



DOLBY VISION - MASTERING CONTENT USING NUCODA AND PHOENIX

2018.2



Mastering HDR content with Dolby Vision in Nucoda and Phoenix

Dolby CMU 2.6.3 Firmware

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Dolby Vision Mastering Workflow

A Dolby Vision master has an HDR grade plus scene by scene metadata to optimise playback on displays of different brightness. It uses the ST2084 PQ curve but requires a display with Dolby Vision licensed firmware to play back correctly. LG, Sony and Visio currently offer Dolby Vision licensed consumer displays.

The workflow entails the grading of the master HDR version on the brightest display available, then creating scene by scene metadata. The scene based metadata is used to create additional versions of the content that are suited to different displays. This process requires operator input using a limited set of tools that were defined by Dolby.

A monitor capable of displaying material with the ST2084 PQ EOTF is required to grade Dolby Vision Master and deliverables.

Currently the list of approved mastering monitors are:

- Dolby Pulsar 4000 nits - not commercially available, but can be provided by Dolby on request
- Dolby Maui 2000 nits - not commercially available, but can be provided by Dolby on request
- Sony BVM X300 1000 nits - available from Sony
- Dolby PRM - available from Dolby - *this monitor is only capable of 600 nits but it is possible to create the master project at 600 and then make the trim passes on a brighter display.*

The output of a Dolby Vision grading session consists of two parts. The first part is the image sequence encoded and exported as Tiff or EXR files. The files are created with the PQ curve as part of the rendered images.

The other component is the Dolby Vision XML file that contains metadata about the project, the image analysis and trim data for every additional target display.

This XML is used to create different masters and also dynamically map the content on Dolby Vision enabled displays based on the additional target display trim data.

Dolby Vision - Overview

Nucoda and Phoenix have native support for Dolby Vision and when the option is selected, additional UI elements are available when a suitable **Dolby Content Mapping unit (CMU)** is connected to the system.

Contact Dolby directly for information on how to obtain CMU. Dolby also provide a full manual for the CMU hardware itself.

The CMU is an external processing unit provided by Dolby that enables the following Dolby Vision functionality..

- Image analysis and metadata generation for trim passes
- Controls for Dolby Vision tools
- Access to the database of supported mastering monitors and output target displays
- Real-time content mapping processing to the selected target display

The CMU performs the content mapping function from content with embedded Dolby Vision metadata over a SDI interface for a selected target display.

In the interface there are two buttons added in the library when in a Dolby Vision project :

- Config Dolby CM: Allows access to the CMU setup menu
- Export Dolby CM: Export the XML Metadata file

In the grading tool stack an additional layer labelled "Content mapping" will appear after the Master Layer, this is where analysis and trim functions are available. The trim tools are also available on the Precision control panel.

Working with material:

The Dolby Vision trim passes are performed once the graded master is complete. Most users prefer to do the trim passes using a mixed down master that has been exported with linear gamma or material with the PQ curve already applied.

The master is imported, scene detected or cut up with a EDL and the analysed and the trim passes performed. This ensures that the original grade is not accidentally changed by having live grading layers in the stack.

Material must have the PQ curve applied for the analysis to be correct, so, for a source that has linear gamma, the PQ matrix must be applied to the material and applied.

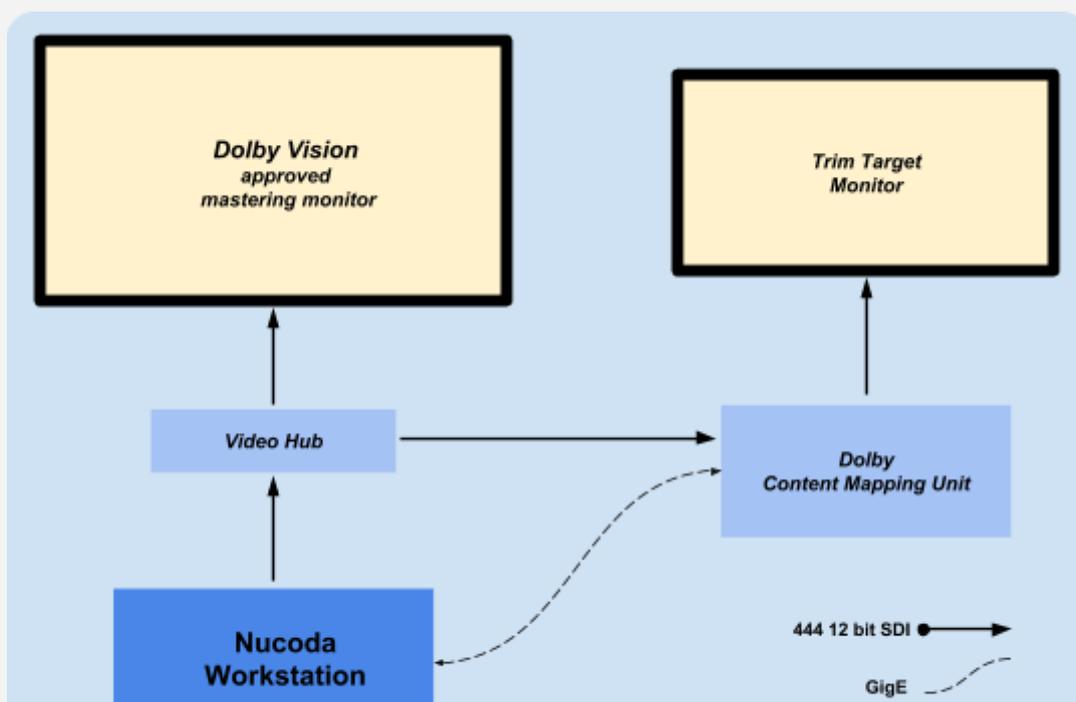
If the master already has the PQ EOTF applied no action is required.

Connecting the CMU

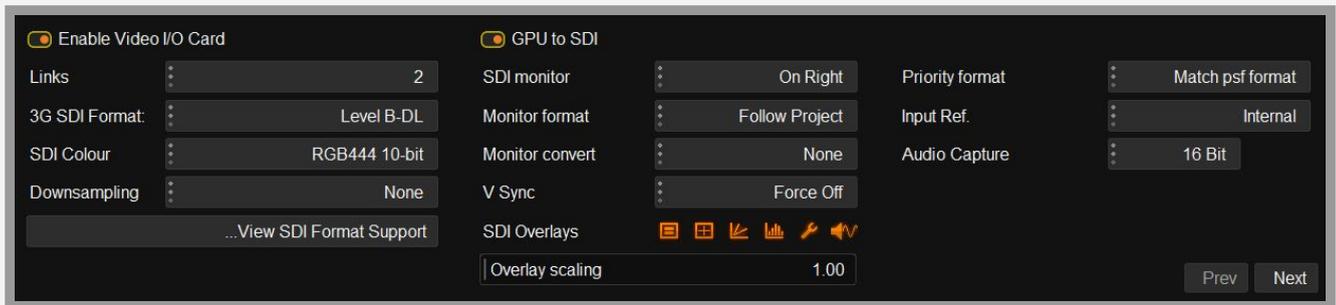
The CMU is designed to be a “headless” box, meaning it is designed to sit in a rack in the server room with no GUI explicitly running. The current CMU OS is Linux.

Not having a monitor connected is normally only an issue when the network has not been configured to work for the environment it is being installed in. As such, it is usually advisable to initially set up the machine with a VGA monitor and USB keyboard. The following steps should be followed for initial connectivity:

- Unbox the CMU and connect power, making sure there is sufficient ventilation top and bottom.
- Locate the included mini-SDI to SDI cable harness. This is used to connected the CMU to the SDI output (from the AJA Kona 4 card). This can be done using either dual-link HD-SDI or single-link 3G SDI.
- The SDI signal must be split - one output to the Mastering monitor and the other to the CMU. The signal must be 444 12 Bit and can be Dual or Single link using the Kona 4
- Connect a network cable to the first port and connect it to the workstation.
- If instead of connecting directly you choose to route through a network then ensure that no ports are blocked.
- Complete networking information should be obtained from the Dolby Vision CMU User Manual
- The default setup for the CMU is DHCP
- Plug a USB keyboard into a usb slot. There is no need for a mouse, as there is no graphical user interface
- Connect a monitor to the VGA port. **Do NOT connect the monitor to the graphics card on the CMU**
- Turn on the machine – all the services will start automatically



Workstation setup (Kona 4 only - no Decklink support)



The SDI output from the AJA Kona 4

- The SDI IO Mode must be set to **RGB 444 12 bit** to support the Dolby Vision workflow
- **The SDI output from should be connected to both the mastering monitor and the CMU input, it is possible to use a looped output from the monitor to the CMU.**
- **Ensure that the Monitor format is set to HD1080p and convert set to None or Fit**
- You can only send 1080p HD SDI signals to the CMU (see CMU manual for details)
- The CMU will accept :
 - 1.5G dual-link SDI (2 Physical links) or 3G Level B-DL - 1 Physical link (recommended)
- Do NOT set the Max Data Rate to 3G (Auto) - Set to 3G Level B-DL
- The CMU will automatically configure the output SDI interface to match the input SDI interface. If needed, the CMU can be set to force a 3G SDI output, even if the input SDI is dual-link HD-SDI
- If possible, it is recommended to use 3G connectivity, if only because of the reduced cabling necessary, but also because there are fewer timing and VPID identification issues.
- Since the workstation IP Address is encoded and sent to the CMU via SDI, please ensure that there is an image on the screen or has a composition open to allow discovery of the CMU.

Ethernet connection between workstation and the CMU

- Please see the CMU User Manual for setup instructions.
- The ethernet address of Nucoda or Phoenix workstation is encoded in the SDI video stream to the CMU and the CMU then connects via the ethernet port.
- You may have to add a windows firewall exception for the port communicating with the CMU or turn off the windows firewall completely.
- You are able to control and reset the CMU by loading a web browser and entering the CMU IP address in the browser.
- The default network on the CMU is configured for DHCP.
- With multiple ethernet connections and complex routing being more and more common it is possible that the CMU cannot be discovered when starting the software, even it can be seen and controlled via the browser application. In cases like this, there is an option in the general.prefs file to enter the IP address of the workstation (not the CMU), to allow the CMU to connect.
 - ForceIPAddress "Nucoda/Phoenix workstation IP"
 - c:\Nucoda\20xx_x\root\Users\All Users\General.prefs
 - c:\Phoenix\20xx_x\root\Users\All Users\General.prefs

Project setup

Full Range - Half or 10bit

Select a resolution and frame rate for the project, using a single AJA Kona 4 in the CMU:

- 1920 x 1080p 23.98
- 1920 x 1080p 24
- 1920 x 1080p 25
- 1920 x 1080p 27.97
- 1920 x 1080p 30

Please contact us if UHD output is required - this requires a dual Kona 4 in the CMU

Video Output scaling set to “Full Range (4-1019)”

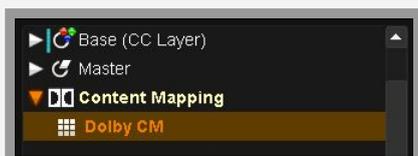
Enable the **Dolby CM** option under the Content Mapping menu



There are 2 new buttons in the Library for controlling **Dolby CM** functions.



You will notice that there is a new layer named **Content Mapping** with a **Dolby CM** tool in the tool stack after the Master layer.



Setting up the Mastering display in the CMU



... Config Dolby CM button

- This will open a new panel called Configure Dolby CMU
- When a CMU is connected the CMU name will be displayed in the left column

Note: It is possible to have multiple CMUs connected

When a CMU had been connected but removed, it will be remembered, along with the CMU mastering settings - there is a list for CMU's known to the project.

- The Master Display dropdown has a list of mastering monitors currently supported - options will change as the product is updated by Dolby.
 - **Current options include:**
 - Dolby Pulsar - 4000 nit
 - Dolby PRM32HFD - 2000 nit
 - Sony BVM X300 - 1000 nit
- Use this selection to select the mastering monitor for the HDR version. The mastering monitor must match the monitor that the HDR version was graded in to ensure correct trim values.
- Select a Target Display in the right column. This is to select the trim target monitor connected to the CMU. The list includes displays that are commonly used.
- These target display list is dynamic - they are sent from the CMU and available targets will depend on the version of CMU software being run.

Note: If a CMU is not connected, you will see a dropdown showing "CMU's that are known to the project, it is not editable but will have the mastering information

There is also a "Re-discover" button for reconnecting to the CMU if it disconnects for some reason.

- Finally there is an "OK button for finalising your selections, or a Cancel button if you decide to make no change at this time to a previous selection.
- The Web interface that is available for the CMU via the browser and the CMU IP address, it is a very useful source of information.
- Remember to check the CMU web interface for error messages if something does not seem to be working as expected.

Image Analysis

Once the HDR Master grade has been completed, the content must be prepared for the trim pass to create the other required deliverables. It is possible to work in the original project with the graded timeline when doing the trims, however many users prefer that the Dolby Vision trim version are performed on a mixed down master that is scene detected or cut up with an EDL.

With regard to adding titles or overlays during the analysis and trim phase. If titles are being added make sure they are mapped to PQ levels and are correct when viewed on a mastering monitor, 150 to 300 nits is a good start.

Titles will affect the analysis, so the title track should be turned off for the analysis pass. If there are already titles applied you may consider analysing a single frame on the clip that has no title showing. For white on black titles, use a single frame analysis and apply to all black and white title cards..

The image master should have PQ already applied.

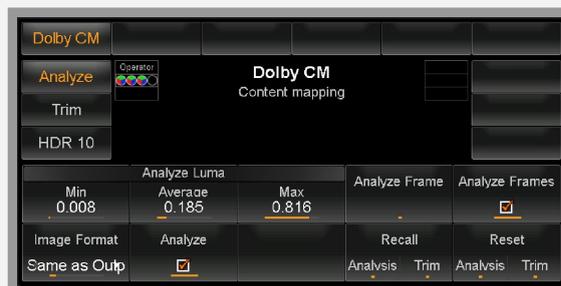
Note: Analysis will be incorrect if the material does not have the PQ curve applied.

The first stage of the trim pass is analysis. The analysis pass works by processing each frame of the content, using the project timeline to generate metadata for each shot. At this point, the metadata consists of just three numbers, a minimum, maximum, and average brightness for each shot.

The analysis has to process every frame in the sequence, and might take some time, our tests we have found that for a typical system the analysis runs at about real time.

The metadata that is generated by the analysis is stored as parameters and are available the CMU process layer.

- Ensure that the Image Format setting matches the content being analysed, the setting should match the picture content and exclude any black bars. There is a user editable file called DolbyOutputFormats.prefs in C:\Nucoda/Phoenix20xx_1\root\Presets\Users that can be customised.
- The image format setting will also be used to correctly mask the image when using the CMU, preventing the masked areas of the image from being processed.
- To only analyse certain clips, select a clip (or multiple clips) on the timeline (Ctrl click or drag select)
- Press the analyse button, this will analyse all selected clips
- Single or multiple clips can be selected, reset and re-analysed
- The option exists to analyse a single frame using the Analyse Single Frame button. (the result will be used for the entire clip)
- Any composited images will be analysed and the result displayed on the bottom layer. Clips with the comp effect will not have the Dolby Trim effect. Use Pg Down to access the track
- If there are any composited titles, mute the track to not analyse the titles. Always make sure titles are not at peak (10000 nit) brightness)



Precision analysis controls

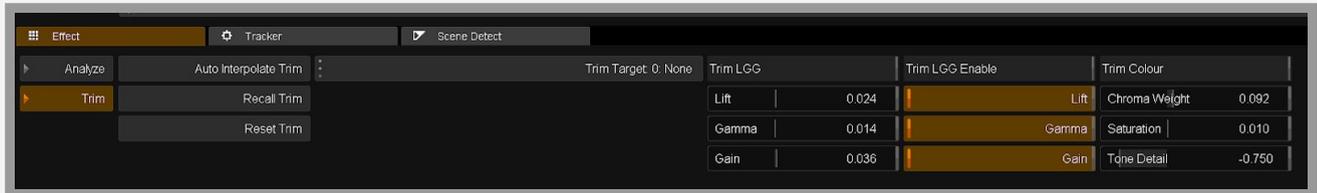
During clip analysis the render status indicator bar will turn purple.

The Analyse Luma column will contain the results of the analysis.

The MaxFall/MaxCLL data is also calculated but is not required for Dolby Vision

Creating trim versions for other displays using the Trim tools

After analysis, select the trim target - make sure the required monitor is connected to the CMU and the CMU is set to the same target.



At this point the colourist will take a view as to whether or not the resultant image is the best representation of his image on the Trim target monitor.

If it is considered that enhancements could be made then there are specific trim tools available in the tool to do this.

- Lift Gamma Gain
- Saturation and CHroma Weight
- Tone Detail must NOT be altered it should remain at -0.750

Remember, the changes made using the trim tools are created by using the trim data to affect the CMU signal. No actual changes are made to the master. Changes are made by the CMU and applied to the image on the connected monitor. There will be a few frames delay due to the processing in the CMU.

- **Important note: To copy Trim or Analysis values between clips, use the Recall Trim and Recall Trim buttons on the tool screen in the Precision. Or use the Turbine button to recall Trims - press to recall and long press to reset current values.**
- It is possible to copy and paste Trim and Analysis values between clips, however using the normal Recall will recall the whole Dolby Layer and that includes both trim and analysis values.
- In cases where there are two clips composited over each other using the Composite effect on the top clip, the Dolby Analysis effect will be on the bottom clip.

The option also exists to interpolate new trim targets based on previously created trim.

- Select the required new trim target.
- Select the Auto interpolate button - calculate the new settings based on the current available trims.
- You are able to recall trim data or analysis data from other clips to one or multiple selected clips on the timeline.
- Analysis of dissolves and dynamics are performed automatically



Precision trim controls

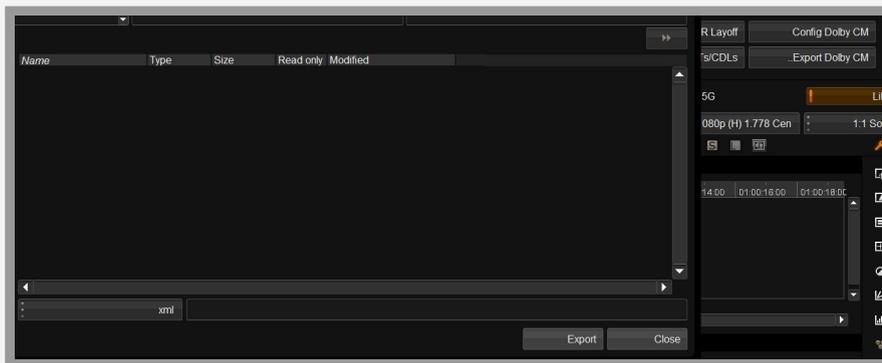
Image comparison when doing the trim pass

Comparisons between the HDR and original SDR master is very useful, however, since the CMU alters the SDI signals it makes using traditional comparisons impossible at this point. It is only possible to use Cut as a compare tool at this point.

The way to work around this issue in is simple

1. Import the comparison media and place on a track below the master that is being graded.
2. Make sure that analysis is turned OFF for the comparison image. This means there is no trim data for the CMU to base any trims on.
3. To do a cut compare, between the HDR and the master, use the Page UP / Page Down keys to cut between the two tracks.

Creating the Dolby Vision XML



...**export data** button in the library

Select a destination and name for the XML file that is being exported. Very important, please ensure that after creating the XML, no additional trims or changes are made to the master or the trim targets.

For any titles that were added, please turn of the title tracks before exporting.

For reference. the XML contains information about the software version, project and composition.

```
<RevisionHistory>
  <Revision>
    <DateTime>2016-09-23T12:13:23+01:00</DateTime>
    <Author>Digital Vision</Author>
    <Software>Nucoda</Software>
    <SoftwareVersion>2018.1.018</SoftwareVersion>
    <Comment>Project: Dolby Test V3, Composition: Test_Composition</Comment>
  </Revision>
</RevisionHistory>
```

File delivery

The XML is delivered with the HDR graded master.

Currently you cannot export media that include the rendered in trim passes. There is a command line tool available from Dolby to do this.

You can also use tools such as:

MTI Cortex 5.0
Colorfront Transkoder
Editorial & QC with Marquise MIST.

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