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DOLBY VISION

Nucoda

Colour and Finish

HDR Mastering with Dolby Vision
2018.3

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HDR Mastering with Dolby Vision

Dolby Hardware eCMU FW 2.63 and 3.0
Integrated Content Mapping V2.9 and V4.0

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Dolby Vision Mastering Workflow

Overview

A Dolby Vision delivery consists of a High Dynamic Range PQ master, graded on a mastering monitor of no less than 1000 nits. It also has an XML file containing 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 Vizio 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 trim metadata for specific target monitors.
The mapping of the HDR content to the target display is based on analysis of the graded images and then mapping the **HDR** signal to a different brightness. At this point the mapping can be refined by manually trimming the values using a specific set of tools and parameters that are provided 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
- EIZO Prominence CG3145
- Dolby PRM 4220 - available from Dolby - *this monitor is only capable of 600 nits but it is possible to create the master project at 600 and the make the trim passes on a brighter display.*

The output of a Dolby Vision session depends on the requirements. For a Dolby Vision delivery there will be two parts. The first part is the HDR master sequence encoded and exported as 16 Bit 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 - Content mapping options

Nucoda and Phoenix have support for Dolby Vision, allowing for image analysis and metadata generation for trim passes, the export of Dolby Vision XML files or rendering the trim pass results as a new master.

A Dolby license is required to unlock the trimming functions of the software content mapping option. Dolby Vision analysis pass can be performed without a licence.

Internal Content Mapping - Dolby Vision v2.9 and v4.0

- The ***Internal Content Mapping*** option allows Dolby Vision mapping and trim functions to be applied and viewed using an integrated version of the content mapping algorithms.
- Dolby Dual view option (Kona 4 required) allows viewing the HDR and SDR version simultaneously to allow trims to the HDR version to improve mapping to SDR if required.
- Trimmed deliverables can be exported directly from the timeline without need for any other tools.

At time of this writing V4.0 has not been cleared for use in production - please check with your client before using v4.0

External Content Mapping unit (eCMU) - v2.9 only

- The *eCMU* can be purchased only from Dolby. It is connected via SDI and it allows content mapping and trims to be displayed on the selected target display monitor, connected to the eCMU.
- Deliverables are generated using the Dolby Vision XML and cm_offline tool available from Dolby.
- Contact Dolby directly for information on how to obtain the hardware eCMU.

Dolby Vision - License

Access to the Trim features in the Integrated CM versions requires a license from Dolby. The license file should be renamed to *"DolbyCM_License.bin"* and placed in the c:\Nucoda\Licenses directory.

Any attempt at altering the license will invalidate it.

Contact Dolby dolbyvisionmastering@dolby.com for license information

Please also ask for the Dolby Vision Best Practice PDF

Approaches to Dolby Vision mastering

There are different ways to approach Dolby Vision

- Work in the original project with the graded timeline - complete the HDR grade, turn on the Dolby content mapping option. Analyse and then do the SDR trim. - Dolby Dual view is not required but can be useful.
.
- Grade the HDR and the SDR version at the same time, analysing and trimming as you go. Dolby Dual view is required in this case - **there is a danger of changing the HDR grade and not re-analysing the material afterwards** - this will cause unexpected results for the trims.
- Dolby Vision trims are performed on a mixed down master that is scene detected or cut up with an EDL - this workflow makes changes to the original HDR grade difficult if needed to enhance the SDR version.

Nucoda Project setup

Select a resolution and frame rate for the project, make sure that resolutions and framerates are compatible if you are using an eCMU. (See eCMU documentation)

Full Range project

SDI Output set to (0 - 1023)
Set bit depth to 16 bit or Half (recommended) - 10 bit is possible but **not** recommended.

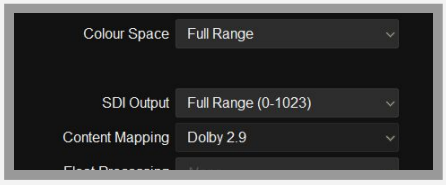
ACES Project

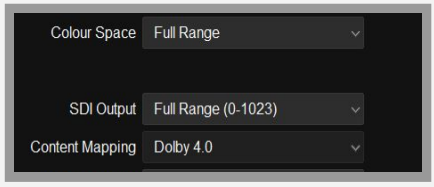
SDI Output set to (0-1023)
Add two identical output formats with the same PQ Output Transforms - typically P3D65 1000 nit depending on your mastering monitor

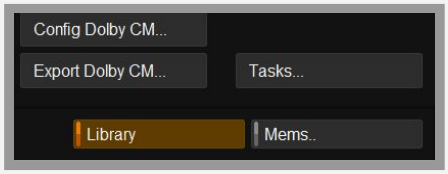
On second output format turn on "***Apply CMS***" - required when using Internal Content Mapping to ensure correct analysis.

Dolby Vision content mapping can be enabled before or after the main grade is performed.

Choose between v2.9 or v4.0 - *Make sure which is the correct version for your production*



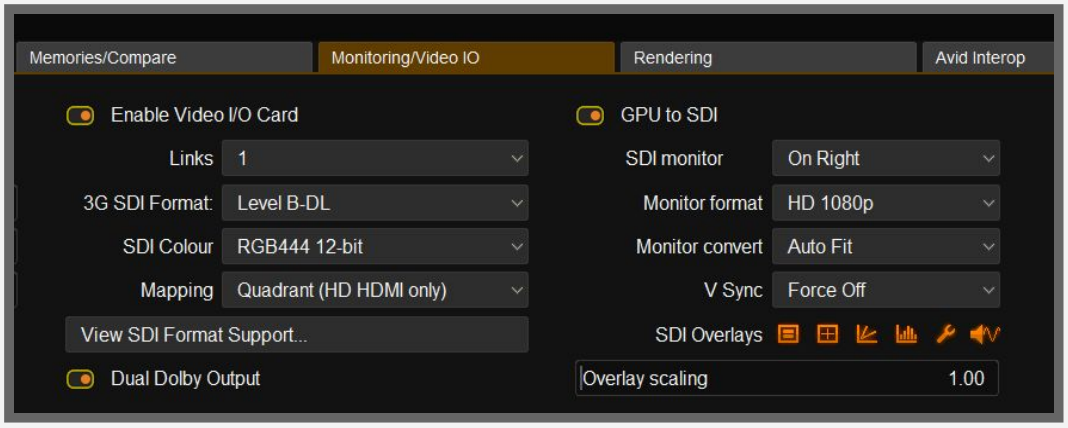




Once inside the project you will notice that the two Dolby buttons in the Library interface are active, this is where the mastering display is selected..

On the timeline you will see that very clip has a new layer added after the Master layer - this is the Dolby Content mapping layer.
Clips with a composite effect will not have this layer as they are seen as part of the clip they are composited over on the layer below.

Monitoring/Video IO



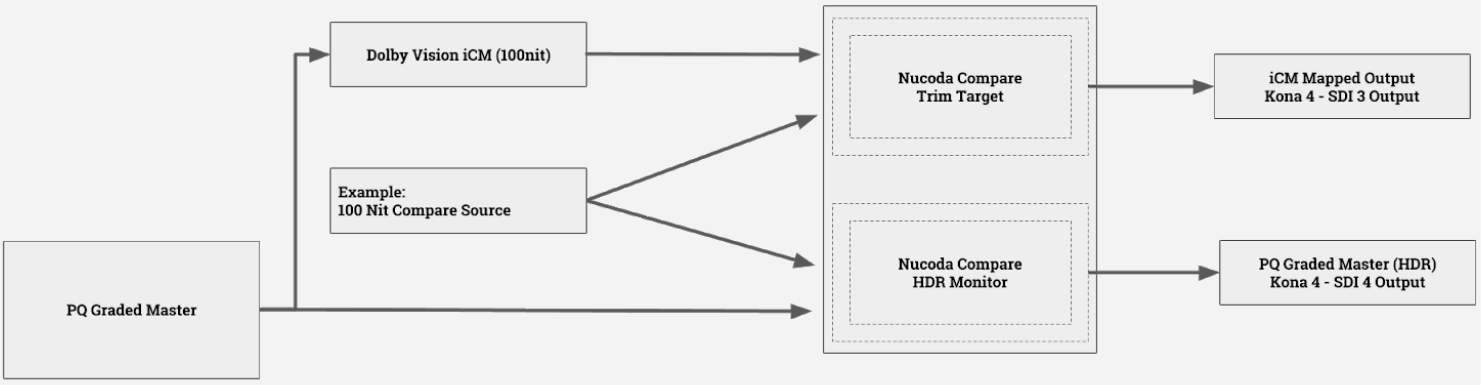
- Link should be set to 1 for using Dolby Dual (3G-DL is required)
- LevelB-DL
- The SDI I/O Mode must be set to **RGB 444 12 bit (no HFR frame rates)**
- Ensure that the ***Monitor format*** is set to 1080p to use Dual Dolby with UHD.

Dolby Dual output switch

Dolby Dual mode Enabled
HD only
RGB444 only supported in below 30fps

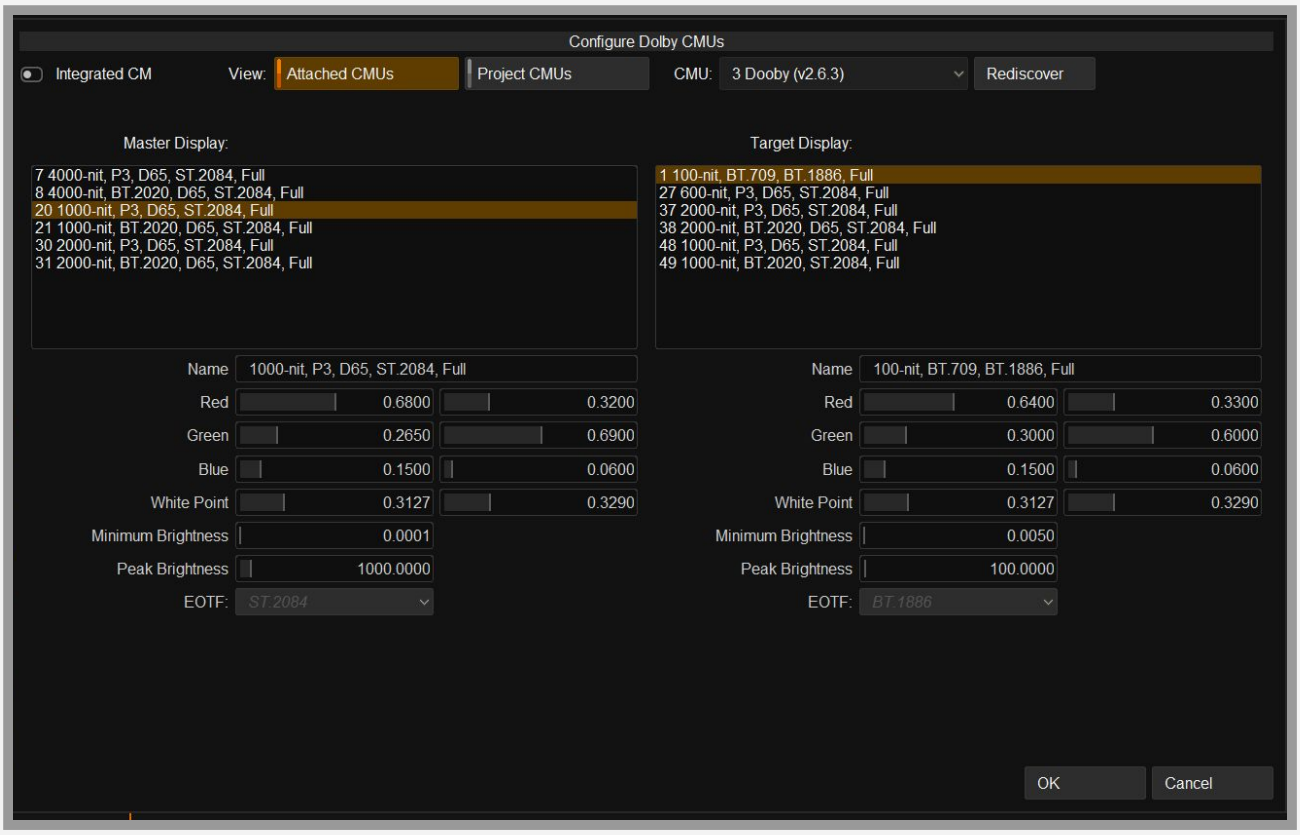
Dolby Dual mode - Comparisons (2018.3)
Compare mode visible on both HDR and iCM Trim monitors.

- HDR monitor output could be distracting on very bright monitors
- Compare source cannot be Dolby Mapped version



Setting up the Mastering display and Trim Target

eCMU - only visible with v2.9 project - see [eCMU Setup] for details on connection



...Config DolbyCM button in the Library

- There is an option to turn on **Integrated CM -** for the hardware eCMU leave this turned off

- In hardware mode with a eCMU connected, select the "Attached eCMUs" button - this will show the name of all currently connected eCMU's - there is also the option to rediscover eCMU's.

  Choosing the Project eCMU button will show a list of eCMU's previously associated with that project. Any hardware eCMU had been connected and later disconnected, will be remembered, along with the eCMU mastering settings.

- The Master Display dropdown has a list of mastering monitors currently supported - options will change as the product is updated by Dolby.

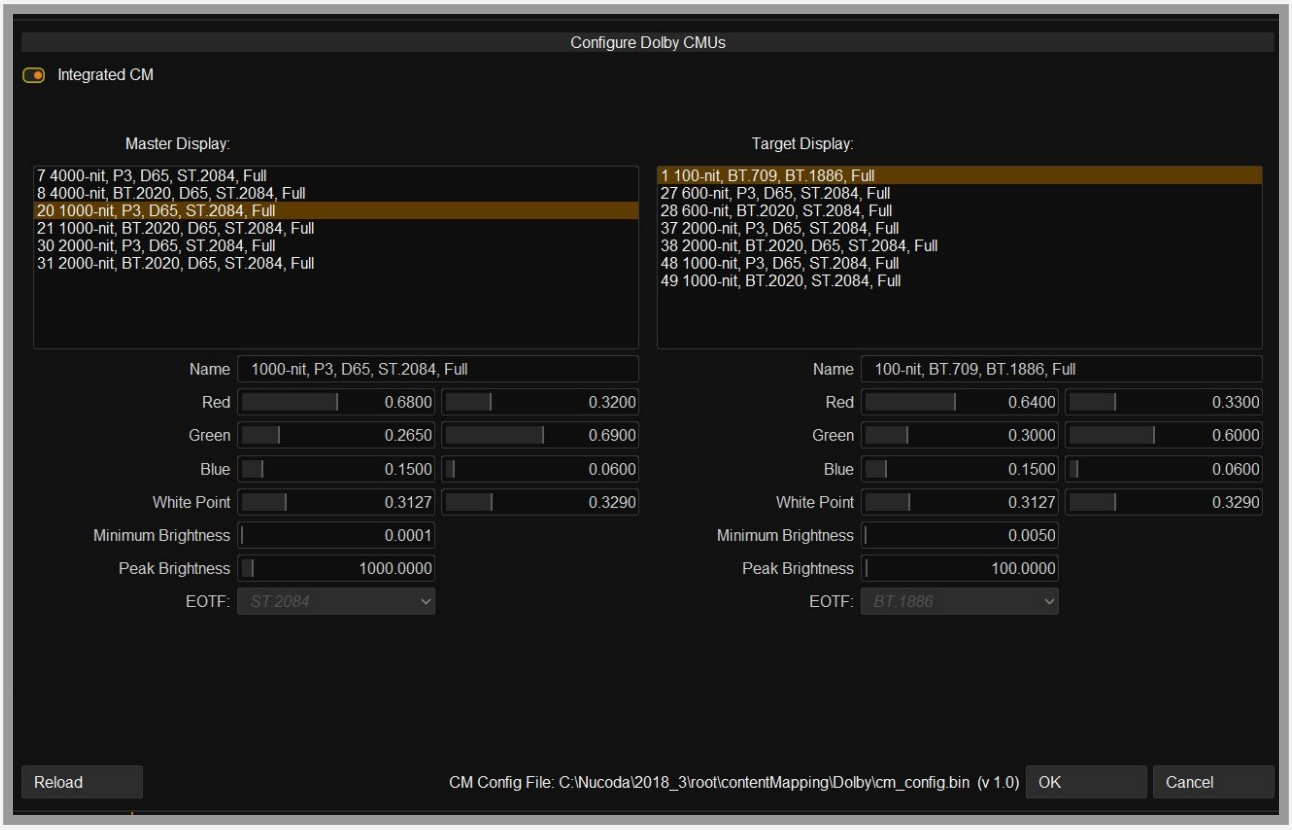
- Use this selection to select the mastering monitor for the HDR version. The mastering monitor must match the monitor that the HDR version was graded and the image colour space to ensure correct analysis values.

- Select a Target Display in the right column. This is to select the trim target monitor connected to the eCMU. The list includes displays that are commonly used. The target is linked to the Target display in the Dolby Mapping tool interface but must be updated in this menu for the hardware eCMU.

- These target display list is dynamic - it is read from a and available targets will depend on the version of eCMU firmware.

- Current supported firmware versions 2.6.3 and 3.0

Integrated Content Mapping v2.9

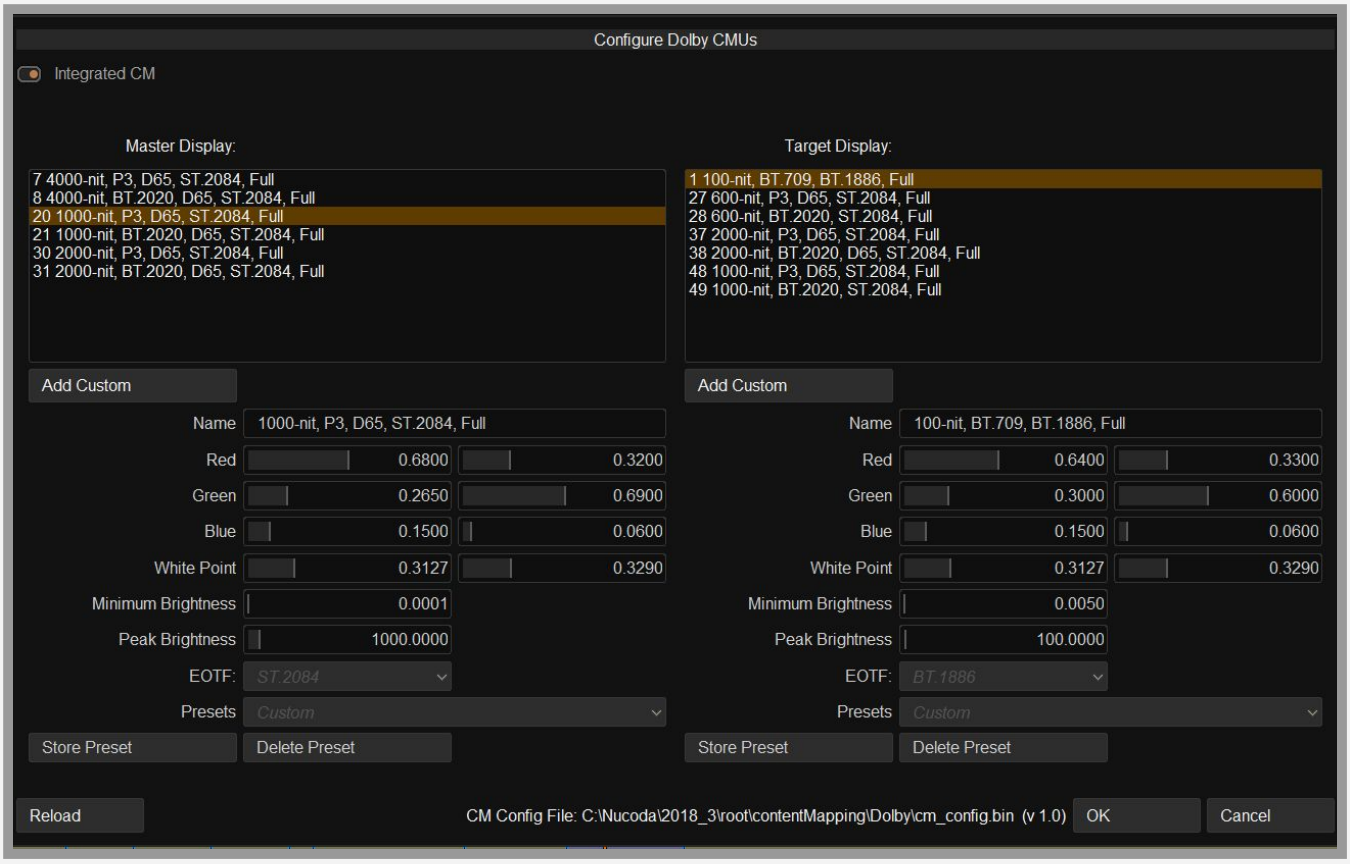


...Config DolbyCM button in the Library

- The Master Display dropdown has a list of mastering monitors currently supported - options will change as the product is updated by Dolby.
- The version of the CM Config is shown in the interface - the current required version is 1.1 - the correct version is provided with the installer - the v1.0 shown is due to a bug in the current binary.
- Use this selection to select the mastering monitor for the HDR version. The mastering monitor must match the nit value and colour space that the master version was graded on to ensure correct analysis values.
- Select a Target Display in the right column. This is to select the trim target monitor connected. The list includes displays that are commonly used. The target is linked to the Target display in the Dolby Mapping tool interface.
- These target display list is dynamic - they are read from the ***CM Config file*** and available targets will depend on the version of software being run. The config file can be updated by the user but should only be done on instruction from Dolby.

- **For 2.9 the mastering monitor colour space will affect the analysis method, so it is important to match the content colour space to the correct Master monitor setting.**

Integrated Content Mapping v4.0 - *Please check before using v4.0 for Dolby Vision Mastering*

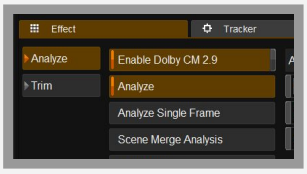


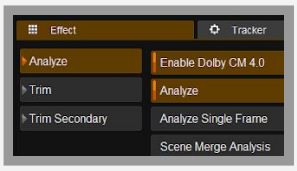
...Config DolbyCM button in the Library

- The Master Display dropdown has a list of mastering monitors currently supported - options will change as the product is updated by Dolby.
- 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 analysis values.
- Select a Target Display in the right column. This is to select the trim target monitor.. The list includes displays that are commonly used. The target is linked to the Target display in the Dolby Mapping tool interface.
- These target display list is dynamic - they are read from the ***CM Config file*** and available targets will depend on the version of software being run. The config file can be updated by the user but should only be done on instruction from Dolby.
- The version of the CM Config is shown in the interface - the current required version is 1.1 - the correct version is provided with the installer - the v1.0 shown is due to a bug in the file.
- Custom Mastering and Target monitors can be created and stored when using v4.0 CM - multiple Presets can be stored but only one custom monitor can ever be used at a time. During creation it is recommended to cut and paste the required values. Invalid entries will show up as red in the interface.

Image Analysis

- Analysis will be incorrect if the material does not have the PQ EOTF applied. If you are in an ACES project ensure the output format has "Apply CMS" turned on in the project settings and that the Output Transform is a PQ enabled transform.
- For 2.9, the mastering monitor colour space will affect the analysis method, so it is important to match the content colour space to the correct Master monitor setting.
- Clips that have not been analysed will display purple above the clip in the timeline ribbon





By default the Analyze button is turned off - it is global, so turning it on turns it on for all clips

Once the HDR Master grade has been completed, the content must be prepared for the trim trim pass to create the other required deliverables.

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 and that the levels and are correct when viewed on a mastering monitor,, 150 to 300 nits is a good start.

In-picture titles can affect the analysis, but normally it is so minimal as to not make a difference to the trims, 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 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.

Things to keep in mind....

- Ensure that the Image Format setting matches the content being analysed, the setting should match the picture content and exclude any black bars. It is possible to add new formats, please email ***support@digitalvision.se*** and we will help you out.

- The image format setting will also be used to correctly mask the image when trimming, preventing the masked areas of the image from being processed.

- Any composited images will be analysed and the result displayed on the bottom layer.

- Clips with the composite effect will not have the Dolby Trim effect. Use Pg Up / Down to access the track below.

- a **100 nit** version is a requirement as an starting point to calculate other trim versions.
- Once you have created the **100 nit** version you need to use the Interpolate function to create the **600 nit** and **1000 nit** versions., you can then refine those trims as needed.

Analysis controls on the panel

Recall and reset analysis values

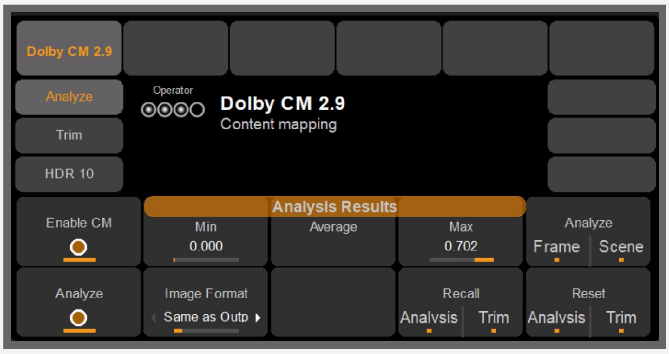
- To recall analysis values between clips, use the recall analysis button on the tool screen on the Precision.
- Do not use the normal Recall button on the Precision or Tangent panels as this will recall the whole Dolby Vision effect, use the Reset Analysis button to reset the analysis

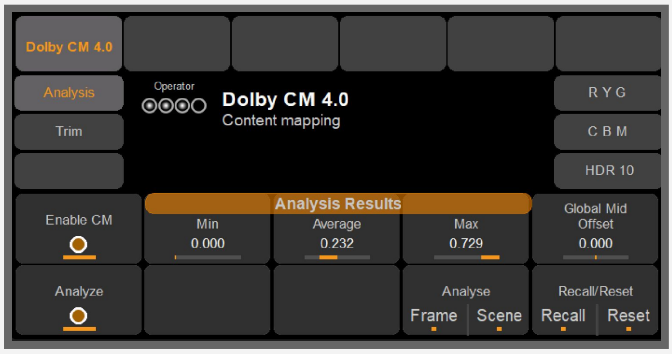
Analyse single frame and Scene Merge Analysis

- Use single frame analysis to set a single frame as value for the whole clip
- Scene merge analysis is used with multiple selected clips and will create a new averaged value for all the selected clips.
- To only analyse certain clips, select a clip (or multiple clips) on the timeline (Ctrl click or drag select) and turn on the analyze button

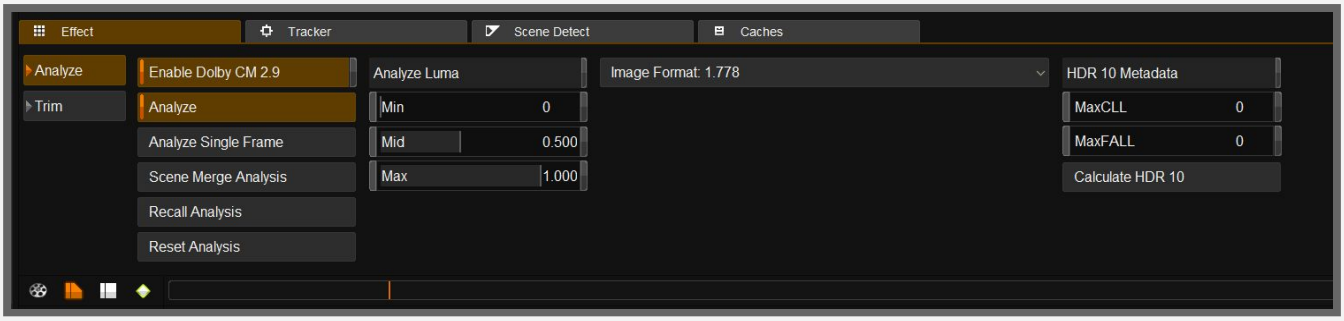
Please note : Analysis values are no longer editable in 2.9.

Precision v2.9 and v4.0 analysis menus- Precision Panel -all controls are available in the Tangent mapper

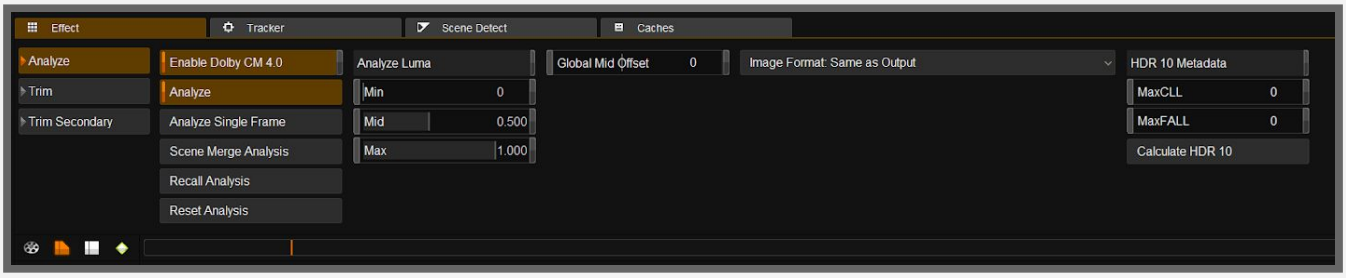




GUI v2.9 analysis menu



GUI v4.0 analysis menu



Trim controls

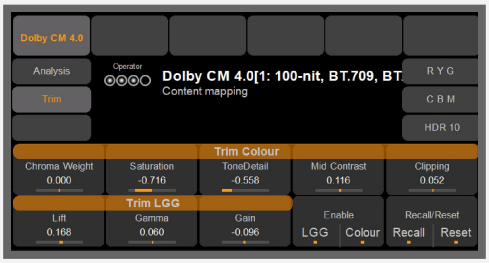
- LGG controls are mapped to the rings and balls
- Dynamics can be used to easily animate between different trim on the same clip

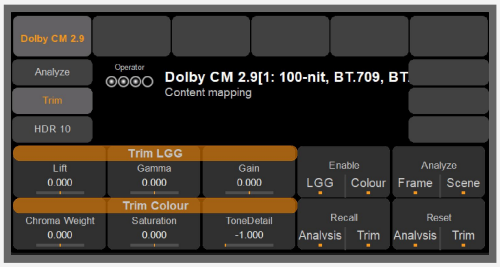
Recall, reset and bypass trim values

- To recall trim values between clips, use the recall trim button on the tool screen on the Precision. Do not use the normal Recall button on the Precision or Tangent panels as this will recall the whole Dolby Vision effect including analysis and trims
- Use the Reset trims button to reset the trims - for 4.0 there are separate resets for LGG and Secondaries
- Use bypass to bypass LGG and colour tools - for 4.0 there is also a bypass for secondaries.
- When recalling ensure that the Content Mapping layer is selected as the source
- You can also use the Turbine button to recall trims, long press to reset trims

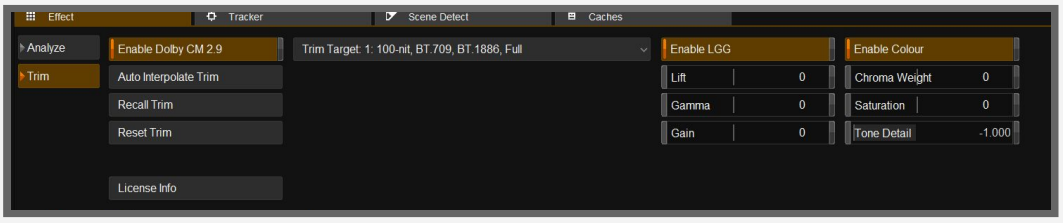
Please note: In 100 nit trims the Tone Detail option cannot be edited

Precision v2.9 and v4.0 trim menus - Precision Panel -***all controls are available in the Tangent mapper***

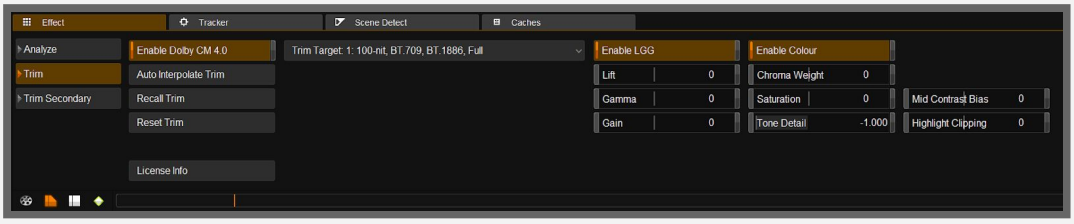




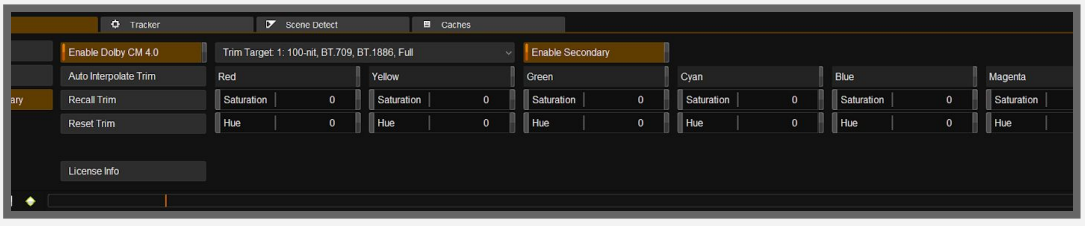
GUI v2.9 trim menu - LGG and Colour trims



GUI v4.0 trim menu 1/2 - LGG and Colour Trims - Contrast Bias and Highlight Clipping



GUI v4.0 trim menu 2/2 - Secondaries - 6 Vector Hues and Saturation



Precision controls for Dolby Vision (from 2018.3)

A new mode has been added to the Precision Panel that will allow users to use the familiar Master Reset, Bypass All, Recall and Append buttons on the panel while doing Dolby Trims.

In a Dolby project, press the Turbine button, this will place the layer focus on the Dolby Content Mapping effect and place the panel in Dolby group mode, in this mode the following buttons will have their functions changed as follows:

MReset - Reset trim values - LGG and Colour
Ctrl + MReset - Reset Secondaries (4.0)
Hold MReset - Reset Analysis

Recall - Recall trim values - LGG and Colour
Ctrl + Recall - Recall Secondaries (4.0)
Hold Recall - Recall Analysis

Append - Analyse single frame
Ctrl + Append - Analyse Scene Average

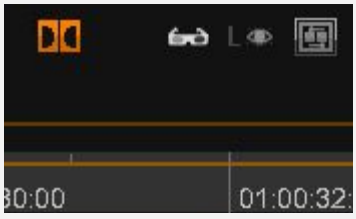
Bypass All - Bypass all trim values - LGG, Colour and Secondaries (4.0)
Ctrl + Bypass - Bypass Colour and LGG
Hold Bypass - Bypass Secondaries (4.0)

P - Recall trim values - LGG and Colour
Hold P - Reset Trim

We recommend you set the Layer focus on shot change to “Match between shots” when working in Dolby.Trim - It is available by right clicking on the timeline and choosing
Effect Focus -> Match Between Shots

Bypassing Dolby Vision mapping

- Selecting this option will turn the content mapping on and off
- Please note that this will affect the rendered output.



Using comparison modes - applies to Integrated CM only

- In Dual Dolby mode using the compare tool will not apply the content mapping to the comparison Source - meaning that you can compare a Rec.709 version of an original with the Dolby Vision trimmed Rec.709 master.

- This does mean that you are currently unable to compare to the trimmed version (this will be addressed in a future update)

Creating trim versions for other displays

Only ***once the HDR master grade is complete*** can the timeline can be analysed to allow content mapping.

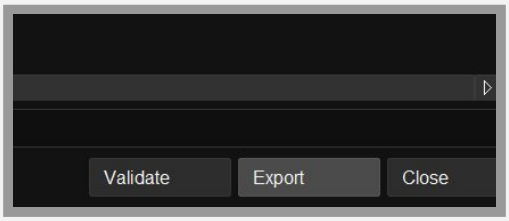
After analysis the colourist will take a view as to whether or not the resultant image is the best representation of the image on the Trim target monitor

Interpolate new trims

- a 100 nit version is an requirement as an starting point to calculate other trim versions.
- Once you have created the 100 nit version you need to use the Interpolate function to create the 600 nit and 1000 nit versions., you can then refine those trims as needed.

- Interpolation will only be possible if at least one other trim exists.
- Select the required new trim target.
- Select all the clips on the timeline
- Press the Interpolate button - calculate the new settings based on the current available trims.

Creating the Dolby Vision XML



...export Dolby CM button in the library

Select a destination and name for the XML file that is being exported.

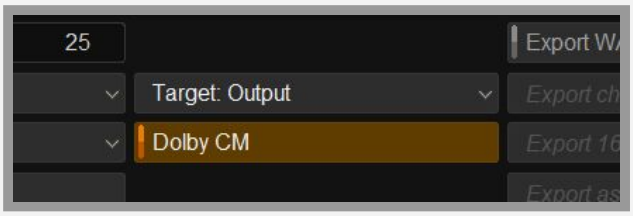
Any trims or changes are made to the master or the trim targets will require a re-export of the XML.

For any titles that were added on seperate tracks please turn of the title tracks before exporting. Only| active tracks will be included in the XML - overlapping clips are not supported, the export will be a top down mixdown.

During the export process the XML will be validated - if there are any errors the user is notified with a popup dialog with information on the problem. Selecting an existing XML and pressing the Validate button will validate the XML

A file validation file is also written when the XML is exported. the file has the same name as the XML with _validation appended to the name. This file will contain the dialog information in case of a failure.

Exporting current trim as SD or HDR masters from Nucoda



...**export files** button in the library

- Ensure the Dolby CM button is selected - this option is not available in External eCMU mode.
- Choose the export option for the trimmed master files and export.
- Turning the Dolby CM button of will export the HDR master

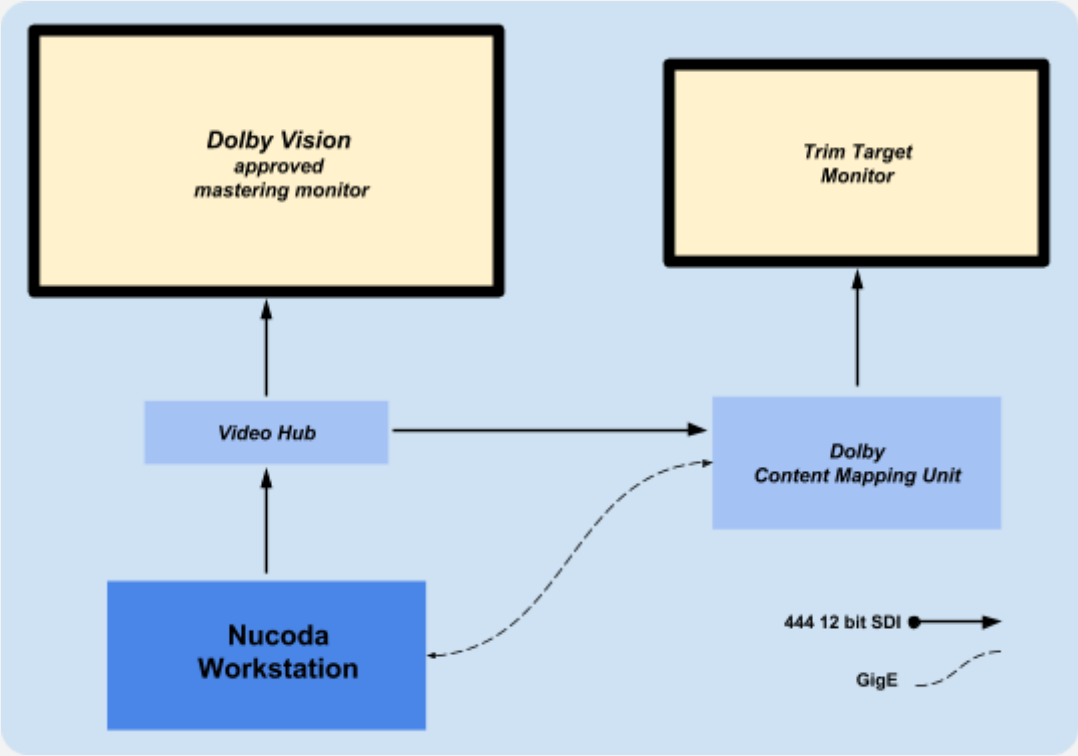
Connecting the eCMU

The eCMU is designed to be a “headless” box, meaning it is designed to sit in a rack in the server room and operate with minimum interaction..

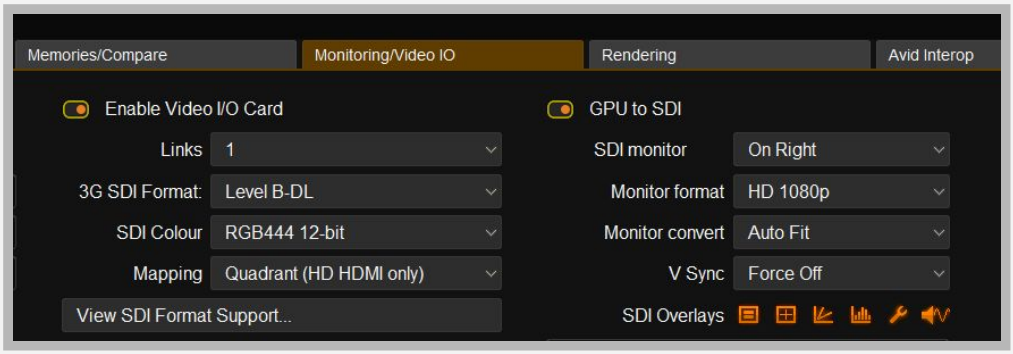
It can be useful to connect a keyboard and monitor to set up initial networking options.

- Plug a USB keyboard into a usb slot. There is no need for a mouse, as there is no GUI
- Connect a monitor to the VGA port. ***Do NOT connect the monitor to the graphics card on the eCMU***
- Please follow the eCMU setup instruction in the eCMU Manual

eCMU - Nucoda SDI and networking (Kona 4 only)



SDI output from the AJA Kona 4



- The SDI I/O Mode must be set to **RGB 444 12 bit** to operate the eCMU
- Note: UHD - 12 bit is only available using the Quadrant mode, not 2Si
- The SDI output should be connected to both the mastering monitor and the eCMU input, it is possible to use a looped output from the monitor to the eCMU.
- Ensure that the ***Monitor format*** is set to HD1080p or UHD depending on the eCMU model, and convert set to None or Fit. (see image above)
- The eCMU supports 1080P and UHD formats depending on the model..
- Connectivity with the eCMU is recommended to be 3G Level B-DL - 1 link.
- The eCMU will automatically configure the output SDI interface to match the input SDI interface.
- Since the workstation IP Address is encoded and sent to the eCMU via SDI, please ensure that there is an image on the screen or has a composition open to allow discovery of the eCMU.

Ethernet connection between workstation and the eCMU

- Please see the eCMU User Manual for setup instructions.
- The ethernet address of Nucoda or Phoenix workstation is encoded in the SDI video stream to the eCMU and the eCMU then connects via the ethernet port.
- You will have to add a windows firewall exception for the port communicating with the eCMU or turn off the windows firewall completely.
- You are able to control and reset the eCMU by loading a web browser and entering the eCMU IP address in the browser.
- Please add the Nucoda workstation IP address to the general.prefs file here:
  c:\Nucoda\20xx_x\root\Users\All Users\general.prefs
  the option is right at the bottom of the file

  ForceIPAddress "Nucoda/Phoenix workstation IP"

Most common reasons for not detecting the eCMU

1. Make sure you can ping the eCMU and connect to via a web browser
2. The Windows Firewall is on
3. The video settings are not 12 Bit 444
4. Monitor format is set to Follow Project and not 1080p or UHD
5. Inactive timeline - make sure there is video going to the monitor
6. In the browser check that the input signal matches Nucoda output and is valid
7. The Web interface that is available for the eCMU via the browser and the eCMU IP address, it is a very useful source of information.
8. Remember to check the eCMU web interface for error messages if something does not seem to be working as expected

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