~~ISDCF-Doc3 – Disk Drive Recommendations~~
~~Update proposed 03 November 2009~~
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ISDCF-Doc3 – Physical Distribution Recommendations June 2015 Revision

Overview

This document is intended to capture field experience and recommendations for distribution of digital cinema content (DCPs) on physical media, as defined in SMPTE ST429-9 – Asset Mapping and File Segmentation. As of this writing, the latest version of that standard is ST429-9:2014. This document has evolved as that standard has evolved, and as experience has accumulated. See the revision history at the end of this document for reference. Current versions of the standard are available at smpte.org.

~~For review, the following ISDCF recommendations have existed for some time now, but should be restated for confirmation and reference. These previous recommendations have been slightly expanded for clarity and specificity.~~

~~Existing Recommendations~~

Electrical Interfaces

The current population of fielded physical ingest and playback devices in the field covers an age range of about ten years. While there has been significant evolution of interfaces over that period, older systems have generally not been upgraded to to support the latest interfaces. For maximum compatibility, expecting a USB 2.0 type A receptacle on the ingest device remains the baseline expectation for users who wish to distribute content. For ingest system designers, new systems should have some method of supporting legacy USB devices, although the hardware may be USB 3.0, 3.1, or later standards.

A significant number of systems have been deployed that expose an e-SATA interface, either through a cable connection, or more commonly through a proprietary carrier/docking system. A content distributor may assume that support for this physical/electrical system is available at most ingest sites.

Direct physical/electrical interfaces are currently migrating toward the USB 3.0/3.1 standard, and will likely also begin to support the USB Type-C interface in the near future. At the same time, physical distribution is slowly being replaced by network and other electronic delivery systems. Physical/electrical interfaces will continue to be supported by most or all systems for at least the next five years or so.

~~1. Distribution media devices, playback servers, and theater-based library servers should support the USB2 data interface presently and for the near future, at least until existing systems are retired.~~

~~2. Future distribution media devices, playback servers, and library servers should include eSATA support where practical, but only to extend, not to replace USB2 support.~~

Physical Storage Devices

The most common physical storage devices used for content distribution currently are: Hard Disk Drives (HDDs), Solid State Disk Drives (SSDs), and portable Flash devices (USB Sticks). As the latest revision of ST 429-9 has removed support for “File Segmentation”, DVDs and CDs are now deprecated for distribution of any but the smallest DCPs. The appropriate physical storage device for any particular application should be chosen for convenience in the use case, as any of these devices will work if the appropriate electrical connections are provided as detailed in the discussion of electrical interfaces.

~~3. The storage partition format should be EXT3.~~

~~4. Optical media such as DVD or CD may be used where appropriate. If DVD format is used, the disks should be single-sided, single-layered, 4.7 GB data format. The storage partition format should be UDF.~~

~~5. Playout servers and library servers should include means of reading CDs and DVDs as specified above. External USB reader units may be used if internal readers are impractical.~~

~~**New Recommendations**~~

Logical File System (Storage Device Format)

Physical storage devices (HDD, SSD, USB Stick, etc.) that connect to a server using USB, e-SATA, and similar interfaces will expose a simple storage interface – basically, just a bunch of addressable blocks of storage. In order to store a DCP on such a device, a File System is required. A file system is created on a

storage device by a process referred to as formatting, and there are hundreds of possible formats that can be created. To make interchange of files possible, a particular format or family of compatible formats must be specified. The format that all digital cinema systems support is identified and constrained here.

While a physical storage device may be divided into multiple partitions at the lowest level, only one physical partition per physical device is universally supported on these systems. In addition, the specific type of partition is specified here.

Storage device format requirements

1. Storage devices shall contain a standard “MBR” partition table. This is meant to specifically exclude “GPT”, “BSD”, and other partition table types. The MBR partition table shall contain one and only one partition record. The single partition record shall be the first Primary partition record. The partition identifier shall be 0x83, indicating a Linux native partition.

Note 1: In practice, additional partitions may exist, but only the first one will reliably appear to the system that reads the storage device.

Note 2: Storage device purchased at retail, particularly USB sticks, may have existing partition tables. If so, the partition table will almost certainly be incorrect for the purpose, so a new partition table must be created for a new device, even if a partition table already exists.

2. The partition on the storage device shall be formatted as EXT3 or EXT2, with the inode size set to 128 bytes.

Note 1: These are not standard settings for the default Linux formatting command, as the defaults have evolved since this configuration was agreed upon. Following is a suggested command to format a distribution device from a Linux prompt. Various GUI-based formatting programs may require you to explicitly specify these settings.

Note 2: The suggested Linux formatting command is:
'mkfs -t ext3 -I 128 -m 0 /dev/xddN'
where “-t ext3” specifies the filesystem type, “-I 128” specifies the inode size, “-m 0” specified that no blocks need be reserved for the operating system, and “/dev/xddN” is the name of the device/partition that you intend to format. N will almost always be 1.

Storage Device Usage Recommendations

1. Devices whose function is to read distribution media should mount the media in read-only mode where practical. This should reduce the possibility of file

system damage when the media is removed from the system without a clean unmount operation performed. While preventing unclean unmounts is physically impossible with USB drives, if distribution drives are mounted read/write, every effort should be made to perform a clean unmount operation before the device is disconnected.

2. When distribution devices are mass-duplicated, care should be taken to assure that the target drives are as large or larger than the master drive in order to prevent illegal partitions from being created by the duplication system.

3. When files and directories are written to a distribution media partition, the permissions shall include the following settings: Files shall allow “read” permission for “Other” users. Directories shall allow “read” and “execute” for “Other” users.

4. Distribution service providers should recognize that the current deployed base of player and library systems in the field may already be several years old, and are expected to have an extended lifetime relative to typical computer system installations. Thus new or upgraded mastering and duplication systems should be thoroughly vetted for backward compatibility prior to deployment.

5. Theater operators should maintain, at each location, spare USB cables, power supply cables, and “power bricks” to account for the possibility of defective pieces that may be supplied with distribution devices. Note that older USB cables may be problematic when used with recent USB 3.0 devices.

6. SMPTE ST 429-9:2014 now supports multiple AssetMaps per partition using first-level subdirectories, in addition to the previous requirement for a single AssetMap at the root level. Please refer to Annex A: Basic Map Profile v2 of ST 429-9:2014 for further details.

~~1. Allow EXT2 for storage format partitions. EXT2 is EXT3 without a journal, and a journaled file system is of questionable value for a distribution format.~~

~~2. Devices whose function is to read distribution media should mount the media in read-only mode where practical. This should reduce the possibility of file system damage when the media is removed from the system without a clean unmount operation performed. While preventing unclean unmounts is physically impossible with USB drives, if distribution drives are mounted read/write, every effort should be made to perform a clean unmount operation before the device is disconnected.~~

~~3. Distribution disks shall contain a standard “MBR” partition table. This is meant to specifically exclude “GPT”, “BSD”, and other partition table types. The MBR~~

partition table shall contain one and only one partition record. The single partition record shall be the first Primary partition record. The partition identifier shall be 0x83, indicating a Linux native partition.

4. The distribution media partition shall be formatted in either the EXT2 or the EXT3 format. When the file system is formatted, the inode size shall be set to 128 bytes.

5. Per SMPTE 429-9-2007, the storage volume (partition) shall contain exactly one Asset Map.

6. If a USB "Thumb Drive" is to be used for any purpose in a digital cinema system, it should be reformatted to a clean state prior to use. (This is intended to prevent the spread of virus code that has been detected on commercial "thumb drive" products.)

7. When distribution devices are mass-duplicated, care should be taken to assure that the target drives are as large or larger than the master drive in order to prevent illegal partitions from being created by the duplication system.

8. Distribution service providers should recognize that the current deployed base of player and library systems in the field may already be several years old, and are expected to have an extended lifetime relative to typical computer system installations. Thus the temptation to upgrade to the latest and greatest new operating system software for mastering and duplication should be resisted, and new systems should be thoroughly vetted for backward compatibility prior to deployment.

9. Theater operators should maintain, at each location, spare USB cables, and power supply cables, and "power bricks" to account for the possibility of defective pieces that may be supplied with distribution devices.

10. When files and directories are written to a distribution media partition, the permissions shall include the following settings: Files shall allow "read" permission for "Other" users. Directories shall allow "read" and "execute" for "Other" users.

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Mixed Distribution Package ISDCF Recommendation

June 17, 2010

Introduction

As SMPTE DCP's start becoming available, there will be a strong need to allow the distribution of media containing a mixture of Interop DCP's and SMPTE DCP's. For example, when the first SMPTE DCP trailer is released, there may be a need to distribute it on a single hard drive along with several Interop DCP's. The duration during which this functionality will be needed will be a minimum of several months and may be several years.

The final goal of the ISDCF Mixed Distribution Package subcommittee was to propose a recommended practice that all vendors can follow in order to reliably use content on media with both SMPTE and Interop DCP's. The target audience of this document includes those that master DCP's, content distributors, player manufacturers, and theater management system manufacturers.

This subcommittee reviewed several methods for accomplishing this goal and decided on the method identified as Multiple Top-level Directories.

Multiple Top-level Directories

Advantages:

The ability to allow multiple asset maps on a single disk has often been requested by to make it easier to combine content from multiple sources.

This method avoids the need to merge asset map files which can introduce errors into the distribution package.

Many systems already support this method.

Disadvantages:

This would require a revision to the SMPTE standard 429-9.

This adds the requirement of scanning multiple directories. However, this additional step is only necessary if there is not an asset map in the root. Additionally, a modern operating system caches disk access and should not be perceptibly slowed down by this.2

Description:

In this method, the current Interop and SMPTE standards would be extended to also allow ASSETMAP or ASSETMAP.xml files in directories immediately below the root directory.

Example Directory Listing:

\MyInteropTrailer1\

- ASSETMAP
- VOLINDEX
- PKL1.xml
- CPL1.xml
- Video1.mxf
- Audio1.mxf

\MySMPTETrailer1\

- ASSETMAP.xml
- VOLINDEX.xml
- PKL1.xml
- CPL1.xml
- Video1.mxf
- Audio1.mxf

\MyInteropTrailers2and3\

- ASSETMAP
- VOLINDEX
- PKL2.xml
- CPL2.xml
- Video2.mxf
- Audio2.mxf
- PKL3.xml
- CPL3.xml
- Video3.mxf
- Audio3.mxf

Media without an asset map in the root but with top-level directories shall be treated as if each top-level directory were a different drive.

Only the root and the directories immediately within the root directory (top-level directories) need to be checked for asset maps. Directories within top-level directories do not need to be checked for asset maps, although they may contain assets referenced by an asset map. If an asset map exists in the root, no other directories must be searched for other asset maps. DCP's in top-level directories shall not refer to assets in other top-level directories.

Note that when asset maps are in subdirectories, referenced asset file names are relative to the directory containing the asset map file, not the root directory.3

This directory structure can be used on media containing only SMPTE content, only Interop content, or any mixture of SMPTE and Interop content. Additionally, it can be used on media containing one or more DCP's.

As this directory structure has benefits beyond mixing Interop and SMPTE content on the same media, it is recommended that all Digital Cinema systems support this directory structure permanently and not just during the Interop to SMPTE transition period.

The pseudo-code to identify the content on media is recommended to be as follows:

1. If ASSETMAP.xml exists in the root, then parse it according to SMPTE standards and stop looking for additional asset maps on the media.

2. If ASSETMAP exists in the root, then parse it according to Interop standards and stop looking for additional asset maps on the media.

3. For all top-level directories in the root, perform the steps below.a. If the directory name is exactly lost+found or RECYCLER, then ignore the directory and process the next directory.

b. If ASSETMAP.xml exists, then parse it according to SMPTE standards and process the next directory.

c. If ASSETMAP exists, then parse it according to Interop standards and process the next directory.

d. Otherwise (no asset map found), ignore the directory and process the next directory.

Different algorithms for parsing media for content are allowed provided that all correctly structured content is identified.

The following was submitted to SMPTE in November 2013 for compatible means of including SMPTE-DCP and Interop-DCP in the same file structure.

IF YOU WRITE OR READ DCPs — THIS IS REALLY IMPORTANT!!

1. Ext3 remains as file structure
2. Always show file extensions
3. All servers needs to look at assetmaps (assets not referenced by an assetmap should be ignored // mastering should not have assets that are not referred to by an assetmap)
4. Allow for hard links
5. Do not allow for sym links
6. THOU SHALL Not ../ (don't allow a fragile link - stay within the tree)
7. Assetmap in root - also look in directory for additional assetmaps in directory - both are allowed
8. Assetmaps found only one directory down
9. Recommended that mastering should not have both assetmaps in root and subdirectories
10. Servers need to look for root & first-level directories for assetmaps
11. Ingest valid assets as much as possible (see an error, skip on to next asset)
12. If two assets with same UUID. If hashes match, no problem; if hashes don't match, big problem
13. Think before ingesting … e.g. look at file size first, then hash
14. vol index in a given directory is associated with assetmap in same directory.
15. There should not be both SMPTE and Interop asset maps in same directory

What mods are needed for 429-9?

1. Multiple assetmaps allowed
2. Can't leave the tree defined by assetmap
3. Assetmaps only one directory down
4. mastering shall not have both assetmaps in root and subdirectories
5. Ingest valid assets as much as possible
6. Fix URL scheme example. in 429-9 (do not use "file://" in relative paths! The syntax of the path shall be "file")
7. Remove clause referencing /.. in 8.1 of 429-9
8. vol index in a given directory is associated with assetmap in same directory. vol index is marginally optional.
9. Should examples be included in 429-9?
10.

Revision History

Date	Notes
MistyPast	Original version
11/21/09	First Revisions (partition tables, Inode size, duplication issues, etc)
09/06/12	Mixed packages specs added
02/26/14	Proposals for SMPTE 429-9 revision added
Mid-June 2015	Clean up and re-integrate document following release of S429-9-2014