Recommended Guidelines for Digital Cinema Source and DCP Content Delivery

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1   GENERAL NOTES ABOUT THIS DOCUMENT

This document and the specifications herein, like the industry they serve, are subject to change at any time without notice. Failure to provide 100% accurate data or information, and/or failure to deliver content conforming to this specification, may result in the following, including but not limited to:

- inaccurate color reproduction(s)
- issue(s) and/or error(s) during presentation of content in a theatrical environment
- additional charge(s)
- delay(s) to agreed upon project completion time(s)

NOTE: QC of source material is not performed unless specifically requested and agreed to ahead of time. Provider of source materials assumes liability and warranty for completeness and/or quality of content provided to DTDC.

1.1 ABOUT THESE REQUIREMENTS

Where applicable, these requirements adhere to the following industry standards, specifications, recommended practices:

- Digital Cinema Initiatives (DCI) System Requirements and Specifications for Digital Cinema:
  - http://www.dcimovies.com/specification/index.htm

- ISDCF Industry Recommended Practice Technical Documents:
  - http://www.isdcf.com/ISDCF/technical-documents.html

- SMPTE DCP Published and Draft Standards:
  - https://www.smpte.org

DTDC has advised in the creation, writing, and editing of many of the above published documents, and in a multitude of cases has further refined a number of "operational constraints" based on general feedback, testing, and/or informational data provided by theatrical release date as well as from equipment manufacturers, theater exhibitors, content owners, studios, distributors, content vendors, and industry groups and peers, that may or may not be reflected in the above documents.

In some cases, ambiguous information within specification documents may have been clarified or refined in this document based on best industry practices and/or "known issues" with release versions of equipment in theatrical settings.

This is not a full list of the documents referenced herein. Where needed, further links to documents or websites may be noted in the text. Where a topic is unspecified, one shall defer to the above noted standards, specifications, and recommended practices.

2   SOURCE CONTENT AND FILE REQUIREMENTS

2.1   IMAGE

2.1.1   SUPPORTED IMAGE FORMATS (FILE BASED)

For a complete list of all the video/image file formats accepted, see **TABLE 6 – "VIDEO FILE FORMATS"** in Section **5.1.1** of **APPENDIX I**. Below are the most common formats currently being utilized and their requirements.

2.1.1.1   TIFF

- 3 Channel, Interleaved, 16 bit files
- Uncompressed, or LZW compressed (valid only for delivery of between 1-192 frames)
- Big Endian
- Single Strip/One tile per image

2.1.1.2   DPX/Cineon

- 3 Channel, Interleaved RGB, 10 bit files
- Big Endian

2.1.1.3   J2C

- 12 Bit unsigned
- Encoded to DCI/SMPTE specifications with a max Variable Bitrate (VBR) of (250) MB/s, or (500 – may be lower in some cases) MB/s for HFR and HDR (Dolby Vision) content.

2.1.1.4   QuickTime

- Progressive frame rate preferred (interlaced can be accommodated, but requires more time/cost to process)

NOTE: Because there are several thousand codec and format combinations available, we cannot guarantee support for all QuickTime files. It is recommended you send a small test clip at minimum 48 hours prior to delivering the final source material to ensure 100% compatibility (proof of concept testing may be required).

2.1.2   FILE HANDLING AND NUMBERING

All image sequences shall be delivered in reels. Any length variations of picture/audio/subtitle assets in a reel, or longplay delivery, may be broken into matching reels to accommodate limitations on playback systems, and may incur additional editorial charges.

2.1.2.1 *File numbering scheme (assuming 24fps):*

- 01:00:00:00 = 0086400.tif = "Picture Start" (8 second Academy leader) Reel 1
- 01:00:08:00 = 0086592.tif = program start (first frame of action) Reel 1
- 02:00:00:00 = 0172800.tif = "Picture Start" (8 second Academy leader) Reel 2
- 02:00:08:00 = 0172992.tif = program start (first frame of action) Reel 2
- 03:00:00:00 = 0259200.tif = "Picture Start" (8 second Academy leader) Reel 3
- 03:00:08:00 = 0259392.tif = program start (first frame of action) Reel 3
- And so on... (60 mins X 60 secs X 24 frames = 0086400)

Note: Pad filenames using leading zeroes, so that all filenames in a sequence are comprised of the same number of characters, as shown above.

2.1.2.2 *Other File Handling Considerations*

Each Pickup/Replacement (Texted/Textless) shot file sequence must be delivered in a separate clearly labeled directory. File numbers for Pickup/Replacement shots must match respective OV file numbers. Failure to number files correctly, and/or provide accurate, frame based EDL information may result in additional editorial charges.

For 3D content, left and right eyes shall either be in separate folders clearly named as such, or interleaved with specific notes of a frame cadence of (2).

2.1.3 LEADER AND BLACK FRAMES

Image must be provided on all reels with 8 second Academy head and tail leader, with 2-pop and tail-pop matching the audio.

There shall be at minimum (1) frame of black at the head and tail of the full run time of the content. This is to accommodate content being "parked on pause" before playback is started in a theatrical setting.

2.1.4 IMAGE SIZE

2.1.4.1 *Container Resolution*

For 2K (2D and 3D) presentations, a DCI 2K resolution of:

- 1.85/FLAT = 1998x1080
- 2.39/SCOPE = 2048x858

For 4K (2D) presentations, a DCI 4K resolution of:

- 1.85/FLAT = 3996x2160
- 2.39/SCOPE = 4096x1716

NOTE: 4K 3D is only supported on a very limited number of systems in presentation environments such as museums, and special venues. Wide industry support does not yet exist, as it's based on equipment capabilities. Use at your own risk.

NOTE: For all other container resolutions or aspect ratios, including but not limited to, FULL CONTAINER (2048x1080 / 4096x2160) or HD (1920x1080), the container will be resized and/or cropped to either DCI 2K/4K FLAT or SCOPE.

2.1.4.2   Active Image Area

For DCI full active image area resolutions SCOPE or FLAT, image should fill the frame edge to edge in both vertical and horizontal directions. 3D "floating windows" are acceptable, but must be within the edge boundaries.

All other aspect ratios (1.90, 1.40, 1.78, etc) and resolutions must be sized and padded with black to fill the frame to the DCI SCOPE or FLAT container resolutions in section **2.1.4.1**. The closest container to content's frame size should be utilized to take advantage of as many pixels as possible to preserve quality. See **TABLE 1 - "COMMON ACTIVE IMAGE SIZES AND PADDING"** for some examples of common padding of active image to DCI containers.

TABLE 1 - "COMMON ACTIVE IMAGE SIZES AND PADDING"

Active Image Aspect Ratio	Container Aspect Ratio	Active Image Size (2K/4K)	DCI Image Container Size (2K/4K)
SCOPE/2.39	FLAT/1.85	1998x836/3996x1672 [1]	1998x1080/3996x2160
FLAT/1.85	SCOPE/2.39	1588x858/3176x1716 [2]	2048x858/4096x1716
"Full Container"/1.90	FLAT/1.85	1998x1051/3996x2103	1998x1080/3996x2160
HD/1.78	FLAT/1.85	1922x1080/3844x2160	1998x1080/3996x2160
CinemaScope/2.35	SCOPE/2.39	2048x856/4096x1713	2048x858/4096x1716

2.1.4.3   Pickup and Replacement Geometry

Geometry and size for Pickup/Replacement (Texted/Textless) shots must match respective OV files. Where this cannot be achieved and a geometry conversion is required, a reticule must be provided in a format matching that of the source material - additional editorial charges may apply.

2.1.5   FRAME RATES

Support for various frame rates is based on target DCP format type and image resolution. See **TABLE 2 – "FRAME RATES"** for acceptable frame rates. All "drop" frame rates (such as 29.97, 23.98, etc) and any frame rate not noted below are not supported by specifications and standards and are not expected to work in any DC equipment. As such, they will be converted to the closest frame rate for the DCP format being used.

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[1] For SCOPE trailers playing in front of FLAT features.
[2] For FLAT trailers playing in front of SCOPE features.

TABLE 2 – "FRAME RATES"

Supported Frame Rate	Interop (IOP) DCP	SMPTE DCP	Image Size
24	Yes	Yes	2K/4K
25	Limited	Yes	2K/4K
30	No	Yes	2K/4K
48	3D Only	Yes	2K
50	No	Yes	2K
60	No	Yes	2K
96	No	Yes	2K
100	No	Yes	2K
120	No	Yes	2K

NOTE: All frame rates of 60fps and above are not widely supported, and are based on a very limited number of installed equipment, and their individual equipment capabilities. Use at your own risk.

2.1.6   COLOR AND BIT-DEPTH INFORMATION

All Images MUST be provided with File Format, Codec, Color Space, Target Display Luminance, Gamma, Code Value Range (e.g. Full Range 0-1023 vs. Legal/Head Range 64-940) and bit depth information.

Some preferred and valid examples include, but are not limited to:

- DCDM - 16 bit TIFF, XYZ, Gamma 2.6 @ 14fL, Full Range
- DCDM - 16 bit TIFF, XYZ, PQ @ 10000 nits, Full Range (for DolbyVision)
- QuickTime - H264, 10 bit, Rec- 709, Gamma 2.4, Head Range 4:2:2
- 10 bit DPX - ITU-R BT-709, Gamma 1.8, Legal Range
- 10 bit DPX - Rec-709, Gamma 2.2, Full Range
- HDCAM-SR - Rec-709 (ITU-R BT-709), Gamma 2.2, Full Range 4:4:4
- D5 - DCI-P3, Gamma 2.6, Full Range 4:2:2

NOTE: Files in LOG (or any custom or working) color space MUST be accompanied by the appropriate LUT (Autodesk 3dl, or DVS Clipster formatted) needed to convert the content to the target color space.

2.1.7   3D LOOK UP TABLES

Three-dimensional look-up table (3D LUT) files must be provided unencrypted. The following formats are accepted:

- Autodesk Lustre 17x17x17 LUT format (*.3dl)
- Clipster 17x17x17 LUT format (*.xml)
- Cube 3D LUT format (*.cube)

Upon receipt, it must be indicated whether the LUT is of Creative or Technical intent.

2.1.8   IMPORTANT CONSIDERATIONS FOR EXTENDED/HIGH DYNAMIC RANGE CONTENT

All files for non-standard DCI content MUST be clearly labeled as DVis, PQ, HLG, etc… with intended display luminance information. Files not labeled as such will be assumed to be standard DCI delivery. All pickup/Replacement (Texted/Textless) shots must match the dynamic range of the respective OV files. Mixed dynamic range cannot be used within the same composition.

2.1.9   OTHER SOURCE INFORMATION

2.1.9.1   Frames of Action

For each reel, frame count reference of FIRST FRAME OF ACTION/COMPOSITION (FFOC) and LAST FRAME OF ACTION/COMPOSITION (LFOC) must be provided.

2.1.9.2   Credits

For a feature, frame count reference of FIRST FRAME OF END CREDITS (FFEC) and FIRST FRAME OF MOVING CREDITS (FFMC) must be provided.

2.2 AUDIO

Files MUST be provided in reels matching the image frame to frame (including leaders, 2-pop, and tail-pop). Any length variations of picture/audio/subtitle assets in a reel, or longplay delivery, may be broken into matching reels, or extended, to accommodate limitations on playback systems, and may incur additional editorial charges.

2.2.1 SUPPORTED AUDIO ENCODING

For a complete list of all the audio file formats accepted, see **TABLE 7 – "AUDIO FILE FORMATS"** in Section **5.1.2** of **APPENDIX I**.

The preferred format of audio delivery is:

- Uncompressed 24-bit PCM wav, 48Khz sample rate

2.2.2 AUDIO LEVELS

- Ref level = -20dBFS
- Output level = 85dBc

2.2.3 WAVEFORM CHARACTERISTICS

Assuming 24fps, 1st Modulation of 2 pop must land at exactly 6 seconds (288000 Samples). 2 pop must be exactly 1 frame (2000 Samples) in duration, and must be exactly 2 seconds (96000 samples) from the start of program.

LFE channel audio shall be low passed (e.g. ~24-48db roll-off above ~125-160Hz) applied to prevent unwanted frequency ranges from finding their way to exhibition locations that may not have low pass filters in-line.

2.2.4 FILE HANDLING AND NAMING

Only stereo pair interleaved WAV files (OR) single channel (monaural) WAV files will be accepted. Each file for a single reel must be the same exact sample length.

All channels of a single reel shall have identical naming with the channel assignments clearly labeled. See **TABLE 3 - "AUDIO CHANNEL LABELS"** for common channel assignment labels to use.

TABLE 3 - "AUDIO CHANNEL LABELS"

5.1 Channel Assignment	Label	7.1 Channel Assignment	Label
Left	L	Left	L
Right	R	Right	R
Center	C	Center	C
Low Frequency Effects	LFE	Low Frequency Effects	LFE
Left Surround	Ls	Left Side Surround	Lss
Right Surround	Rs	Right Side Surround	Rss
		Left Rear Surround	Lrs
		Right Rear Surround	Rrs
Hearing Impaired	HI	Hearing Impaired	HI
Visually Impaired Narration	VI	Visually Impaired Narration	VI
DBox	DBox	DBox	DBox

2.2.4.1   Channel Layout

If providing stereo pairs, use BOTH labels noted above, and channels layout pairs shall be configured as:

- 5.1 Channel Layout
    - Left/Right
    - Center/Sub
    - Left Surround/Right Surround

- 7.1 Channel Layout
    - Left/Right
    - Center/Sub
    - Left Side Surround/Right Side Surround
    - Left Rear Surround/Right Rear Surround

2.3 SUBTITLES/CAPTIONS

2.3.1 XML GUIDELINES

For Interop DCP utilized subtitles or captions, timed text subtitle XML and any ancillary files must conform to the Texas Instruments DCinema Subtitle Specification V1.1 available at:

- http://www.deluxecdn.com/dcinema/reference/ti_subtitling_spec_v1_1.pdf

For SMPTE DCP utilized (OR) 3D (for use in 3D subtitle compositing) subtitles or captions, timed text subtitle XML and any ancillary files must conform to the SMPTE ST 428-7:2014 DCDM Subtitle specification.

- See https://www.smpte.org/

2.3.2 REEL OFFSETS

Each reel's XML start shall always be equal to a value of "00:00:00:00". No hour based "offsets" for reel number shall be used within any event's `TimeIn` or `TimeOut` element values (i.e. "01:00:00:00" for reel 1, "02:00:00:00" for reel 2, etc).

2.3.3 FILESIZE LIMITATIONS

In order to facilitate interoperability across many captioning and subtitling systems the below file size limits shall be adhered to:

- Font Files – must not exceed 640 kB
- Timed Text XMLs (*only if to be used for CLOSED CAPTIONS*) – must not exceed 256 kB
- Cumulative limit of reel (when utilizing PNGs) – must not exceed 115 MB

2.3.4 PNG GUIDELINES

PNG images shall be the same intrinsic picture resolution and aspect ratio of the intended composition, and should be cropped to fit the exact size of the text. No full frames PNG will be accepted.

PNG images shall be rendered in RGB colorspace, indexed colors will not be accepted.

2.3.5 LANGUAGE CODES

Language element and attribute code values for both Subtitle DCDM XML and CPL must conform to ISO RFC 5646.

2.4 ACCESSIBILITY TRACKS

2.4.1   HEARING IMPARED (HI)

HI tracks shall be provided as single channel (monaural) WAV file per reel with all the provisions of the Section **2.2** above. These tracks may be produced as an audio mix down during the production. If this is not available, the track is recommended to be produced with the minimum formula:

```
Center Channel @ 0dB
+ Left Channel @ -6dB
+ Right Channel @ -6dB
+ Peak Limiter @ -14dBFS
+ Compressor @ 2.5:1
```

NOTE: This method will miss dialogue in channels outside of the L/R/C mix.

2.4.2   SIGN LANGUAGE VIDEO

Sign language video tracks shall be provided per reel and shall be encoded as one of the following:

- H.264 / AVC .mp4, 24fps, RGB, 480X640 resolution
- .VP9, 24fps, RGB, 480X640 resolution

Audio tracks included on the video will be ignored and not utilized. As noted in Section **2.1.3** with other video type tracks, 8 second Academy head and tail leader, with 2-pop and tail-pop matching the audio must be included.

For inclusion into track 15 of the completed DCP, the files will be transcoded into a VP9 file within a monaural WAV file header. WAV files will not be accepted as source.

*NOTE: In Brazil, SLV is referred to as "LIBRAS" (Brazilian Sign Language). **ALL** DCPs going to Brazil after Sept 18, 2017 **must** contain a LIBRAS BSL track.*

2.5 OTHER TRACKS

2.5.1   MOTION CONTROL SEATS

2.5.1.1   DBOX

DBOX tracks shall be provided as single channel (monaural) WAV file per reel with all the provisions of the Section **2.2** above.

3 DCP (Digital Cinema Package) REQUIREMENTS

3.1 MASTERING SPECIFICATIONS AND DCP TYPES

Where appropriate, all standards to be followed are included, but not limited to, the specifications documents as described above in Section **1.1**. Source file requirements noted in Section **2** will also apply to all assets that are included as part of a DCP. To that end, the specific information referred to is not repeated in this section.

3.1.1 DCP FORMAT

Interop (IOP) DCP is to be used for general releases for feature, trailer, policy, ratings, etc. Specific requirements for IOP DCP are noted in Section **3.3** below.

SMPTE DCPs are to be used only in these circumstances:

- Dolby ATMOS DCP
- Dolby Vision DCP
- High Frame Rate (HFR) or Additional Frame Rate (AFR) DCP
- Test Release DCP
    - Coordination with Deluxe for Distribution and Mastering must be done prior to receipt.
    - Due to the nature of current equipment in the field, playback is not 100% guaranteed at all sites, and care must be taken to not send SMPTE DCP to theaters with "known issues" with this type of content.
    - Certain theaters and exhibitors have requested that IOP DCP is sent to them during these test releases, due to issues with various components in their auditoriums (audio routing, CCAP devices, etc).
    - More information regarding the above will be shared upon coordination meetings.

Specific requirements for SMPTE DCP are noted in Section **3.4** below.

3.1.2 DISCLAIMER ABOUT THESE REQUIREMENTS

Individual content owners and/or studios may have further and/or different DCP specific requirements that are not covered specifically within this document. In those cases, Deluxe will defer to the content owner's/studio's specification or requirement documents, if applicable and available. Deluxe may "reject" DCP content based on those requirements with minimal explanation provided.

3.2 GENERAL MASTERING REQUIREMENTS

These following requirements in this section apply to both IOP and SMPTE formatted DCPs. Specific requirements for each format are in subsequent sections.

3.2.1 COMPRESSION RATES

Image shall be encoded to DCI specification JPEG-2000 with a max Variable Bitrate (VBR) of (250) MB/s, or (500) MB/s for HDR (DolbyVision) and HFR content. Please note that individual content owners and/or studios may have lower limits or further specific compression requirements.

3.2.2 ENCRYPTION

When utilizing DCP encryption, all MXFs of the same asset type throughout a CPL shall be encrypted. If one MXF asset type is encrypted, the MXFs of all remaining asset types shall be encrypted as well.

> *NOTE: Encrypted Timed Text MXFs (only for SMPTE DCP) are on a case by case basis, and shall remain unencrypted except for as noted below in Section 3.4.7.5 below. However, if encryption is used on these tracks, as noted above, all Timed Text MXFs shall be encrypted.*

Unless specifically required and/or requested by the content owner and/or studio, all "feature" DCPs should be encrypted.

3.2.3 REEL HEAD & TAIL LEADER

When wrapping both Picture and Audio/ATMOS MXFs, care shall be taken to preserve all reels' head and tail leaders, including 2-pop and tail pop, within the MXF. CPL asset `EntryPoint` and `Duration` shall be used to "hide" these leaders from playback to ensure a seamless reel transition.

3.2.4 NAMING CONVENTION

3.2.4.1 *ContentTitleText*

Even though the "Digital Cinema Naming Convention" is an agreed upon voluntary recommended practice, care should be taken to ensure the `ContentTitleText` of a CPL follows the naming convention as closely as possible. This convention, with examples and definitions for the multiple fields, is described at: http://isdcf.com/dcnc/.

> *NOTE: Individual content owners and/or studios have the final say with regards to the naming they wish to use and have variations on the naming convention. Please confirm with both DTDC and/or content owner prior to delivery.*

No two DCPs shall ever have the same exact `ContentTitleText` value. Any time a CPL is revised, either the date field or version number shall be updated or amended in some way to denote a new version has been created.

3.2.4.2   Asset File Names

Asset file names shall be as short as possible to account for path name limitations in an AssetMap (around 100 characters), but unique enough to not cause file name collisions on creating a mapped file set (DCP) of similarly named assets. Full UUID of the asset is not recommended for inclusion in the file name, but partial (first section for example) is acceptable. File names should consist of only alphanumeric character and should not contain spaces.

3.2.5   ANNOTATION TEXT

Some playback and theater management systems present `AnnotationText` from *either* the PKL(s) or CPL(s) within a DCP to the user at the time of ingestion of content. To that end, the `AnnotationText` in both the PKL and CPL shall be included, and the below logic be utilized for the PKL.

- In the case where a PKL contains a single (1) CPL:
    - Both the PKL and CPL `AnnotationText` shall match exactly the CPL's `ContentTitleText`.

- In the case where a PKL contains (2) or more CPLs:
    - Each CPL `AnnotationText` shall match its own `ContentTitleText`.
    - The primary CPL's `ContentTitleText`, or a string to best describe the collection of CPLs, shall be used for the PKL `AnnotationText`.

3.2.6   AUDIO CHANNEL LAYOUT

Audio MXFs must always have number of tracks in multiples of (2). For combining with other pre-existing elements and/or reels, Audio MXFs shall be padded with "black" to either 8 or 16 channels.

See **TABLE 4 – "MXF AUDIO CHANNEL TRACKS"** below for mapping channel layouts into MXF tracks. Channels 9, 10, and 16 shall be left blank (with MOS audio), as they are currently not in use for any channel layouts. The channel format "7.1 SDDS" shall not be used (Lc and Rc installs are very rare).

TABLE 4 – "MXF AUDIO CHANNEL TRACKS"

Channel	1	2	3	4	5	6	7	8	11	12	13	14	15
5.1	L	R	C	LFE	Ls	Rs	HI	VI	-	-	DBOX	-	SLV
7.1	L	R	C	LFE	Lss	Rss	HI	VI	Lrs	Rrs	DBOX	-	SLV
7.1 (ATMOS)	L	R	C	LFE	Lss	Rss	HI	VI	Lrs	Rrs	DBOX	SYNC	SLV
Stereo	L	R	-	-	-	-	HI	VI	-	-	-	-	SLV
Mono	-	-	C	-	-	-	HI	VI	-	-	-	-	SLV
MOS	-	-	-	-	-	-	-	-	-	-	-	-

3.2.7   SUBTITLE TIMED TEXT

All subtitle DCDM guidelines and requirements that are noted in Section **2.3** also apply to DCP delivery.

3.2.7.1   CPL Entry Point

`EntryPoint` in a CPL referencing any Timed Text asset may never contain a non-zero value. This applies to both Subtitles and both Open or Closed Captions.

3.2.7.2   Timed Text XML Reel Number

`ReelNumber` in a Timed Text XML shall always match the corresponding CPL's reel number.

3.2.7.3   Closed Captions and Subtitles Simultaneous Usage

Due to playback issues with some equipment transposing subtitle and caption playout, if using BOTH Closed Captions and Subtitles, for every reel that contains one, the other must also be used.

3.2.7.4   DOM Closed Caption Language Code

For US DOM English releases only – Due to equipment nuances with language tags, `Language` value within the Closed Caption element of the CPL and the Timed Text header shall be "en". This is to ensure the captions will appear on channel "1" of all current equipment.

3.3 INTEROP (IOP) DCP SPECIFIC REQUIREMENTS

3.3.1   FRAME RATES

See Section **2.1.5** for acceptable frame rates for IOP DCP.

3.3.2   RATINGSLIST ELEMENT

`RatingsList` shall be present and represented as an "Empty Closed Element":

```
<RatingList/>
```

3.3.3   SUBTITLE TIMED TEXT

3.3.3.1   Timed Text XML Uniqueness

Timed Text XML files must not be "reused" in different DCPs. This is due to the way both mastering systems package ancillary (fonts and PNGs) files that are referenced by XMLs, and how some systems ingest these files, in some cases overwriting them. In order to accomplish the "reuse" of Timed Text XML assets (for example, using the same CCAP files for both a 5.1 and 7.1 feature version), it is recommended that for each XML instance used, the `SubtitleID` is updated to reflect a new UUID.

3.3.3.2   Subdirectory

For each Timed Text reel, the XML file, and all ancillary files (fonts and PNGS) must be placed within a sub directory, and the name of this sub directory must be the UUID of the XML's `SubtitleID`.

3.3.3.3   CPL Asset Types

For Closed Caption Timed Text, `MainClosedCaption` CPL asset type shall be used. For Subtitle and Open Caption Timed Text, `MainSubtitle` CPL asset type shall be used.

3.3.3.4   Timed Text XML Length

Timed Text XML duration shall not be longer than corresponding reel's length.

3.4 SMPTE DCP SPECIFIC REQUIREMENTS

3.4.1   SMPTE "FLAVORS"

Although there are no official SMPTE DCP versions per se, the industry has agreed on a set of components for three different feature sets, or flavors, of SMPTE DCP.

See
TABLE 5 – "ISDCF SMPTE FLAVORS" below for the components for theatrical release agreed upon by multiple companies in ISDCF meetings. These feature sets are colloquially called the "flavors" of SMPTE for standard release and ease of use. These components have been tested in both ISDCF PlugFests and internationally during major studio releases.

TABLE 5 – "ISDCF SMPTE FLAVORS"

A	Bv2.0	Bv2.1
SMPTE DCP	SMPTE DCP	SMPTE DCP
Audio SMPTE MXF Config 4	Audio SMPTE MXF Config 4	Audio SMPTE MXF Config 4
		Audio SMPTE MXF w/ MCA Sub Descriptors Label ULs
Timed Text with CPL EntryPoint value = "0"	Timed Text with CPL EntryPoint value = "0"	Timed Text with CPL EntryPoint value = "0"
	CPL CompositionMetadataAsset	CPL CompositionMetadataAsset
		MCASubDescriptors included in CPL CompositionMetadataAsset
Subtitles	Subtitles	Subtitles
Closed Captions	Closed Captions	Closed Captions
Open Captions	Open Captions	Open Captions
	Markers	Markers
	Ratings	Ratings
	3D Subtitles	3D Subtitles

NOTE: This grid of features is solely for informational purposes only, and unless specified below any SMPTE DCP for general release must be of the SMPTE "A" flavor. However, there are still issues with wide release of even SMPTE A, as there are known audio routing issues when switching older and/or legacy systems from IOP to SMPTE DCP. To that end, IOP DCP is still recommended for full interoperability for any wide release.

NOTE: The above mentioned "3D Subtitles", is not meant as full support for "Variable Z" 3D moving subtitles in DCI theatrical projection. As no playback equipment yet supports this feature, it is implied that the system will not crash when encountering subs of this type, and will default to the static Z positions defined in the XML. For functionality of true Z-axis moving subtitles, the subtitles must be burned into the image.

All trailers, policies, shorts, or other content accompanying SMPTE feature content (within the same DCP) should be SMPTE flavor A to ensure highest compatibility. If accompanying content is delivered separately, IOP DCP for those are acceptable. If the accompanying content is Dolby ATMOS or DolbyVision, the requirements for those DCP types apply as noted in Sections **3.4.5** or **3.4.6** below.

3.4.2   FRAME RATES

See Section **2.1.5** for acceptable frame rates with various container resolutions for SMPTE DCP.

3.4.3   AUDIO FORMAT

Audio MXF shall utilize the "Configuration 4" Channel Assignment UL as noted in SMPTE ST 429-2, commonly referred to as "Wild Track Format". No other channel formats, included "Undefined" or "0" (IOP) will be accepted.

3.4.4   SUBTITLE TIMED TEXT

3.4.4.1   Encryption

Unless specifically noted below as in test releases, SMPTE Timed Text MXF should not be encrypted.

3.4.4.2   Intrinsic Duration

The `IntrinsicDuration` of any Timed Text MXF asset must be at minimum the length of the reel it is to be contained in.

3.4.4.3   Timed Text XML Namespace

SMPTE Timed-Text XML should use the 2010 XML namespace unless features of the 2014 namespace are specifically required.

3.4.4.4   Timed Text XML Start Time

`StartTime` in a Timed Text XML shall always be equal to a value of "00:00:00:00". No "offsets" for reel number shall be used.

3.4.4.5   CPL Asset Types

For Closed Caption Timed Text, `ClosedCaption` CPL asset type shall be used. For Subtitle and Open Caption Timed Text, `MainSubtitle` CPL asset type shall be used. `ClosedSubtitle` or `MainCaption` shall not be used, as support in existing equipment is minimal.

3.4.5   DOLBY ATMOS DCP

Dolby ATMOS DCPs shall be SMPTE Flavor A and fully flattened OV DCP, unless specifically requested.

If part of a test release and requested for SMPTE Bv2.0 or Bv2.1 flavor, DCP may or may not include some or all the components described in Section **3.4.7** below. Verify which components are required prior to delivery.

3.4.5.1   *Subtitles*

Currently, all on-screen subtitles and/or captions must be "burned in" to the picture assets.

3.4.6   DOLBY VISION DCP

DolbyVision DCPs can be of the either the SMPTE Bv2.0 or Bv2.1 flavor, and may or may not include some or all the components described in Section **3.4.7** below. Minimum component requirement is the inclusion of the `CompositionMetadataAsset`. Verify which additional components are required prior to delivery.

Furthermore, all Dolby Vision CPLs must include the following Extension information within the `ExtensionMetadataList` **inside** `CompositionMetadataAsset`:

```
<cpl-meta:ExtensionMetadata scope="http://www.dolby.com/schemas/2014/EDR-
Metadata">
  <cpl-meta:Name>Dolby Vision</cpl-meta:Name>
  <cpl-meta:PropertyList>
    <cpl-meta:Property>
      <cpl-meta:Name>image transfer function</cpl-meta:Name>
      <cpl-meta:Value>PQ10K</cpl-meta:Value>
    </cpl-meta:Property>
  </cpl-meta:PropertyList>
</cpl-meta:ExtensionMetadata>
```

3.4.7   TEST RELEASES (Bv2.0/Bv2.1)

The below requirements ONLY apply to releases done in the SMPTE Bv2.0 or Bv2.1 formats. Use of these components within other SMPTE releases may cause ingest or playback issues.

3.4.7.1   *Audio MXF MCA Sub Descriptors*

For SMPTE Bv2.0 - Audio MXF MCA sub descriptors label ULs shall not be used.

For SMPTE Bv2.1 - Audio MXF MCA sub descriptors label ULs shall be used, and MXF Channel Assignment UL must remain as "Configuration 4". The Channel Assignment UL "Configuration 6" (used to denote "true" MCA), or any other configuration UL, shall not be used. All audio reel MXFs shall contain the same exact MCA layout.

3.4.7.2   CPL Metadata (CompositionMetadataAsset)

3.4.7.2.1   General Info

The `CompositionMetadataAsset` field within SMPTE CPL is a way to put information previously stored only within the `ContentTitleText` directly into the CPL in a manner that can be machine and/or human read and utilized for automation purposes. Further information about CPL Metadata is described within SMPTE ST 429-16.

All fields within `CompositionMetadataAsset` shall be filled out as completely as possible. Where applicable, in fields such as `VersionNumber`, the values used should match what is used within the `ContentTitleText`, including, but not limited to, facility, studio, language, and territory codes for automation purposes.

3.4.7.2.2   Additional Info for Bv2.1

Furthermore, for SMPTE Bv2.1 CPLs, the `MCASubDescriptors` element shall be used within the `CompositionMetadataAsset` as described in "ISDCF Doc 4 – Audio Channel Assignments" at http://www.isdcf.com/ISDCF/technical-documents.html. The information and UUIDs for this element shall correspond to the MCA sub descriptor label UL and layout information in the first audio MXF referenced (first reel) within the CPL.

3.4.7.2.3   Flavor Info Extension

For determination of which flavor that is being used, there shall be an extension added that denotes the flavor as such (where "#" in `Value` is replaced with either "0" or "1"):

```
<cpl-meta:ExtensionMetadata scope="http://www.smpte-ra.org/schemas/429-
16/2014/Ext-Meta#scope">
  <cpl-meta:Name>SMPTE</cpl-meta:Name>
  <cpl-meta:PropertyList>
    <cpl-meta:Property>
      <cpl-meta:Name>Version</cpl-meta:Name>
      <cpl-meta:Value>Bv2.#</cpl-meta:Value>
    </cpl-meta:Property>
  </cpl-meta:PropertyList>
</cpl-meta:ExtensionMetadata>
```

3.4.7.3   Markers

To assist with exhibition lighting and other cue automation, the following markers shall be included:

- First Frame of Composition ("FFOC")
- First Frame of End Credits ("FFEC") [3] - Only applies to feature content with end credits
- First Frame of Moving Credits ("FFMC") [4] - Only applies to feature content with end credits
- Last Frame of Composition ("LFOC")

3.4.7.4   Rating List

If applicable to release territory, `RatingList` should be filled out completely in compliance with SMPTE ST 429-7, including both `Agency` and `Label`. If there is no current rating, the territory has no agency or ratings system, or the rating is unknown, the `Agency` and `Label` should be filled out with the values "NA".

3.4.7.5   Timed Text

All Timed Text MXF assets shall be encrypted. Standard file size limits in Section **2.3.3** shall apply.

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[3] Typically, these refer to director and/or actor credits done in card style or heavy styled end credits sequences. If neither of these types of credits exist, can be the same frame number as FFMC. Both FFEC and FFMC markers must be present.

[4] Typically, these refer to the "rolling credits". If there are no rolling credits, can be the same frame number as FFEC. Both FFEC and FFMC markers must be present.

3.5 DKDM – DTDC CERTIFICATE IDENTITY

When providing distribution key delivery messages (DKDM), please target the leaf certificate of the chain at the link at:

- http://www.deluxecdn.com/dcinema/support/DTDC-Ont_DKDM__Waimea_SMPTE.pem

4 DELIVERY

4.1 ELECTRONIC

4.1.1 PROTOCOLS

Files may be delivered using the following methods:

- Aspera
  - Point to Point (P2P) – Preferred delivery method for all data types.
- Connect – For DCP data and small audio/image/video deliveries, not for full features.
- Faspex – For DCP data and small audio/image/video deliveries, not for full features.
- Signiant
  - Manager/Agent – Preferred delivery method for all data types.
  - Media Shuttle – For DCP and small audio/image deliveries, not for full features
- Fotokem Global Data
  - For DCP and small audio/image deliveries, not for full features.

4.1.2 SECURITY CONCERNS

Successful transfer to one Deluxe Technicolor facility DOES NOT constitute an established connection to any other facility or location. Due to strict content security protocols, we maintain separate firewall and access control lists for each location and new connections and protocols require serious review, as such:

- First time electronic transfers or transfers to locations that have not been utilized for more than 6 months must be arranged a minimum of 3 business days in advance.
- Establishing connection using a protocol not mentioned above may require up to 20 business days advance notice, and there is no guarantee the method will be approved.

4.1.3 TRANSFER SPEED

Excessive transfer times due to slow connection may result in additional charges and delay otherwise previously agreed upon turnaround times.

- We consider 200 Mbps the absolute minimum speed for full feature DCDM ingests; Ideal speeds are 800-3000 Mbps.
  - At 200 Mbps, a full feature 2D package that's 2.0TB in size will take 24 hours to download;
  - At 800 Mbps, the same package will take 6 hours.
- We consider 50 Mbps the absolute minimum speed for small file delivery; Ideal speeds are 200 Mbps.
  - At 50 Mbps, 10 GB of 7.1 audio will take 0.5 hours to download.
  - At 50 Mbps, 220 GB of reference QuickTime will take 10 hours to download; At 200 Mbps, the same package will take 2.5 hours.

4.2 PHYSICAL

All media MUST be labeled, or be accompanied by a shipping list that clearly identifies the contents (including any associated file system information), project (security titles accepted) and contact information. Virus or erroneous file detection, improper packaging or labeling (or lack thereof) will result in rejection, and the asset will be returned to the point of origination.

NOTE: Excessive scanning or ingesting may result in project delays and or additional charges.

4.2.1 Source File Media Formats

- LTO-6, LTO-5, LTO-4, LTO-3
  - LTFS
  - Linux tar format, with blocking factor clearly specified on the label and/or insert
  - NOTE: Tar-per-frame tapes take significantly longer to ingest and as a result, additional charges may be incurred when tapes are delivered in this manner. Tar per reel is preferred.
- Hard Drive or USB Stick
  - Format: EXT2, EXT3, EXT4, HFS+, NTFS, FAT32
  - Interface: CRU, eSATA, Thunderbolt, USB3.0, FW800, FW400, USB2.0
- Tape Format
  - 1080/24p HDCAM-SRW
  - D5 1080/24p

4.2.1.1 Other Media Concerns

- Currently, Left and Right eye images must be supplied separately when delivered on tape.
- HDCAM Dual (4:2:2) Stream (created with SRW-5800 with HKSR-5803HQ and SRW-5100 with HKSR-510) must be sent out for L/R eye separation.
- Excessive transfer times due to low speed media (transfer speeds < FW800) may result in an inability to make agreed upon deadlines and additional data charges.
- Any revised files MUST be delivered on media labeled in such a way that all revisions are uniquely identifiable.

4.2.2 DCP Media Formats

- LTO, as noted above
- Hard Drive or USB Stick
  - EXT2, EXT3 – inode size set to 128 bytes
  - Other requirements can be found in "ISDCF Doc 3 – Hard Disc Drive Formats" at http://www.isdcf.com/ISDCF/technical-documents.html

NOTE: Multiple top-level directories as described in the above document is only recommended for content to be shared among mastering facilities or for archiving purposes, and not for general distribution.

4.3 GENERAL

For first time content exchange between Deluxe Technicolor and an outside facility, it is recommended that a file transfer and content compatibility test be performed prior to the mastering project start date.

5   APPENDIX I

5.1 SUPPORTED FILE FORMATS

5.1.1   Video File Formats

TABLE 6 – "VIDEO FILE FORMATS"

File Format	Specs
Bitmap	8 bit BGR 8 bit BGRA
DPX	10 bit RGB cineon big endian 12 bit RGB big endian 16 bit RGB cineon big endian 8 bit RGB 8 bit UYVY 10 bit YUV422 cineon big endian 8 bit YUVA4224 10 bit YUVA4224 8 bit RGBA 10 bit RGBA 8 bit YUV422 b.e. V2 8 bit YUV422 l.e. V2 10 bit YUV422 b.e. V2 10 bit YUV422 l.e. V2 8 bit YUV444 b.e. V2 8 bit YUV444 l.e. V2 10 bit YUV444 b.e. V2 10 bit YUV444 l.e. V2 8 bit RGB b.e. V2 8 bit RGB l.e. V2 10 bit RGB b.e. V2 10 bit RGB l.e. V2 12 bit RGB b.e. V2 12 bit RGB l.e. V2
AVI	8 bit UYVY 10 bit raw YUV422 16 bit YUV422 big endian
QuickTime	QuickTime Conversion 8 bit UYVY 10 bit YUV422 (v210) ProRes 422 ProRes 422 (HQ) ProRes 422 (LT) ProRes 422 (Proxy) ProRes 4444 DV25 DV25 Avid DVCPro25 DVCPro50 DVCPro50 Avid DVCProHD100

	DNxHD,1080p,10bit,220Mbps DNxHD,1080p,8bit,145Mbps DNxHD,1080p,8bit,220Mbps DNxHD,720p,10bit,185Mbps DNxHD,720p,8bit,185Mbps DNxHD,720p,8bit,120Mbps DNxHD,1080i,10bit,220Mbps DNxHD,1080i,8bit,145Mbps DNxHD,1080i,8bit,220Mbps DNxHD,Thin,8bit,145Mbps DNxHD,1080p,8bit,36Mbps DNx444,1080p,10bit,440Mbps IMX50 IMX50 Avid IMX40 IMX30 XDCamHD 25Mbps CBR 8Bit 4:2:0 XDCamHD 35Mbps VBR 8Bit 4:2:0 XDCamEX 35Mbps VBR 8Bit 4:2:0 XDCamHD 50Mbps CBR 8Bit 4:2:2 AVC-Intra50 AVC-Intra100
MPEG-1	8 bit UYVY
MPEG-2	8 bit UYVY
Windows Media	8 bit BGR
Cineon	10 bit RGB cineon big endian
Targa	8 bit BGR 8 bit BGRA 8 bit Luma
TIFF	8 bit RGB 8 bit RGBA 12 bit RGB 12 bit RGBA 16 bit RGB big endian 16 bit RGB little endian 16 bit RGBA big endian 16 bit RGBA little endian 8 bit Luma 12 bit Luma 16 bit Luma big endian 16 bit Luma little endian 32 bit RGB b.e. 32 bit RGB l.e. 32 bit RGBA b.e. 32 bit RGBA l.e.
JPEG2000	JPEG2000 10 bit RGB JPEG2000 12 bit RGB JPEG2000 16 bit RGB JPEG2000 8 bit YUV JPEG2000 10 bit YUV
DC MXF 250 (DCI)	JPEG2000 10 bit RGB JPEG2000 12 bit RGB MPEG2 VES

OpenEXR	16 bit RGB l.e. 16 bit RGBA l.e.
XDCamIMX	IMX50 IMX40 IMX30
XDCamHD	XDCamHD 50Mbps CBR 8Bit 4:2:2 XDCamHD 18Mbps VBR 8Bit 4:2:0 XDCamHD 25Mbps CBR 8Bit 4:2:0 XDCamHD 35Mbps VBR 8Bit 4:2:0
DV	DVCPro25 DVCPro50 DVCProHD100 DV25
DC MXF 500	JPEG2000 10 bit RGB JPEG2000 12 bit RGB MPEG2 VES
P2-Style MXF	DV25 DVCPro25 DVCPro50 DVCProHD100 AVC-Intra50 AVC-Intra100 AVC-Intra200
XDCamDV	DV25
MXF(OPAtom)	DNxHD,1080p,10bit,220Mbps DNxHD,1080p,8bit,145Mbps DNxHD,1080p,8bit,220Mbps DNxHD,720p,10bit,185Mbps DNxHD,720p,8bit,185Mbps DNxHD,720p,8bit,120Mbps DNxHD,1080i,10bit,220Mbps DNxHD,1080i,8bit,145Mbps DNxHD,1080i,8bit,220Mbps DNxHD,1080p,8bit,36Mbps DNx444,1080p,10bit,440Mbps DNxHD,Thin,8bit,145Mbps DV25 DVCPro25 DVCPro50 DVCProHD100 XDCamHD 50Mbps CBR 8Bit 4:2:2 XDCamHD 35Mbps VBR 8Bit 4:2:0 XDCamHD 25Mbps CBR 8Bit 4:2:0 XDCamHD 18Mbps VBR 8Bit 4:2:0 XDCamEX 35Mbps VBR 8Bit 4:2:0 IMX50 IMX40 IMX30 AVC-Intra100 AVC-Intra50
IMF MXF (AS02)	PEG2000 8 bit RGB JPEG2000 10 bit RGB JPEG2000 12 bit RGB

	JPEG2000 16 bit RGB JPEG2000 8 bit YUV JPEG2000 10 bit YUV
MXF JPEG2000 LRCP	PEG2000 8 bit RGB JPEG2000 10 bit RGB JPEG2000 12 bit RGB JPEG2000 16 bit RGB JPEG2000 8 bit YUV JPEG2000 10 bit YUV
MXF AVCIntra	AVC-Intra50 AVC-Intra100 AVC-Intra200
MPEG-4	MPEG-4 Part 10 (AVC/H.264)
H.264 Stream	MPEG-4 Part 10 (AVC/H.264)
AS-02 MXF	JPEG2000 8 bit RGB JPEG2000 10 bit RGB JPEG2000 12 bit RGB JPEG2000 16 bit RGB JPEG2000 8 bit YUV JPEG2000 10 bit YUV
XAVC MXF	XAVC HD Intra class 50 CBG XAVC HD Intra class 100 CBG XAVC 4K Intra class 100 CBG XAVC 4K Intra class 300 CBG XAVC 4K Intra class 480 CBG
AS-11 MXF	IMX50 AVC-Intra100
HDF-01 MXF (OP1a)	XDCamHD 50Mbps CBR 8Bit 4:2:2
HDF-02 MXF (OP1a)	XAVC HD Intra class 100 CBG
HDF-02 MXF (OP1a)	XAVC HD Intra class 100 CBG

5.1.2   Audio File Formats

TABLE 7 – "AUDIO FILE FORMATS"

Format Name	Default Extension	Description
AIF AIFF	*.aif *.aiff	Audio interchange format. Platform-independent file format for sound. Capable of storing multiple mono or stereo channels.
BWF	*.rf64 *.wav	Broadcast wave format. Platform-independent file format for sound. Extension of the Wave format capable of storing multiple mono or stereo channels together with metadata and enabling file sizes of more than 4 GB.
Wave	*.wav	File format for digital audio (waveform) data under Windows. Capable of storing multiple mono or stereo channels.
Dolby® ATMOS®	.mxf (container)	File format based on audio objects technology instead of channels. Cannot be played out directly in CLIPSTER unless a third-party decoder is used.