DCP Delivery Recommendations

ISDCF Doc3

1 Overview

This document captures recommendations for the distribution of digital cinema content (DCPs), based on SMPTE ST 429-9:2014.

NOTE: The most recent revision of SMPTE ST 429-9 adds supports multiple Asset Map files on a single filesystem using top-level directories, in addition to a single Asset Map file at the root level, and removes support for segmenting assets across multiple chunks.

The target audience of this document includes those that master DCPs, content distributors, player manufacturers, and theater management system manufacturers.

A revision history is provided at the end of the document.

2 References

SMPTE ST 429-9:2014, D-Cinema Packaging — Asset Mapping and File Segmentation

3 Physical Distribution

3.1 Electrical Interfaces

Fielded physical ingest and playback devices cover 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 support the latest interfaces.

For maximum compatibility, a content distributor should assume that a USB 2.0 type A receptacle is exposed by the ingest device.

For ingest system designers, new systems should support legacy USB devices, although the hardware may expose a USB 3.0, 3.1, or later USB interface.

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.

NOTE: 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 satellite, terrestrial 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.

3.2 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).

The kind of physical storage device can be chosen based on the needs each individual use case, as any physical storage device will work if it follows the recommendations of Section 3.1.

DVDs and CDs are deprecated for the distribution of any but the smallest DCPs since SMPTE ST 429-9 no longer supports segmenting assets across multiple chunks.

3.3 Spare Parts

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.

4 Partitioning and Formatting

4.1 Overview

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 collection 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, family of compatible formats is identified and constrained here.

4.2 Partitioning

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: 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 systems.

This partition type can only be used on hard-drives no larger than 2TB. This is an intrinsic limit of MBR and drives that exceed that limit should not be used.

NOTE 2: In practice, additional partitions may exist, but only the first one will reliably appear to the system that reads the storage device.

NOTE 3: 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.

4.3 Formatting

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

NOTE: 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.

The suggested Linux commands for both partitioning and formatting are:

```
$ parted -s            /dev/sdX mklabel msdos
$ parted -s -a optimal /dev/sdX mkpart primary 0% 100%
$ mkfs -t ext3 -I 128 -m 0 /dev/sdX1
```

where "`/dev/sdX`" is the device node associated with the hard-drive, "`-t ext3`" specifies the filesystem type, "`-I 128`" specifies the inode size, "`-m 0`" specifies that no blocks need be reserved for the operating system, and "`/dev/sdX1`" is the name of the device/partition intended to be formatted. In this case, the first partition is specified as required above.

5 File System Contents

The contents of the file system shall conform to the Basic Map Profile v2 specified in SMPTE ST 429-9.

The permissions of files and directories of the file system shall include the following settings:

- Files shall allow "read" permission for "other" users.
- Directories shall allow "read" and "execute" for "other" users.

6 Avoiding Device Corruption

6.1 Clean Unmounting

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.

6.2 Connect only to DCP-Aware Devices

It is not safe to connect a device containing a DCP to general purpose computer running many common consumer operating systems.

NOTE: Many consumer systems attempt to be "helpful" by destroying the contents of storage devices containing formats that they do not recognize. Also, there is no way to electronically protect most devices against this issue, as write protection is only enforced at the level of file system contents.

Devices containing DCPs should only be connected to DCP-aware systems, such as SMSs, TMSs, or other digital cinema systems.

In addition, storage devices used to transport DCPs should carry a warning label, cautioning the user that the device should not be connected to consumer systems. Suggested warning label wording might be:

```
CAUTION: Do not attempt to read this media with a consumer computer system
```

6.3 Operating System Drivers

Beware of utilizing open source or shareware EXT2 reader drivers for both Mac and PC systems. Much as described above, many will unintentionally corrupt the media on the device and/or will not allow for easy unmounting of the device, further possibly corrupting data.

7 Mixed Interop-SMPTE DCP Distribution

7.1 Overview

There is a need to distribute media containing a mixture of Interop and SMPTE DCPs. For example, a SMPTE DCP trailer can be distributed on a single hard drive along with several Interop DCPs. This functionality will be needed as long as Interop DCPs continue to be made.

The approach described in this section extends the Basic Map Profile v2 specified in Annex A of SMPTE ST 429-9, and allows SMPTE and Interop DCPs to be combined on a single file system using multiple top-level directories.

While this approach is not universally supported in fielded devices, it is the only recommended approach for combining SMPTE and Interop DCPs to be combined on a single file system. It also has benefits beyond combining Interop and SMPTE content on a single filesystem, and should be supported going forward.

This approach has the following advantages and drawbacks.

Advantages	Drawbacks
▪ Makes it easier to combine content from multiple sources. ▪ Avoids the need to merge Asset Map files which can introduce errors into the distribution package. ▪ Can be used on media containing only SMPTE content, only Interop content, or any mixture of SMPTE and Interop content ▪ Can be used on media containing one or more DCPs ▪ Consistent with SMPTE standards	▪ This adds the requirement of scanning multiple directories. A modern operating system caches disk access and should not be perceptibly slowed down by this. ▪ Multiple ingests steps might be required ▪ Not universally supported in legacy systems

For purposes of this document the term *Asset Map file* refers to either a file named ASSETMAP (Interop) or ASSETMAP.xml (SMPTE).

7.2 Description

Historically, each filesystem contained a single Asset Map file placed in its root directory of the filesystem, as such:

```
ASSETMAP
```

```
VOLINDEX
PKL1.xml
PKL2.xml
CPL1.xml
CPL2.xml
Video1.mxf
Video2.mxf
Audio1.mxf
Audio2.mxf
```

When combining SMPTE and Interop DCPs on a single filesystem, multiple Asset Maps are placed in directories immediately below the root directory of the filesystem, with each directory containing either SMPTE or Interop DCPs, as such:

```
/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
```

7.3 Expected Behavior

Only the root and the directories immediately within the root directory (top-level directories) shall be checked for Asset Maps files.

Nested directories within top-level directories shall not be checked for Asset Maps files, although they may contain assets referenced by Asset Map files.

If an Asset Map file exists in the root, no other directories shall be searched for other Asset Map files.

Asset Map files and DCPs in top-level directories shall not refer to assets in other top-level directories.

NOTE 1: When Asset Map files are located in top-level directories, asset paths contained therein are relative to the directory containing the Asset Map file, not the root directory.

The pseudocode to identify content on a distribution media is recommended to be as follows:

```
If a file named ASSETMAP.xml exists in the root, then then process it as a
Mapped File Set that conforms to Basic Map Profile v2 at SMPTE ST 429-9,
and stop looking for additional Asset Map files on the media.

If a file named ASSETMAP exists in the root, then parse it according to
Interop specifications and stop looking for additional Asset Map files on
the media.

For all top-level directories in the root, perform the steps below in
order.

(a)     If the directory name is exactly lost+found or RECYCLER, then
        ignore the directory, and proceed to the next top-level directory.

(b)     If a file named ASSETMAP.xml exists, then process it as a Mapped
        File Set that conforms to Basic Map Profile v2 at SMPTE ST 429-9,
        and proceed to the next top-level directory.

(c)     If a file named ASSETMAP exists, then parse it according to
        Interop specifications, and proceed to the next top-level
        directory.

(d)     otherwise, ignore the directory, and proceed to the next top-level
        directory.
```

NOTE 2: Different algorithms for parsing media for content are allowed provided that all correctly structured content is identified.

8 Other Recommendations

8.1 Mass Duplication

When physical storage devices are mass-duplicated, care should be taken to assure that the capacity of the target device is no smaller than that of the master device in order to prevent illegal partitions from being created by the duplication system.

8.2 Testing of mastering and duplication systems

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.

9 Revision History

Date	Notes
Misty past	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 . (Bill Elswick)
Mid-July 2015	Incorporate accidental corruption warning with consumer systems. (Bill Elswick)
2017-06-29	Updated "Mixed Distribution Package ISDCF Recommendation" Added parted example usage, clarified 2TB limit, etc. Removed information already specified in SMPTE ST 429-9 (Steve LLamb, Mike Radford and Pierre-Anthony Lemieux)