ISDCF-Doc3 – Physical Distribution Recommendations
July 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.

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.

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.

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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

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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.

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General Notes

Precautions

Unintentional Device Corruption Risk

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

Historical Revision Details

In June 2010, the ISDCF recommended to SMPTE that a number of changes be made to S429-9-2007 in order to accommodate the transition to SMPTE format, and mixed Interop/SMPTE format distribution; and to reflect usage patterns developed in practice (and accommodated on some deployed systems). Later, in November 2013, ISDCF published a list of additional recommendations based on field experience and testing. SMPTE subsequently released S429-9-2014, which reflects the requested changes.

These changes include the introduction of Mapped File Sets, replacing the concept of a “volume”. Support for distributing file sets across multiple storage volumes was removed. The various recommendations for organization, naming, subdirectories, etc. were captured in “Annex A – Basic Map Profile v2” of ST249-9:2014. Please refer to that document for details.

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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
Mid-July 2015	Incorporate accidental corruption warning with consumer systems.

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