Final Report
R30 Technology Committee
Study Group on Content Identifier Harmonization

Final Draft
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1.0 Introduction & Terminology

This is the final report of the findings of the R30 Study Group on Content Identifier Harmonization. The purpose of this study was to understand the scope and purpose of each of several identifiers being defined and used in the television industry.

1.1 Terms

Content – **Material** and any associated **Metadata**.

Essence – any data or signal necessary to represent any single type of visual, aural, or other sensory experience independent of the method of coding.

Identifier – A symbol that serves to identify, indicate, or name a body of data.

Instance – a specific occurrence of **Content** or **Material.**

Label[1] – an **Identifier** once it has been bound to its **Material.**

Locator – information that specifies a location, and possibly time of availability, where a **Content Instance** can be acquired.

Material – any one or any combination of picture (or video) essences, sound (or audio) essences and data (or auxiliary) essences.

Metadata – that data which convey information about **Material**. For example, information about identification, essence decoding, timelines, intellectual property, business operations etc.

Version – A particular form or variation of an earlier or original **Work**.

Work – A completed artistic creation, produced or accomplished through the effort, activity or agency of a person or group.

For a more detailed background discussion of essence and metadata, please see [1].

2.0 Overview of the Identifiers

This section provides an overview and purpose of the four major identifiers considered in this report:

- cIDf Content IDentifier (CID)
- ISO Versioned International Standard Audiovisual Number (V-ISAN)
- SMPTE Unique Material Identifier (UMID)
- TV Anytime Content Reference Identifier (CRID)

Each identifier is discussed in more detail in the sections that follow. The material in this section was either extracted from the respective standards documents, or was provided by a key contributor of the working group that defined the identifier. Other than attempting to align the terminology, this Study Group as a whole took the material at face value. The Study Group's summary of the identifiers is found in Section 3.

2.1 CIDf Content IDentifier (CID)

The cIDf content identification system is defined in the CIDF Specification 1.0 [7]

[1] This is not necessarily a SMPTE universal label.

2.1.1 Purpose

Tracking of distributed **Content Instances** for:

- Mode of delivery
- Coding quality
- Permissions

Used for Digital Rights Management (DRM), copyright clearing and allocation of royalties, **Content** distribution route tracing, and the ability to monitor illegal copying.

Identification of the distributed **Content Instance** is used for gathering marketing data on a per-**Instance** basis (e.g., tracking distribution records, managing editing history).

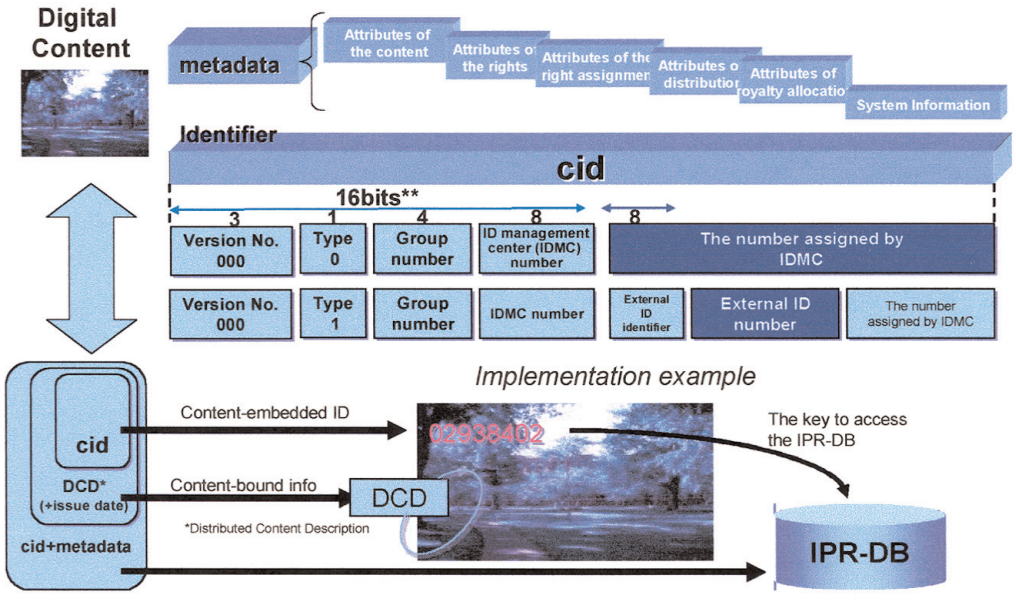
Differentiating legitimate from illegal copies of distributed content.
Used for usage surveillance services called "Net-Police," which uses web 'spider' to search out sites that might potentially be infringing content.

Obtain information about the permitted scope of use and who to contact to obtain permission for secondary use of **Content Instances**.

2.1.2 Summary

The Content ID developed by cIDf was designed to provide a unique **Identifier** that can accommodate the full range of **Content Instances** that are distributed over networks. Figure 2-1-1 shows a schematic overview of the Content ID.

Figure 2-1-1. CID Construction (courtesy of cIDf).



The cIDf's basic approach in handling the key attribute data included in the **Identifier** is to write this data using XML to a descriptor called the Distributed Content Descriptor (DCD), and then to tightly bind the DCD to a **Content Instance** by insertion to the header portion or by other method. Regarding the **Identifier** part, if the object to which it is assigned is **Content**, a persistent embedding scheme using digital watermarking is stipulated. Various digital watermarking schemes have been proposed around the globe. Most of them are propriety. cIDf is considering a two-layer water-

marking approach and some alternative approach that enable co-existence of these different propriety watermarking schemes. Refer to the cIDf Specifications [7] for detail technical information.

The cIDf's Content ID consists of a prefix part and a suffix part that are issued by two different entities adopting a two-tier issuing authority model: the prefix part of the identifier is issued by the Registration Authority (RA), while the remaining suffix part is issued by one of the ID Management Centers authorized by the RA, of which there may be up to several hundred in any given region. When a Content ID is issued, the attributes of each registered content instance are not stored in a single centralized database, but rather in a distributed database connected with and independently managed by the dispersed ID Management Centers. A resolution service is proposed for pinpointing the location of the database where copyright and other content attribute data associated with content instances are stored. A Uniform Resource Name (URN) resolution scheme for the service has been studied and now is being tested.

The cIDf-based scheme provides a high degree of robustness and security against deletion, tampering, and substitution of its identifiers through a combination of three strong security tools: persistent binding of the identifier to the content instances by digital watermarking, an XML signature applied to the content of the DCD, and a content hash that joins the content and the DCD.

The Content ID is applied as an **Identifier** to a distributed **Content Instance** at the furthest point downstream on the value chain. We can therefore probably rightly assume that other **Identifiers** (UMID, V-ISAN, crid:, etc.) have already been assigned to the same **Content**. Our scheme features the ability to look up any other **Identifiers** that may have been assigned to **Content** using a Content ID attribute called *Other Identifiers*. If required, the capability is also available to encapsulate other **Identifiers** in the Content ID and embed them in an AV work by watermarking.

2.2 ISO Versioned International Standard Audiovisual Number (V-ISAN)

The ISAN system is defined in ISO 15706 [5]. V-ISAN is a system proposed to be defined in ISO 20925-1 [4].

2.2.1 Purpose

An ISAN identifier identifies the collection of all **Versions** of a **Work.**[2] A V-ISAN identifier is for identification of a specific **Version** of **Content** throughout its life and independent of any physical form in which that **Version** is distributed.

The assignment of an ISAN or V-ISAN identifier to a **Version** of **Content** is not used as evidence of the ownership of rights.

The key properties of the ISAN and V-ISAN systems are:

- identity: If two ISAN or V-ISAN identifiers are the same, they always identify the same underlying Work or Version of a Work.
- predictability: ISAN or V-ISAN identifiers can be assigned in advance of creating the Work or a particular Version of a Work.
- enumerability: a comprehensive list of all assigned ISAN and V-ISAN identifiers is maintained by a registry and an organization can determine that it has accounted for all relevant Works or Versions of Works.

2.2.2 Summary

Although ISAN and V-ISAN identifiers can be assigned and used in many ways, this section will follow their use by a sample television series.

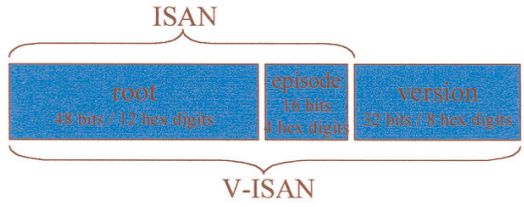
[2] Note that the ISO 15706 (ISAN) definition of a Work currently is more constrained to be "a sequence of related images, with or without accompanying sound, which is intended to be made visible as a moving image through the use of devices, regardless of the medium of initial or subsequent fixation."

When the series is first created, an ISAN identifier is obtained for the series as a whole. As scripts for episodes are commissioned, they are assigned episode identifiers from the series' ISAN identifier.

For each episode, **Content** is obtained. As that **Content** is edited into a **Work**, several **Versions** may be created (e.g., each with a different language track). Each **Version** will be assigned a V-ISAN identifier. Note that even if only one **Version** of the **Work** is created, that **Version** must be assigned a V-ISAN identifier for later use: the ISAN identifier itself does not identify any **Version** or even an **Instance** of the **Work**.

Figure 2-2-1 shows the structure of ISAN and V-ISAN identifiers.

Figure 2-2-1. V-ISAN Construction.



2.3 *SMPTE Unique Material Identifier (UMID)*

UMID is an Identifier defined in SMPTE 330M [3]. This Standard defines the creation of the UMID from a combination of a pre-registered Identifier and Time in order to permit the generation automatically and in isolation of numbers that can be guaranteed to be globally unique. The UMID may optionally have a metadata extension to give enhanced functionality.

2.3.1 Purpose

A common, unambiguous means of uniquely identifying **Material** for system-to-system or system-to-device communication.

Enable the tracing of **Material** as it passes through a system.

Enable the linking of **Material** to other **Material** and/or associated metadata in complex production environments.

Allow for copies and clones of **Material** to exist within the system in various locations, and to refer to them independent of their location, including **Material** that has been removed from the system (for example when transferred to archival storage, or when delivered out of the system).

Given a supporting system, trace other **Material** and/or metadata linked with material given only the UMID (which may have been found from a search, such as a researcher's query).

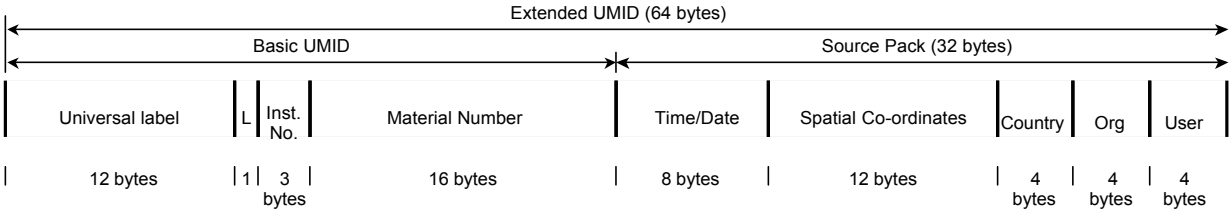
Uniquely identify **Material**, including source **Material,** finished or unfinished **Material,** and transient or intermediate **Material**.

A key property of the UMID is that it can be treated as a dumb number—i.e., one with no intrinsic numerical significance other than being unique.

2.3.2 Summary

The basic UMID requires 32 bytes and the extended UMID an additional 32 bytes of metadata to make a total of 64 bytes. All components of the UMID have a defined byte order for consistent application in storage and streaming environments. Figure 2-3-1 defines the layout of both the basic UMID and the extended UMID.

Figure 2-3-1. UMID Construction.



The basic UMID is comprised of the first group (left to right) of 32. The components of the basic UMID are:

- A 12-byte universal label to identify this as a SMPTE UMID. It defines the type of material which the UMID identifies and also defines the methods by which the material number and instance number are created;
- A 1-byte length value that is the length of the remaining parts of the UMID. The length value is 13h for a basic UMID and 33h for an extended UMID;
- A 3-byte instance number which differentiates between different representations of material with the same material number;
- A 16-byte material number that is globally unique for every item of material. A given material number has the same value for related instances of the same audio-visual material only where the instance number is used to uniquely identify these related instances.

The extended UMID is a basic UMID as described above, followed immediately by a metadata source pack. The source pack shall comprise a second group of 32 bytes and is optional. The components of the source pack are:

- An 8-byte date stamp and unit count code which shall identify the time and date of origination of the material unit with which the source pack is associated;
- A 12-byte value which defines the spatial coordinates at the time of origination of the material unit with which the source pack is associated;
- A 4-byte registered alphanumeric code which identifies the registered country name of the originator of the material unit with which the source pack is associated;
- A 4-byte registered alphanumeric code that identifies the registered organization name of the originator of the material unit with which the source pack is associated. The organization name is local to the country name, so organizations may use the same name provided the country name is different;
- A 4-byte alphanumeric string that identifies the local name of the originator of the material unit with which the source pack is associated. This name is local to the organization for a given country name, so the same name may be used provided the country and organization names are different. It may be a device name or person name as determined by the organization.

Note that the terms origination and originator above refer to physical origination and have no meaning in terms of intellectual property.

2.4 TV Anytime Content Reference Identifier (CRID)

The TV Anytime crid: is defined in Specification Series: S-4 On: Content Referencing [8].

2.4.1 Purpose

Allow the acquisition of a specific **Instance** of **Content**.

The CRID system is the location independent identification of **Content**, the location information, and the process of finding the location when an **Identifier** is given.

2.4.2 Summary

A CRID is the output of the search and selection process and is an unambiguous identifier that refers to a piece of **Content**, however multiple CRIDs may refer to that same piece of **Content**.

It is permissible for a CRID to resolve into one or more other CRIDs. This CRID to CRID functionality can be used for two purposes:

- A CRID can resolve into multiple CRIDs for grouping **Content** items such as an entire collection of episodes of **Content**.
- A CRID may also resolve into one or more CRIDs to allow one authority to refer to CRIDs of another authority

The syntax of the CRID is:

CRID://<authority>/<data>

<authority> Uses the TV-Anytime authority naming rules to assure uniqueness.

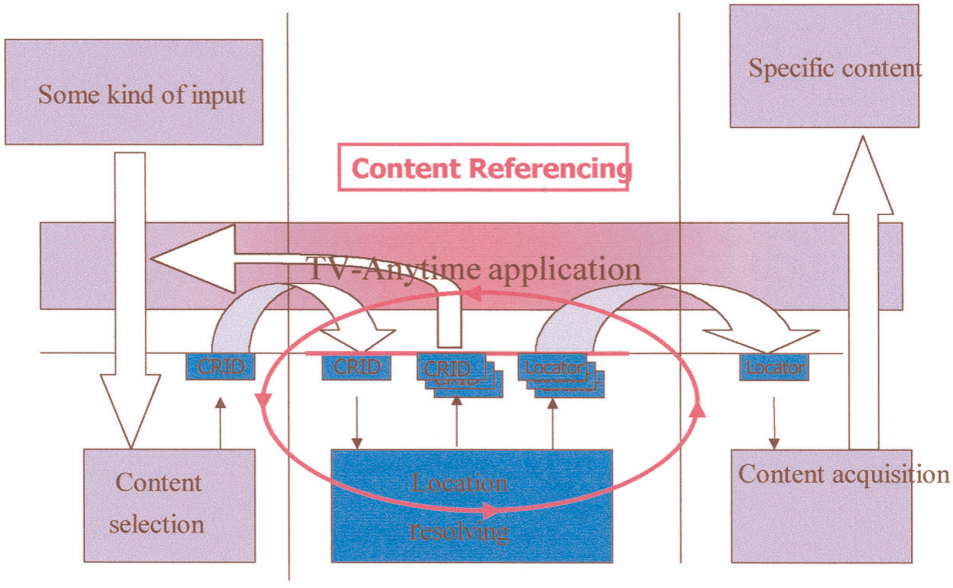
<data> is a free format string that is Uniform Resource Identifier (URI) compliant, and is meaningful to the authority defined by the <authority> field. The <data> portion of the CRID is case insensitive.

Location resolution is the process of translating a CRID into other CRIDs or locators. It involves mapping a location-independent CRID to its location in time (e.g., scheduled transmission time in a broadcast system) and space (e.g., TV channel, IP address). In the context of the TV Anytime specification, locations in time and space are referred to as "locators."

The process of location resolution may happen inside the PDR device (for example in a broadcast only system) or using a physically remote server (e.g., a server on the Internet.)

The content referencing process begins after **Content** has been selected by a consumer through to, but not including, the actual acquisition of the desired **Content**. In Figure 2-4-1 the scope of the content referencing process is shown. Some parts outside the scope of content referencing are included in Figure 2-4-1 to give it a global context.

Figure 2-4-1. CRID Environment (courtesy TV Anytime).



3.0 Summary of Identifier Scope and Purpose

This is a summary of the scope and purpose for each of the **Identifiers** considered in this report.

A UMID is an **Identifier** for **Material**. That is, it is used to **Label Material** at every point in the production and post-production creation and editing processes. Ultimately, a UMID is assigned to **Content**, and **Content** will generally be made up of many pieces of **Material** and thus labeled with many UMIDs.

A V-ISAN is an **Identifier** for **Versions** of **Content**. It will normally be the case that there will be at least one mapping of a UMID to a V-ISAN.

A CID is used to **Identify** and **Label Instance** of **Content** in distribution. It will normally be the case that there are many CIDs to a single V-ISAN, each **Identifying** a unique distribution instance.

CRID is used to locate **Instances** of **Content**. That is, a **Content** provider will specify a CRID **Identifier** that is then used by the consumer to "locate" **Content**. A CRID will occasionally map to more V-ISANs, and thus more CIDs for each V-ISAN.[3]

Figure 3-1 below shows the summary of the supply chain usage.

Figure 3-1. Supply Chain Usage Summary.

Identifier	Creator	Editor	Distributor	Consumer
UMID	X	X		
V-ISAN		X	X	X
CID			X	X
crid:				X

Figure 3-2 below shows the usage as identifiers and labels.

Figure 3-2. Identifiers Versus Labels.

Identifier System	Identifier	Label
UMID	X	X
V-ISAN	X	X
CID	X	X
Crid:	X	

Figure 3-3 shows the use of UMID, V-ISAN, and CID.

Starting in the upper-left corner, at the "Source level" label, **Materials** 1, 2, and 3 each receive a *UMID* identifier as they are created. They then receive a new *UMID* identifier when they are combined into a new **Material** 4. To help in understanding, consider that **Material** 1 contains video and **Materials** 2 and 3 are separate audio tracks. **Material** 4 then may be a tape with the video and two audio tracks.

In this diagram, **Material** 4 happens to also be a **Work**. As a **Work**, **Work** 1 would receive an *ISAN* identifier. The first **Version** of **Work** 1 would in general also receive a *V-ISAN* identifier, **Version** 1.

Work A **Version** 1, then, can be thought of as a relabeled **Material** 4. Or **Material** 4 for that matter as the two

[3] A consumer will only have limited access to the content available in the whole world. In the case of webcasting they probably can search the whole world, but still the person who makes the content available assigns the CRID, not the consumer. V-ISAN can be used in addition, to identify more details of the work.

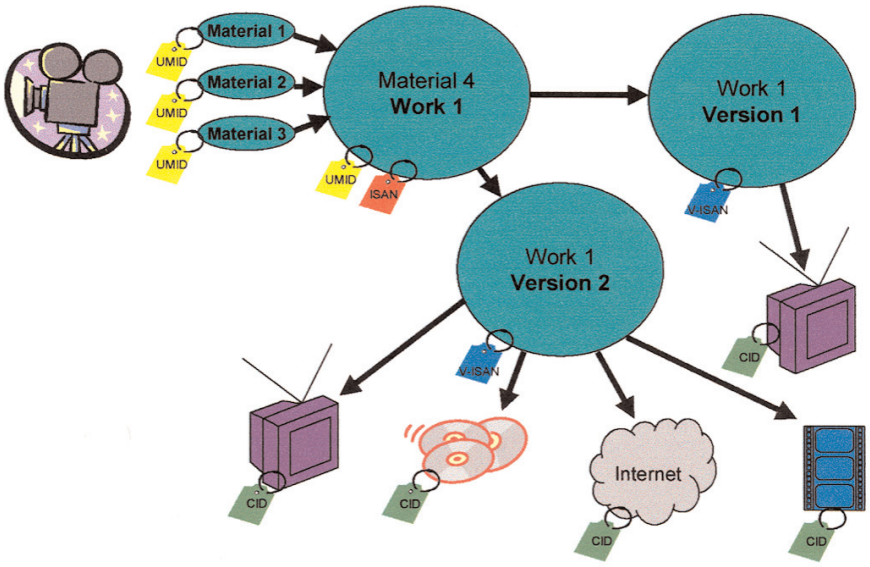
instances are identical except for the differing *UMID* identifier instance values. This distinction shows how the different identifier semantics interact.

For example, a tape duplication facility would attach a different *UMID* identifier to each copy, or instance, of a tape made. In general, it is neither practical nor desirable to track which tape is sent to which customer: what matters is that *any* of the copies of the tape for **Work** X **Version** Y (and no other **Version** nor **Work**) be used, not *which* copy. Thus, the *V-ISAN* identifier is the correct one to use for identifying the tape to broadcast.

On the other hand, if your purpose were to track quality in the duplicating process or to track the components of the **Work**, the *UMID* identifier would be best.

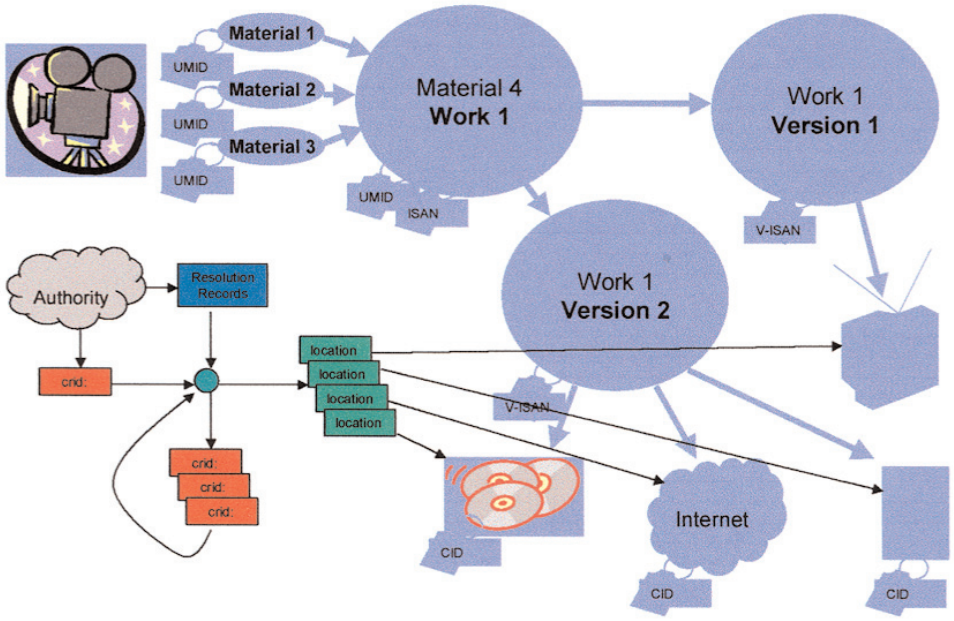
Finally, the lower-right portion of the diagram shows the "Content Instance." In this case, the same **Work** X **Version** Y is distributed via DVD, the Internet, and on film. Since all instances are of the same **Version**, they carry the same *V-ISAN* identifier. However, each path would receive its own *CID* identifier, thus enabling tracking of the distribution path.

Figure 3-3. Summary of Identifiers.



A crid: identifier is not used in the creation and distribution identification and labeling, but rather to assist in locating distributed **Versions** of **Works**. In other words, once a **Work** has been created and distributed, when given a crid: and a resolution infrastructure, one can locate the various distributed **Instances** of **Versions** of **Works**. This identification and resolution is shown diagrammatically in Figure 3-4. Note that the other identifier systems may also include resolution processes, but for crid: it is an essential part of the functionality.

Figure 3-4 Crid: Identification and Resolution.



4.0 Findings & Recommendations

Based on the findings of the work of this Study Group, we recommend the following…..

- Each organization and their related documentation for their identifiers should respect the main purpose of the other identifiers
- This report should be distributed to relevant external organizations, specifically:
  - EBU
  - TV Anytime
  - Content ID Forum
  - ARIB, ATSC & DVB
- R30 should continue an ongoing dialog with the organizations that are defining these identifiers
- R30 should consider the development of interchange points and how the identifiers may interact with, or reference, each other.

There is a need to resolve the scopes and definitions of “ISAN Work” and “Work.” This may require a new identifier to include audio-only and/or data-only Works, which SMPTE may wish to undertake.

5.0 Bibliography

Note that italics indicates a work in process document and may not be publicly available.

[1] SMPTE/EBU Joint Technical Report, “Task Force for Harmonized Standards for the Exchange of Program Material as Bitstreams Final Report: Analyses and Results.”

[2] SMPTE Standard 330M, “Unique Material Identifier (UMID).”

[3] *SMPTE Draft RP 205, “Application of Unique Material Identifiers in Production and Broadcast Environments.”*

[4] *ISO PWI 20925-1, "Information and documentation — Identifier for versions of audiovisual works (V-ISAN) — Part 1: Format and use."*

[5] ISO 15706, "Information and documentation — International Standard Audiovisual Number (ISAN)."

[6] SMPTE Standard 298M, "Universal Labels for Unique Identification of Digital Data."

[7] CIDF, "Specification1.0," http://www.cidf.org/english/download.html.

[8] TV Anytime, "Specification Series: S-4 On: Content Referencing."
ftp://tva:tva@ftp.bbc.co.uk/pub/Specifications/SP004v11.zip.

5.1 External Organizations

Content ID Forum (cIDf) http://www.cidf.org

ISO http://www.iso.ch

TV Anytime Forum http://www.tv-anytime.org

6.0 Acknowledgments

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