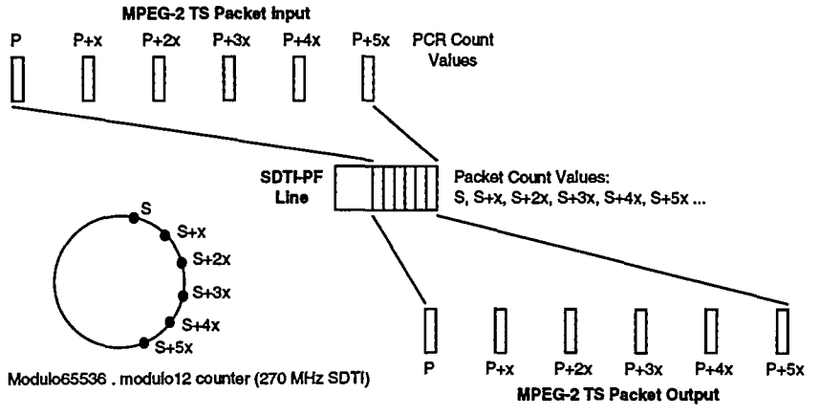

Figure A.1 – SDTI-PF timing reconstruction

Annex B (informative)
System delay considerations

The SDTI line is generally packed with as many packets as the SDTI can manage. This ensures that SDTI lines are not wasted and thus the maximum number of lines is available for the transfer of other data.

The following examples are based on 270-Mb/s SDTI-PF carrying MPEG-2 TS packets:

At a bit rate of 4 Mb/s, approximately 15 lines per frame (525/60) are used for the carriage of MPEG-2 TS packets and the SDTI-PF codec delay is just over 2 ms.

At a bit rate of 50 Mb/s, approximately 185 lines per frame (525/60) are used for the carriage of MPEG-2 TS packets and the SDTI-PF codec delay is thus reduced to around 200 µs.

To a first approximation, the SDTI-PF codec delay is inversely proportional to the bit rate. Thus at low bit rates, delay can only be reduced by reducing the number of TS packets per line and thus occupying proportionately more SDTI lines. If the 4-Mb/s example above occupied only 1 TS packet per line, then the delay would be reduced to approximately 400 µs.

Annex C (informative)
Bibliography

SMPTE 331M, Television — Element and Metadata Definitions for the SDTI-CP

Forthcoming SMPTE 335M, Television — Metadata Dictionary

DVB, Interfaces for CATV/SMATV Headends and Similar Professional Equipment; Asynchronous Serial Interface (ASI)

IETF RFC 1112, Host Extensions for IP Multicasting, 1989

ISO/IEC 13818-2, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Video

ITU-T I.361, Broadband ISDN ATM Layer Specification, 1992

PROPOSED
SMPTE RECOMMENDED PRACTICE

SDTI-CP MPEG Decoder Templates

1 Scope

This practice defines decoder templates for the encoding of SDTI content packages (SDTI-CP) with MPEG coded picture streams.

The SDTI-CP comprises a standard for the package format and a further standard for the definition of elements and metadata. The combination of these two standards results in a very flexible means of transferring content over the SMPTE 305M (SDTI) transport which would demand an unnecessarily complex receiver/decoders if all possibilities were met. The purpose of this practice is to provide appropriate limits to the requirements for a receiver/decoder in order to allow practical working devices to be supplied to meet the needs of defined operations.

Additional MPEG templates are expected to be added to this practice as the standard matures. It is recommended that each new template is a superset of previous templates so that any decoder defined by a template in this document can operate with both the defined template and all subsets.

2 Normative references

The following standards contains provisions which, through reference in this text, constitute provisions of this practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

AES3-1992, Digital Audio Engineering—Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

ANSI/SMPTE 298M-1997, Television — Universal Labels for Unique Identification of Digital Data

SMPTE 12M-1999, Television, Audio and Film — Time and Control Code

SMPTE 305M-1998, Television — Serial Data Transport Interface

SMPTE 326M, Television — SDTI Content Package Format (SDTI-CP)

SMPTE 328M, Television — MPEG-2 Video Elementary Stream Editing Information

SMPTE 331M, Television — Element and Metadata Definitions for the SDTI-CP

ISO/IEC 13818-2:1996, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Video and Amendment 2:1997 (MPEG-2, 4:2:2@ML)

ISO/IEC 13818-2:1996, Amendment 2:1997 (MPEG-2, 4:2:2P@ML)

3 General

This practice defines templates for SDTI-CP decoders based on MPEG picture coding. All templates defined in this document shall have the class name of MPEG template with a value of 01_h.

The template is identified by ANSI/SMPTE 298M, universal label, having the names and values as defined in table1.

Table 1 – Specification of the MPEG content package label

Byte No.	Description	Value (hex)
1	Object identifier	06_h
2	Label size	$0E_h$
3	Designation: ISO	$2B_h$
4	Designation: SMPTE	34_h
5	Registry: Wrappers	03_h
6	Registry: Simple wrappers	01_h
7	Standard: Content package	01_h
8	Version number	01_h
9	Template class: MPEG-2	01_h
10	*Template type*	XX_h
11	Template extension	XX_h
12–16	Zero fill	00_h

The default case of the template type value is 00_h, which defines no exclusive decoder template type shall apply from this document. A non-zero template type value indicates a template type specified in this document. Specification of a non-zero template type value defines that the content package meets an upper encoding limit in terms of operation modes in combination with the elements and metadata types. A non-zero template type also defines the minimum performance of a suitable decoder. Therefore, a template type defines the lowest capabilities of an SDTI-CP decoder so that an encoder can always expect a predefined performance in absence of any other specific information.

There are cases where an encoder may have prior knowledge of a decoder capability beyond the specified decoder template. This is particularly true in closed systems where decoders have a known performance. An encoder may encode more than is defined by the decoder template with such prior knowledge. Clearly, caution should be exercised if any encoder encodes more than the decoder template as unexpected effects may occur dependent on the decoder.

To define whether an encoded content package lies within, or exceeds, the template type, the universal label has a template extension word. This word is set to 00_h if the content package lies within the limits set by the template type value. The template extension word may be set to 01_h if the content package exceeds the defined template type under the following conditions:

– the extensions are backwards compatible and will not cause decoder failure of those elements and metadata which lie within the template; and

– the set of extensions do not cause the content package to fall under another template type.

4 MPEG-2 baseline template

This template is provided for receiver/decoders operating with MPEG-2 4:2:2P@ML encoded pictures accompanied by an 8-channel uncompressed audio capability. It specifies a receiver/decoder capable of only basic operating modes.

This template type has the value of 01_h.

Receivers/decoders specified to this template shall meet or exceed the capabilities specified below.

4.1 Format capability

The minimum decoder format compliance is specified below.

The following list defines the format limitations of this template:

– Transfer modes: 0 (synchronous) only.

– Timing modes: 0 (normal) and 2 (dual).

– No multiplexing (channel handle = 0000_h).

– Forward error correction is supported (FEC active flag = 1).

– The order of items shall be system, picture, audio, and auxiliary.

– Operates only on SMPTE 305M at 270 Mb/s.

4.2 Element types

The minimum list of element types which shall be decoded is as follows:

– One MPEG-2 video stream element according to element definition 6.1, type: 01_h. The MPEG picture coding is limited to MPEG-2 4:2:2P@ML and MPEG-2 MP@ML according to ISO/IEC 13818-2 (video) and ISO/IEC 13818-2 amendment 2 (MPEG-2 4:2:2P@ML). The element may contain user data according to SMPTE 328M.

– One AES-3 8-channel audio element according to element definition 7.1, type: 10_h. This template supports only uncompressed AES-3 audio.

– One general data auxiliary element according to element definition 8.3, type: 22_h.

4.3 Metadata types

The minimum list of metadata types which shall be decoded as follows:

– SMPTE 12M time code metadata according to metadata definition 9.2, type = 81_h.

– MPEG-2 picture editing metadata according to metadata definition 9.5, type = 84_h.

– AES3 audio editing metadata according to metadata definition 9.6, type = 85_h.

PROPOSED SMPTE RECOMMENDED PRACTICE

RP 205

Application of Unique Material Identifiers in Production and Broadcast Environments

Contents

1 Scope

This practice defines the use in service of unique material identifiers (UMIDs) in production and broadcast environments. The UMID is one of a number of unique identifiers defined in the forthcoming SMPTE metadata dictionary, SMPTE 335M. The UMID separately identifies picture, audio, data, and other essence.

It includes requirements for the unique identification (tagging) of essence to enable its reliable access and tracking at appropriate levels of granularity.

It outlines the fundamental role of the UMID in preserving bidirectional links to the metadata associated with the essence as well as example usage of the UMID's relationship with other identifiers (for example, a unique program identifier) used in the production processes.

2 Normative references

The following standards contain provision which, through reference in this text, constitute provisions of this practice. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE 330M, Television — Unique Material Identifier (UMID)

Forthcoming SMPTE 336M, Television — Data Encoding Protocol Using Key Length Value

3 Underlying principles

The UMID is the core component in tagging essence to make reliably possible both its tracking-in systems and speedy access to them. Its sole purpose is to provide globally unique identification of material through the entire production chain from acquisition to emission to enable the reliable linking of essence with its metadata.

3.1 The UMID is the major element in enabling the linking of essence with metadata generated by processes and systems.

3.2 The UMID is used both to enable the location of associated metadata given only the essence and to locate the essence given the results of a search on distributed databases containing metadata.

3.3 UMIDs are referenced at the clip or file level.

3.4 A system purpose is that the UMID enables system complexity to be hidden from the user.

3.5 Human-readable intelligible data can be provided within the extended UMID for the purpose of providing sufficient information to assist in attempts to reestablish broken links with disparate databases.

3.6 On passing from stream to file and vice versa, metadata may require specific processing.

In all circumstances, the UMID itself is sacrosanct; it is never altered.

4 Requirements

4.1 Global uniqueness

4.1.1 The fundamental requirement of the UMID is that it is globally unique.

4.1.2 A UMID material number is created and allocated for a specific piece of contiguous essence (that is, for a specific media asset such as a clip or file).

4.1.3 The essential metadata which can be encapsulated as an extension to the basic UMID is to provide a signature so that data recovery can be attempted in an emergency (as 3.5 above). Any meaning embedded in the UMID material number is accidental to the method of creating it and its deconstruction to recreate meaning is deprecated.

4.1.4 To ensure differentiation between duplicate numbers generated by different identification schemes, the SMPTE label prefixing the UMID material number includes registered types of unique identifiers from the forthcoming SMPTE metadata dictionary (including ISBN/ISAN/UPID/UMID [SMPTE 335M]). This will also enable both existing and future material to be handled by systems.

4.2 Consistency

Operational consistency in the use of UMIDs and associated metadata is essential. For example, specific rules for the treatment of UMIDs on multiple streams inputting to a process must be determined and applied consistently.

4.3 Granularity

4.3.1 A basic UMID will always be generated at the start of creation of each new clip. Legacy material will have a UMID allocated at the earliest point of essence processing.

4.3.2 The frequency of UMID insertion will depend on user application and usage since, in some cases, time or positional information (extracted from the extended UMID) will be important. In streaming applications, insertion frequency will need to take into account factors such as the available bandwidth, particularly for audio and data essence. Similarly, for storage applications, considerations such as file chunking, database structures, and searching criteria, network traffic and access time must be taken into account.

4.3.3 For pictures, identification is referenced to the level of a shot or equivalent. Identification of the individual frames within a shot is possible by combining the UMID material number and an associated time reference (for example, from time data within the extended UMID or from linked metadata such as time code) to give a lower-level definition than the basic UMID material number. Note however that a shot may be a single frame. For this reason, any process which generates a new instance of an extended UMID must preserve the time stamp within it.

4.3.4 For audio, the equivalent level of referenced granularity is a clip. As for pictures, finer granularity is possible by combining the UMID material number and an associated time reference.

4.3.5 For data with associated audio or video, combining the data's UMID material number and associated time references from the audio or video may best meet the user requirement.

4.4 UMID generation

4.4.1 UMIDs can be generated automatically and dynamically in any capture location without prior or current reference to a central authority. UMID metadata fields for which values cannot be accurately determined or guaranteed are filled with zeros. In the case of equipment in fixed locations, it may be practical to manually allocate accurate fixed location and other details; this would be a one-off requirement at installation.

4.4.2 Any technical process which results in the creation of a new configuration of essence for intellectual reasons (that is, editorial and/or creative), such as for instance by cropping, grouping, or rearranging, requires the allocation of a new UMID for each of the essence types involved.

4.4.3 There is no fundamental relationship between UMIDs for different types of essence; thus, for example, an uninterrupted original sound track accompanying a continuously edited video sequence will involve one audio UMID and multiple video UMIDs.

4.5 UMID linking

4.5.1 It is essential for both operational and legal reasons that essence can be identified and its metadata referenced at any point in the production chain. Hence, UMIDs must move through the chain with their essence and be inviolate.

4.5.2 Where a new UMID is generated, it is essential that the UMIDs of both the original material (containing the number of the earliest extant form of the material) and the UMIDs of the immediately preceding material used to generate this new UMID are entered in the associated metadata for each of the essence types involved. In the case of a mix or montage, there could, therefore, be many metadata entries. Note that in some applications, granularity metadata, such as in- and out-points, will also need to be carried through processing.

4.6 Persistence

A UMID is persistent as metadata beyond the life of its essence. This ensures correct referencing of metadata in archival and legal material.

5 Example usage

5.1 UMIDs and UPIDs

The following proposals are sample statements illustrating the relationship between the unique material identifier (UMID) and a possible unique program identifier (UPID).

5.1.1 When a program is first commissioned, it will probably be allocated a unique program identifier (UPID). At this stage, the UPID does not relate to any essence and is used to track paperwork associated with the commissioned program.

5.1.2 UPIDs can be registered and allocated by different program makers and broadcasters without the need to maintain global uniqueness or a

common format. If a program is moved from one organization to another, the receiving organization is at liberty to apply its own UPID to the material — only the UMID is inviolate. Links in the database(s) of metadata referring to the program should track the connection between original and new UPIDs.

5.1.3 At the point of capture, the UPID given by the original commissioning body can be recorded in the metadata associated with the captured essence and linked to by the UMID. Each UMID may be linked to any number of UPIDs, or none at all if the material is for archival storage only. Alternatively, material received from the field, for instance, amateur and freelance sources, can be logged against the UPID, linked again by the UMIDs.

5.1.4 When the final edited version of the program is completed, a link is made between the final set of UMIDs and the UPID. The UPID itself does not replace the UMID, being an entry in the metadata tables linked to the program essence.

5.2 Video program production

5.2.1 Captured material is allocated UMIDs on a shot-by-shot basis. Any ancillary metadata, including commissioning metadata if available, is entered into the field recording system referencing the UMIDs. Metadata may be wrapped or embedded with the essence or retained in a database linked to the essence by the UMID.

5.2.2 During editing, new UMIDs will be created. The history will be incorporated within the metadata wrapped or embedded with the essence or may be retained in databases linked to the essence by the UMID. The tracking of the editing process and heritage is an application function rather than a core function of any metadata specification.

5.2.3 Off-line editing at reduced resolutions is essentially a work-in-progress process with its own UMIDs. During the conforming process, material numbers are preserved, but instance numbers will be changed and nonzero on the conformed material.

5.2.4 In order to retain the clarity of this concept and to remove any ambiguity, there is no provision

within the UMID itself to indicate versioning. Any change to the essence which results in a new, stored version requires the issuing of a new UMID; for example, the correction of a spelling mistake.

5.2.5 When the completed editing process produces a final program, this is fundamentally no different from any other edit, and the new essence is allocated a new UMID.

5.3 Rights

5.3.1 Context

The growth in demand for program content, growing awareness of its value, and the availability of new technology to exploit it is leading to pressure for increased protection of creator's rights (for writers, performers, specialist cameramen). Interactive viewing and greater control over usage of content by the end consumer exacerbates the rights issues and hence the pressure for protection.

This leads to a demand for ownership accounting at finer levels of granularity than ever before, across more distribution outlets, and functional within domains subject to increased automation.

5.3.2 UMID requirements

5.3.2.1 Rights metadata must, therefore, be capable of association with the UMID of any elemental essence at any level of granularity; e.g., program, shot/clip, frame.

5.3.2.2 For management of primary and secondary distribution rights (without reversioning), the relevant UMID is at program or item level. Versioning is defined as where creative change takes place to meet differing program objectives — for instance, different audiences or time slots.

5.3.2.3 For management of contributor rights through reversioning, extracts or reediting, the relevant UMID is at shot, still, or clip level, with the capability to identify single frames.

5.4 Research

5.4.1 Background

5.4.1.1 The process of making programs is a creative one, reliant on the spawning of ideas, conceptual thought, and human creativity. Editing is a late stage in this process and playout is irrelevant to it.

5.4.1.2 The key to the early formative stages in the process of realizing a completed program from the initial idea is the undertaking of detailed research, usually by a small team of research staff dedicated to the individual program. An organization's archive is its most important asset in finding already validated authoritative background material, in avoiding unnecessary and expensive duplication of work already done in both production based and technology based skill areas, and in minimizing payment of rights and royalties to third parties.

5.4.1.3 Because sources are currently diverse and researching an anarchic process, much of the current researcher's art is based on tacit knowledge gained from experience of the methodologies most likely to yield the best results. Contacts lists, information sources, and useful media are, as a result, jealously guarded even within one organization.

5.4.1.4 Significant added value can be realized from archived material if the data held about it can be readily and unambiguously accessed so that footage can be repurposed for new programs, previously validated research work accessed, and information about previous or potential research sources readily found.

5.4.2 UMID requirements

5.4.2.1 The UMID must, therefore, be capable of being used as the key to metadata stored on distributed databases across an organization, much of which will not be wrapped or embedded with the essence — researcher's notes and scripts for instance — but which needs to remain associated with it if the full value of the archive is to be realized.

5.4.2.2 The use of the UMID will be bidirectional; it will be used both to recover all the metadata and essence of a clip given the UMID and to

determine the UMID of a clip as a result of having searched the databases on other metadata parameters.

5.4.2.3 The UMID must always lead back to the clip in its earliest extant, unchanged form. Usually the original source material will be required if any portion of the video shot/audio clip is to be repurposed for use in a new program.

5.4.2.4 The UMID must be robust. It must not be affected in any way by other processes subsequently performed on the clip for any purpose whatsoever.

Annex A (informative)
Bibliography

ANSI/SMPTE 298M-1997, Television — Universal Labels for Unique Identification of Digital Data

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