence into SMPTE 291M Ancillary Data Packets.

A3 SMPTE Standard 326M-2000 for Television – SDTI Content Package Format (SDTI-CP)

A4 SMPTE Standard 331M-2000 for Television – Element and Meta-data Definition for the SDTI-CP

A5 Proposed SMPTE Standard for Television – Material Exchange Format (MXF) series