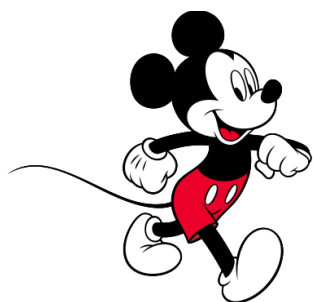




The **WALT DISNEY** Studios

Dolby Vision Best Practices Guide

Version 1.3.1
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2 Release Notes

Date	Version	Editor	Notes
18 August 2020	0.1	MK	Outline and first Rough Draft
2 September 2020	0.2-0.4	MK	General Editorial Added MDP line items
October 2020	1.0	MK	Publication
April 2021	1.1	MK	Added L5 info Exported v2.9 must be approved Added warnings for incorrect Mastering or Encoding values Minor editorial corrections
October 2021	1.2	MK	Added 5.1.0 version info Added additional Mastering displays Updated Mastering Display Primaries chart and added verification technique Added CMVersion information
October 2022	1.3	MK	General editorial for clarity Updated v4.0 to preferred version throughout document Additional references to mediatechspecs.disney.com Restricted use of custom mastering monitors Limited use of secondary monitors during grading
March 2023	1.3.1	MK	General editorial for readability Updated v4.0 workflow as primary

3 Introduction

Dolby Vision is a robust and complicated dynamic metadata system describing shot-by-shot values of image content. Dolby Laboratories, Inc. provides training, documentation, and best practices as part of their system. It provides filmmakers with the ability to better guide their content across many levels of the distribution landscape. It maps higher luminance levels, dark and shadow details, and wider color gamut, to the capabilities of a monitor or device to help maintain creative intent from the finishing bay to the audience. Dolby Vision also provides a measure of post-production workflow enhancements to the HDR-first finishing process. These guidelines are supplement to, and in some cases additional constraints upon Dolby Laboratories' training and best practices, as well as common industry practices.

These guidelines comprise the post-theatrical and home Dolby Vision finishing and mastering environment. Theatrical Dolby Vision is out of scope of this document.

Please refer to Disney's ***HDR Finishing and Mastering Best Practices Guide*** and the ***Mastering and Digital Supply Chain Specifications*** series of documents (available on mediatechspecs.disney.com) for complete technical requirements. It is the responsibility of a production or vendor to be sure they are referencing the most recent specifications prior to delivery.

All variations upon these best practices must be approved by Disney Mastering and Technology prior to beginning color grading and Dolby Vision creation.

For questions about the Dolby Vision working environment please contact Disney Mastering Technology.

Disney recommends Dolby training and certification for Dolby Vision.

4 Recommended Practices

Disney Mastering allows productions the option to use Dolby Vision as appropriate to their finishing workflow. Disney recommends Dolby Vision v4.0 for most mastering workflows, while v2.9 is allowed upon request.

Dolby Vision v4.0 offers a more robust algorithm and more granular color controls which may better facilitate creation of a Rec.709 grade with metadata trims.

Choice of Dolby Vision version and workflow should be determined with Disney Mastering and Mastering Technology prior to color grading.

4.1 Environment

Grading should be done in an environment following the guidelines set forth in Disney's *HDR Finishing and Mastering Best Practices Guide*. This includes:

- Use of an approved finishing/mastering monitor
- Mastering display calibration
- Use of approved secondary or “client” monitors
- Grading in an approved color space and workflow

4.2 Approved Monitors

As of July 2021, the following are approved HDR finishing/mastering monitors:

- Sony BVM-X300 (1000 nits peak)
- Sony BVM-HX310 (1000 nits peak)
- EIZO CG3146
- Flanders Scientific XM310K
- Dolby PRM-4200 (600 nits peak)
- Dolby Pulsar (4000 nits peak) may be used with permission from Mastering and must include a content check on approved 1000 nit display to ensure offshoots do not clip unacceptably.

Use of other monitors, including custom settings and related HDR or Dolby Vision metadata, **must** be approved by Mastering and Mastering Technology prior to color finishing and Dolby Vision creation. Monitors are subject to full calibration requirements.

4.3 Secondary Monitors

Any secondary or “client” monitors must be approved for use and agreed upon between filmmakers, the post-production facility, and Mastering.

Uses might include luminance tech checks (i.e. do or how do high peaks clip badly on a consumer display?), tunneling of metadata trims prior to final renders (preview of metadata using a CMU to embed in HDMI), or other similar cross-checks.

Disney does not recommend using secondary monitors during the primary color grade. Attempting to match shots on a secondary monitor to a mastering monitor may result in an inferior grade.

4.4 Finishing Color Space

Working color space should follow workflow determined at start of grading. This information must be captured as part of the Dolby Vision metadata (and any peripheral data required by the Disney Title Producer) as noted below.

This metadata, once confirmed as correct, must be carried through the lifecycle of the master, both in the Dolby Vision XML and any standalone uses as ST 2086 metadata for HDR10.

4.5 Luminance Levels

Luminance levels of HDR Masters may vary by studio banner, though the preferred design of an HDR show should fall within 1000 nits peak luminance. Several studio banners are specifically and strictly limited to 1000 nits peak.

Studio/Feature Masters vary based on studio banner. Variations in peak luminance above 1000 nits must be approved by Mastering.

4.6 Metadata Levels and Trims

Levels of metadata within the Dolby Vision XML are commonly referred to as “L#.” Proper shot-based L1, or analysis metadata, is the minimum required for all content.

- L0 metadata refers to Mastering Display values.
- L1 metadata are baseline video analysis values.
- L2 metadata are trim values in v2.9 Dolby Vision.
- L5 metadata refers to `<ImageAspectRatio>` adjustments by shot.
- L6 metadata refers to MaxFALL and MaxCLL values.
- L8 and L3 metadata are primary and secondary trim values in v4.0 metadata.

L2 or L8 metadata trims are required for most features, while preferred for episodics and other content types. When L2/L8 trim passes are included, it is required to include a 100 nit trim and a 600 nit trim (unless the peaks of the grade are under 600 nits).

Studio/feature masters above 1000 nits peak luminance must include:

- 100 nit trim
- 600 nit trim
- 1000 nit trim

L2 or L8 trims are meant to guide monitor mapping based on capability as well as set baseline levels for rendering to a target output. Not every shot will require adjustments to trim values to achieve a desired look. For example, dub cards may only need L1; placeholder values for a 100 nit Rec.709 or a 600 nit target are optional.

Additional description is available from Dolby’s training and best practices documentation.

4.7 Synchronicity

Metadata must be frame accurate and all events must synchronize properly with video content. Some sync errors may be caused by incorrect head formatting or improper concatenation of reels into a long-play element, others by mis-timing of events in the timeline, adjustment of the cut without updating the Dolby Vision, or improper alignment of the XML with the corresponding image element. The creating facility should confirm sync as part of final QC prior to delivery to Disney. Sync errors caught during mastering QC sometimes require fixes performed at the originating facility.

Subsequent QC should confirm sync at least twice per reel/act, or at least once at the start of program and approximately every 3 minutes thereafter.

4.8 Derived Submasters

Using the Dolby Vision target output process, shows may use metadata trims for Rec.709 at 100 nits to generate their SDR master. Note for some shows this may not be creatively attainable with Dolby Vision v2.9. If working in v2.9 it is recommended to test a segment to determine if this is possible. If not, plan to create a unique SDR Rec.709 100 nit grade for delivery in parallel to the HDR master.

Derived Rec.709 SDR masters vs discrete Rec.709 grades must be established with Mastering as early in the finishing process as possible.

In a v4.0 workflow, derived submasters must be processed using v4.0 metadata, **not** from downgraded v2.9.

Only toolsets approved by Disney Mastering Technology may be used to derive a targeted master, including:

- Dolby Vision Professional Tools
- Colorfront Transcoder
- Blackmagic DaVinci Resolve
- Rohde and Schwarz Clipster

Please confirm use of toolsets not listed here.

Each toolset's interface dictates proper workflow to create derived elements. Use of either iCMU or eCMU is permissible as required.

In select feature workflows, a submaster to limit luminance for HDR10-only or HLG distribution Masters (commonly termed "HDR-C") may be requested at Mastering's discretion, made using the Dolby Vision 1000 nit target output.

Warning: Use of a LUT or mastering tools' effects or filters, not leveraging Dolby Vision XMLs, does not constitute a "Dolby Vision derived" use case or one approved by Dolby best practices. Those methods are prohibited in these workflows.

4.8.1 Derived Rec.709 Submasters

Derived Rec.709 masters must be rendered to the proper `<TargetDisplay>` of “ID 1.” Note that a subsequent range conversion from Full to Narrow/Head may be required, depending on system used and output file format.

4.8.2 Derived Constrained Submasters (HDR-C)

In select feature workflows, constrained submasters from masters with very high luminance may be required for HDR10-only or HLG distribution where 1000 nits or less luminance is required. This operation is only performed with prior planning and approval by Disney Mastering.

A constrained HDR master will typically be rendered to the `<TargetDisplay>` of “ID 21” in Rec.2020. Note that original Mastering Display metadata must be carried across to this submaster appropriately. Dolby Vision metadata must not be included with or applied when servicing this type of asset.

Note: Disney+ Originals and similar programs are strictly limited to 1000 nit peak luminance and will **not** require creation of a constrained submaster.

4.9 Versioning

The number of versions or cuts of a film, alternate shots, the addition of dub/credit/warning cards, etc., dictate the number of metadata XMLs to be generated.

A standard, reusable set of Dolby Vision metadata should be created to match each “base” version of a title. The base versions account for the following primary master types:

1. Domestic and common International length

Select masters may also receive:

2. International variant length
3. Unique versions

Most live-action titles will have a single base version applying to the Domestic and all localized masters. They may repurpose a single XML across numerous masters.

More complex, often animated, titles may have several base versions meeting different territory needs. Each base version should have a conformed XML assigned for downstream use. This also limits the number of XMLs generated for a given title.

This “one size fits most” methodology supersedes the legacy methodology of creation and duplication of Dolby Vision XMLs for every language variant required during mastering, rather creating fewer files and assigning adjustment to localization and/or downstream servicing.

Textless elements do not receive unique XMLs at this time. They are meant to be interchanged with texted elements during servicing and should not significantly alter main picture L1 values.

Fixes or patches to a master element do not necessarily require a new version XML. A new XML is only required when color or luma or shot composition has changed dramatically, the cut or timing has been altered, etc. Correcting hits, bad pixels, removing a boom mic does not usually require XML replacement. Confirm with Mastering or Mastering Technology as needed.

4.9.1 Domestic and common International length masters

Domestic and common International length masters conform to the same “base” version of a film. Most often this begins with the Original US English Domestic version and includes most localized or semi-textless versions that match that original total run time of the feature.

Localized or other image inserts in these types of masters do not change the timing of shots or overall total run time, nor do they radically change the luminance and color properties of shots. The Domestic XMLs may be repurposed for localized versions of these types of assets.

Dub cards commonly appear at the tail of an international language master. When added in mastering, the Dolby Vision master metadata should include a generic Dub Card event (see below) following end of program. Number and length of dub cards may vary by territory or translation and the event will be trimmed to match the appropriate version upon servicing. When dub cards are added to a long-play file after the initial mastering run, a dub card event will not appear in the original master metadata and will be added during servicing.

4.9.2 International variant masters

International variant length masters may be localized by language or semi-textless versions, generally including one or more of the following differences:

- Donut credits, and/or
- Variant final reel, and/or
- Other similar changes to runtime compared to Domestic master which apply to numerous localized versions.

These masters conform to a different “base” version than the Domestic master, necessitating a new Dolby Vision XML.

Most often this type of International master will be a Pixar title.

4.9.3 Unique masters

Complex versioning occasionally requires a unique master that does not match the domestic or international original versions. Most often this is a change in cut or edit, runtime, and color of numerous shots. This may include:

- Hulu-branded programs, where the logo is replaced with black for distribution on other platforms. The black inserts must have the L1 and trim values replaced in those events, necessitating an additional Dolby Vision XML for the non-Hulu-logo version.
- Director’s or Extended cut (potential for numerous differences compared to Domestic OV)
- Single territory version (censorship, local content, etc.)
- TV Repurposing / S&P edits
- Custom program or dub card elements (such as animated dub cards in select territories)
- Single version requirement with runtime or alternate shot changes not matching Domestic or common International length

These types of masters are a unique base, sometimes an entirely new cut of the program, and require a uniquely modified Dolby Vision XML. These should be handled separately from the original version as well as clearly named and noted as such in inventory.

Unique versions may in turn carry dub cards for international, or other add-ons.

4.9.4 Example File Naming

File names for Dolby Vision metadata may vary from the examples below. Commonality will be noted by Mastering and be recorded in inventory databases for downstream use.

Domestic and common International length

Wonderland

ThorRagnarok_OV_V30004976_FP_DPO_DoVi16_UHD-HDR_23_ENG-239_WLID#.xml

ThorRagnarok_OV_V30004976_FP_DPO_DoVi12_UHD-HDR_23_ENG-239_WLID#.xml

ThorRagnarok_OV_V30004976_FP_DPO_DoVi40_UHD-HDR_23_ENG-239_WLID#.xml

WMLS (Legacy)

(Media) THOR_TH-HDR_PRO-XQ_2160P23_240_ENG-ENG_WMLSID#

(Folder) THOR_TH-HDR_FEA_META-DOVI-LP_2160P23_240_MOS-MUL

(File) THOR_TH-HDR_META-DOVI-LP_2160P23_240_MOS-MUL.xml

International variant length

Wonderland

InsideOut_OV_V30002121_FP_DPO_DoVi16_UHD-HDR_23_JPN-239_WLID#.xml

InsideOut_OV_V30002121_FP_DPO_DoVi12_UHD-HDR_23_JPN-239_WLID#.xml

InsideOut_OV_V30002121_FP_DPO_DoVi40_UHD-HDR_23_JPN-239_WLID#.xml

WMLS (Legacy)

(Media) THOR_TH-INT-HDR_PRO-XQ_2160P23_240_NOR-NOR_WMLSID#

(Folder) THOR_TH-INT-HDR_FEA_META-DOVI-LP_2160P23_240_MOS-MUL

(File) THOR_TH-INT-HDR_META-DOVI-LP_2160P23_240_MOS-MUL.xml

Some titles may require additional sub-version or specific language designation to conform to their use of a territory-specific variant image base for international versioning, such as with the films *Inside Out* or *Zootopia*. In the cases where this is not used, their titles otherwise follow the standard international naming.

Unique versions

Unique versions will be named specific to the cut of the film. Note this may often include the matching WMLSID or another inventory number for more specific cross-reference.

Wonderland

ThorRagnarok_EX_V30004978_FP_DPO_DoVi16_UHD-HDR_23_ENG-239_WLID#.xml

ThorRagnarok_EX_V30004978_FP_DPO_DoVi12_UHD-HDR_23_ENG-239_WLID#.xml

ThorRagnarok_EX_V30004978_FP_DPO_DoVi40_UHD-HDR_23_ENG-239_WLID#.xml

WMLS (Legacy)

(Media) THOR_EX-HDR_PRO-XQ_2160P23_240_ENG-ENG_WMLSID#

(Folder) THOR_EX-HDR_FEA_META-DOVI-LP_2160P23_240_ENG-ENG_WMLSID#

(File) THOR_EX-HDR_META-DOVI-LP_2160P23_240_ENG-ENG_WMLSID#.xml

4.9.5 Metadata layout and use

It is required that there is an event at the end of program prior to the start of tail out or the dub card event. Where there is more than 1 second of black before the first dub cards, it is recommended that be its own event. Typical format is 2 seconds (48 frames) but may vary by title.

4.9.6 Dub Card Event

When needed, a dub card event following program may be included in the mastering workflow to support international servicing. It may be built differently depending on use case:

- Dub cards added during mastering
- Generic dub cards delivered as sidecar elements
- Dub cards created and added downstream during servicing (e.g. Blu-ray, some Disney+ titles)

The dub card event should only be added to metadata matching servicing or distribution level master metadata, i.e. IMFD or ProRes XQ masters.

When dub cards are added during mastering, the original domestic Dolby Vision XML should be copied and archived prior to adding the dub card event. The new localized Dolby Vision XML will include a single, 1800 frame (75 seconds) event, regardless of the number of dub cards used in any language versions. The dub card event is intended to cover any potential duration of dub cards tied to a program master, regardless of the number of cards. Changes/cuts or dissolves between simple dub cards do not need individual events at this time.

Note that this event is not just inserted black frames with all “0” values in the XML. The dub card event must include proper L1 values.

Standardized set of Dub Card XMLs representing common Mastering Display Primaries and luminance capabilities are available as a Wonderland asset (# 605b7905acf8baca6292e4d2).

The original domestic Dolby Vision XML will carry the language code ENG in its file name. The localized XML, meant to be repurposed for numerous language variants will carry the language code ALL (legacy) or ZXX in its file name. XMLs specific to a master should match naming.

Titles with standardized white-on-black dub cards should use the corresponding standardized dub card XML to concatenate onto the tail of the copied domestic metadata. This new “international” long-play XML should be entered into inventory for use on all localized versions of a title that conforms to this program version.

Titles with customized dub cards, where luminance or color of text may vary, should analyze the dub cards for proper L1 values during creation of the first and/or longest language set during mastering. Those L1 values are applied to an 1800 frame event, then concatenated as above, and entered into inventory. These measured values should only be used for the customized cards attached to that specific title.

In the event dub cards are complex, such as use of animated text or backgrounds, or as after-program material, they should be treated as program during the original Dolby Vision finishing session and would be used as an *International Variant Length* or even a *Unique* master (see above).

Upon servicing, the end of the metadata may be trimmed if required by the distribution partner specification to match:

- End of Domestic program, or
- End of common international program, including dub cards per language, and/or
- Any required tail out (padded with black) to match partner delivery requirements

In the event embedded dub cards are not used by a specific distribution partner in-territory (i.e. dub cards are added dynamically during playback), the Dolby Vision file may simply be trimmed to match the servicing file requirement.

Generic dub cards delivered after the initial mastering run (such as with a Semi-Textless element) may be accompanied by a standardized 1800 frame XML, meant to be concatenated during servicing.

Dub cards added during downstream servicing (e.g. Blu-ray, some Disney+ Originals titles, select territory partners) will be implemented as directed by Disney LTS, following Disney localization and distribution strategies.

4.9.6.1 Example Dub Card event in the XML (v2.9)

```
<Shot>
  <UniqueID>524715b0-5247-5247-5247-524715b04d4d</UniqueID>
  <Source>
    <ParentID>95a0f3e1-95a0-95a0-95a0-95a0f3e1acbe</ParentID>
    <In>0</In>
  </Source>
  <Record>
    <In>195932</In>
    <Duration>1800</Duration>
  </Record>
  <PluginNode>
    <DolbyEDR level="1">
      <ImageCharacter>0,0.00884938,0.486229</ImageCharacter>
    </DolbyEDR>
  </PluginNode>
</Shot>
```

5 Dolby Vision Metadata

Dolby provides colorist, operator, and facility best practices training and documentation as part of their usage program. The guidelines here supplement Dolby's system. See Disney's *Dolby Vision Mastering Specifications* for condensed technical requirements.

5.1 Validating and Updating Dolby Vision Metadata

All Dolby Vision XMLs must pass a validation check using Dolby Metafier prior to delivery. This is in addition to other quality assurance for program sync, metadata entries matching file formats, etc. XMLs that do not pass validation will be rejected.

Editing or updating Dolby Vision metadata should only be performed during color grading or using approved toolsets such as Dolby's Metafier. Manual edits via text editor may not properly update subsequent metadata values and may cause other unintended errors.

For assistance with advanced Dolby Vision functionality and correction, please contact Disney Mastering Technology or your Dolby support representative.

5.2 Dolby Metafier

Metafier is essential to ensuring Dolby Vision XML integrity. Confirm the latest approved version of the tool with Disney Mastering Technology.

Any **FAIL** or **ERROR** messages must be remediated.

Any **WARNING** must be examined and adjusted where necessary. Notes should be included for Mastering records or entered as line items in a QC report for downstream use.

An example of a Metafier report for v2.9 metadata, matching a ProRes XQ inventory element:

```
Metadata: INFO Validation Summary:
=====
Metadata version: "2.0.5"
Level254 CMVersion: 2 2
Aspect Ratios (Canvas - Image): 1.77778 - 1.85
Frame Rate: 23.976fps
Mastering Monitor: 1000-nit, BT.2020, D65, ST.2084, Full (ID 21): Bit Depth: 16bit -
Diagonal: 42.00in - Application Type: ALL - Color Info: "pq(0.0001,1000) rgb computer
bt2020"
Mastering Monitor Validation Test: PASS
Target Displays Validation Test: PASS
Level6 (MaxFALL - MaxCLL): 43.87 - 738.96
Color Encoding: "u12 444 pq(0,10000) rgb video bt2020"
Color Encoding Validation Test: PASS
Overlapping Shots Validation Test: PASS
Gap between Shots Validation Test: PASS
Negative Shot duration Validation Test: PASS
Per-Frame Data out-of-range Validation Test: PASS
Number of Shots: 2183
Frame Range: 0-233788
L2 Trim Count (TargetID, count): (1, 3704) (28, 3704) (49, 3704)
L1 Metadata Validation Test: PASS
L2 Metadata Validation Test: PASS
=====
06/15/2020/10:19:28.520263442 Metadata: WARNING List of WARNINGS:
```

```

=====
WARNING: L1=0,0,0 metadata for longer than 1 second at shot: UniqueID = 76814b7a-7681-7681-
7681-76814b7a8308 @[0-3119]. Fix it, if it contains image data.
WARNING: L1=0,0,0 metadata for longer than 1 second at shot: UniqueID = 40936238-4093-4093-
4093-4093623815f8 @[233669-233788]. Fix it, if it contains image data.
=====
06/15/2020/10:19:28.520318215 metafier: INFO No issues found in the Metadata

```

Note that the **WARNING** in this example refers to black padding at the head and tail of the element. This is acceptable based on the formatting of the ProRes XQ it matches.

Example of v4.0 metadata report, matching the same element in the above example:

```

Metadata: INFO Validation Summary:
=====
Metadata version: "4.0.2"
Level254 CMVersion: 4 1
Aspect Ratios (Canvas - Image): 1.77778 - 1.85
Frame Rate: 23.976fps
Mastering Monitor: 1000-nit, BT.2020, D65, ST.2084, Full (ID 21): Bit Depth: 16bit -
Diagonal: 42.00in - Application Type: ALL - Color Info: "pq(0.0001,1000) rgb computer
bt2020"
Mastering Monitor Validation Test: PASS
Target Displays Validation Test: PASS
Level6 (MaxFALL - MaxCLL): 43.87 - 738.96
Color Encoding: "pq(0,10000) rgb video bt2020"
Color Encoding Validation Test: PASS
Overlapping Shots Validation Test: PASS
Gap between Shots Validation Test: PASS
Negative Shot duration Validation Test: PASS
Per-Frame Data out-of-range Validation Test: PASS
Number of Shots: 2183
Frame Range: 0-233788
L2 Trim Count (TargetID, count): (1, 3704) (28, 3704) (49, 3704)
L8 Trim Count (TargetID, count): (1, 3273)
L1 Metadata Validation Test: PASS
L2 Metadata Validation Test: PASS
L3 Metadata Validation Test: PASS
L8 Metadata Validation Test: PASS
L9 Metadata Validation Test: PASS
=====
06/15/2020/10:29:52.528968794 Metadata: WARNING List of WARNINGS:
=====
WARNING: L1=0,0,0 metadata for longer than 1 second at shot: UniqueID = d834d2c4-d834-d834-
d834-d834d2c4e7b6 @[0-3119]. Fix it, if it contains image data.
WARNING: L1=0,0,0 metadata for longer than 1 second at shot: UniqueID = 9e376719-9e37-9e37-
9e37-9e37671987c1 @[233669-233788]. Fix it, if it contains image data.
WARNING: 127 Shots contain identical Level8 values
=====
06/15/2020/10:29:52.529021572 metafier: INFO No issues found in the Metadata

```

Note in this example the **WARNING** regarding L8 values refers to a number of shots to which the colorist applied the same correction for a consistent look. A warning like this is allowed but should be noted to the Disney Title Producer by the creating facility.

5.3 Dolby Vision Version

Dolby Vision v4.0 is preferred by Disney, while v2.9 is allowed in approved workflows. The Dolby Vision Version must match the version assigned at start of color correction:

- **4.0.2** for v4.0 metadata
- **2.0.5** for v2.9 metadata or,
- **2.0.5** is also correct for v2.9 metadata exported from a backwards compatible v4.0 XML

Note: metadata version and toolset version do not necessarily correspond.

Version **5.1.0** is not used by Disney at this time.

Dolby Vision shall be created in either a v4.0 workflow (preferred) or a standalone v2.9 workflow (allowed). Disney previously supported a v4.0 workflow with an exported v2.9 submaster, which is now deprecated. Confirm workflow with Disney Title Producer.

Examples of version in metadata:

v2.9

```
<DolbyLabsMDF version="2.0.5"...>
```

v4.0

```
<DolbyLabsMDF xmlns="http://www.dolby.com/schemas/dvmd/4_0_2">  
  <Version>4.0.2</Version>
```

Shows shall not change version mid-way through finishing without confirming with Disney Mastering.

Episodics will use the same version for all episodes in a season. Version should also be consistent for teasers, “next on,” etc., whenever possible.

Shows originating in v2.9 cannot be “updated” to v4.0. Attempting to do so will result in unusable metadata. If v4.0 metadata is desired after the original version was created in v2.9 a new Dolby Vision grading session is necessary.

5.3.1 Compatibility

Dolby Vision v4.0 must include backwards compatible v2.9 metadata. Confirm using Metafier prior to delivery. Failure to apply this update when needed will result in rejection.

The `<CMVersion>` tag displays metadata version and algorithms used.

- CMVersion [4 0] indicates the older algorithm (not backwards compatible)
- CMVersion [4 1] indicates the current algorithm with backwards compatibility

Compatibility is listed in the XML like this example:

```
<Level254 level="254">
  <DMMode>0</DMMode>
  <DMVersion>2</DMVersion>
  <CMVersion>4 1</CMVersion>
</Level254>
```

In Metafier it should appear like this example:

Level254 CMVersion: 4 1

In current workflows, v2.9 metadata must be exported as a deliverable using Metafier. Exported v2.9 metadata is subject to creative approval by a show's color supervisor (director, colorist, etc.) as well as technical approval.

5.3.2 CMVersion Table

Display Profile	v4.0	v2.9	Notes
CMVersion	4 0		4 0 made with old algorithm, must be updated using Metafier prior to exporting downgraded v2.9. Will be rejected by Disney without update.
	4 1		4 1 current algorithm.
	4 2		Includes custom L2; do not update using Metafier --update command or creative L2 trims may be lost.
		0 0 2 0	Native v2.9 metadata.
		2 1	Downgraded from old algorithm.
		2 2	Made with current algorithm.
		2 5	Downgraded from 4 2 metadata; do not update using Metafier --update command or creative trims may be lost.

5.4 Canvas and Image Aspect Ratio

The Canvas Aspect Ratio will typically be 1.78 for 16x9 content. The Image Aspect Ratio will vary based on a title's OAR, and metadata **must** match the active line count of the video content. These values should be calculated to five decimal places for accuracy. Evenly divisible aspect ratios such as 2.40 do not require additional decimals.

These values are often referred to as the “global” settings for Aspect Ratio. They may be further modified on a shot-by-shot basis using Level 5 metadata (see below).

The Image Aspect Ratio value example below is of a 2.39 letterboxed UHD element with a vertical active line count of 1608.

```
<CanvasAspectRatio>1.77778</CanvasAspectRatio>  
<ImageAspectRatio>2.38805</ImageAspectRatio>
```

L1 analysis must be performed on active image area only. If a letterboxed show was analyzed properly but the XML export rounded off the Image Aspect Ratio value, it may be remedied in Metafier as needed. Adjusting Aspect Ratio values by a line or two should not adversely affect analysis or trims.

Warning: If a program was analyzed as a full-frame image including letterboxing, this may not reflect the correct minimum or average luminance analysis values and may also cause unwanted lift or color artifacts in the mattes. Errors of this type must be remedied in the color corrector and new Dolby Vision generated. Attempting to correct these after the fact, outside the color corrector, may not properly represent the needed analysis or desired trims of these shots.

5.4.1 Level 5 Aspect Ratio Adjustments

Level 5 or “L5” metadata describes shot-based changes to the global Aspect Ratio settings. These may be used to adjust between widescreen, full-frame and/or pillarboxed presentation, address studio or production logos that vary from program Aspect Ratio, etc. L5 entries are not required for many masters. Where shots change aspect ratio as part of program presentation it is important to capture this information not only in the Dolby Vision but in show notes for distribution and archival records.

Incorrect values may clip lines of active video or allow matte lines to be affected by tone mapping adjustments causing artifacts. Dolby Metafier does not (yet) specifically validate L5. These entries must be confirmed manually using an XML or text editor. It is recommended to use the “find” function to check for presence and values of L5.

L5 appears within a `<Shot>` tag, following other trim metadata.

Example of L5 metadata with Image Aspect Ratio value set differently than used in the “global” example above:

```
<DolbyEDR level="5">  
  <AspectRatios>1.77778,1.77778</AspectRatios>  
</DolbyEDR>
```

In this example, the L5 metadata describes a shot that is full frame 16x9, differing from the main program. The opposite is also possible, where the majority of program may be 1.78 full frame, but select shots are assigned L5 for a wider aspect ratio.

These values must also match the line count of media used in the particular shot, and should similarly be calculated to five decimal places where needed.

Extraneous or redundant L5 entries should be removed.

5.4.2 L5 Methodology

Where changes in program Aspect Ratio are present there are several ways to apply L5. Shots must always be analyzed and trimmed using their proper aspect ratio, excluding mattes, for optimal presentation. Application of proper L5 Aspect Ratio shot by shot differs between color correction systems.

One recommended method is to match the global Aspect Ratio to the OAR of the majority of program, then analyze the differing shots and assign L5 to match line count – only the differing shots receive an L5 adjustment. Using the examples above, a program might be 2.39, while its logo at the head and tail and end credits might be 1.78 full frame.

- `<ImageAspectRatio>` matching the program timeline would be calculated to the line, in this case 2.38805
- The Dolby Vision events for the full frame logos and credits would include L5, noting the `<AspectRatios>` as 1.77778.

Displayed in emulation/QC, the events should properly display the full frame logo at the head, switch to 2.39 global setting for program, then switch again for the end logo and credits. The full frame elements should *not* adopt the wider program Aspect Ratio to display as cropped.

This method is most effective for programs with few events needing different Aspect Ratios, but it can still be used for more complex metadata.

For programs where the Aspect Ratio changes frequently, it may be simpler to leave the global setting as 1.77778 and adjust every shot. Depending on the color correction system, this may be as simple as applying aspect ratios to a group of shots, or as an adjustment node, or even to the source media for the timeline to detect.

5.5 Frame Rate

The frame rate listed must match the corresponding video content. Typically, this will be 23.976 fps as pictured below, but this may vary depending on title workflow.

```
<Rate>  
<n>24000</n>  
<d>1001</d>  
</Rate>
```

Dolby Vision events are based on frame counts and adjusting frame rates using Metafier, such as updating a 24p source XML to 23.976p for proper playback, should not change event timing.

5.6 Mastering Display

Mastering Display metadata must be properly assigned in the color corrector prior to beginning Dolby Vision creation and must reflect original finishing environment. It is automatically entered in the Dolby Vision XML in the `<MasteringDisplay>` tag.

Mastering Display metadata is static. It does not change if the video is transformed to a different specification, such as color space. It must be carried across the lifecycle of a master.

Warning: Applying incorrect `<MasteringDisplay>` values will cause a color shift.

There are two sets of Mastering Display Primaries (“MDP”), assignment is based on the finishing environment:

1. P3 finish with subsequent conversion to Rec.2020 = P3 MDP (a common legacy workflow)
2. 2020 finish
 - 2020 “native” = Rec.2020 MDP
 - With P3 constraint via LUT = Rec.2020 MDP
 - With P3 limit via project setting (e.g. Resolve gamut limiter) = Rec.2020 MDP
 - *The project setting option was previously specified as “P3 MDP” which may cause mismatches in some workflows. Always double check prior to delivery.*

NOTE: The color space setting of the display during finishing dictates the final MDP values.

Changing the mastering primaries’ metadata may adversely alter the color representation of a master on encode and playback and must not be done unnecessarily.

Use of a custom Mastering Display and related Dolby Vision metadata must be approved by Disney.

Entries in the examples below demonstrate the correct values for standard mastering displays. These values must match corresponding ST 2086 metadata.

5.6.1 1000 nit P3 Mastering Display Profile

```
<MasteringDisplay id="20" name="1000-nit, P3, D65, ST.2084, Full">
  <ID>20</ID>
  <Name>1000-nit, P3, D65, ST.2084, Full</Name>
  <Primaries>
    <Red>0.68,0.32</Red>
    <Green>0.265,0.69</Green>
    <Blue>0.15,0.06</Blue>
  </Primaries>
  <WhitePoint>0.3127,0.329</WhitePoint>
  <MinimumBrightness>0.0001</MinimumBrightness>
  <PeakBrightness>1000</PeakBrightness>
  <Encoding>pq</Encoding>
  <ColorSpace>rgb</ColorSpace>
  <SignalRange>computer</SignalRange>
  <DiagonalSize>42</DiagonalSize>
  <BitDepth>16</BitDepth>
  <ChromaFormat>444</ChromaFormat>
</MasteringDisplay>
```

5.6.2 4000 nit P3 Mastering Display Profile

```
<MasteringDisplay id="7" name="4000-nit, P3, D65, ST.2084, Full">
  <ID>7</ID>
  <Name>4000-nit, P3, D65, ST.2084, Full</Name>
  <Primaries>
    <Red>0.68,0.32</Red>
    <Green>0.265,0.69</Green>
    <Blue>0.15,0.06</Blue>
  </Primaries>
  <WhitePoint>0.3127,0.329</WhitePoint>
  <MinimumBrightness>0.005</MinimumBrightness>
  <PeakBrightness>4000</PeakBrightness>
  <Encoding>pq</Encoding>
  <ColorSpace>rgb</ColorSpace>
  <SignalRange>computer</SignalRange>
  <DiagonalSize>42</DiagonalSize>
  <BitDepth>16</BitDepth>
  <ChromaFormat>444</ChromaFormat>
</MasteringDisplay>
```

5.6.3 1000 nit Rec.2020 Mastering Display Profile

```
<MasteringDisplay id="21" name="1000-nit, BT.2020, D65, ST.2084, Full">
  <ID>21</ID>
  <Name>1000-nit, BT.2020, D65, ST.2084, Full</Name>
  <Primaries>
    <Red>0.708,0.292</Red>
    <Green>0.17,0.797</Green>
    <Blue>0.131,0.046</Blue>
  </Primaries>
  <WhitePoint>0.3127,0.329</WhitePoint>
  <MinimumBrightness>0.0001</MinimumBrightness>
  <PeakBrightness>1000</PeakBrightness>
  <Encoding>pq</Encoding>
  <ColorSpace>rgb</ColorSpace>
  <SignalRange>computer</SignalRange>
  <DiagonalSize>42</DiagonalSize>
  <BitDepth>16</BitDepth>
  <ChromaFormat>444</ChromaFormat>
</MasteringDisplay>
```

5.6.4 4000 nit Rec.2020 Mastering Display Profile

```
<MasteringDisplay id="8" name="4000-nit, BT.2020, D65, ST.2084, Full">
  <ID>8</ID>
  <Name>4000-nit, BT.2020, D65, ST.2084, Full</Name>
  <Primaries>
    <Red>0.708,0.292</Red>
    <Green>0.17,0.797</Green>
    <Blue>0.131,0.046</Blue>
  </Primaries>
  <WhitePoint>0.3127,0.329</WhitePoint>
  <MinimumBrightness>0.005</MinimumBrightness>
  <PeakBrightness>4000</PeakBrightness>
  <Encoding>pq</Encoding>
  <ColorSpace>rgb</ColorSpace>
  <SignalRange>computer</SignalRange>
  <DiagonalSize>42</DiagonalSize>
  <BitDepth>16</BitDepth>
  <ChromaFormat>444</ChromaFormat>
</MasteringDisplay>
```

5.6.5 Confirming Mastering Display Primaries

Verifying proper Mastering Display Primaries in Dolby Vision or IMF metadata is necessary in some workflows, or when validating in QC. Through previewing with Dolby Vision, one may confirm this metadata setting. Use a mastering tool that allows onboard processing through “eCMU,” often called Preview, Remap, or Emulation mode:

- The image master, an IMF or ProRes XQ, will be encoded as Rec.2020 PQ
- Set system output to Rec.2020 PQ
- Apply Dolby Vision metadata and set a target output of 1000 or 600 nits in Rec.2020
 - Some systems enable toggling on/off a target output preview, others require rendering a file
- Compare results on a program monitor and scope, either A/B of files on a timeline or toggling on/off settings:
 - If the proper MDP have been assigned, the luminance may adjust to the target output level but the color should not suffer a hue shift
 - If the MDP are incorrect, hue will shift and metadata must be fixed.
- Legacy masters encoded as P3D65 PQ require a different color pipeline to ensure proper conversion to Rec.2020 and metadata integrity.

Note: This method can also reveal if the file encoding is incorrect, such as when a P3 finished element was not properly converted to Rec.2020.

5.7 MaxFALL and MaxCLL (L6)

MaxFALL and MaxCLL should be calculated against active program (excluding letterboxing) as part of generating a histogram/frame light level report during mastering. These values are referenced as title data but not entered into the Dolby Vision XML. Default entries should be “0”

These values appear in the XML within the `<Level6>` tag.

Example of L6 metadata with “0” values:

```
<Level6>
<MaxFALL>0</MaxFALL>
<MaxCLL>0</MaxCLL>
</Level6>
```

Downstream use of L6 is subject to requirements by distribution partner. When calculated values are required, they should be entered using Metafier, including decimal places. Note that Metafier may round extended decimal places of Max values. This is an allowed variance.

When set to “0” some systems may drop the `<Level6>` tag entirely. In these cases, it should be re-added using Metafier.

Library titles produced before 2020 may include values in L6. This is an allowed variance and should be changed or entered as appropriate during servicing.

5.8 Color Encoding

Color Encoding metadata must reflect the file to which the metadata refers. Generally, this will be Rec.2020 encoding for IMF or ProRes 4444 XQ masters. Pixel content must match the file metadata. This is sometimes referred to as “Color Encoding Primaries” or “CEP.”

Warning: this entry in the Dolby Vision XML looks similar to the Mastering Display entry but each serve a distinct purpose and are **not** interchangeable. Applying incorrect `<ColorEncoding>` values will cause a color shift.

Disney Legacy archival masters (Clipster or TIF-V) and some other masters (such as Hulu programs) may have been created in P3 finishing space with Rec.2020 distribution masters made from them, converting upon transcode. These converted elements must maintain the original mastering display primaries metadata but carry Rec.2020 color encoding metadata.

The code block in XML looks like this example:

```
<ColorEncoding>
  <Primaries>
    <Red>0.708,0.292</Red>
    <Green>0.17,0.797</Green>
    <Blue>0.131,0.046</Blue>
  </Primaries>
  <WhitePoint>0.3127,0.329</WhitePoint>
  <MinimumBrightness>0</MinimumBrightness>
  <PeakBrightness>10000</PeakBrightness>
  <Encoding>pq</Encoding>
  <ColorSpace>rgb</ColorSpace>
  <SignalRange>computer</SignalRange>
  <BitDepth>16</BitDepth>
  <ChromaFormat>444</ChromaFormat>
</ColorEncoding>
```

`<Primaries>` state the primaries of the color space of the element with which the XML corresponds. This is Rec.2020 for most Disney masters.

`<WhitePoint>` is D65, and always listed in the XML.

Minimum and Peak brightness in this block refer to the value range of the encoding function.

`<Encoding>` is the transfer function of the element, typically PQ for a Disney Dolby Vision master.

`<ColorSpace>` notes the color system of the color space of the element with which the XML corresponds. This is RGB for most Disney masters.

- Some library elements may be in “ycbcr_bt2020” and should be confirmed with Mastering prior to use.

`<SignalRange>` notes use of full (“computer”) or head/narrow (“video”) range of code values.

`<BitDepth>` typically:

- v4.0 does not track bit depth; this tag does not appear in v4.0 XML
- 16bit for TIFF, DPX and Lossless IMF masters
- 12bit for ProRes XQ and Lossy IMF masters
- Some library elements may be 10bit masters. Confirm with Disney Mastering prior to use.

`<ChromaFormat>` is typically 444 chroma sampling.

- Some library elements may be 422 subsampled. Confirm with Disney Mastering prior to use.

6 QC Requirements – General

Dolby Vision XMLs must include quality assurance checks prior to delivery including analysis using Dolby Metafier, Interra Baton, and other approved systems.

Metadata entries as line items are presented in Disney’s *Dolby Vision Specifications* documentation.

Initial checks for sync and trims should occur during finishing or online. Shot-based L1 analysis, regardless of v2.9 or v4.0 metadata version, is the baseline requirement. Black frames based on conform set should be included at the head and tail as needed. Single-shot L1 is not allowed.

Any trims for target outputs or changes in image aspect ratio must be viewed by the color supervisor(s) on a given show with Dolby Vision activated to ensure proper representation of color and luminance and/or framing. This should be performed using emulation, such as the preview mode in Resolve or Transcoder, output to an approved mastering display (e.g. X300/X310). Optionally this may be reviewed using “tunneled” metadata feeding a secondary monitor, such as an LG C-series monitor or approved equivalent. Disney requires trims be checked at start and end of program, and approximately every 4-5 minutes of run time (e.g. 2-3 times per reel, concatenated) to ensure sync. When a show intends to derive an HDR-C to a 1000 nit target or a Rec.709 100 nit version using metadata trims, the color-baked master should be viewed and color approved by the show’s color supervisor(s) and Disney Mastering.

Subsequent checks against masters or submasters should include checks for conform set and any values based on master type as described in Disney’s specification.

Dolby Metafier should be used extensively, checking the initially exported metadata prior to any adjustments, and at every step through creating final deliverables. If metadata does not pass crucial checks in Metafier it will be rejected by Disney.

QC software, such as Interra Systems’ Baton and Venera Technologies’ Pulsar, offer some metadata checks and are approved for use in the metadata QC process. Increasingly, Metafier and other tools are being integrated into mastering systems and onboard use will be approved as systems are updated.

7 Delivery Requirements

All Disney HDR masters are expected to adhere to current Disney Mastering and Digital Supply Chain Specifications. During transition or revision of specs, the latest specifications will usually be applied rather than altered during creation of final masters. As new specs are published all shows will transition with guidance from Disney Mastering and Technology.

It is recommended that all delivery requirements and specifications be discussed during show kickoff meetings, onboarding, as well as through regular contact with the assigned Disney Title Producer, supported by Mastering Technology. Detailed walkthrough of all aspects of delivery and other best practices are available upon request.

Dolby Vision for Disney masters shall be delivered as standalone XMLs. If interleaved into IMF packages that media will be rejected. Future workflows may require sidecar and/or ISXD track file inclusion in IMF, but not at this time.

7.1 Anticipated Deliverables

The full set of Dolby Vision deliverables will vary by program and production methodology. It is recommended that the original metadata exports from the finishing system be kept as part of the archival elements. In legacy workflows, these have been delivered alongside elements matching Clipster Uncompressed or IMF Lossless level elements.

Dolby Vision XMLs are subject to various quality assurance including analysis using Dolby Metafier and Interra Baton, or other approved systems.

For a generic feature master, the following may apply:

- Original reel-based XMLs (prior to concatenation) for archival.
- Long-play XML matching encoding of Uncompressed or Lossless master.
- Long-play XML matching encoding of Mezzanine or Lossy master.

If a feature was posted/finished in long-play, the need for reel-based XMLs would be waived.

For a generic episodic master, the following may apply:

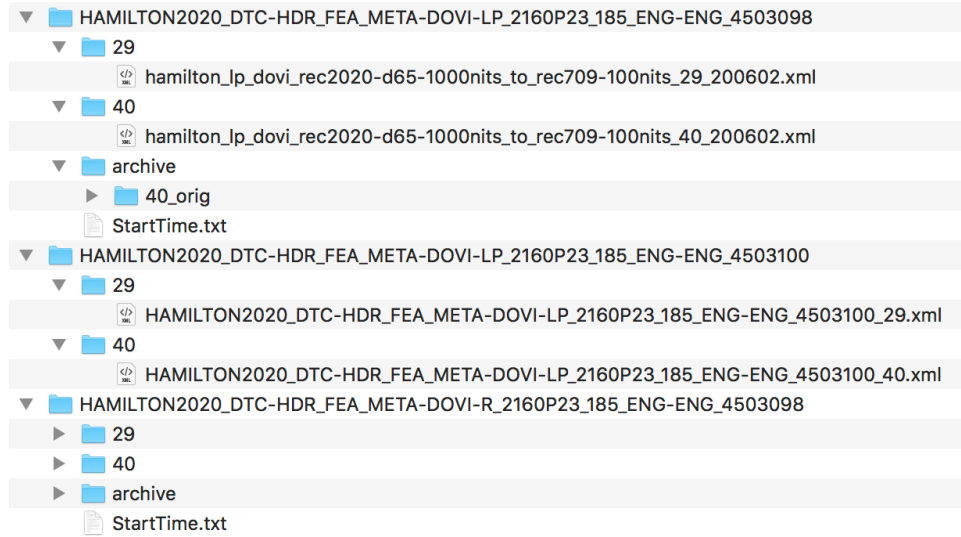
- Copy of original XML export for archival.
- XML matching encoding of Uncompressed or Lossless master
- XML matching encoding of Mezzanine or Lossy master.

Shows finishing with v4.0 metadata must deliver both original v4.0 XMLs for archival and exported long-play v2.9 as deliverables.

Additional metadata deliverables will commonly include a Histogram (Colorfront Frame Light Level report or equivalent), Max values calculations, and an ST 2086 XML for Disney+ Originals.

Final deliverables will be confirmed by the Disney Title Producer.

Example Dolby Vision set of deliverables (legacy Disney naming):



Note how v4.0 and v2.9 metadata is clearly marked

Example deliverables (Disney Wonderland naming):

```
ThorRagnarok_OV_V30004976_FP_DPO_DoVi40_UHD-HDR_23_ENG-239_AARAVBRVY
ThorRagnarok_OV_V30004976_FP_DPO_DoVi16_UHD-HDR_23_ENG-239_AARAVBRVY
ThorRagnarok_OV_V30004976_FP_DPO_DoVi12_UHD-HDR_23_ENG-239_AARAVBRVY
```

8 References

Disney's *HDR Finishing and Mastering Best Practices Guide* and the *Mastering and Digital Supply Chain Specifications*

SMPTE ST 2084

SMPTE ST 2086

SMPTE ST 2113

ITU-R BT.2020

ITU-R BT.2100

ISO 11664-2

Dolby Vision Best Practices / Content Creation Help Center
<https://contentsupport.dolby.com/hc/en-us>

Dolby Professional Support
<https://professionalsupport.dolby.com>

Disney Mastering Specifications <https://mediatechspecs.disney.com/>