



**easyDCP Plus**

easyDCP Player+

User manual

**Version**

4.2

**Date**

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# 1 Introduction

Thank you for purchasing easyDCP Player+, a software-based solution for playback and quality analysis of Digital Cinema Packages (DCPs). While easyDCP Player+ was designed to be a quality assurance tool for checking packages before their final distribution, it may also be a perfect low-budget solution for screenings in your facilities. Bundling easyDCP Player+ with easyDCP Creator+, an application for creating DCPs, and easyDCP KDM Generator+, a tool for creating Key Delivery Messages (KDMs), Fraunhofer IIS offers everything necessary to benefit from the advantages of Digital Cinema.

easyDCP Player+ handles video resolutions up to 4K at arbitrary frame rates as well as multi-channel audio, subtitles and captions. Furthermore it is even capable of playing back encrypted DCPs and lets you watch stereoscopic DCPs. It also allows you to export your DCPs' audio, video and timed-text content to allow for fast repackaging, creation of proxies for subtitling or transcoding into other formats.

## 2 Feature Overview

	easyDCP Player+	Demo Version
GPU-based real-time decoding *, ***	✓	15 sec
Software-based real-time decoding **	✓	15 sec
Playback of DCPs, MXF, QuickTime, dcpproj, JPEG 2000, TIFF, DPX, PNG, JPEG, GIF, BMP, PPM, M3U Playlists	✓	✓
Playback of DCPs containing Sign Language	✓	✓
Customizable color space conversion	✓	✓
Finely-tunable Quality-vs.-Performance Trade-off	✓	✓
Audio waveform visualization	✓	✓
Multichannel Audio Framework (MCA)	✓	✓
Multiple Timed Text Tracks (Text, PNG) visualization	✓	✓
Add external Timed Text (XML or MXF) on the fly	✓	✓
Timeline shows reel boundaries and timed text	✓	✓
HD-SDI output**	✓	✓
30 bit DisplayPort output***	✓	✓
Stereoscopic playback	✓	✓
DCP validation and creation of comprehensive report in HTML format	✓	✗
Playback of encrypted DCPs with KDMs	✓	✗
Export to JPEG 2000, QuickTime, TIFF, DPX, WAV	✓	✗
Available for 64 bit Windows 10	✓	✓
Available for 64 bit Mac OS X (10.14-10.15)	✓	✓

\*) Required graphics device setup described below

\*\*) Required hardware described below

\*\*\*) Windows only

## 3 System Requirements

easyDCP Player+ comes with a GPU-based JPEG 2000 Codec and a software-based JPEG 2000 Codec. The GPU-based codec is only available for Windows and requires an additional graphics device.

Provided the proper hardware is available, easyDCP Player+ is capable of decoding 2K and 4K DCPs in real-time.

### 3.1 Software-based decoder

In order to guarantee real-time playback with at least 24 fps, the software-based decoder requires a fast multi-core CPU with at least four cores. It is recommended to download the demo version in order to find out how your system performs.

The scalability of JPEG 2000 encoded images can be exploited to watch a 1K or 0.5K resolution preview in real-time on systems that don't have a sufficiently powerful CPU. Optionally you can choose to upscale the lower resolution preview to full-screen, without negatively impacting the maximum speed.

### 3.2 GPU-based decoder (Windows only)

For smooth playback in GPU-based mode, easyDCP Player+ always requires a bundle of **two graphics devices** - a primary device for rendering (with OpenGL) and a secondary device for video decoding (with NVIDIA® CUDA®<sup>1</sup>). Using a sufficiently powerful graphics device pair, the GPU-based codec can provide real-time playback even for framerates above 24. Both graphics devices should ideally be connected with PCIe x16.

When using two NVIDIA® graphics cards (e.g. one for rendering and one for decoding with CUDA®), it might be necessary to explicitly configure the graphics card that should be used for rendering: NVIDIA® Control Panel -> 3D Settings -> Manage 3D settings -> Global Settings -> OpenGL rendering GPU -> <select the graphics card that drives the display where easyDCP Player+'s canvas is located>. This can make a significant difference in terms of render performance.

<sup>1</sup> CUDA® is a registered trademark by the Nvidia Corporation

## Primary graphics device

This device is dedicated to rendering video and optionally color post-processing, using OpenGL. Displays need to be attached to this device. It is recommended to install the primary device in the mainboard's top slot. This device does not necessarily need to support the NVIDIA® CUDA®<sup>2</sup> technology.

In order for the 3D output option "Quad-buffered stereo" to be available, this device needs to support quad buffering (e.g. NVIDIA® Quadro®<sup>3</sup> series). Using this technology, easyDCP Player+ supports the use of active shutter glasses or Stereo over Dual-DVI. The graphics driver control panel can be used to specify how stereo images should be processed by the primary graphics card.

In order for the "30 bit Colors" option to be available, this device as well as the connected display need to support 30 bit per color.

When a HD-SDI output device is used and the option "Enable subtitling, color-processing and scaling" is activated, images are also processed with the primary graphics card, before they are emitted to the HD-SDI device. In this use case, a NVIDIA® Quadro® series graphics card (e.g. Quadro K600) might also be beneficial for a better render performance. Otherwise, a mid-range NVIDIA® GeForce® device, e.g. NVIDIA® GeForce®<sup>4</sup> GTX 750 Ti, is a good choice.

## Secondary graphics device

This device is dedicated to the computationally very expensive JPEG 2000 decompression. It must not be used as a video output, i.e. no display should be hooked up to this device. For best performance, this device should be a CUDA®-enabled graphics card (e.g. from the latest NVIDIA® GeForce® series) with many CUDA®-cores installed in the mainboard's secondary slot. Please refer to [www.easydcp.com](http://www.easydcp.com) for a list of supported devices. It should be connected with PCIe x16. PCIe x2, x4 or x8 will lower the performance significantly. Make sure to connect both on-board power connectors to the power supply unit and that the power supply unit meets the system's requirements.

<sup>2</sup> CUDA® is a registered trademark by the Nvidia Corporation

<sup>3</sup> NVIDIA® Quadro® is a registered trademark by the Nvidia Corporation

<sup>4</sup> NVIDIA® GeForce® is a registered trademark by the Nvidia Corporation

## 4 Licensing

### 4.1 Demo Mode Restrictions

In demo mode,

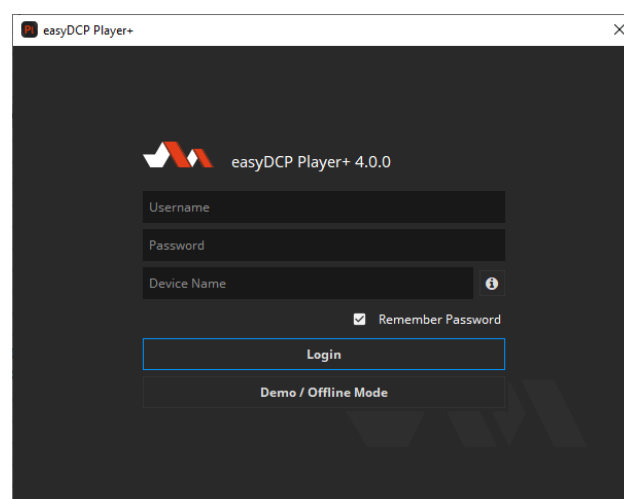
- Full-resolution playback is limited to 15 seconds. Afterwards, the quality is reduced and audio is muted.
- Issues found while loading the DCP are not disclosed
- Playback of encrypted DCPs and ingesting KDMs or easyDCP Digest files is locked
- The export module is locked
- All tests of the validation module will not disclose their true result or any issues they might have identified

### 4.2 License Activation and Certification

Download easyDCP Player+ at [www.easydcp.com](http://www.easydcp.com).

#### 4.2.1 Offline workflow

After installing and starting easyDCP Player+ the following dialog appears:



Click "Demo / Offline Mode" to start a free version of easyDCP Player which is subjected to the demo mode restrictions listed in chapter 4.1. After startup has finished, open the options dialog, select "Activation Status" and press



“Request License & Certificate”. Fill in the licensee’s name, the URL that shall be stated in the custom server certificates and a password that is used to protect access to the certificates. If the computer is connected to the Internet, click the “submit” button. The default web-browser will open [www.easydcp.com](http://www.easydcp.com), where further instructions will guide you through the purchase process.

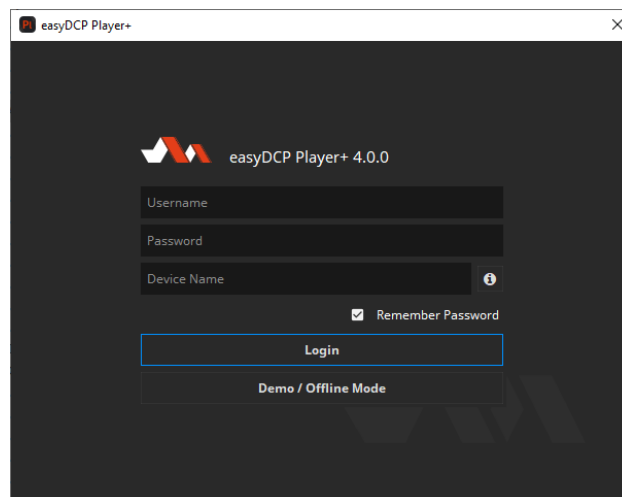
After the purchase, a link to the zip file with the License & Certificate will be available for download within your user account at [www.easydcp.com](http://www.easydcp.com). The zip file can be dragged & dropped into easyDCP Player+ installation to unlock it.

The procedure is also described in a screen cast at [www.easydcp.com](http://www.easydcp.com).

Please be aware that this workflow only works with permanent licenses. For subscriptions you have to follow [Online workflow](#).

#### 4.2.2 Online workflow

Purchase one of the available subscription plans at [www.easydcp.com](http://www.easydcp.com). After the purchase, a license and the necessary certificate for easyDCP Player+ is linked to your easyDCP account.



Install and start easyDCP Player+ and fill in the username and password you’ve used for your easyDCP account. After clicking “Login”, easyDCP Player+ will automatically download the linked license and certificate from [www.easydcp.com](http://www.easydcp.com) and activate your instance.

The “Device Name” field is prefilled with the name of the machine you use easyDCP Player on. You can change the name freely. The name will be send to easyDCP.com and is used for convenient device identification only.

Please be aware that a permanent internet connection is required. As soon as easyDCP Player+ detects a connection loss, the graphical user interface will be locked until the internet connection has re-established.

With the online licensing workflow it's possible to run easyDCP Player+ on different systems with the same license. Please be aware that multiple subscriptions are necessary to run easyDCP Player+ instances at the same time on different machines.

Please be aware that for each computer a server certificate will be generated. Example: If you login on system 1 and afterwards on system 2, there will be two server certificates linked to your easyDCP account.

### 4.3 Application Data and Settings

easyDCP Player+ automatically creates an application data folder. It contains the settings file as well as a folder where the server certificates are stored, a repository for KDM and easyDCP Digest files and a repository for color transform files.

The folder is located at

`<User Application Data>/Fraunhofer IIS/easyDCP Player+/`

Additionally, all easyDCP applications share a folder with additional files such as color space descriptions. It is located at

`<User Application Data>/Fraunhofer IIS/easyDCP Shared/`

The user application data folder on Windows is in

`C:/Users/<username>/AppData/Roaming/`

A shortcut is to just enter %APPDATA% into the address bar.

On Mac OS X, the user application data folder is at

`\Users\<username>\Library\Application Support\`

### 4.4 Software Update

Please make sure you leave the automatic check-for-updates enabled, so that you get informed immediately when new versions are available for download.

Multiple versions of easyDCP Player+ can be installed side-by-side, so there is no need to uninstall the old version before installing a new one.

A new license file is only required for major updates, e.g. version 3.6 to version 3.7, and can be purchased at [www.easydcp.com](http://www.easydcp.com). Point releases do not require a new license, e.g. 3.7.0 to 3.7.1.

The update procedure is as follows

**Point Release** (only the last version number changes, e.g. 3.7.0 to 3.7.1)

1. Log into your account at [www.easydcp.com](http://www.easydcp.com)
2. Download the new installer file and install it
3. **Offline licensing workflow:** The new easyDCP Player+ version will automatically detect your existing license file and is good to go.
4. **Online licensing workflow:** easyDCP Player+ will automatically download the necessary license and certificate information from [www.easyDCP.com](http://www.easyDCP.com) as described in 4.2.1. There is nothing else you have to do.

**Major Release** (first or second version number changes, e.g. 3.6.x to 3.7.x)

#### **Offline licensing workflow**

1. Log into your account at [www.easydcp.com](http://www.easydcp.com) and purchase the license for the new version. The installer is then available for download. Download and install it.
2. Open the new easyDCP Player+ version and proceed with the steps described in 4.2.1
  - a. If you have already used easyDCP Player+ before, you likely already have personalized server certificates. easyDCP Player+ will prompt you for the password. If the password can be verified, the new version of easyDCP Player+ will continue to use your existing server certificates and only request a new license file (the next step will prompt for a server certificate URL and password anyway, but the inputs are ignored then).

#### **Online licensing workflow**

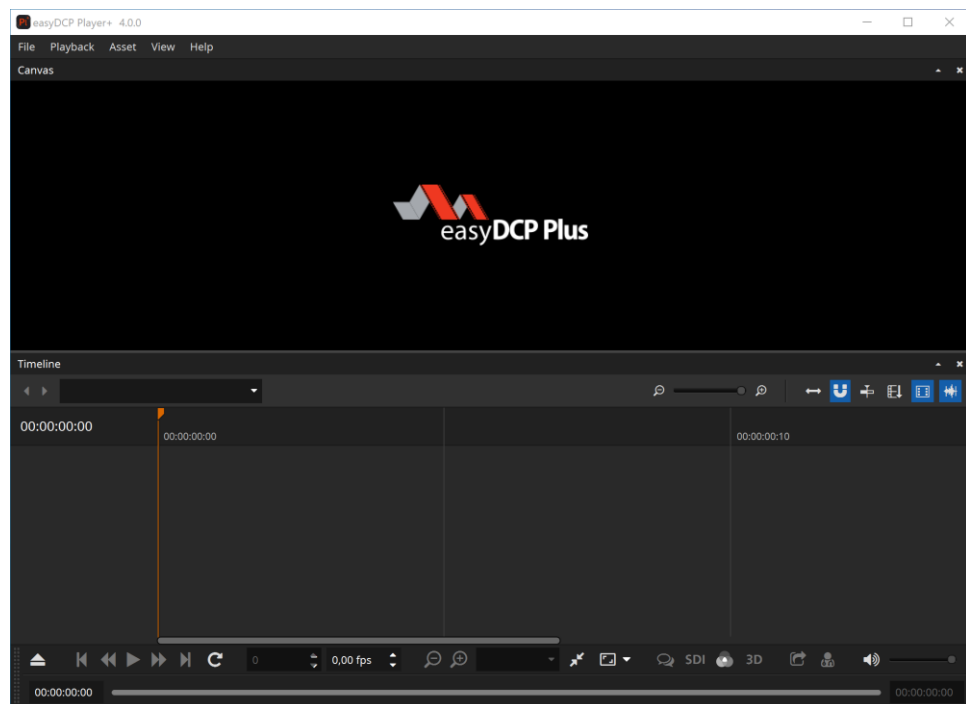
If you have a valid subscription plan the installer of the new version can be downloaded at [www.easydcp.com](http://www.easydcp.com). All further steps are described in 4.2.2.

## 5 Playback

When launching easyDCP Player+, a splash screen will be displayed during the start-up phase.

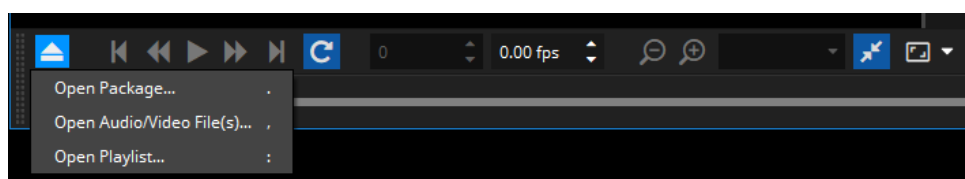
At the first launch of easyDCP Player+, a message will pop up, prompting you to request a server certificate. Each easyDCP Player+ installation has an individual server certificate, which will be created by Fraunhofer IIS. This certificate is required to be able to receive Key Delivery Messages (KDMs), which unlock encrypted DCPs. Please refer to chapter 9 for more details.

This is the main window:



### 5.1 Opening a DCP

To open an existing package, click on the button with the eject icon in the bottom left corner.

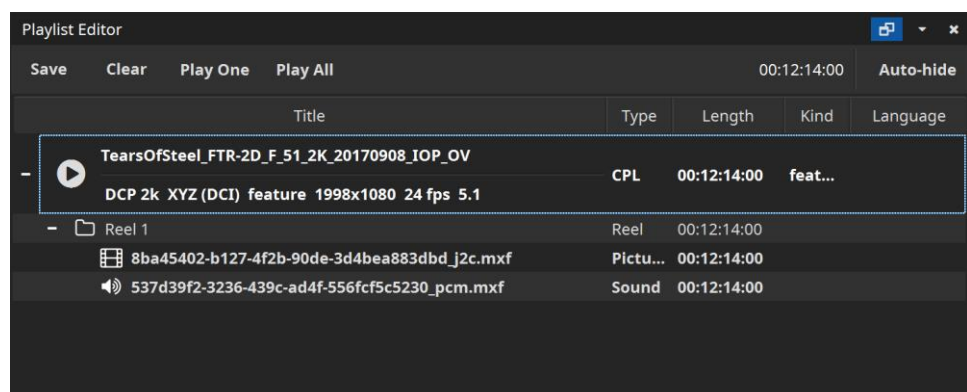


For convenience you can also drag and drop supported sources directly onto the canvas, playlist editor or the playback toolbar, or onto the application icon to open a new instance. Supported sources are

- one or more DCP folders
- a CPL / Assetmap or PKL .xml file
- a numbered file sequence (folder or first file) (see chapter 2 for supported file types)
- \*.mxf with audio and/or video essence
- \*.wav files
- QuickTime files (\*.mov, \*.mp4, \*.avi, \*.mpg, \*.mpeg)
- a \*.m3u playlist file
- a DCP project file (\*.dcpproj), created with easyDCP Creator+

If one or more packages were opened, the playlist editor will pop up. It lets you select a single composition playlist for playback or arrange a playlist. You can always drag further assets into the playlist editor or re-open it from the context-menu.

For some of the fields, the tooltips contain more information or metadata like the creator, issue date, etc. You can also browse the XML or MXF files, or expand/collapse all items.



## 5.2 Opening a Supplemental package (VF)

A supplemental package (typically ends with “\_VF”, which stands for Version File) is an add-on container that does not contain all the track files it references, but relies on the presence of an additional package (typically one that ends with “\_OV”, which stands for Original Version). The concept is well explained at [www.digitalcinemanamingconvention.com/appendix\\_8.asp](http://www.digitalcinemanamingconvention.com/appendix_8.asp).

Often, the folder that contains the VF, resides within the folder that contains the OV, but other times, the two folders are located next to each other on the same level.

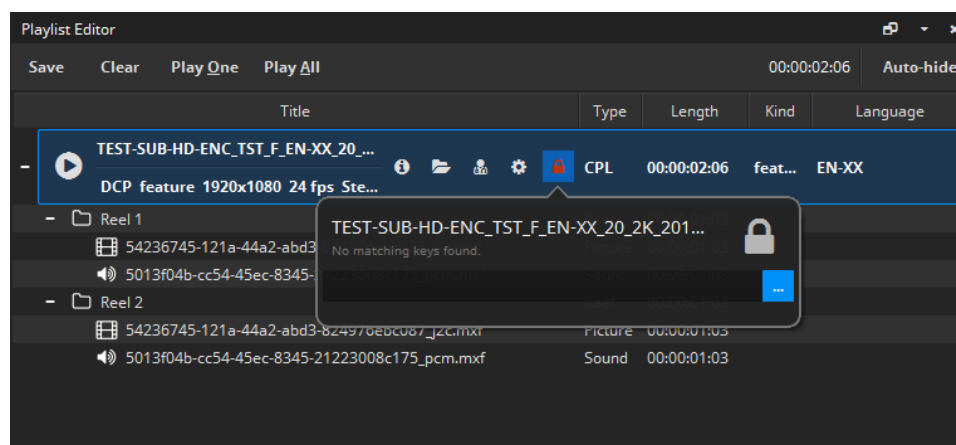
If a folder with an OV is opened, easyDCP Player+ will automatically detect any additional VF packages located within the folder and load them as well.

When only the VF is loaded into easyDCP Player+, the original location of all those track files that are not contained in it, is unknown. These track files, as well as the whole Composition is drawn in grey.

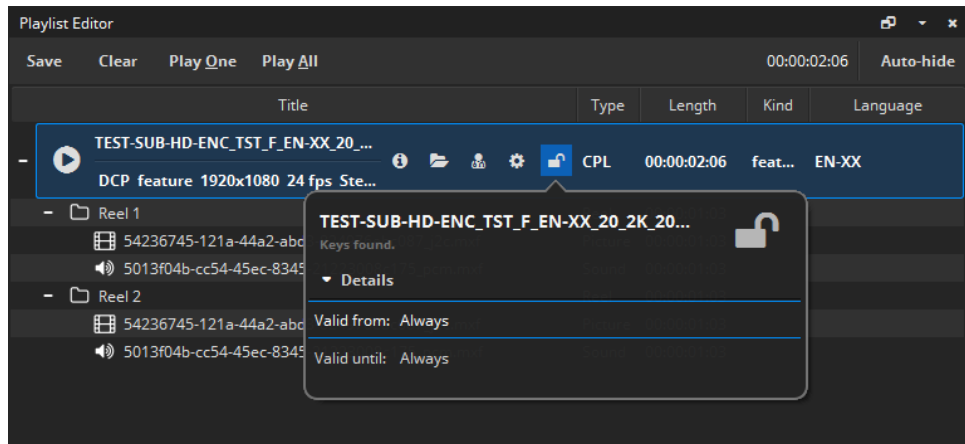
When the corresponding OV package is also loaded into easyDCP Player+, it will automatically resolve all missing references from the VF against the OV and the VF will become available.

## 5.3 Opening an encrypted DCP

When an encrypted DCP is opened and the keys have not yet been ingested, the missing keys can be loaded from the corresponding Key Delivery Message (KDM) or easyDCP Digest (\*.dcpdig) file. Either click on the lock icon or simply drag & drop the file into the playlist editor.

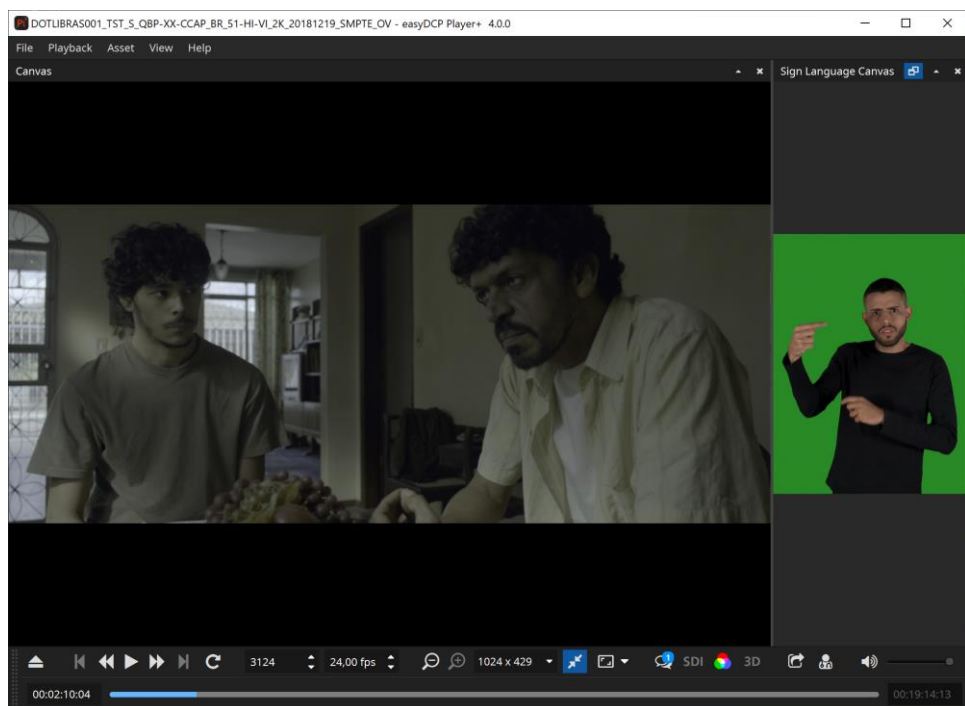


If the keys are read from a Key Delivery Message (KDM), they are only valid within a certain time window (“engagement window”).



## 5.4 Opening a DCP with sign language

Since easyDCP Player+ 3.7 it's possible to open and playback DCPs containing sign language [9].

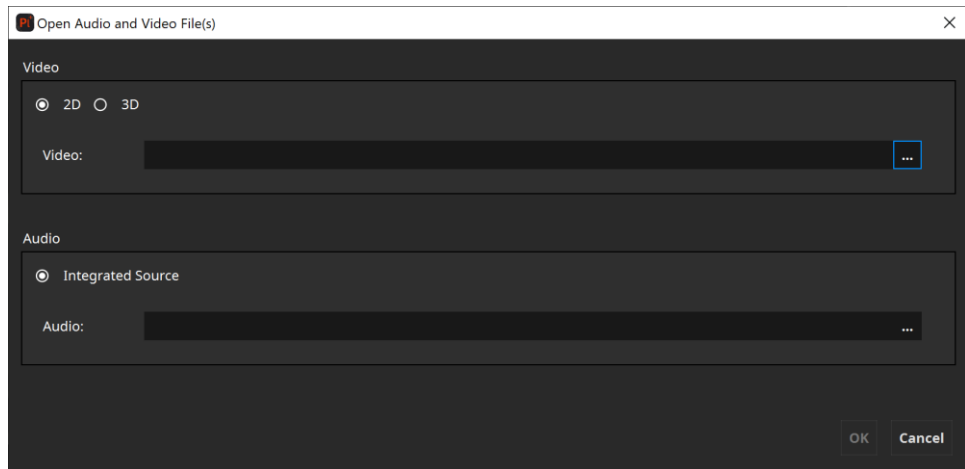


If present in the 15<sup>th</sup> channel of the audio MXF, the decoded video will be shown in a separate canvas. The sign language canvas can be opened via main menu -> Asset -> Sign Language Canvas.

## 5.5 Opening Audio/Video File

To open an existing media essence other than a DCP package (e.g. audio file, video file(s)), click on the button with the eject icon in the bottom left corner.





Here you can select single video and/or audio files. Currently supported video sources are numbered file sequences (select first file of the sequence), DCI-compliant MXF files with JPEG 2000 content or QuickTime files (\*.mov, \*.mp4, \*.mpg, \*.mpeg, \*.avi).

Currently supported audio sources are wave files (\*.wav) with uncompressed PCM samples or DCI-compliant MXF files with uncompressed PCM samples.

easyDCP Player+ also supports encrypted MXF files. When an encrypted MXF file is selected, a button with the key icon will become visible, allowing you to enter the decryption key. Content keys for individual encrypted MXF files are not looked up in the repository. You will always have to re-enter them, either by entering the key manually, or by re-ingesting the corresponding content key file (easyDCP Digest). The "OK" button will only be enabled when all fields are either empty or contain a valid essence.

It is also possible to combine two MXF files or file sequences to a stereoscopic video asset by clicking on the "3D" radio button.



It is perfectly possible to arbitrarily combine any two kinds of video sources: file sequence with file sequence, file sequence with MXF, MXF with MXF. If a stereoscopic MXF file is selected, only its first channel is regarded. If the same file sequence is selected for both channels, the sequence will be interpreted as two interleaved channels, i.e. frames at even indices will be used for the left channel, frames at odd indices for the right channel.

For convenience, supported file formats can also be dragged onto the easyDCP Player+ canvas or playlist editor.

Both video channels are required to have matching technical properties like edit rate and resolution. The shorter channel's duration will be used as the overall duration.

## 5.6 Opening and Creating a Playlist

easyDCP Player+ has limited support for playlists. Currently, only the m3u format is supported. To open an m3u file, drag and drop it onto the canvas or the easyDCP Player+ icon. Items will be played back to back. Enabling the loop button will cause the whole playlist to be looped, not individual items. Playlists may be nested, but not recursively nested.

A playlist can be created from within the Playlist Editor, with the "Save Playlist" option. The simplest form of a m3u playlist is a text file with one absolute path to a source asset per line. Optionally, each line may be preceded by a line with metadata that starts with "#EXTINF:". It is followed by a number that denotes the maximum number of seconds the asset shall be played. A negative value or zero indicates that the full length shall be played. If the asset is shorter than the provided duration or the easyDCP Player+ demo's maximum playback duration limit is reached, the duration stated in the playlist is ignored. Following the duration, separated by a comma, a title needs to be specified. However, easyDCP Player+ will continue to display the asset's title and not the one stated in the playlist. A proprietary extension is that an additional, comma-separated, field, stating the audio volume, can be supplied. Valid values are numbers between 0-100. All blank lines and lines that start with "#" are ignored.

Sample:

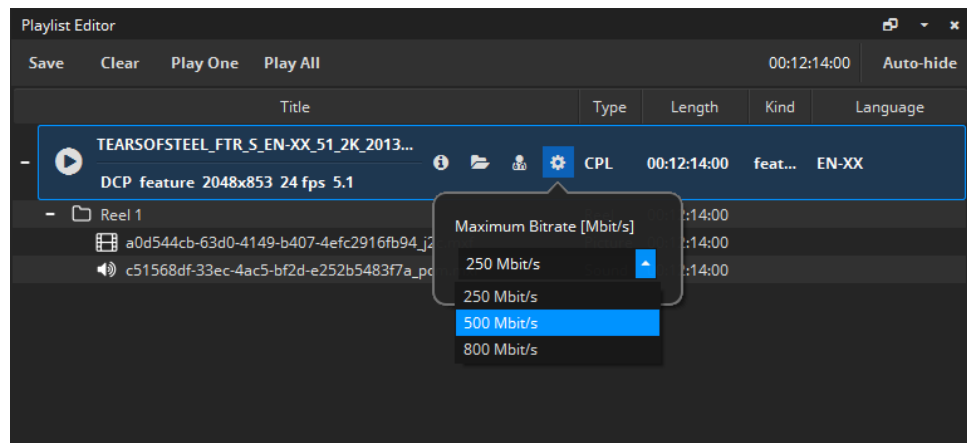
```
#EXTM3U

# play only first 5 seconds
#EXTINF:5, title 1
\\server\DCPs\sample DCP\cpl.xml

# play at 50% audio volume
#EXTINF:0, title 2, 50
\\server\FileSequences\j2c\img_00.j
2c
C:\DCPs\sample DCP\video.mxf
```

## 5.7 Opening high-bitrate content

According to DCI specifications, the video bitrate for DCPs shall not exceed 250 Mbit/s. Surpassing that limit will cause easyDCP Player+ to generate a warning message. To set a custom limit, e.g. when working with high-framerate (HFR) content or high-bitrate (HBR) content, open the playlist editor window (Press "P" or context menu -> Playback -> "Playlist Editor") and modify the bitrate setting. easyDCP Player+ will remember custom values set for each item across program starts.



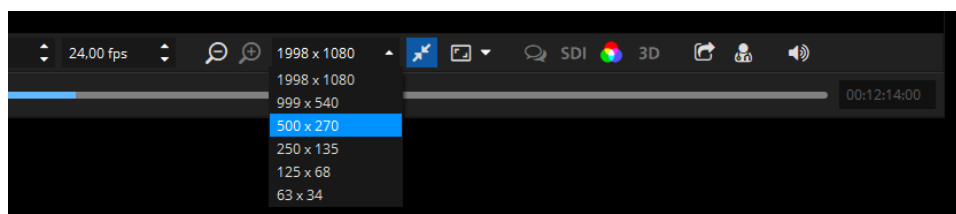
## 5.8 Playback control

### **Play/Pause Playback:**

Starts or pauses playback of the currently loaded media asset (hit 'Space').

### **Loop Video:**

When this option is activated, the currently loaded playlist will be restarted from the beginning when it reaches the end.

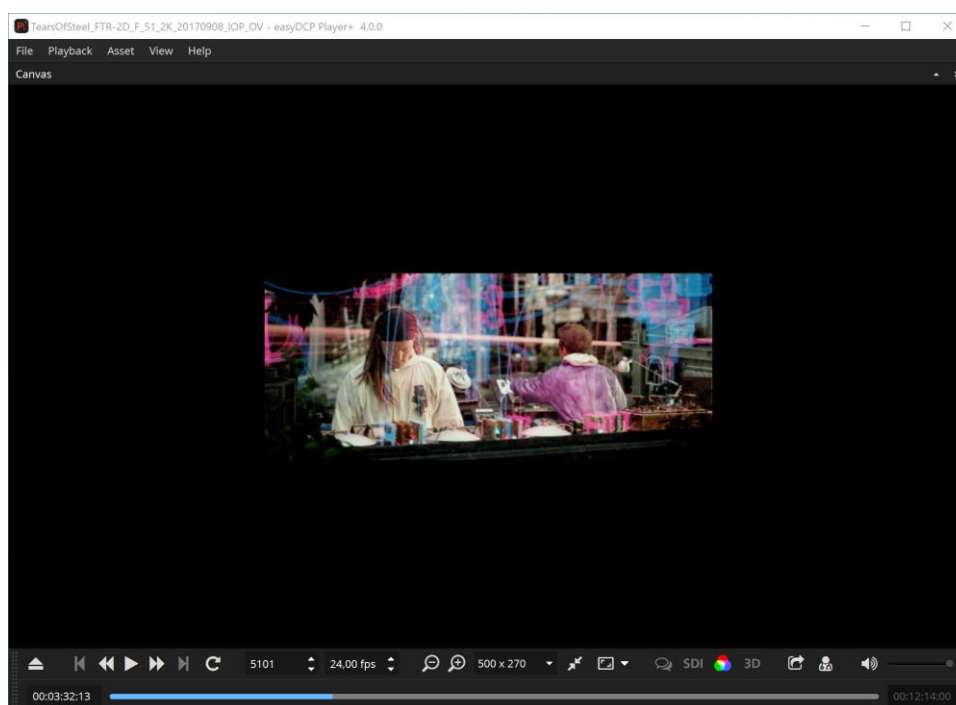


### **f Discard resolution level:**

By clicking this button, a resolution level of the JPEG 2000 code-stream will be discarded. Discarding a resolution level will half the resolution in both dimensions, while speeding up decompression times. Discard a resolution level, if the picture essence cannot be played back in real-time.

### **e Add resolution level:**

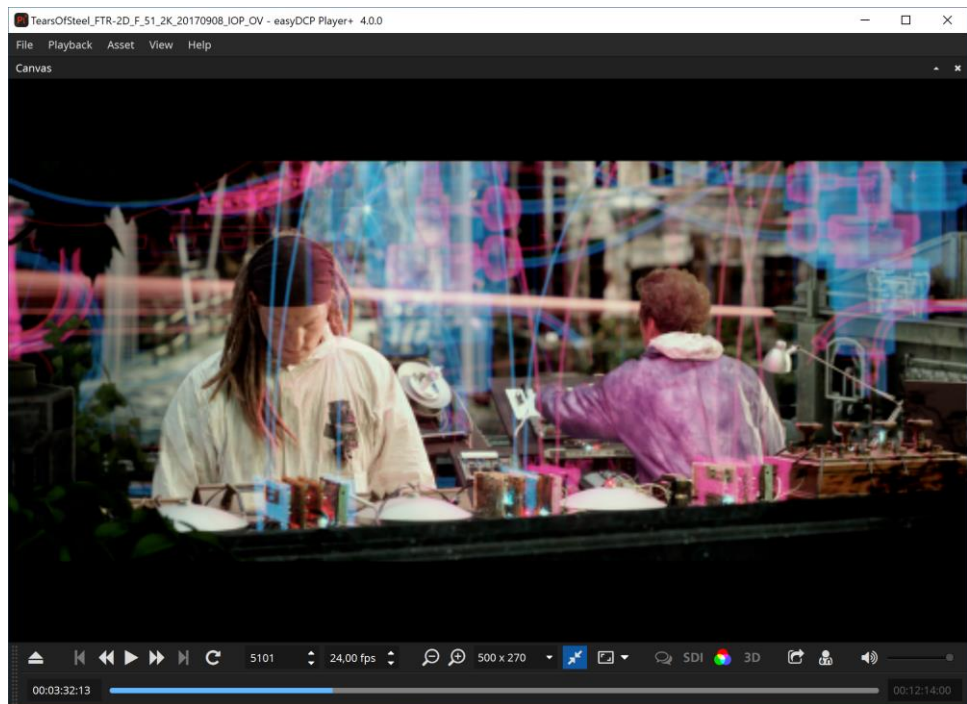
By clicking this button, an additional resolution level of the JPEG 2000 code-stream will be added. Adding a resolution level will double the resolution in both dimensions while slowing down decompression times.



As seen above, a DCP contains multiple embedded resolutions.

### **Fit to Window**

This button is grouped with the resolution level buttons as well as the combo box listing all accessible embedded resolutions. Normally, the application window resizes itself to the decoded video resolution, which is always visible in the drop-down combo box displayed above. If the window is too small to fit the video resolution, scroll bars appear. When the “Fit to Window” button next to the combo box is checked, however, the displayed video resolution will be artificially scaled to optimally fit the current window size. Tip: In order to speed up the decompression, discard one resolution level and scale the resolution back up to full screen by enabling the “Fit To Window” option. The loss in quality may be acceptable in some cases.



The above screenshot shows the same 512x214 pixels embedded resolutions, but with the “Fit to Window” option enabled.

### **M Full screen**

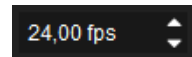
This button toggles the full screen mode of the video canvas. With the arrow button next to it, it's possible to configure the target display device for full screen.

### **Frame number**



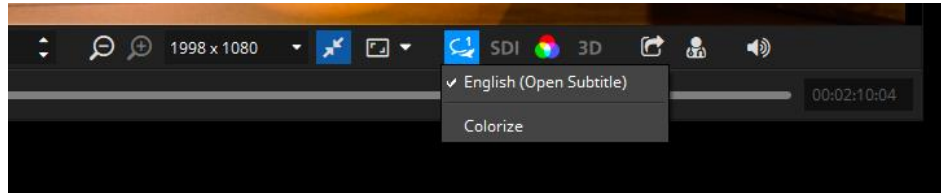
Enter a value to directly jump to a specific frame number of the currently loaded asset. You can also use the blue slide bar to jump to a specific location.

### Frames per Second



Arbitrary frame rates can be specified. If the audio edit rate is known (as is the case when playing a DCP or MXF), audio will only be played for the original edit rate. If a fractional frame rate is specified, the time code display will round to the next even integer. Hence, the time code no longer matches the world time.

## **Timed Text**



The currently opened package's timed text tracks can be shown or hidden. To be able to distinguish the tracks they can be colorized. Further timed text related features are accessible from the Subtitle Inspector windows (refer to chapter 5.9 Subtitle Inspector).

## **SDI HD-SDI output device**

Select whether or not the video should also be played out over an SDI device. Support devices are *Blackmagic Design UltraStudio*, *DeckLink* or *Intensity* series devices. Advanced SDI options can be configured in the options dialog as described in chapter 8.3.

## **Color Transform**

Setup the color spaces of the currently opened asset as well as of the computer monitor and/or SDI monitor. Please refer to chapter 5.11 for more details.

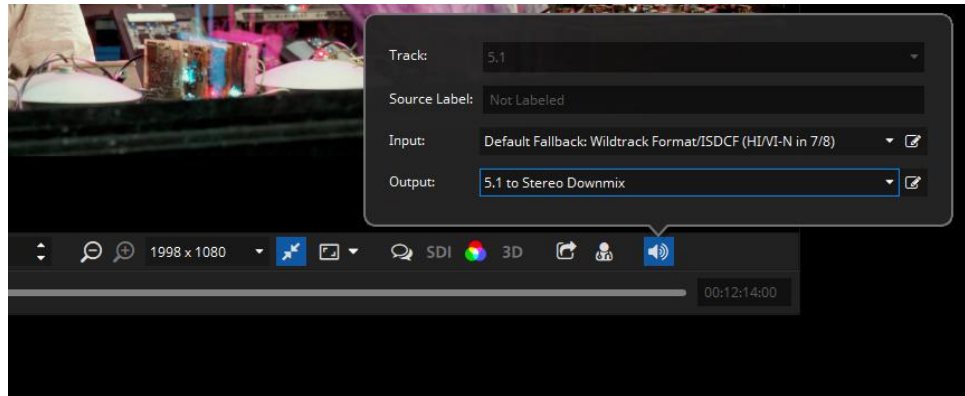
## **Export**

Export or unwrap the currently opened asset. Please Refer to chapter 6 for more details.

## **Validate**

Run a set of quality tests on the currently opened DCP and create a validation report. The button is only available when a DCP is opened.

## Audio

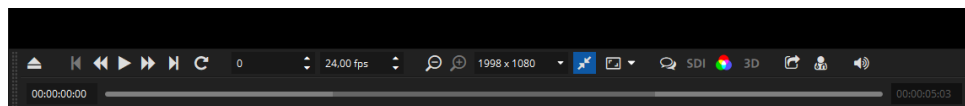


Within the audio popup it's possible to select the active track of the currently loaded asset and the input and output audio channel mapping.

For more details about output channel mapping, please refer to chapter 8.2, and for audio routing in general to chapter 10.

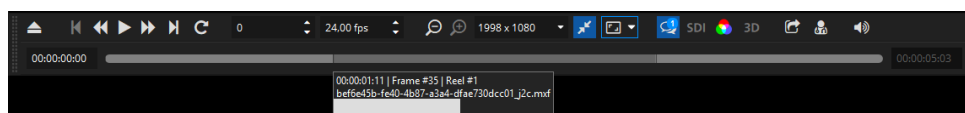
## Media Slider

The timeline displays the playback progress of the current playlist item. Hovering over it will display additional information, clicking will jump to the associated time code. If the currently playing asset contains subtitles, markers will be drawn on the timeline at the fade-in points of all subtitle entries.



Multiple reels inside a single package will be drawn in slightly different colors for easier distinction. Additionally, the context entries in Playback->"Jump to" allow navigation between reels, subtitles or playlist items.

Timed texts are visualized as thin vertical bars. When hovering over a subtitle with the mouse cursor, the tooltip will display the text.

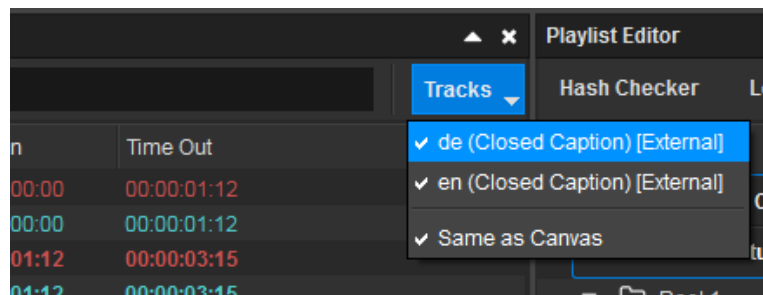


## 5.9 Subtitle Inspector

Since version 3.0 of the easyDCP Player+, a Subtitle Inspector window can be used to display subtitles and their properties for an opened asset. A Subtitle Inspector window can be opened by using the easyDCP Player+ context menu (right click on Canvas) or main menu -> Asset -> Subtitle Inspector #1 to #4 (or



using the shortcuts CTRL+1 to CTRL+4). Each window can be used to show different Subtitle Tracks and search results. By default, the same subtitles like in the Canvas are shown in the Subtitle Inspector windows. To change this behavior, the "Tracks" menu can be used by disabling its "Same as Canvas" option and selecting the subtitle tracks arbitrarily and independently from the Canvas.

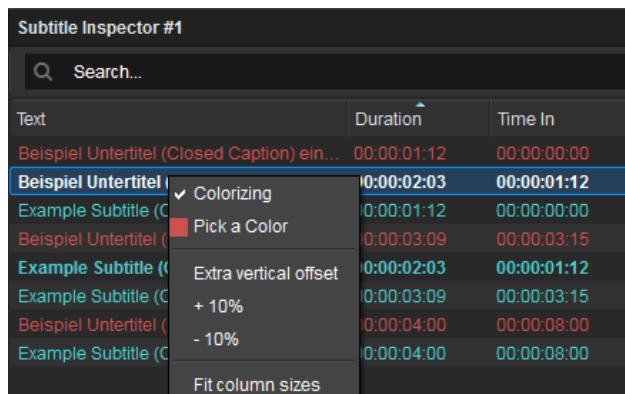
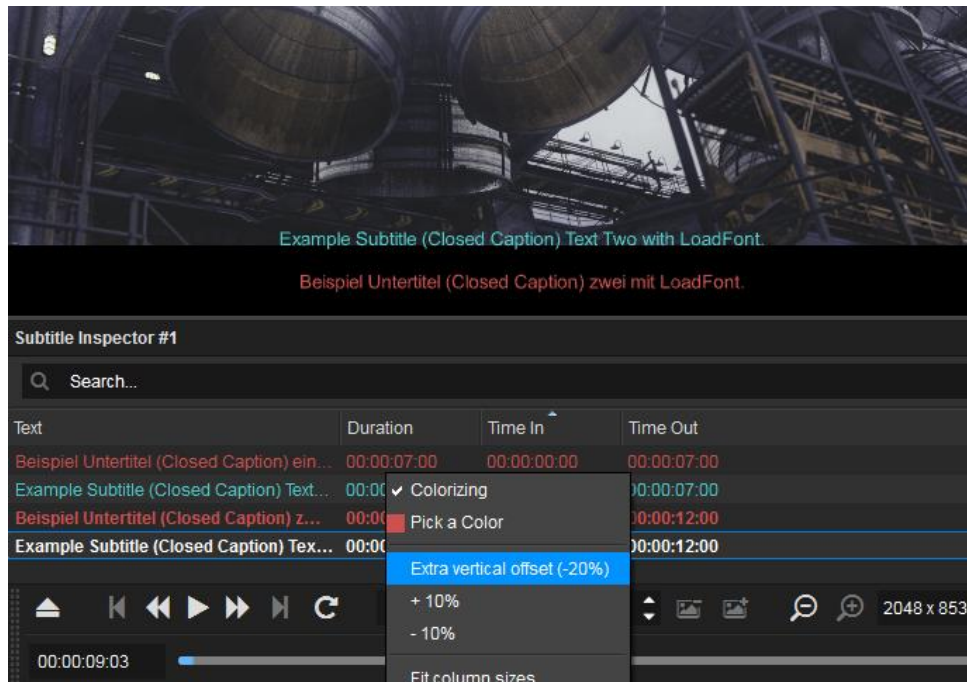


Additionally, the search box in the top of the window can be used to instantly find particular subtitle entries by typing in, for example, a part of their text or their time code. All visible columns will be searched and wild-cards like "?" and "\*" can also be applied.

The order of the columns can be re-arranged via drag & drop of the column headers. The column headers' context menus contain options to hide or show a particular column.

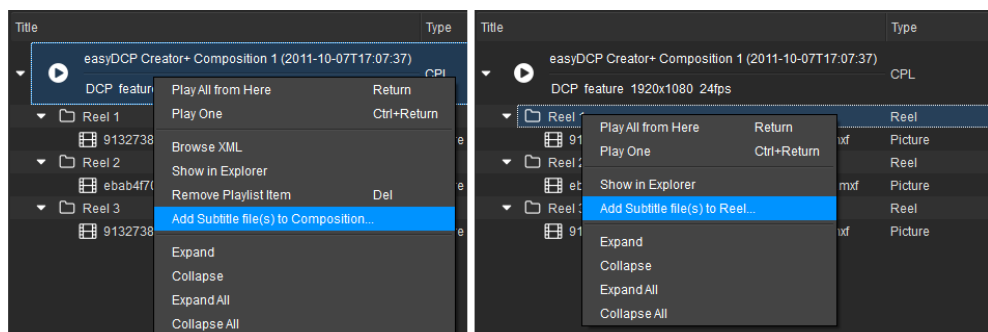
Selecting a subtitle in the Subtitle Inspector by clicking on it automatically jumps to the first frame the subtitle appears (please note that the subtitle could still have a high transparency in that first frame because of the fade-up time). The other way around, while playback is running, the subtitles that are currently visible in the Canvas are also marked in the Subtitle Inspector windows.

For testing purposes, each subtitle track can be rendered in a different color by either enabling the "Colorizing" option in the Subtitle menu of the tool bar or in the context menu of any subtitle entry in the Subtitle Inspector (right click on a subtitle entry to open up the context menu). Using this context menu, alternatively a custom color can be selected for each subtitle track by choosing "Pick a Color" for one of its subtitle entries. Moreover, by clicking on "Extra vertical offset", each subtitle track can get an additional offset for its position in the image, so all of its subtitle entries get moved up or down in the image. This is convenient when comparing two alternative subtitle tracks (e.g. two different languages) that would normally overlap each other. The default percentage of +/-40% can also be customized in the context menu by using the "+10%" and "-10%" options.



## 5.10 Adding external subtitle files

easyDCP Player+ (+) can also load external subtitles on-the-fly via the playlist editor window. To do so, right click the desired package and choose "Add subtitle file(s) to Composition" or "Add subtitle file(s) to Reel". Drag & Drop is supported as well.



Please note that it makes a difference whether you drop the subtitle on the composition or on a particular reel. In case you selected to add the subtitle file to the composition and its length exceeds the duration of the first reel, the remaining subtitle contents will be added to the following reels (if any). When you later unwrap the package in the Export dialog (see chapter 6), the single imported subtitle file will then be split up into multiple files (one for each reel). "Add subtitle file(s) to Reel" will only affect the selected reel. Make sure that the subtitle contains no entries beyond the reel's end.

To remove an external subtitle element, right click it and choose "Remove Subtitle" from the context menu.

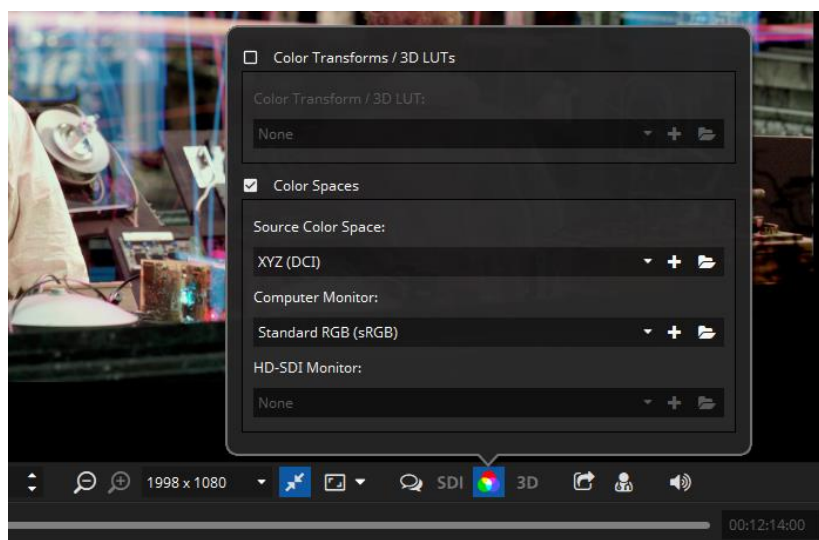
For convenience, no distinction between the different supported subtitle formats (SMPTE DCP, Interop DCP) is made. For instance, adding SMPTE subtitles to an Interop package or vice versa will work as expected. When the package is exported, the subtitle format will automatically be converted.

You may add multiple subtitle files at the same time.

In order to distinguish them from regular ones, external subtitle elements in the playlist editor are displayed in italics.

easyDCP Player+ will automatically monitor external subtitle files for changes and update them accordingly (e.g. in case you modify the wording in an external editor)

## 5.11 Color Transforms



With this button you can select a color transform. Enabling a color transform results in a better representation of how colors and "look" appear on the screen. Multiple standard color transforms are included with easyDCP Player+.

## Color Transform Presets

In versions prior to 3.3.2, color transforms were of the form “*source space -> target space*”. Each transform is represented by a file in the color transform repository. They use a proprietary XML format. The files can be edited and new ones can be added. These types of color transforms are still available for backwards compatibility. In the screenshot above, select the “Color Transforms / 3D LUTs” group box. The repository can be opened by clicking the folder icon. New files or 3D LUTs (\*.3dl) can be added with the plus icon.

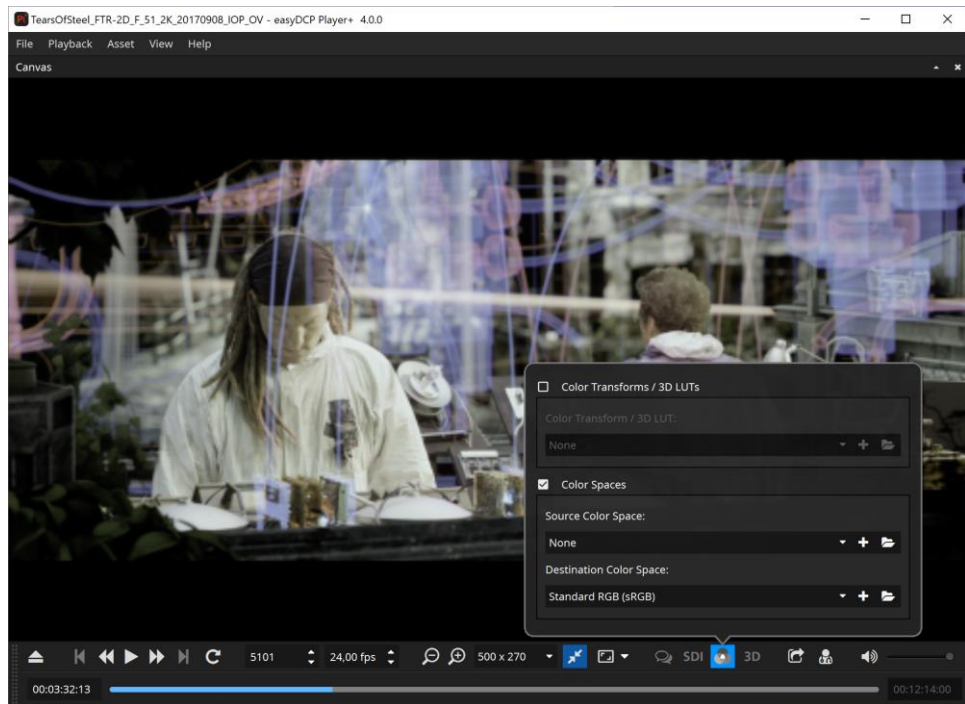
## Color Space Presets

Beginning with version 3.3.2, the more flexible way to define color transforms is by individually assigning source and destination color spaces. The source color space is specific to the currently loaded package and will be restored the next time the package is loaded. The first time a package is loaded, the source color space will be automatically inferred from the metadata. The destination color spaces can be individually selected for the computer monitor and for the SDI monitor. These selections will be permanently maintained. The color spaces are also represented by files that are located in the color space repository. The files are stored in a proprietary XML format that is different from the one used for the legacy color transform files. This repository is shared by both easyDCP Player+ and easyDCP Creator. Existing presets can be edited and new ones can be created. When adding new files, please make sure to assign a unique name. The “comment” attribute will be displayed as a tool tip. When creating a new preset it is recommended to copy and paste any of the existing presets and make adjustments as opposed to starting from scratch. All possible values can be looked up in the “template.xml.example” file located in the repository.

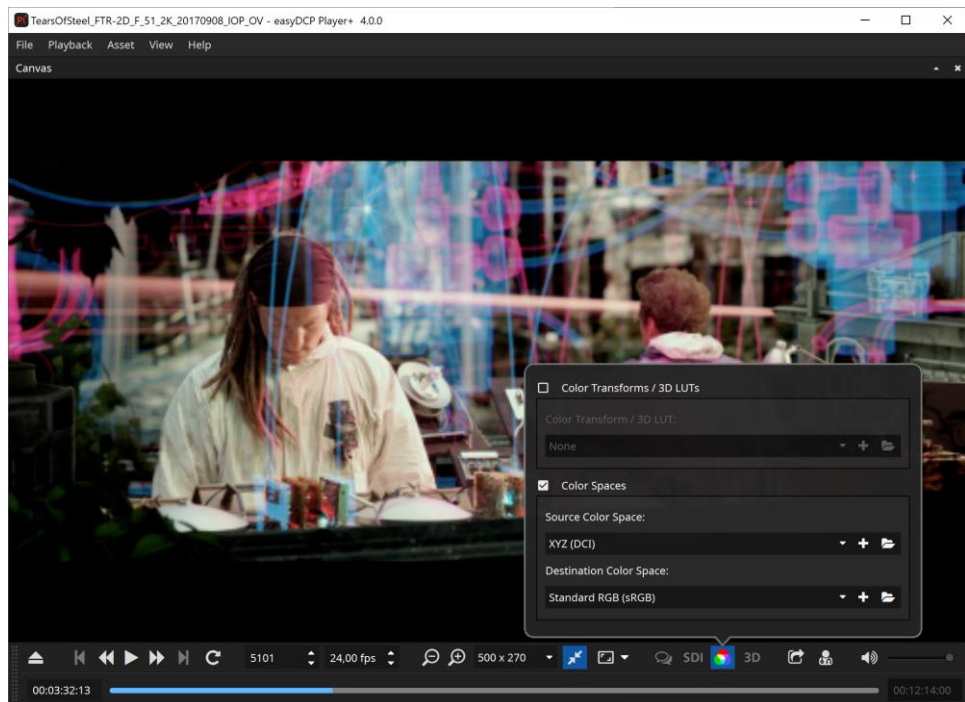
## ICC Profile

Optionally, a separate ICC profile file can be referenced. This works with both the color transform and color space formats. The profile file needs to be located in the same folder. This profile will then be embedded when exporting QuickTime or TIF files to enable proper downstream color management.

## Example: DCP

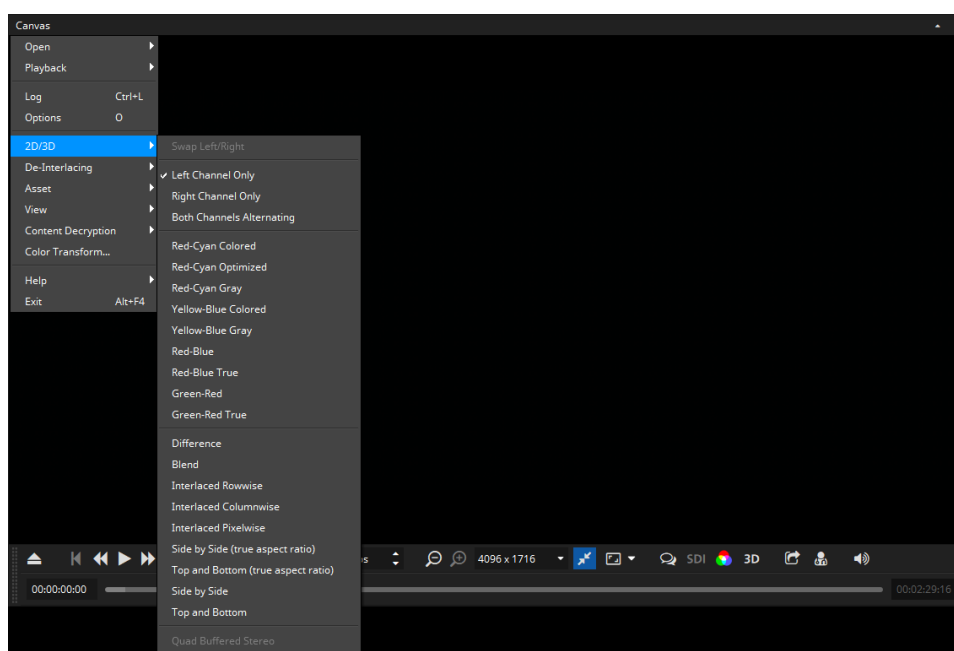


As seen above, images look greyish or greenish, when displayed in the package's native X'Y'Z' color space with 2.6 gamma and P3 white point. When viewing on a computer monitor with the sRGB color profile, the colors need to be converted into the sRGB color space.



## 5.12 2D/3D

The 2D/3D context menu lists the same options as the 3D button in the detachable control bar. Features are only enabled when a stereoscopic asset is loaded.



The “Swap Left/Right” check box works in combination with all following modes that display both channels. It swaps the input channels and should therefore normally be unchecked.

The first group of modes only displays one channel at a time.

The second group of modes lists several common anaglyph filters that can be used with widely available anaglyph glasses.

The third group contains a range of modes, most of which spatially interleave both channels or place them next to each other. Especially the side-by-side and top-and-bottom formats are common for addressing 3D displays.

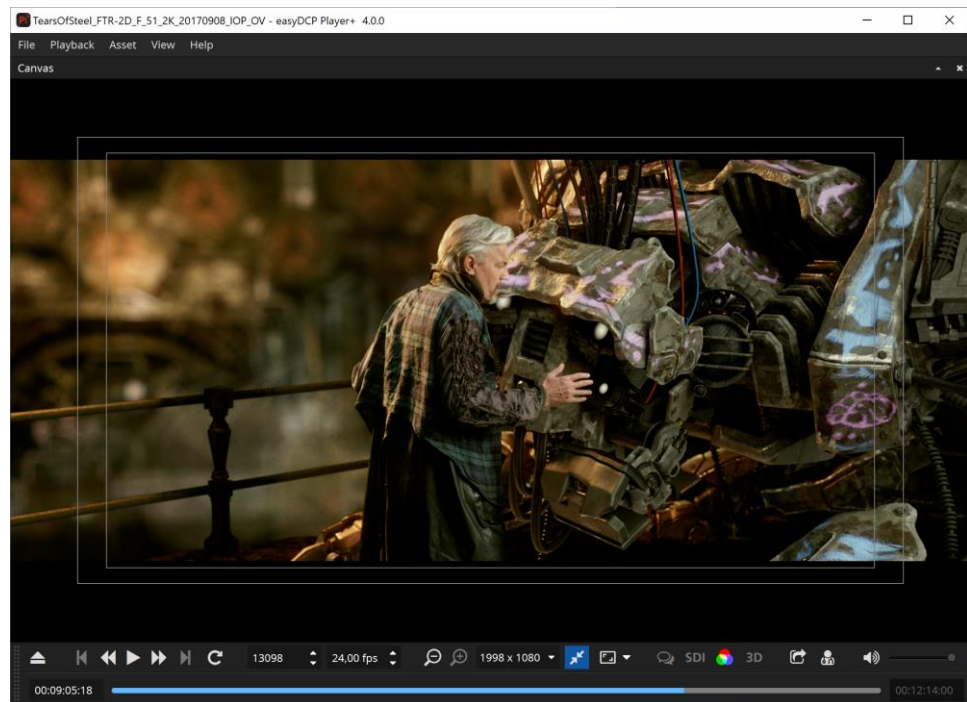
Finally, Quad Buffered Stereo delivers the highest-quality 3D effect as it provides synchronous double-buffering for each eye. This option is only supported by professional graphics devices and therefore not always available.

In order for this option to be available the graphics device needs to support Quad Buffering and stereo needs to be enabled in the graphics device control panel as well as in the easyDCP Player+ video options pane. When this option is selected in easyDCP Player+, the graphics driver control panel is also the place to configure how exactly left and right images should be output. Common choices are output for shutter glasses or Dual-DVI stereo, e.g. left images over

one DVI output and right images over the other DVI output. easyDCP Player+ simply passes left and right images at full resolution to the graphics driver.

### 5.13 Safe Areas

Introduced in version 3.4.5, easyDCP Player+ can overlay "Title Safe" and "Action Safe" areas as well as the DCI containers *Flat*, *Scope* and *Full*.

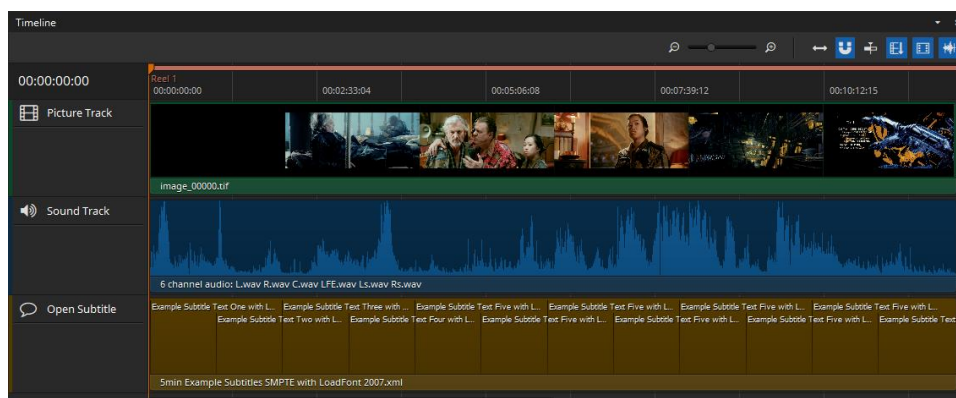


Each preset is based on an XML file that are located in a directory which can be opened by selecting "Open Repository". The "Title Safe", "Action Safe" and "Center" presets are defined by specifying coordinates relative to the image. The remaining presets, on the other hand, are defined based on absolute coordinates. Based on the presets it should be straight forward to add additional custom presets, when required. They can either be copied into the directory where they will be detected by easyDCP Player+ after a restart or they can be imported by selecting the "Add new preset..." option. The colors or thickness cannot currently be changed. The overlays cannot be burnt into the image when exporting the DCP package.

## 5.14 Timeline

The timeline module was introduced with easyDCP Player+ 3.5.0. It can preview picture, sound and timed text tracks of a loaded composition.

You can open the timeline in easyDCP Player+ pressing keys "CTRL + T" or using the menu "View -> Timeline".



### Time Code Edit

The time code on the left side of the timeline is clickable and allows to jump directly to a specific time code. When it is selected it becomes blue and accepts all keys from 0 to 9. Pressing enter will accept the input and jump to the position in the timeline. It is also possible to start the editing via Ctrl + G after clicking the timeline once.

### f e Zoom:

The two zoom buttons and the zoom slider control the zoom level of the timeline. Additionally zooming is possible with "CTRL / CMD + mouse wheel" while the mouse is over the timeline.

### Zoom to fit:

Shows the entire timeline in respect to the available space in the user interface.

### Snap to clip borders:

Helps to properly align the playhead at the clip borders.

### J Center view on playhead:

Auto-aligns the timeline so that the play head is placed in the center.

### j Render Reels / Segments:

When active, reel / segment borders will be shown in the timeline header.



**L Render picture thumbnails:**

When active, thumbnails will be rendered for all video tracks in the timeline.

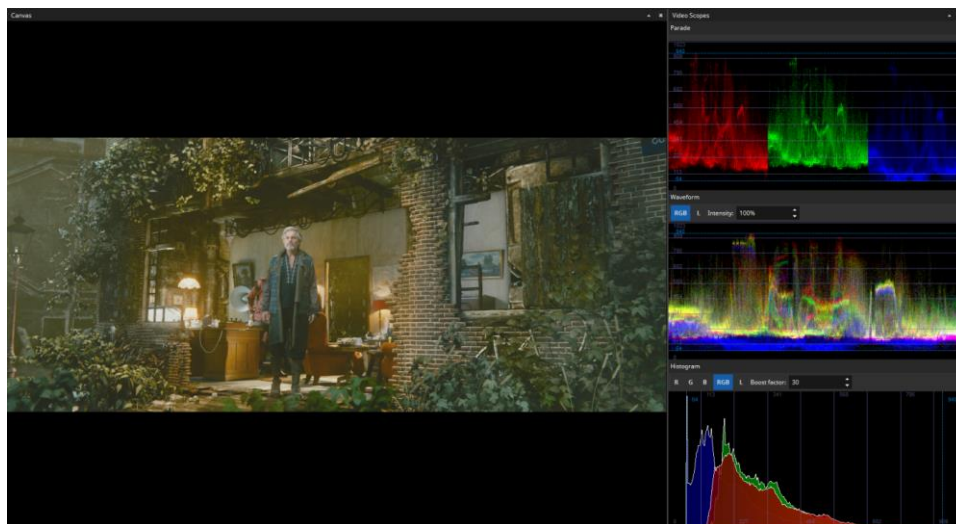
**K Render waveform thumbnails:**

When active, a visual representation of each audio track will be displayed in the timeline. Depending on the length of the audio tracks the rendering of the waveform for the first time can take a while.

**Navigation**

Using arrow key left and right allows for frame wise stepping in the timeline as it does for Player in general. With arrow up and down it is possible to jump to the next/previous reel/sequence in the composition.

## 5.15 Video Scopes



The video scopes module was introduced with easyDCP Player+ 3.6.0. It provides an alternate representation of the video frames in real time during playback. They represent the channel wise (RGB) distribution of intensity levels. This option can be found under "View" -> "Video Scopes".

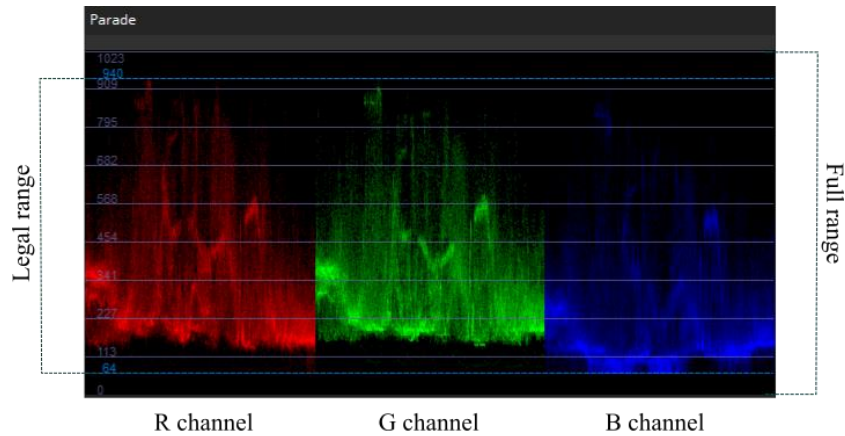
There are three video scopes provided, namely:

1. RGB parade
2. Waveform
3. Histogram (Windows only)

All of them provide a comprehensive representation of the video material rendered on the video canvas.

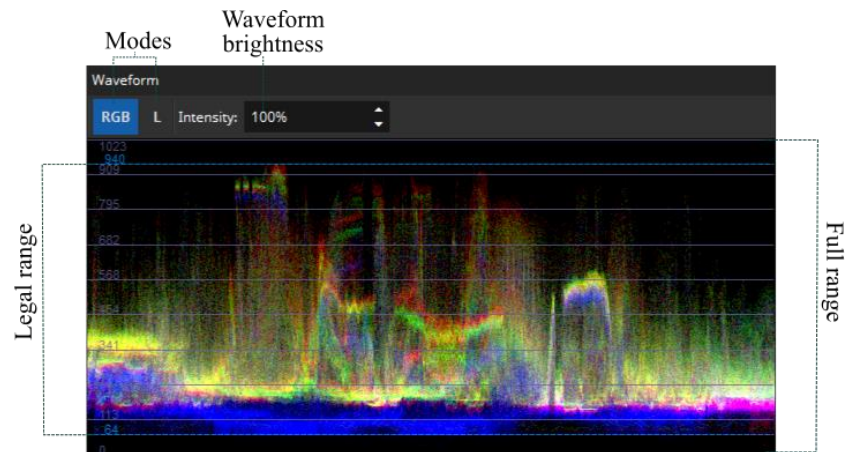
**RGB parade:** This scope represents the spatial color intensity distribution of the component channels R, G and B across the frame. The horizontal axis represents the image width itself, divided into three parts, one for each color channel. The vertical axis represents the intensity levels for the current asset, based on its bit depth. The intensity distribution across channels in the video frame can be compared with the parade scope.

The following figure illustrates the RGB parade. The red, green and blue channels are rendered in the respective colors. In this example, it can be seen that the intensity level of blue is slightly lower than that of red and green. It can also be seen that the intensity levels of red and green are higher to the left of the frame, which can be clearly understood by comparing with the actual frame rendered on the canvas.



**Waveform:** The waveform scope is similar to the RGB parade, with R, G and B components overlapped. The horizontal axis represents the image width and the vertical axis represents the intensity levels based on the bit depth of the asset. There are 2 modes – RGB and L (luminosity). The intensity option ranges from 0 to 100%. The intensity of the waveform scope can be adjusted using the provided spin box.

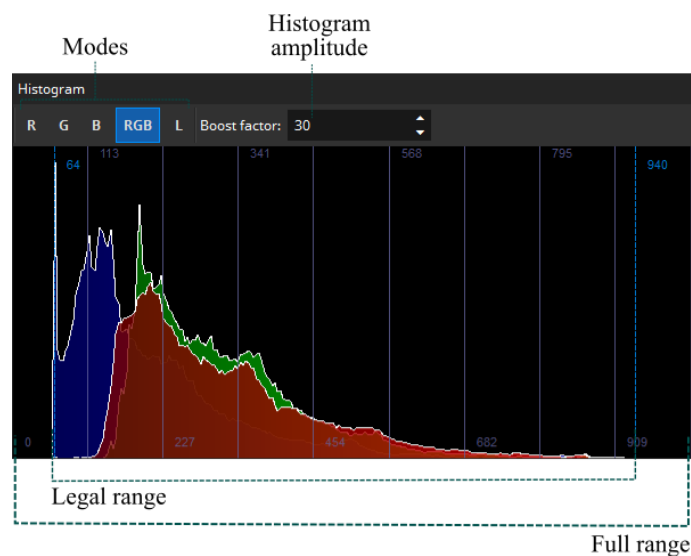
The waveform scope is similar to the RGB parade. We have all the channels superimposed together into a single waveform scope to obtain a collective representation of the color distribution in the current frame. The figure below illustrates the waveform scope. The horizontal axis represents the image from left to right. It can be seen that the rendered frame has an overall yellow tint, which can be verified by comparing it with the waveform scope.



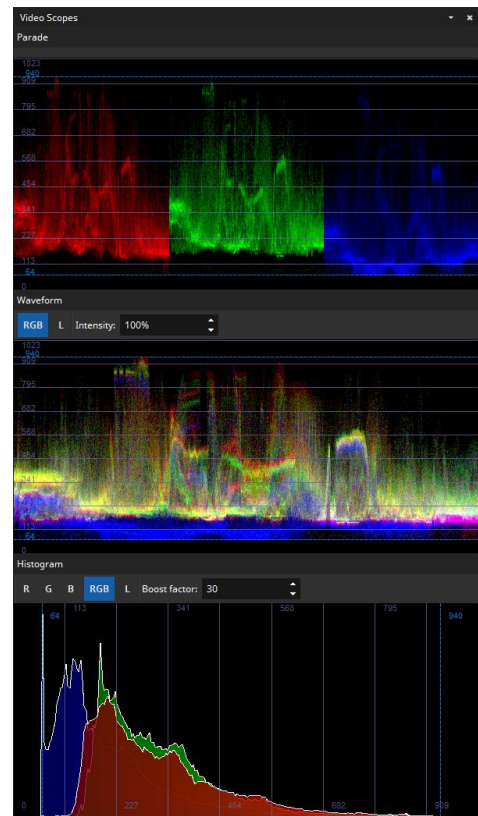
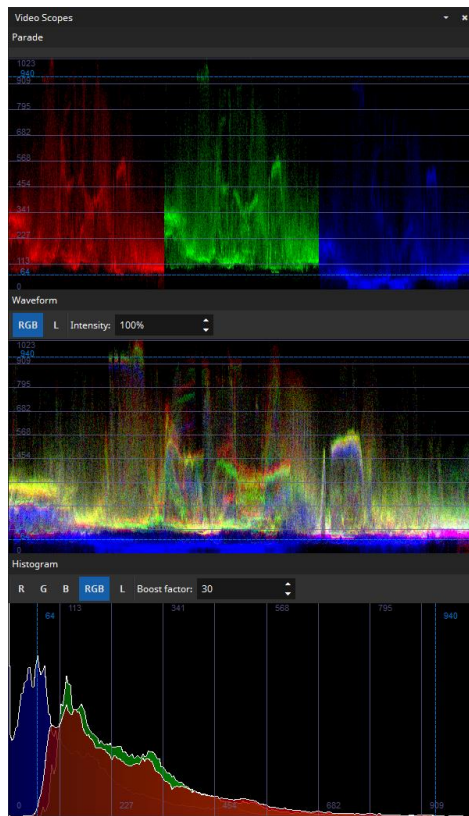
**Histogram (Windows only):** The histogram provides an overview of the intensity distribution in the video frame. The horizontal axis represents the intensity levels based on the bit depth of the current asset. The vertical axis represents the number of pixels with a particular intensity level / bin. There are five types of histograms available, namely:

1. R – red channel
2. G – green channel
3. B – blue channel
4. RGB – combined R, G and B channels
5. L – Luminosity

The histograms provide intensity distribution across a single color channel or all of them combined. The “Boost factor” is provided to amplify the visibility of histogram entries. It ranges from 1 to 200. Similar to the other scopes, the intensity levels are indicated in addition to the lower and upper legal limits.



The below figure demonstrates the video scopes for a video frame in two different scenarios. The left one is with a full range color (ITU-R BT.709 Full-Range) and on the right hand side, it is in legal range (ITU-R BT.709). Thus, the video scopes can be used as a tool for quality check with respect to the color intensity ranges.



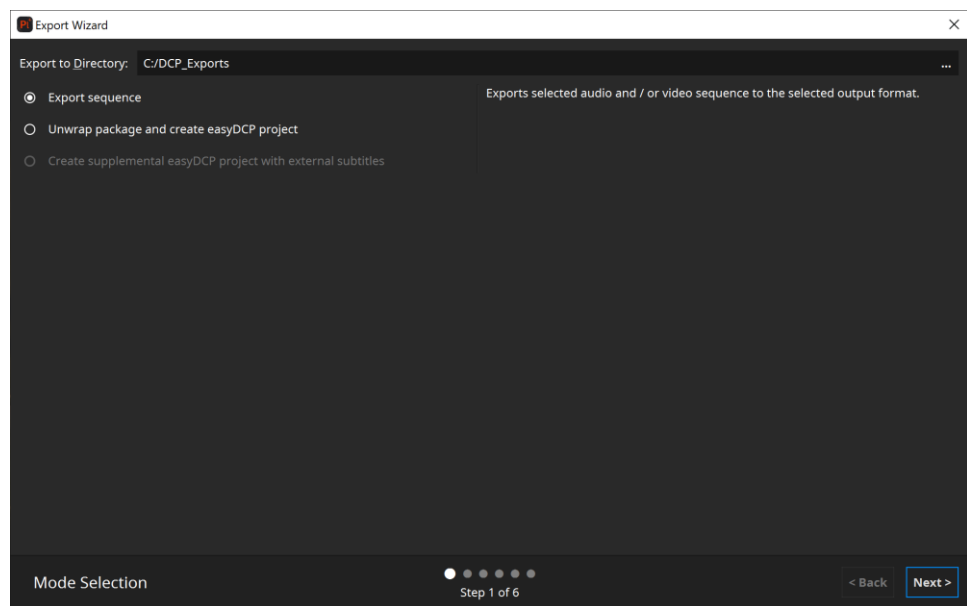
## 6 Export

easyDCP Player+ allows exporting a source's video, audio or timed-text assets.

The individual video frames can be unwrapped and saved as JPEG 2000 images (\*.j2c) or decoded to uncompressed DPX, uncompressed TIF or a QuickTime container using any of the available installed QuickTime codecs. When exporting decoded images, various image processing options can be applied.

Since easyDCP Player+ 3.5.0 the export process is divided into a wizard. The necessary steps will be explained in the following sections.

### 6.1 Mode selection

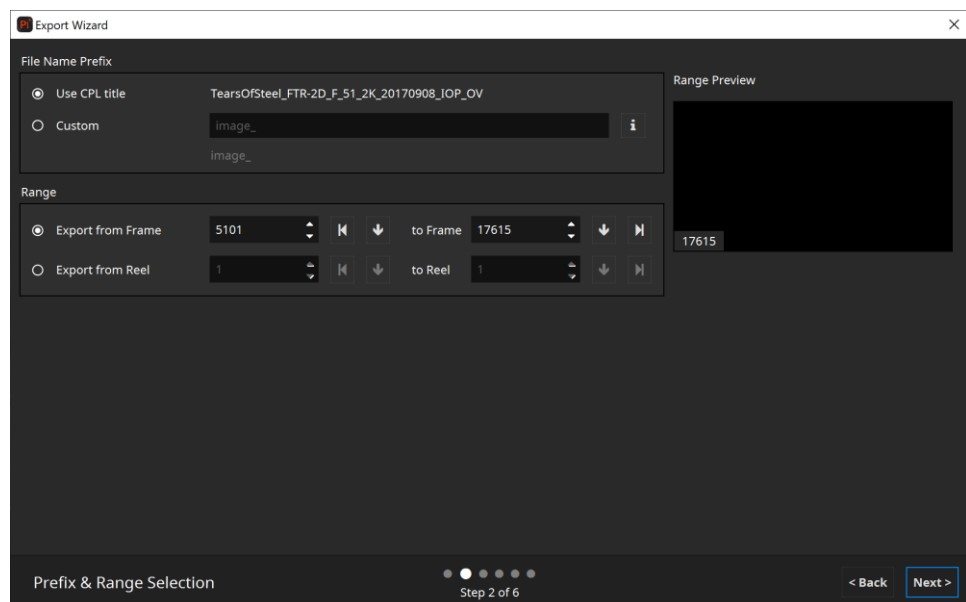


**Unwrap DCP and create easyDCP project:** easyDCP Player+ can simply unwrap the whole DCP track file by track file. It will automatically generate an easyDCP Creator project file, which can be opened with easyDCP Creator to generate a new package. Regenerating the exported DCP will be almost as fast as a copy operation since image files are already in the proper format and a time-consuming JPEG 2000 compression is not necessary. Just make sure that easyDCP Creator is configured to (1) disable JPEG 2000 re-encoding, (2) disable automatic pillar-/letterboxing, (3) bypass the video track files' color transform. This option requires that keys were ingested for all compositions as it will unwrap the whole package. When extending an existing package, e.g. by adding subtitles, this option should usually be preferred over the "Export sequence" option.

**Create supplemental easyDCP project with external subtitles:** This option is only available if external subtitles were loaded. Exporting in this mode will create a easyDCP Version File (VF) project file to be opened by easyDCP Creator. The project will reference all track files from the original package. Any externally added subtitles will be split into reels and converted to SMPTE or Interop, when necessary. During the conversion, any subtitle attributes that use the default values defined in the specifications will be stripped.

**Export Sequence:** This option can be used to export a package's content into image and audio files. However, it will skip the reels' invisible frames, e.g. when the movie has a run-in. To work around this, it is also possible to load a package's MXF files individually and unwrap those one by one. This is effectively what the "Unwrap DCP" option does.

## 6.2 Range Selection

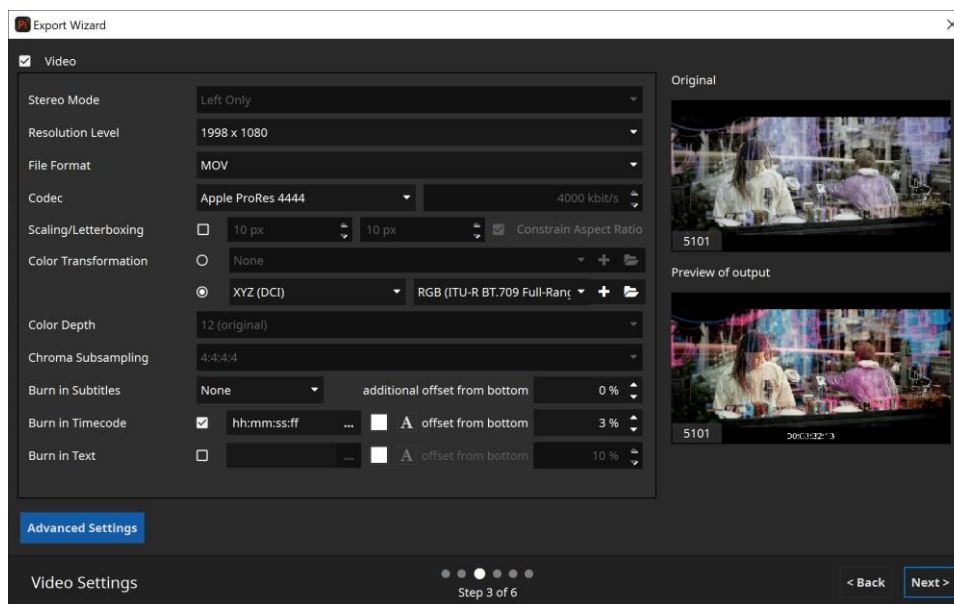


**File Name Prefix:** Will be used as the base file name. As a quick setting, the CPL title can be used as prefix. It's also possible to define a custom prefix. All available options can be shown via the i button.

**In- and Out-Points:** Start and end points can be specified in terms of frame indices or reel indices. Exporting reels comes in handy when creating proxy file sequences to be used during the subtitling process, because subtitle files have to be provided individually for each reel.

**Preview:** The preview displays the first and last frame based on the configured range. For convenience, a few frames in between the configured range will be shown as well.

## 6.3 Video Settings



**Stereo Mode:** A stereo package's left and right channel will be exported individually. Creating a stereoscopic QuickTime video is not supported.

**Resolution Level:** JPEG 2000's scalability by resolution can be utilized to export proxy sequences.

**File Format:** JPEG 2000 (unwrap only), DPX, TIF or QuickTime. "Check (decode only)" is a quality assurance feature. It will decrypt and decode all frames in the package as fast as possible, verifying that the JPEG 2000 files are decodable, contain the proper profile flags and don't violate the maximum bitrate assigned to the asset (250 Mbit/s by default).

**Codec:** When exporting to QuickTime, any of the installed QuickTime codecs can be selected (Audio and Video).

**Scaling/Letterboxing:** When exporting to QuickTime, the source can optionally be scaled and/or letterboxed. When enabled, the image will be scaled until either the width or height matches the desired resolution. If the output aspect ratio is different from the source, the remainder will be letter-/pillarboxed.

**Color Transform:** Any of the XML-based color transforms can be applied during the export. Please note, that this will impact the decoding performance.

**Color Depth:** For DPX, bit depths of 8, 10 and 16 bits as well as the native bit depth can be selected. Choose 10-bit for the highest compatibility with other tools. For TIFF, bit depths of 8 and 16 bits as well as the native bit depth can be selected. Export to QuickTime is restricted to 8 bits or 16 bits per color. The



option to export to QuickTime in 16-bit mode will only be present when the source material actually exceeds a bit depth of 8 bits.

**Chroma Subsampling:** When exporting chroma-subsampled source material (i.e. in 4:2:2 or 4:2:0 configurations) to DPX or TIFF, 4:4:4 or the native subsampling scheme can be selected. In case 4:4:4 is selected, the video material will be up-sampled accordingly.

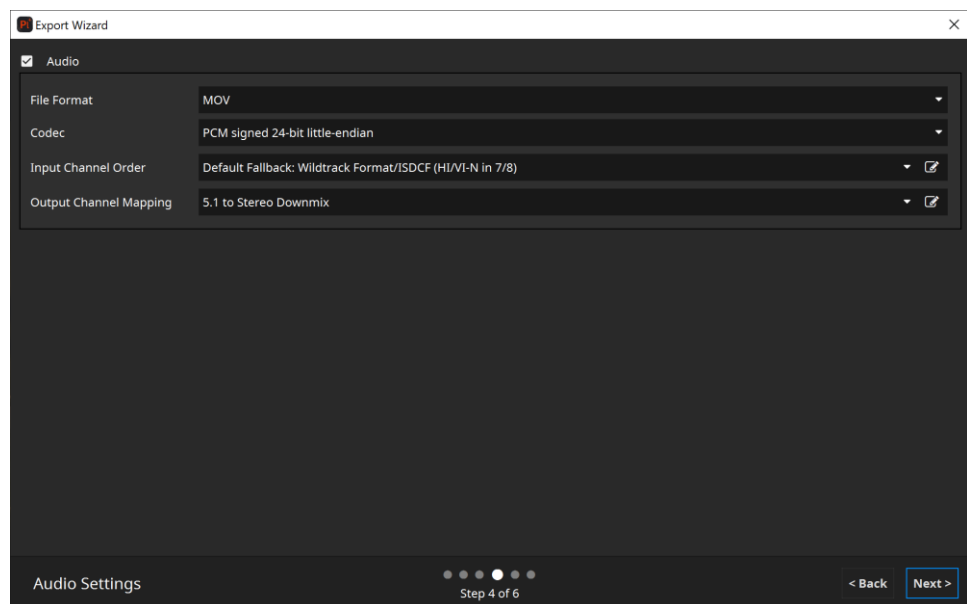
**Burn-In Subtitles:** Any of the present timed-text tracks can be embedded into the image. Optionally, the subtitles' original positions can be shifted vertically. This comes in handy when creating new subtitles: a proxy file with the original subtitles burnt-in can be provided to the subtitler, who can add a new translated subtitle track and position it comfortably.

**Burn-In Timecode:** Allows to burn in the time-code.

**Burn-In Text:** Allows to burn in a static text, e.g. "Property of Fraunhofer". Clicking the "... " button, will pop up an editor dialog that provides more space.

**Preview:** The preview displays all frames which will be used for export based on the configured range on the previous export wizard page. Furthermore, the preview reflects all settings made on this export wizard page (except "Scaling / Letterboxing").

## 6.4 Audio Settings

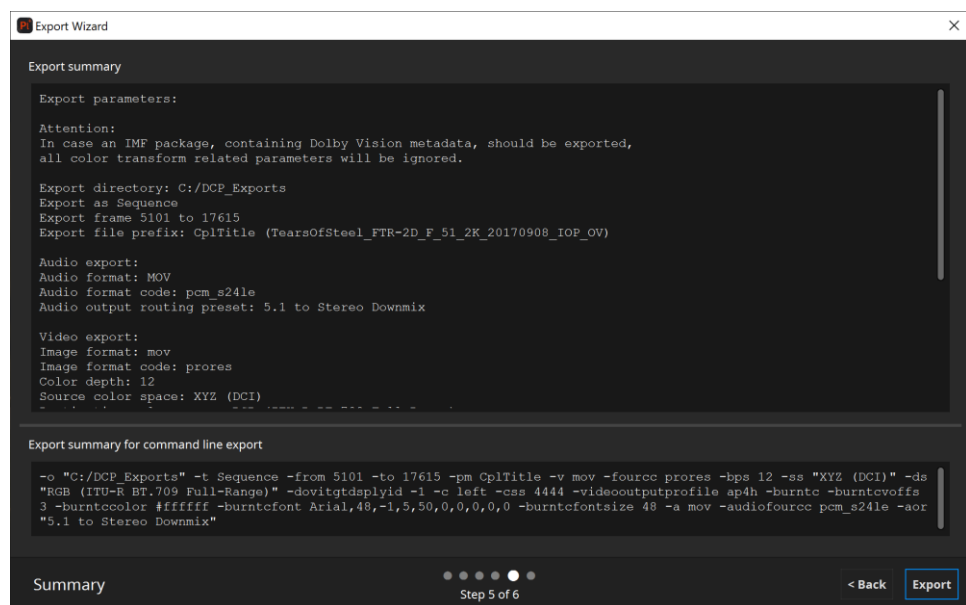


**File Format:** Audio essence can be stored as a single multi-channel WAV file, multiple single-channels WAV files or a in a QuickTime container. When the

target wav-file exceeds the limit of 2GB file size, it will be split into multiple files. If both audio and video essence is exported using the QuickTime format, data will be interleaved into a single container file. Please note that depending on the selected codec, not all audio channel layouts might be supported.

**Input Channel Order and Output Channel Mapping:** Since easyDCP Player+ 3.6.0 it's possible to configure the audio input channel order and output channel mapping for export. To do so select a preset from the existing list or click on the edit button next to "Input Channel Order" or "Output Channel Mapping" to define own presets. Please refer to chapter 10 for detailed information.

## 6.5 Summary



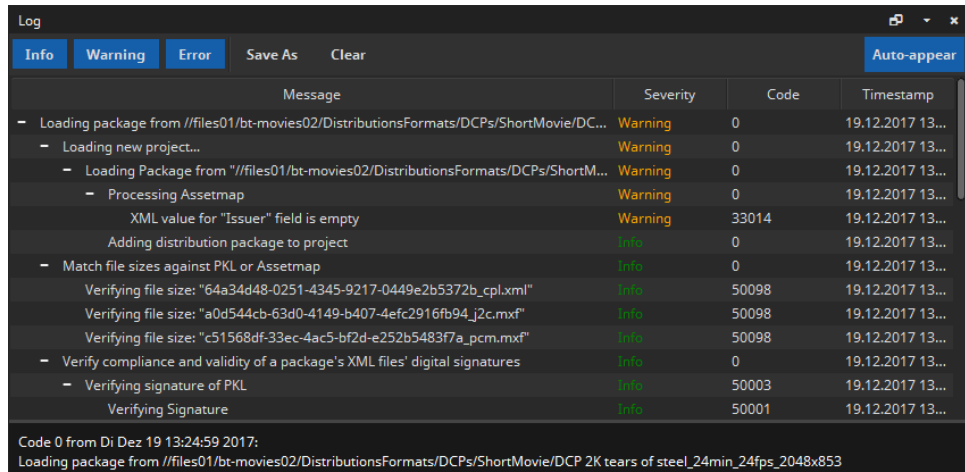
At the end of the export wizard a summary will be displayed. The bottom section displays the corresponding arguments to export the currently loaded asset via command line. Please refer to chapter 11 for more information regarding the available command line interface.

## 7 Quality control

Before distributing a DCP, it is highly recommended to run both the hash check and the validation test (both explained below). When running these tests, the package should be loaded not from the local drive, but directly from the mobile hard-drive.

### 7.1 Log/Issue Reports

When a new asset is loaded, easyDCP Player+ automatically executes numerous checks, identifying potential issues related to integrity, formatting and security. The results are collected and presented to the user in a log window.



Message	Severity	Code	Timestamp
- Loading package from //files01/bt-movies02/DistributionsFormats/DCPs/ShortMovie/DC...	Warning	0	19.12.2017 13...
- Loading new project...	Warning	0	19.12.2017 13...
- Loading Package from "//files01/bt-movies02/DistributionsFormats/DCPs/ShortM...	Warning	0	19.12.2017 13...
- Processing Assetmap	Warning	0	19.12.2017 13...
XML value for "Issuer" field is empty	Warning	33014	19.12.2017 13...
Adding distribution package to project	Info	0	19.12.2017 13...
- Match file sizes against PKL or Assetmap	Info	0	19.12.2017 13...
Verifying file size: "64a34d48-0251-4345-9217-0449e2b5372b_cpl.xml"	Info	50098	19.12.2017 13...
Verifying file size: "a0d544cb-63d0-4149-b407-4efc2916fb94_j2c.mxf"	Info	50098	19.12.2017 13...
Verifying file size: "c51568df-33ec-4ac5-bf2d-e252b5483f7a_pcm.mxf"	Info	50098	19.12.2017 13...
- Verify compliance and validity of a package's XML files' digital signatures	Info	0	19.12.2017 13...
- Verifying signature of PKL	Info	50003	19.12.2017 13...
Verifying Signature	Info	50001	19.12.2017 13...

Code 0 from Di Dez 19 13:24:59 2017:  
Loading package from //files01/bt-movies02/DistributionsFormats/DCPs/ShortMovie/DCP 2K tears of steel\_24min\_24fps\_2048x853

The user should always read the error or warning messages very carefully. Issues are presented in a hierarchical tree. Typically, the lowest level contains the most detailed error message. The bottom half of the window shows all details of the highlighted issue. Each log entry has a severity level: Info, Warning or Error.

**Info:** Feedback to the user or general log entries are classified as info.

**Warning:** Issues that might result in the DCP not working on some servers, but that easyDCP Player+ can still cope with are classified as warnings.

**Error:** If easyDCP Player+ cannot continue to process the asset, an issue is classified as an error.


The whole log can be saved as a \*.HTML or \*.XML file using the "Save As" button in the tool bar. When turning to the easyDCP technical support with a question regarding a specific issue listed in the log, please attach the file.

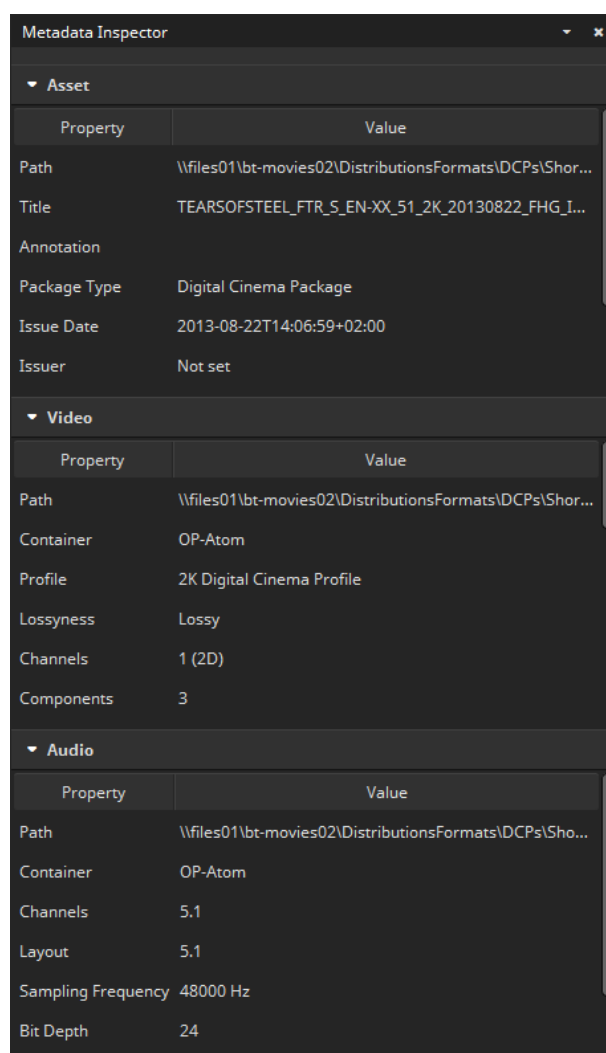
By default, the log window appears whenever a new **Warning** or **Error** was added to the log. By disabling the "auto-appear" checkbox in the top right corner, the window will be kept hidden until it is manually popped up using the context menu -> Log Window option (or press STRG/CMD + L). Disabling the auto-appear option is not recommended.

The MXF hash values are not checked automatically, since this would be too time consuming. Please refer to chapter 7.3 for details on how to apply a hash-check on a single package or the whole playlist.

## 7.2 Metadata Inspector

The Metadata Inspector can be opened via “context menu -> Asset -> Metadata Inspector” or by pressing “I” on the keyboard. It gives information about the current asset’s general properties as well as audio- and video-specific properties. Each field is explained in its tool tip. The video properties “Resolution” and “Bit Depth” contain data that is listed individually for each color component (for DCPs they are always identical).

Additionally, the same information is available by clicking on  next to a playlist item.



The screenshot shows the Metadata Inspector window with three sections: Asset, Video, and Audio. Each section contains a table of properties and values.

Property	Value
Path	\\files01\bt-movies02\DistributionsFormats\DCPs\Shor...
Title	TEARSOFSTEEL_FTR_S_EN-XX_51_2K_20130822_FHG_I...
Annotation	
Package Type	Digital Cinema Package
Issue Date	2013-08-22T14:06:59+02:00
Issuer	Not set

Property	Value
Path	\\files01\bt-movies02\DistributionsFormats\DCPs\Shor...
Container	OP-Atom
Profile	2K Digital Cinema Profile
Lossyness	Lossy
Channels	1 (2D)
Components	3

Property	Value
Path	\\files01\bt-movies02\DistributionsFormats\DCPs\Sho...
Container	OP-Atom
Channels	5.1
Layout	5.1
Sampling Frequency	48000 Hz
Bit Depth	24

## 7.3 Validator

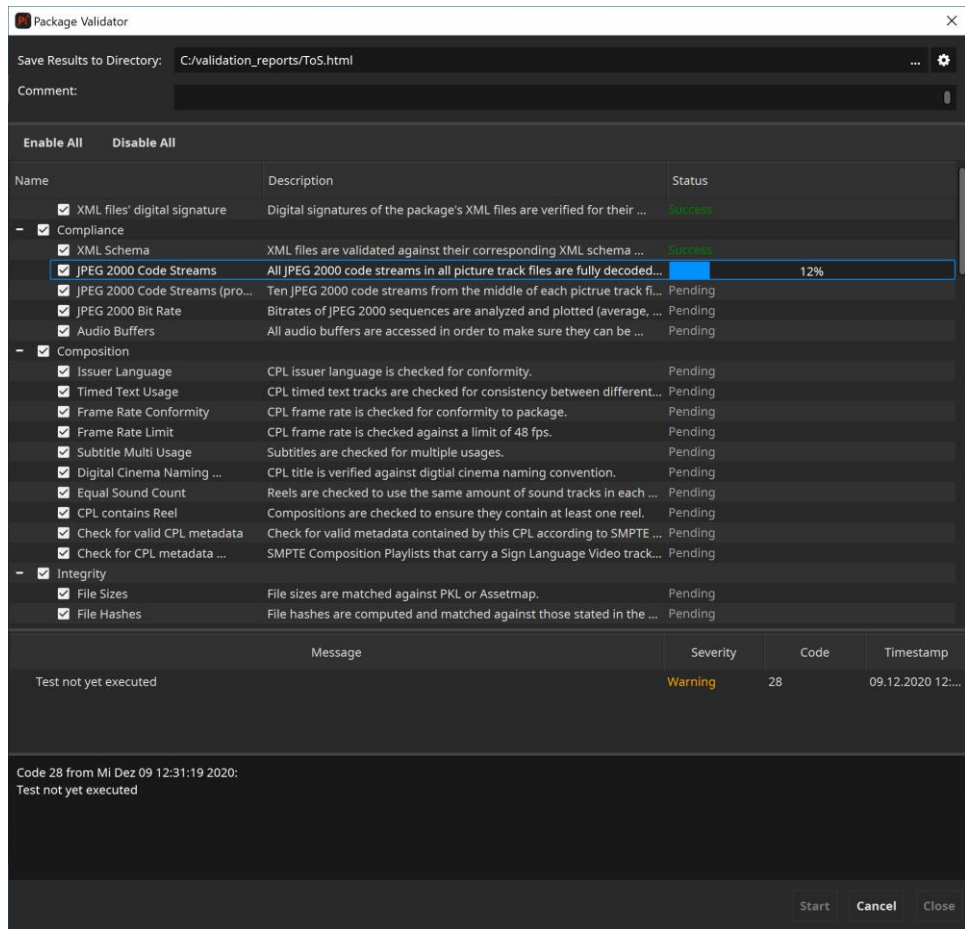
The package validation module was introduced with easyDCP Player+ 3.4.0. It can be used to automatically search for a range of potential issues in a DCP.

The validation is split up into many individual tests. Tests are executed one after the other. Some tests only take a split second (for instance: check if all files exist) while others may take a while (for instance: check if all JPEG 2000 images can be decoded).

Since easyDCP Player+ 3.5.0 it's additionally possible to validate supplemental packages (without the corresponding OV) and encrypted packages (without a corresponding KDM/easyDCP Digest).

Please be aware that only feasible tests will be executed. For example, if the VF references picture tracks from the OV, the JPEG 2000 codestream test will be skipped. The test will be skipped as well, when the KDM for decryption is not available.

Once a test was executed, it gives a result that is either **Success**, **Warning** or **Failed**. When selecting a test, more details can be found in the bottom section of the validation dialog. A tree of events will describe what the test has done and each entry in the tree can in turn be selected to see its details in the dark-grey text edit below. It is often not possible to foresee whether an issue will cause the DCP to be rejected by a cinema server or another tool in the production chain. For this reason we encourage the user to even take warnings seriously.



The result of a validation run is always stored as a report in HTML format. By default, the file will be named after the folder that contains the DCP and be located next to it. Also, the overall test result will be included in the file name:

```
DCP: C:\MyDcps\AliceWonder_FTR-1_S_EN-LAS_US-13_51_2K_DI_20060607_TDC_OV\
Report: C:\MyDcps\AliceWonder_FTR-1_S_EN-LAS_US-13_51_2K_DI_20060607_TDC_OV -
easyDCP Validation Report (Success).html
```

By clicking the cogwheel icon next to the “Save Results to Directory” field, the default behavior can be changed so that the file be located inside the DCP directory and/or that the overall validation result not be included in the filename.

```
DCP: C:\MyDcps\AliceWonder_FTR-1_S_EN-LAS_US-13_51_2K_DI_20060607_TDC_OV\
Report: C:\MyDcps\AliceWonder_FTR-1_S_EN-LAS_US-13_51_2K_DI_20060607_TDC_OV\
AliceWonder_FTR-1_S_EN-LAS_US-13_51_2K_DI_20060607_TDC_OV - easyDCP
Validation Report.html
```

The validation report is separated into six sections:

- **General Information** – contains top-level metadata on the package, the test result and the computer and easyDCP version where the

validation was carried out. Custom annotations that the user entered into the validation dialog's "comment" field will also be added to this section.

- **Composition Playlists** – lists technical properties (such as duration, resolution, package type, JPEG 2000 profile, audio layout, etc.) individually for each composition.
- **Quality Report** – contains all the test results and details in an interactive view
- **Recommendations** – in contrast to Quality Report, this interactive view contains results and details of all recommended test. The test results of these tests do not influence the global test result.
- **JPEG 2000 Bitrate Analysis** – contains an interactive plot of the bitrate in Mbit/s over time for each CPL. Additionally, some statistics such as peak and average bitrate or the time code of the largest frame are stated.
- **Files** – lists the content of each XML file as well as the metadata of each MXF file in the package. If the package is a supplemental package (version file - VF) and the original version (OV) was also loaded, both packages' files are listed.
- **Directory Snapshot** – lists of all files (including those that don't belong to the package) within the folder or any subfolders of the package, including the file's size in Bytes and date of its last modification. Paths are stated relative to the package's root folder so that names of the user's local or network repository are not disclosed.



**easyDCP Plus** Validation Report for "TearsOfSteel2K"

**General Information**

<b>Validation Result</b>	<b>Package Name</b>	TearsOfSteel2K	<b>Validated with</b>	easyDCP Player+ 4.0.0 (x64)
<b>Warning</b>	<b>Package Type</b>	Digital Cinema Package 2k	<b>Computer Name</b>	DESKTOP-96MSC8V
	<b>User Annotation</b>		<b>Operating System</b>	Windows 10 (10.0)
			<b>Validated on</b>	2020-12-09T13:34:11
			<b>Validation took</b>	00:00:01

Error: 0  
 Warning: 1  
 Recommendations: 1  
 Skipped (total): 34  
 Skipped (by user): 5  
 Encrypted: 0  
 Successful: 42  
 Total: 78

Validation result is "Warning", because 1 test was finished with "Warning" and 5 tests were skipped by user. There are 1 recommendations available.

**Composition Playlists**

- TearsOfSteel\_FTR-2D\_F\_51\_2K\_20170908\_IOP\_OV

**Quality Report**

- Recommendations
- JPEG 2000 Bitrate Analysis

**Files**

- 537d39f2-3236-439c-ad4f-556cf5c5230\_pcm.mxf
- 8ba45402-b127-4f2b-90de-3d4bea883dbd\_j2c.mxf
- ASSETMAP
- CPL\_7aa843ff-1516-45fb-83c7-f18d1da01c69.xml
- PKL\_c81e0d0a-3c5c-4a98-b8a7-95b9fcd6d010.xml

**Directory Snapshot**

Size (Bytes)	Modified	Path
634545014	2017-09-08T15:47:29	TearsOfSteel2K\537d39f2-3236-439c-ad4f-556cf5c5230_pcm.mxf
12761029079	2017-09-08T16:48:53	TearsOfSteel2K\8ba45402-b127-4f2b-90de-3d4bea883dbd_j2c.mxf
1569	2017-09-08T16:50:39	TearsOfSteel2K\ASSETMAP
10778	2017-09-08T16:50:39	TearsOfSteel2K\CPL_7aa843ff-1516-45fb-83c7-f18d1da01c69.xml
10811	2017-09-08T16:50:39	TearsOfSteel2K\PKL_c81e0d0a-3c5c-4a98-b8a7-95b9fcd6d010.xml
338	2017-09-08T16:50:39	TearsOfSteel2K\INDEX

The **overall result** of the validation is

- **Failed** – if at least one test found an error
- **Warning**, if at least one test found a warning or has been deliberately disabled by the user (by clicking the check box next to the test in the validation dialog), and no test found an error
- **Success** – if all tests were executed and none of them found any potential issues (warnings or errors)

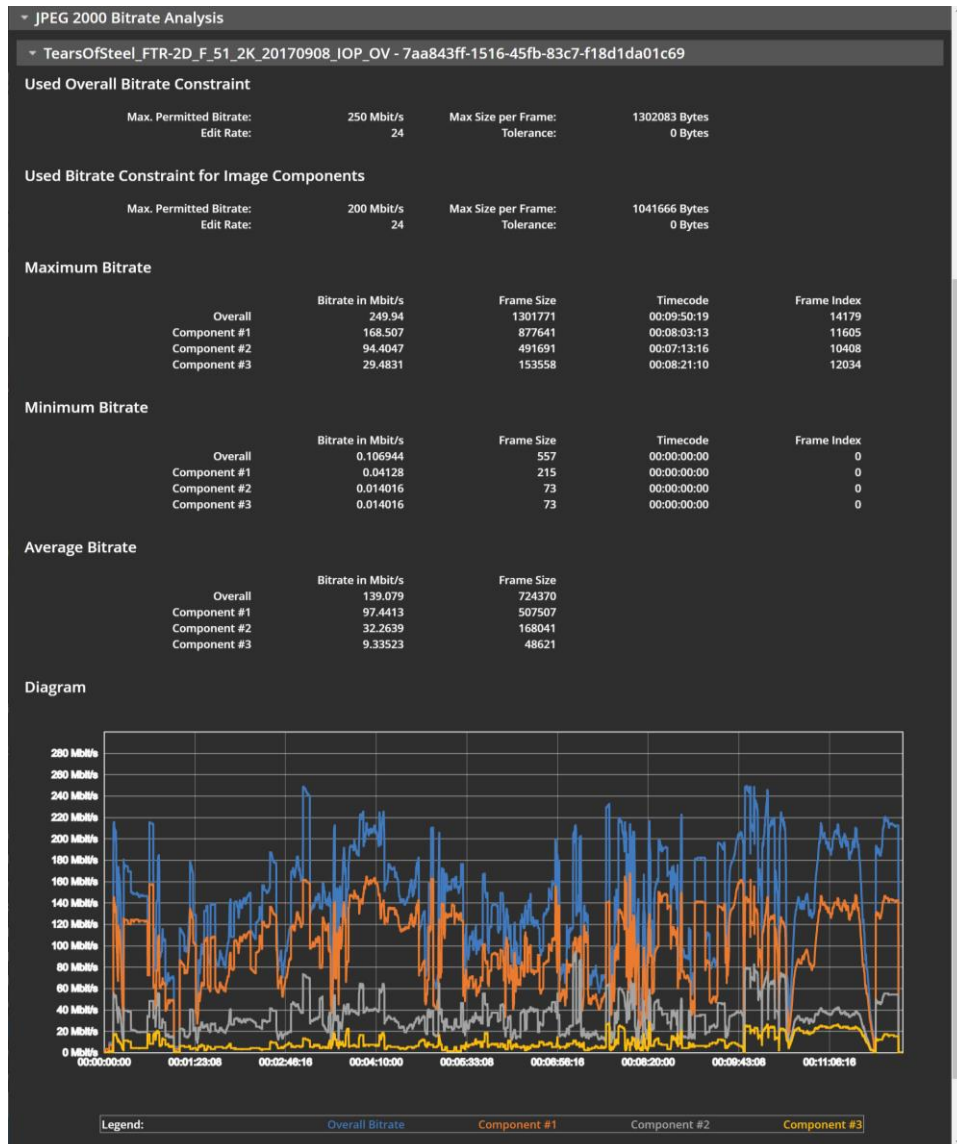
The quality report shows the results and details of all tests. When selecting a test, details are shown in the dark grey box on the bottom. In the below example, the test result is a warning, because the tests was deliberately disabled by the user by deselecting it before the start of the validation.

Quality Report			
Message	Severity	Code	Timestamp
- Validation result for "TearsOfSteel2K"	Warning	0	2020-12-09T13:39:38+00:00
+ Authenticity	Info	0	2020-12-09T13:39:38+00:00
- Compliance	Warning	0	2020-12-09T13:39:38+00:00
+ XML Schema	Info	0	2020-12-09T13:39:38+00:00
+ JPEG 2000 Code Streams	Info	0	2020-12-09T13:39:38+00:00
+ JPEG 2000 Code Streams (probe only)	Info	0	2020-12-09T13:39:38+00:00
+ JPEG 2000 Bit Rate	Info	0	2020-12-09T13:39:38+00:00
- Audio Buffers	Warning	0	2020-12-09T13:39:38+00:00
Test was disabled by user.	Warning	28	2020-12-09T13:36:11+00:00
+ Composition	Warning	0	2020-12-09T13:39:38+00:00
+ Integrity	Info	0	2020-12-09T13:39:38+00:00
+ Package	Info	0	2020-12-09T13:39:38+00:00
+ Reel	Info	0	2020-12-09T13:39:38+00:00
+ Sequence	Info	0	2020-12-09T13:39:38+00:00
+ Timed Text	Info	0	2020-12-09T13:39:38+00:00
+ Track	Info	0	2020-12-09T13:39:38+00:00
+ VirtualTrack	Info	0	2020-12-09T13:39:38+00:00
Warning code 28 from 2020-12-09T13:36:11+01:00: Test was disabled by user.			
Recommendations			

The **Bitrate Analysis** tab gives information on the JPEG 2000 bitrate. Every DCP is subject to a maximum bitrate that should never be exceeded. The maximum is typically 250 Mbit/s for DCPs, but can be higher for high-bitrate DCPs. The maximum bitrate is independent of the resolution or whether the movie is in 2D or 3D. easyDCP Player+ will infer the maximum bitrate based on the package type and JPEG 2000 profile. If the user knows that the maximum bitrate for a particular DCP has been assumed incorrectly (e.g. because it's a high bitrate DCP with up to 500 Mbit/s as opposed to just 250 Mbit/s), they can manually change it in the Playlist Editor.

JPEG 2000 is a highly data-dependent image compression scheme, though. If a particular image is easy to compress, e.g. because there are not a lot of details in it, then the maximum bitrate will not be reached. Only images with many details (or a lot of noise) will have to be capped in order not to exceed the data rate. The bitrate computed by easyDCP is based only on the size of the decrypted JPEG 2000 file (i.e. without MXF overhead) and is converted from bits to Megabits using  $10^3$  (1000) as demanded by the specifications - and not  $2^{10}$  (1024). For 250 Mbit/s DCPs, very minor bitrate violations in the range of 100 or 200 bytes are typically not a problem. For this reason, a tolerance can be configured in easyDCP Player+'s option pane for the CPU-based decoder.

The diagram plots the bitrate over the time for each CPL. The plot is zoomable via the mouse wheel.



The validation can also be triggered from the command line. This way it is also easy to batch-validate an existing collection of DCPs.

Below is an example of Windows Batch file for validating all DCPs in a given folder:

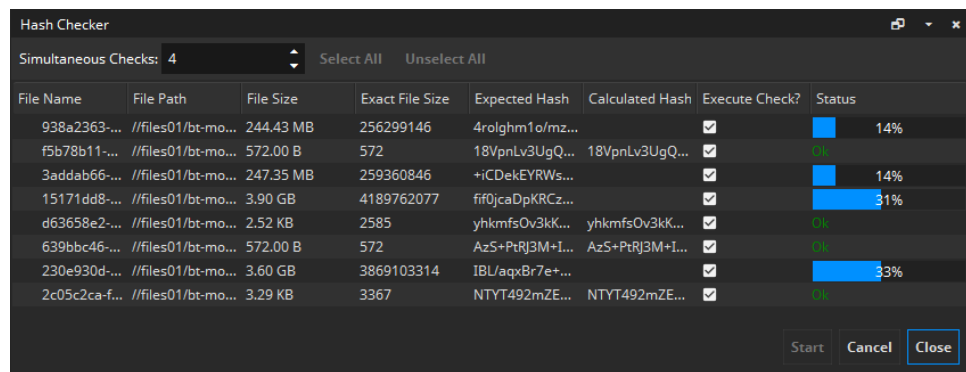
```
@echo off
pushd \\networkstorage\MyDcpRepository
set EasyDcpBin=C:\Program Files\Fraunhofer IIS\easyDCP Player+ 3.7.0\bin\easyDCP
Player.com

for /f "tokens=*" %%D in ('dir /S /B /A:-D assetmap*') do (
  echo Validating %%D
  echo.
  "%EasyDcpBin%" "%%D" -validate -o C:\\Reports
  echo.
)
popd
```

For more details on how to use easyDCP Player+ from the command line, please refer to chapter 11.

## 7.4 Hash Checker

When loading a package, easyDCP Player+ will validate file sizes of all files. However, it will only validate the XML files' hash values. A file hash validation of the remaining files in the package has to be manually triggered by the user since it takes too long to be done automatically, especially for large files. Before distributing a DCP, the hash values should be checked. To do this, it makes sense to load the package directly from the mobile hard drive. Select "Check File Hashes" in the context menu or press "H". If a package has been loaded, all asset files and their reference hash values will be listed. Click "Check Hashes" to start the hash value calculation. To make the hash check available for encrypted DCPs without requiring content keys to be loaded, the "Playlist Editor" Dialog also has a button that opens the "Check File Hashes" dialog.



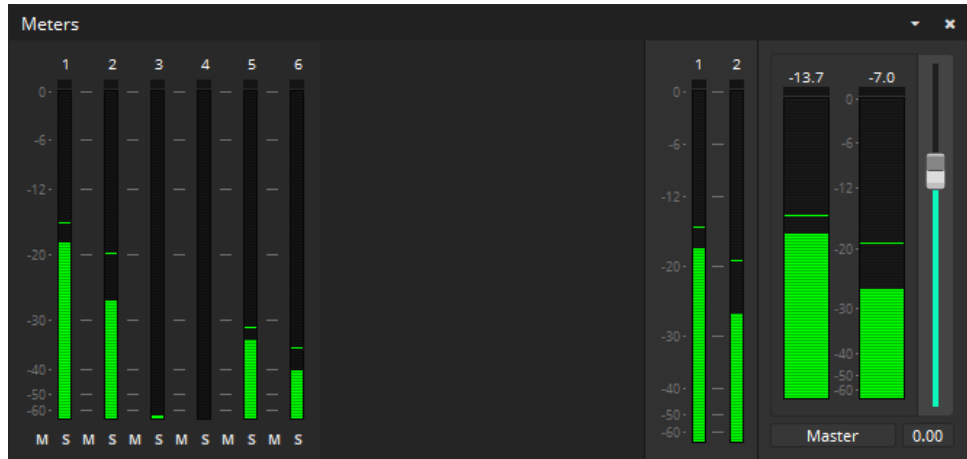
In order to calculate hash values for arbitrary other files, drag & drop the file into the "Hash Checker" dialog.

A hash value validation succeeds if the calculated hash value is identical to the reference hash value listed in the DCP. The "status" column will then display a green "Ok".

easyDCP Player+ also has a command-line parameter to perform the hash check. Please refer to chapter 10 for more information.

## 7.5 Audio Meters

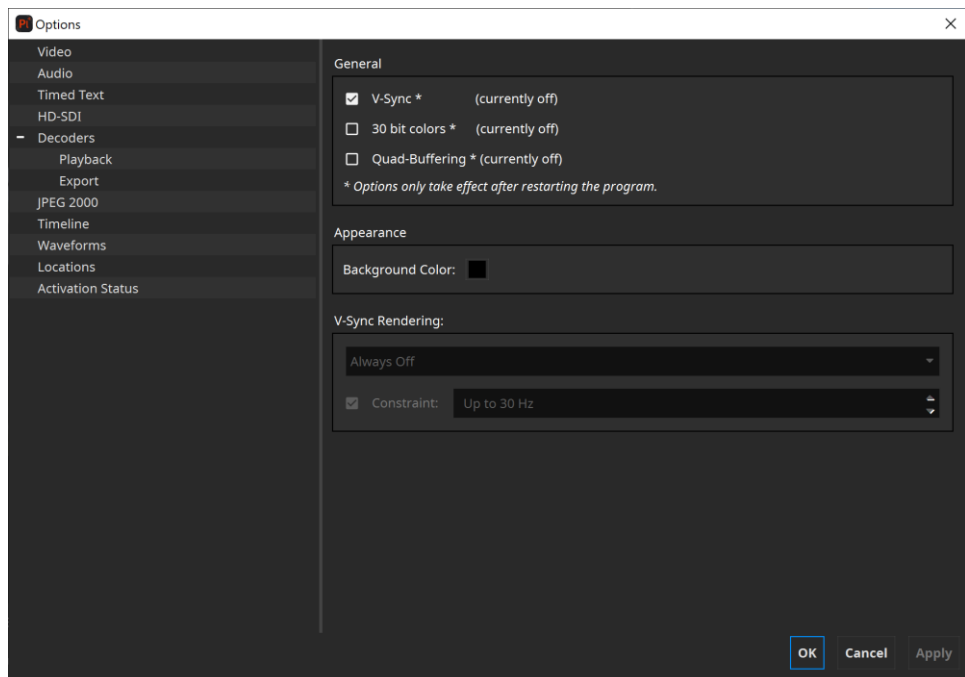
The audio meters module was introduced with easyDCP Player+ 3.6.0. It visualizes the audio processing of the currently opened asset by considering the configured input and output channel mapping (please refer to chapter 10) and the available channels of the currently configured audio output device.



## 8 Preferences

### 8.1 Video Rendering

easyDCP Player+ employs multiple advanced video rendering technologies, that are both platform and hardware dependent. The settings found in the options dialog's "video" pane merely influence if easyDCP Player+ requests these features. If they are actually available on the system can be seen in the easyDCP Player+ system info dialog (Press F10).



**Vertical Sync (V-Sync):** This option should only be enabled, if the video rendering suffers from tearing artifacts. Enabling V-Sync will typically negatively impact the render performance.

**30 bit colors (Windows only):** In order for this option to be available, both the graphics adapter and the display need to support it. Within easyDCP Player+, 30 bit rendering additionally needs to be enabled or disabled with the corresponding option in the "View" menu, e.g. "context menu -> View -> 30 bit Colors".

**Quad-Buffering:** Also, Mac OS X does not support Quad Buffering. Quad Buffering is available, if the graphics adapter supports it (e.g. NVIDIA Quadro® series) and stereo is activated in the driver settings. When active, left and right images of a stereo source are both passed at full resolution to the graphics driver. Within easyDCP Player+, Quad Buffering additionally needs to be enabled or disabled in the "2D/3D" menu, e.g. "context menu->2D/3D->Quad Buffering" or alternatively by pressing the corresponding button in the control bar.

**Background Color:** This button allows to pick a custom color for the video canvas in order to determine if an asset contains black pillar- or letter- boxes.

**V-Sync Rendering:** Since v3.0 easyDCP Player+ has two render modes: V-Sync-independent rendering and V-Sync-rendering.

V-Sync-independent rendering: This was the only option in all versions prior to v3.0. It is still a good choice if the display runs with 60 Hz or more. It is also the fallback option, if V-Sync rendering is not available or not enabled.

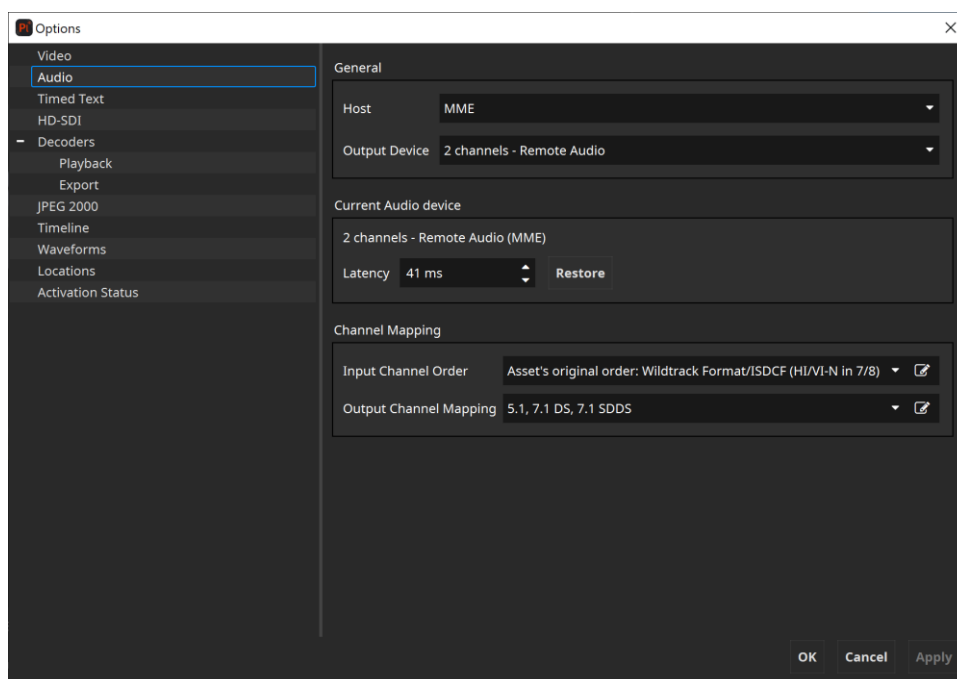
V-Sync-rendering: Especially, if the target display is a LCD-TV or a projector, or if the maximum refresh rate is significantly lower than 60 Hz (e.g. only 30 Hz), then the V-Sync rendering mode should be selected. It can be activated in Options -> Video -> V-Sync Rendering (only available if Options -> Video -> General -> Rendering -> V-Sync is "currently on"). Even if V-Sync was requested, the driver might not enable V-Sync due to other conflicting settings in the graphics driver control panel. When you start playback in V-Sync-Rendering mode, the package's frame rate as well as the display's refresh rate will be started in curly brackets next to the "Render" fps line (e.g. "Render (24 fps @ 24 Hz) in the statistics window. easyDCP Player+ will now explicitly translate between the package's frame rate and the display's refresh rate, which gives best results when both rates are equal or when the display's refresh rate is an even multiple of the package's frame rate.

When using two NVIDIA® graphics cards (e.g. one for rendering and one for decoding with CUDA®), it might be necessary to explicitly configure the graphics card that should be used for rendering: NVIDIA® Control Panel -> 3D Settings -> Manage 3D settings -> Global Settings -> OpenGL rendering GPU -> <select the graphics card that drives the display where easyDCP Player+'s canvas is located>.

This can make a significant difference in terms of render performance.

## 8.2 Audio Rendering

easyDCP Player+ supports multi-channel output. By default the audio output device that supports most channels will be selected. Open the audio options pane (context menu->Options->Audio tab) for a list of all available audio renderers. Supported interfaces are DirectSound (Windows), MME (Windows), ASIO (Windows) and CoreAudio (Mac OS X).



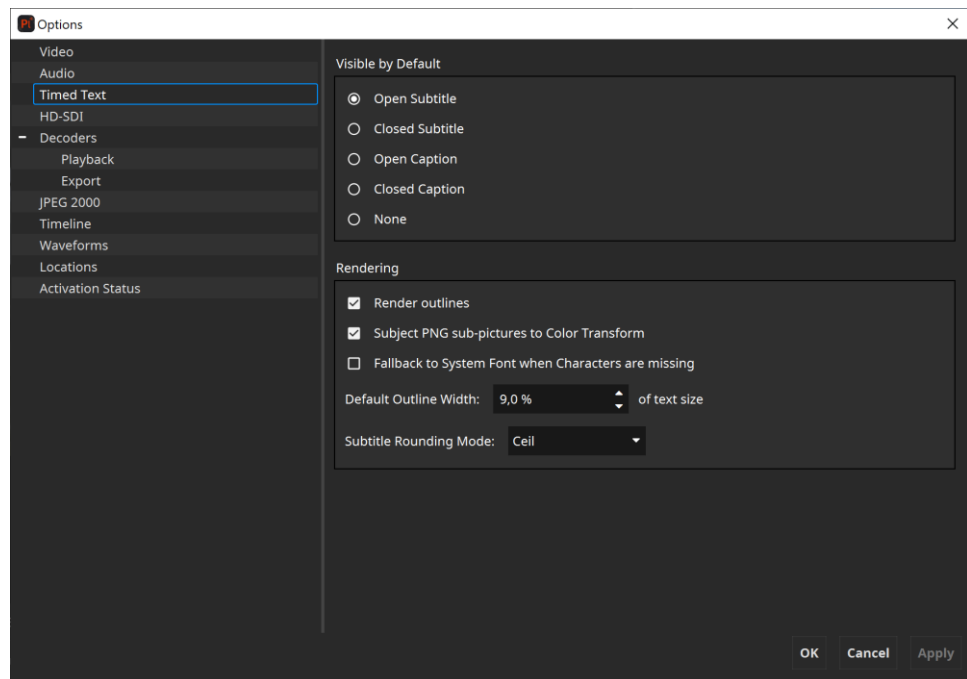
**Latency:** It is possible to specify a latency in milliseconds for each renderer. This latency will be taken into consideration when synchronizing audio and video frames. Changing the latency will take effect immediately, so it can be easily tweaked while simultaneously watching a test package. Except for HD-SDI output, the latency should normally be positive, i.e. video output will be slightly delayed to compensate for the latency introduced by the operating system's audio processing pipeline.

**Input Channel Order and Output Channel Mapping:** Since easyDCP Player+ 3.5.0 it's possible to configure the audio input channel order and output channel mapping via the graphical user interface. To do so select a preset from the existing list or click on the edit button next to "Input Channel Order" or "Output Channel Mapping" to define own presets. Please refer to chapter 10 for detailed information.

**Multichannel Audio on Apple Systems:** easyDCP Player+ does not support 5.1 Audio output using the optical audio ports usually found on Apple Computers. Instead, we recommend using the integrated HDMI port or an USB Sound Card.



## 8.3 Timed Text



**Default Visible Subtitles:** A composition may have one or more timed-text tracks. Select here which track shall be rendered.

**Subtitle Rendering:** On some systems, subtitle outlines are not anti-aliased. This effect is noticeable, when multisampling is not enabled. Whether or not multi-sampling is enabled can be seen in the easyDCP Player+ system info dialog (Press F10). On Windows, disabling "Allow 30 bit colors" and "Allow Quad-Buffering" might lead to multi-sampling becoming available. Alternatively, outlines can simply be ignored by disabling the option "**Render outlines**".

Servers behave differently, when it comes to rendering PNG sub-images. Toggling the option "**Subject PNG sub-pictures to Color Transform**" specifies if sub-images should also be included in a color transform, i.e. XYZ to RGB, or not.

**System Font Fallback:** If characters are missing in the loaded font and this option is enabled, missing characters will be replaced with characters from a similar font.

**Default Online Width:** The outline thickness for timed text is not defined in the specifications. With this setting, the default outline thickness can be configured and will be applied to new Timed Text Tracks.

This setting only affects the way timed text is rendered in easyDCP Player+. Unless timed text is burnt into the images, this setting will not affect how a cinema server renders the outlines.

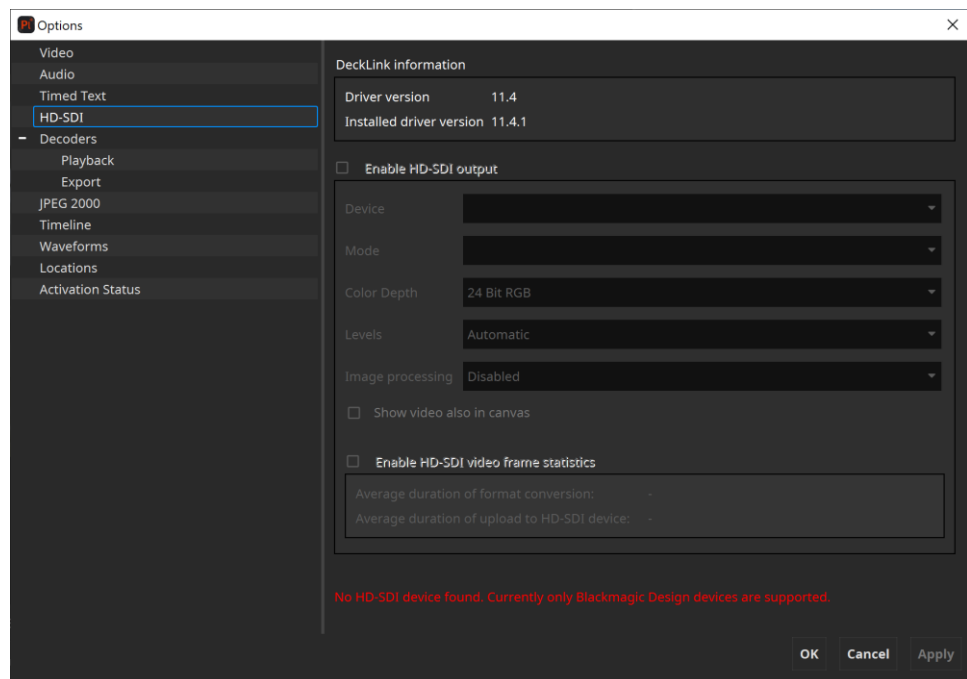
**Timed Text Rounding Mode:** The rounding mode influences in some cases at which exact frame index a subtitle appears or disappears.

This setting only affects the way timed text is rendered in easyDCP Player+. Unless timed text is burnt into the images, this setting will not affect how a cinema server renders the timed text.

**Show Forced Display only:** Displays only TTML-IMSC1 content elements where the computed value of tts:visibility is “visible”.

**Show Grid borders:** Displays a red line around all elements and corresponding boxes.

## 8.4 HD-SDI Play-out



**Enable HD-SDI output:** Since version 2.0, easyDCP Player+ is capable of playing out HD-SDI with the Blackmagic Design UltraStudio, DeckLink and Intensity series. Both, PCIe-connected cards and Thunderbolt-connected external devices are supported.

Thunderbolt devices will only be detected, if they are attached at the time easyDCP Player+ is started. When enabling HD-SDI output within easyDCP Player+, the audio output device should be "ASIO (<name of HD-SDI device>)" on Windows and "CoreAudio (<name of HD-SDI device>)" on Mac OS X, so that audio and video signals emitted via HD-SDI are in sync. ASIO drivers for Windows are available for download at [www.asio4all.com](http://www.asio4all.com). The audio latency should normally be negative.

Advanced HD-SDI related settings can be configured in the Blackmagic Design Control Panel.

**Mode:** Select a HD-SDI output mode. The frame rate is required to be identical to that of the currently playing package. When playing back multiple DCPs with different frame rates back to back, the HD-SDI output is not automatically adjusted. If the resolution is smaller than the package's resolution and "Enable subtitling, color-processing and scaling" is disabled, images will be cropped. On the other hand, if the resolution is larger and the processing option is disabled, images will be pillar-/letterboxed.

**Color Depth:** Sets the bits per component.

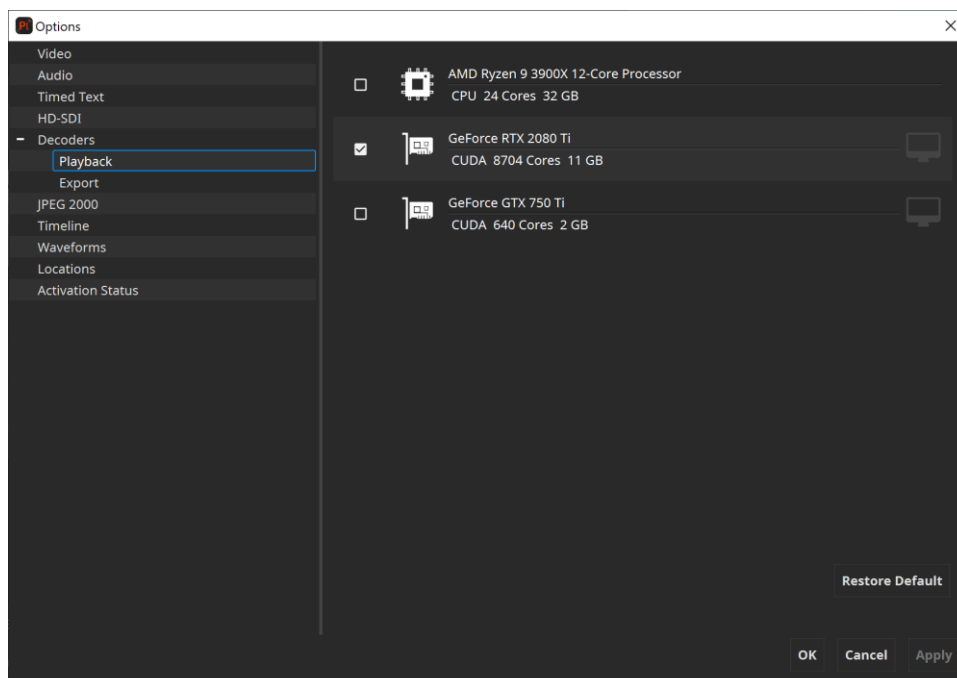
**Levels:** Select whether to apply a legal range conversion or not. "Automatic" will apply a conversion, if the output format requires it. Alternatively, you can select "Convert full-range to legal-range" to enforce the conversion or "No conversion" to always skip it.

**Image Processing:** If this option is set to OpenGL, images will be scaled to meet the currently set-up HD-SDI output resolution. Additionally, the currently selected color transform will be applied and subtitles will be rendered. This option has significant impact on the render performance. (Enable the statistics from "context menu->View->Show FPS stats")

**Show video also in canvas:** Displaying video in the main window while HD-SDI output is active will impact the render performance and might lead to stuttering. Enable this option with care. (Enable the statistics from "context menu->View->Show FPS stats")

**Enable HD-SDI video frame statistics:** This option should normally be disabled.

## 8.5 Decoders



Since easyDCP Player+ 3.5.0 it's possible to configure the devices, which should be used for playback and export, separately. All available devices will be listed under "Playback" and "Export". Refer to chapter 3 for more details on the system requirements.

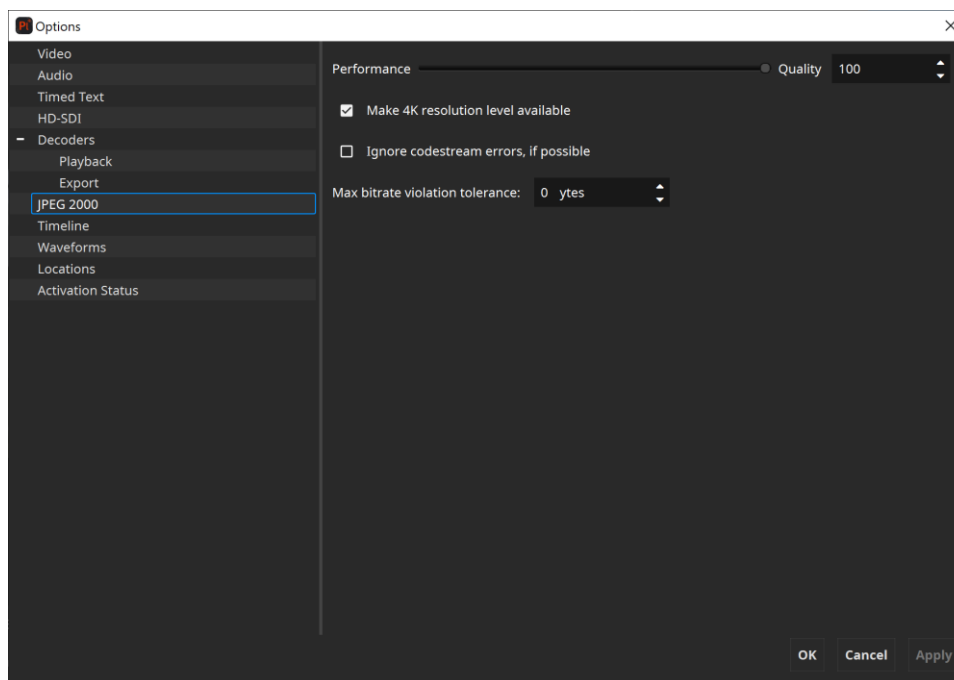
On most systems, easyDCP Player+ is able to automatically configure itself. For playback, it attempts to use only the secondary device's GPUs for JPEG 2000 decompression and ignore the primary GPU as it will be used for rendering. For export, all available GPUs will be selected.

If no GPUs are available that support the NVIDIA® CUDA® technology, the CPU will be used for decoding automatically.

If you play back a video asset with the GPU-based codec, hit 's' to display the performance statistics. The bottom line usually needs to read "GPU Decode (1x GPUs)" (unless the CUDA device has two cores like in the screenshot above. Then it should be "2x GPUs"). Do not enable a CUDA graphics card marked with "(connected to display)"

CUDA®-enabled decoders are only available in the Windows version.

## 8.6 JPEG 2000



**Performance vs. Quality trade-off:** Since version 2.0, easyDCP Player+ is capable of trading some decoding precision for a better performance. Especially, when viewing DCPs (which have 12 bit per color) on a regular 24 bit monitor, some information from the JPEG 2000 codestream can safely be ignored without significantly impacting the resulting image quality.

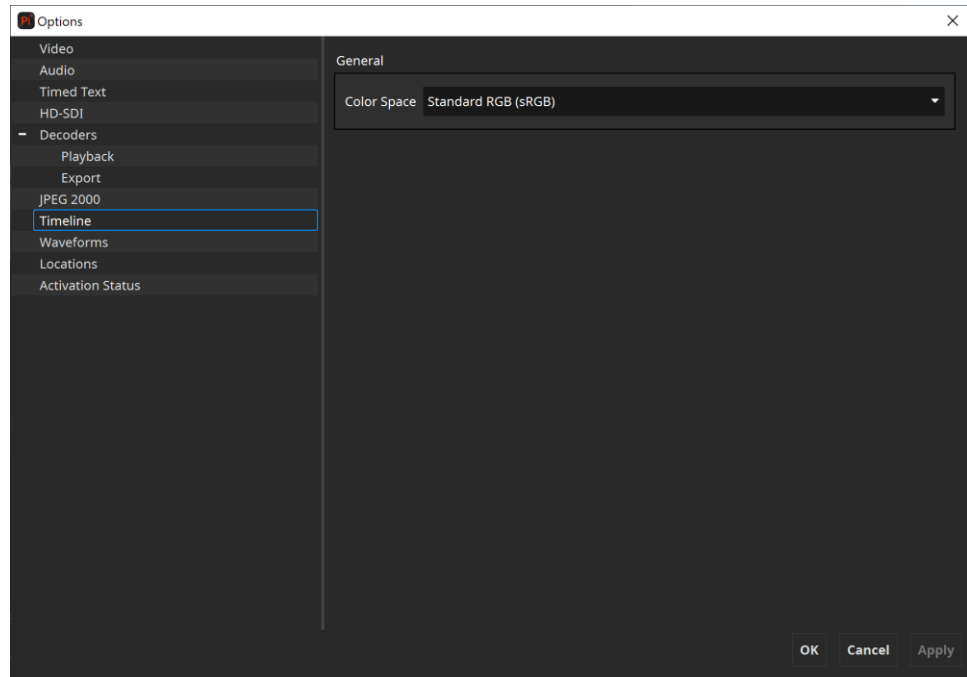
The algorithm is designed in a way that the trade-off does not have to be re-configured for every package. At a certain position, code streams from a DCP that contain so many details that they fully utilized the maximum available data rate might already be truncated. When subsequently loading a package that has only a low data rate, because it does not contain many details, the precision would not be impacted, however, because it has a low-rate to begin with. This is desirable, because the performance requirements for decoding a low-bitrate package is much lower, anyway.

**Make 4K resolution level available:** 4K assets can be loaded in a way that only a maximum resolution of 2K is available, mainly to save memory and lower the performance requirements. Since many displays are not capable of rendering 4K anyway and 4K playback has much higher demands on memory and hardware, only the 2K part of a 4K JPEG 2000 codestream is evaluated. A 4K DCP can also be opened in full resolution by enabling this option. Smooth playback requires much more hardware resources.

**Ignore codestream errors, if possible:** Being a software-quality tool, easyDCP Player+ aborts playback as soon as a corrupt JPEG 2000 codestream is encountered. This option controls the decoder's error resilience mode.

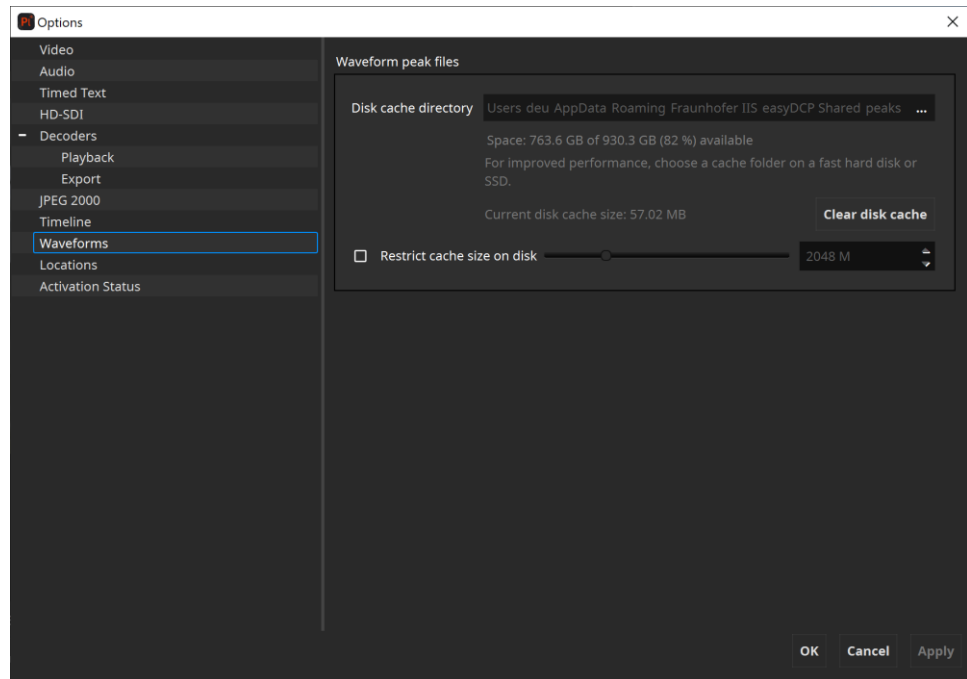
**Maximum bitrate violation tolerance:** Unless error resilience is enabled, easyDCP Player+ also checks if the limit is met. Some packages in the field slightly violate this limit by a few bytes, which does not seem to cause any playback issues on D-Cinema servers. To avoid warning messages in easyDCP Player+, the limit should be slightly raised. The default value is 0 bytes.

## 8.7 Timeline



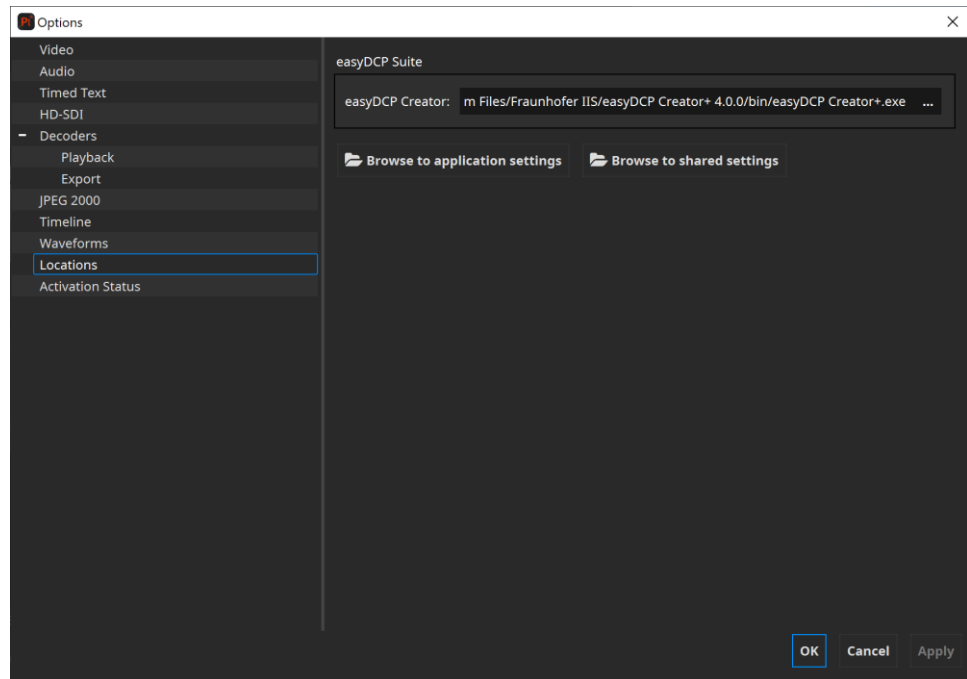
**Color Space:** Configures the target timeline color space which should be used for picture thumbnails. This option does not affect the selected target color space which is used for rendering in canvas.

## 8.8 Waveforms



When (re-)opening a package the timeline displays the waveform of all contained audio tracks. To speed up the waveform generation of an already opened package, easyDCP Player+ caches previously generated waveforms within a repository. Within this options pane the cache directory can be set, cleared and restricted to a certain size on disk.

## 8.9 Locations



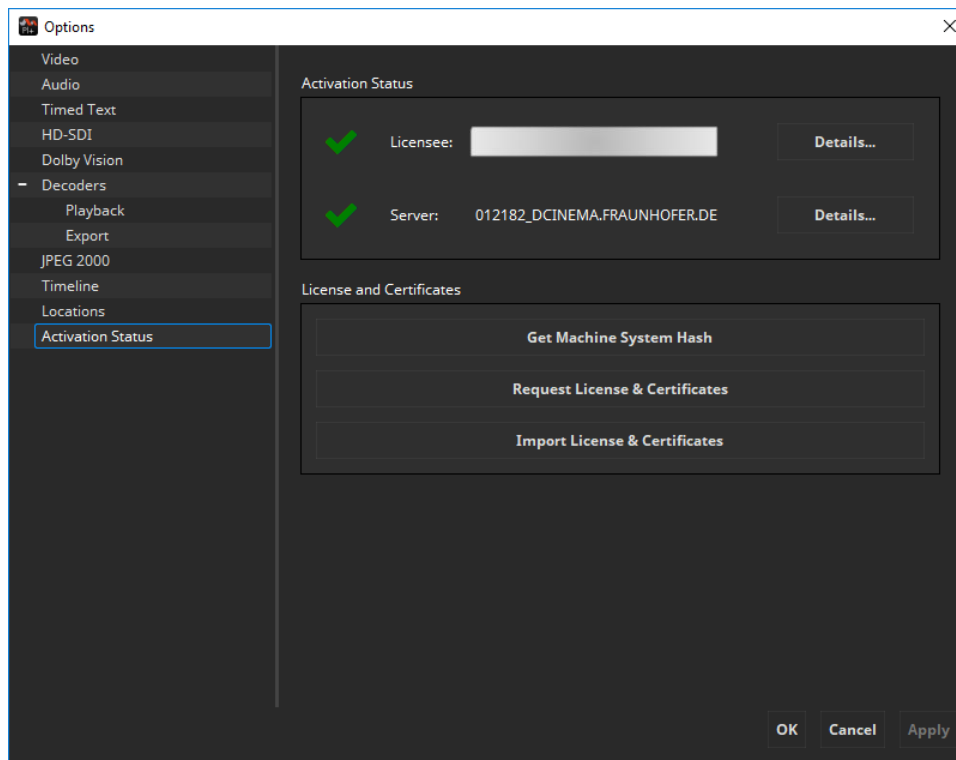
**easyDCP Creator:** Select which installed instance of easyDCP Creator should be used e.g. when an unwrapped DCP should be opened for further editing.

**Browse to application settings:** Opens the directory on disk where the application settings of easyDCP Player are stored.

**Browse to shared settings:** Opens the directory on disk where shared application settings of the easyDCP suite are stored.



## 8.10 Activation Status



Since easyDCP Player+ 3.6.0 all licensing related information and options are part of this options dialog view. It's possible to request or import a license & certificate set. Furthermore, information about the currently imported license and certificate set can be shown.

## 9 Content Decryption

### 9.1 Server Certificates

easyDCP Player+ allows playing back encrypted content. Each Digital Cinema play-out system or mastering station has its own private key and public key, and so does each easyDCP Player+ installation. The private key is known only to the play-out system, whereas the public key is contained in a public server certificate and may be distributed to content providers. When content providers choose to encrypt a DCP, they need to somehow provide the decryption keys (there is one key for every encrypted track file) to the play-out system. To ensure that no one else is able to read these sensitive decryption keys, they are themselves encrypted in a way that only the targeted play-out system is able to decrypt them. To do this, the content provider will need the play-out system's public server certificate. This encrypted message is called a Key Delivery Message (KDM). easyDCP Player+ will keep all ingested KDMs in a repository (key repository subfolder in easyDCP Player+ application data folder. See 4.3) so that encrypted DCPs can be viewed multiple times without having to re-ingest the keys each time. KDMs will not be removed from the repository after they expired, but an expired KDM will no longer grant access to the DCP.

When easyDCP Player+ is first started, it does not yet have a server certificate set. The demo edition does not allow playback of encrypted content. Only in the commercial edition, server certificates can be requested from Fraunhofer support by clicking "Request License & Certificates" within the "Activation Status" pane inside the options dialog. The process is described in a screen cast at [www.easydcp.com](http://www.easydcp.com).

Unique private and public keys will be generated and provided to you online. The received license and certificate set (a Zip file) can be imported via drag & drop (or within the options dialog, "Activation Status" with „Import License & Certificates“).

The certificates are created and signed by Fraunhofer IIS. Fraunhofer IIS will delete the private key immediately, and keep the public leaf certificate in a database. The certificate is digitally signed by a chain of Fraunhofer certificates. These certificates are referred to as a certificate chain and this certificate chain, even though already included in the public server certificate, is additionally saved in a separate file. These certificates are meant for commercial use as they state the licensee's URL and have a unique serial number that links the certificates to the license. These server certificates are tied to the licensee's computer, using the easyDCP system hash. If the license should need to be migrated to another system, a new certificate set will have to be requested. A migration is possible in the user account at [www.easydcp.com](http://www.easydcp.com). Since the private key is very sensitive, it is asynchronously encrypted using a combination

of easyDCP Player+ internal keys and a password selected by the user during the License & Certificates request. Likewise, if the user chooses to store their password, it is first asynchronously encrypted. The user password needs to have 6 to 20 letters and **cannot be changed after it was created**.

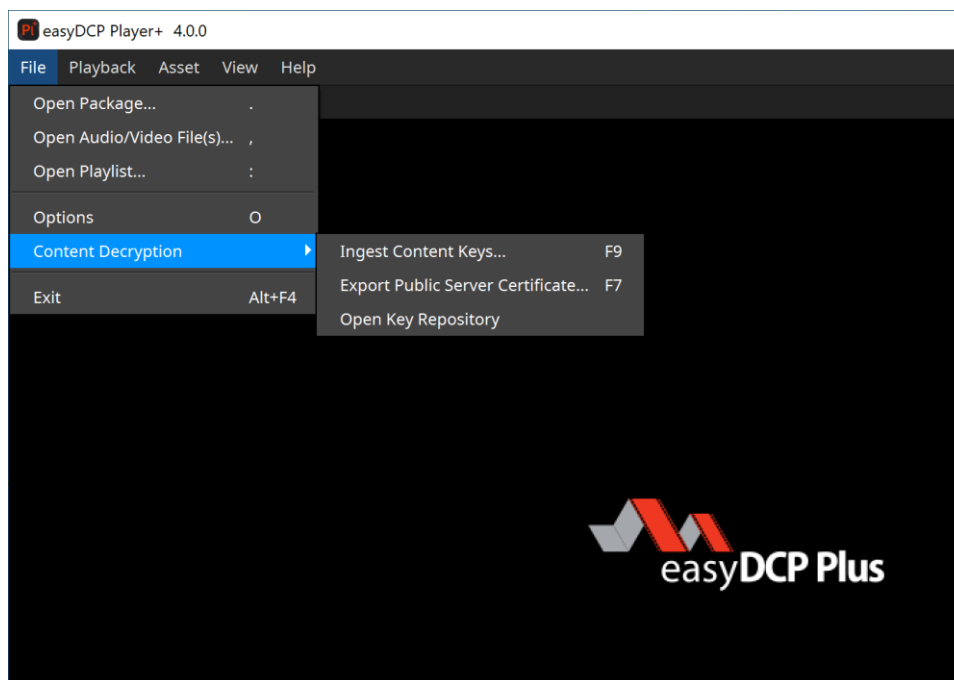
All mentioned files are stored in the user application data folder's certificates subfolder (see 4.3). Hence, the OS user management can be used to maintain multiple sets of certificates simultaneously. In order to easily determine which files belong together, they are each identified by a unique ID. The ID of the set that is currently used by easyDCP Player+ is also listed in the "About" dialog (hit 'F6').

- easydcpexport\_<ID>.privkey.pem contains the encrypted private key
- easydcpexport\_<ID>.cert.sha256.crt is the public server certificate
- easydcpexport\_<ID>.chain.sha256.pem contains the certificate chain
- easydcpexport\_<\_<ID>.privkey.passwd contains the encrypted user password

When easyDCP Player+ is uninstalled, none of these files will be removed. If the user password file (\*.passwd) is manually deleted, the user will simply be prompted for the password again the next time a KDM is ingested or an encrypted DCP is opened.

On demand, we can also offer the easyDCP Player+ NE edition, where "NE" stands for "No Export". It contains all the features of easyDCP Player+ except for the export. Its certificate prefix (stated in the filename as well as in the certificate itself) is "easydcpnoexport\_" as opposed to "easydcpexport\_". This way, content owners easily distinguish which edition they issue a KDM for.

## 9.2 KDM Management



“Ingest Content Keys” pops up a file browser and lets you ingest content key files (Key Delivery Message or easyDCP Digest).

**Drag & Drop:** You can also ingest multiple Key Delivery Messages (KDM) or easyDCP Digests by simply dragging & dropping them onto the canvas.

The option “Export Public Server Certificate” will copy both the public leaf certificate (easydcpexport\_<id>.cert.sha256.crt) and the signature chain (easydcpexport\_<id>.chain.sha256.pem) to the selected folder. The signature chain contains the leaf certificate as well as intermediate certificates and the root certificate. You may safely distribute these certificates to content providers who want to issue a Distribution KDM to your easyDCP Player+ installation. When issuing (D)KDMs with easyDCP KDM Generator, place only the leaf certificate file (\*.crt) into the server certificate’s folder or just drag and drop it into the corresponding input form.

For a description of how to request your custom certificates, please refer to chapter 4.2. For more details on the decryption workflow, please refer to chapter 9.

The option “Open Key Repository” opens the key repository in a Windows Explorer / Finder window. All ingested Key Delivery Messages (\*.xml, \*.kdm) and easyDCP Digests (\*.dcpdig) will be stored in this folder and renamed according to the contained CPL UUID (digests with keys for multiple CPLs are

duplicated). Expired key files can be deleted from here manually when easyDCP Player+ is not running.

## 10 Audio Routing

Different mechanisms are used to identify audio channels carried in MXF Sound Track Files within Digital Cinema Packages (DCP). Playback systems rely on such information for eventually outputting sound to connected loudspeaker setups.

This chapter describes configuration options for easyDCP Player+ and explains routing mechanisms for different package types.

### 10.1 Audio Channel Identification

#### 10.1.1 Interop DCPs

Interop DCPs usually don't carry explicit audio channel configuration information. The Inter-Society Digital Cinema Forum (ISDCF) recommends the channel layout specified in Table 1. Theater operators rely on the optional use of the Digital Cinema Naming Convention [5] in order to identify the channel layout correctly. See [8] for more details.

Table 1 - Recommended Audio Channel Assignments for Interop DCPs

Channel	5.1	7.1 SDDS	7.1 DS	Speaker Position
1	L	L	L	Left
2	R	R	R	Right
3	C	C	C	Center
4	LFE	LFE	LFE	Low Frequency Effects
5	Ls	Ls	Lss	Left Surround (Left Side Surround)
6	Rs	Rs	Rss	Right Surround (Right Side Surround)
7	HI			Hearing impaired (with emphasis on dialog)
8	VI-N			Visually impaired narrative (audio description)
9	-	Lc	-	Left center
10	-	Rc	-	Right center
11	-	-	Lrs	Left rear surround
12	-	-	Rrs	Right rear surround
13	Motion Data			Synchronous signal (e.g. used by D-Box)
14	Sync Signal			Used for external sync – not used for Interop DCP
15	-			Unused
16	-			Unused

## 10.1.2 SMPTE DCPs

Most of today's SMPTE DCPs use an audio channel assignment label in the Sound Track File metadata to identify the audio channel order in the file. SMPTE ST 429-2 [1] describes five different configurations, which can be identified by the associated label:

1. 5.1 + HI/VI-N
2. 6.1 + HI/VI-N
3. 7.1 SDDS Layout + HI/VI-N
4. 16 Channels "Wild Track Format" (WTF)
5. 7.1 DS Layout + HI/VI-N

Table 2 - Standard Audio Channel Assignments for SMPTE DCPs

Channel	5.1 + HI/VI-N	6.1 + HI/VI-N	7.1 SDDS + HI/VI-N	Wild Track Format	7.1 DS + HI/VI-N
1	L	L	L	CH1	L
2	R	R	R	CH2	R
3	C	C	C	CH3	C
4	LFE	LFE	LFE	CH4	LFE
5	Ls	Ls	Ls	CH5	Ls
6	Rs	Rs	Rs	CH6	Rs
7	HI	Cs	Lc	CH7	Lrs
8	VI-N	not used	Rc	CH8	Rrs
9	-	HI	HI	CH9	HI
10	-	VI-N	VI-N	CH10	VI-N
11	-	-	-	CH11	-
12	-	-	-	CH12	-
13	-	-	-	CH13	-
14	-	-	-	CH14	-
15	-	-	-	CH15	-
16	-	-	-	CH16	-

Of course, not all DCPs actually contain HI and/or VI-N channels. Whether these channels are present can be determined by checking the channel count, which is also indicated in the Sound Track File metadata. For example, config #1 (5.1 + HI/VI-N) combined with a channel count of "6", indicates that no HI/VI-N channels are present in the corresponding Track File. That being said, some facilities add silent channels for missing HI/VI-N channels, which makes it difficult to determine whether useful HI/VI-N channels are present, or not.

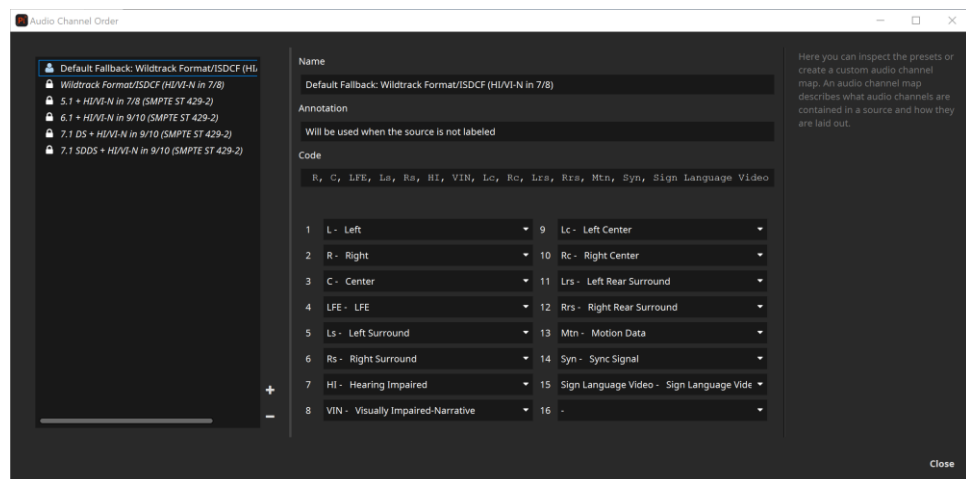
DCPs containing Dolby Atmos® [6] Sound Tracks require a sync signal added to the "traditional" 5.1 / 7.1 Sound Track File. Since such a channel can only be included in channel assignment #4 (WTF), the content of the remaining audio channels present in this Sound Track File remains unclear.

The 2013 version of SMPTE ST 429-2 [2] adds support for Multi-Channel Audio (MCA) Labeling, which is defined in SMPTE ST 377-4 [3]. Sound Track Files using this, contain a number of SubDescriptors in the Wave Audio Essence Descriptor. These SubDescriptors, besides other things, identify and describe every audio channel present in the MXF file and leave no room for ambiguity.

SMPTE 429-16 [4] defines a way to carry additional (machine-readable) metadata in CPLs. Besides other things, sound configurations can be stored for Sound Track Files that are referenced by the CPL in that metadata. While the standard document was released in 2014, hardly any DCPs in the field include this metadata as of today.

## 10.2 Configuration and output behavior

Within the audio channel order dialog (Options -> Audio -> Edit button next to Input Channel Order selection) audio channel maps can be defined. An audio channel map describes, what audio channels are contained in a source and how they are laid out. The audio input channel order is retrieved from the input MXF Sound Track File, if possible. If the audio channels are not labeled in the Track File at all, a default channel order is used.

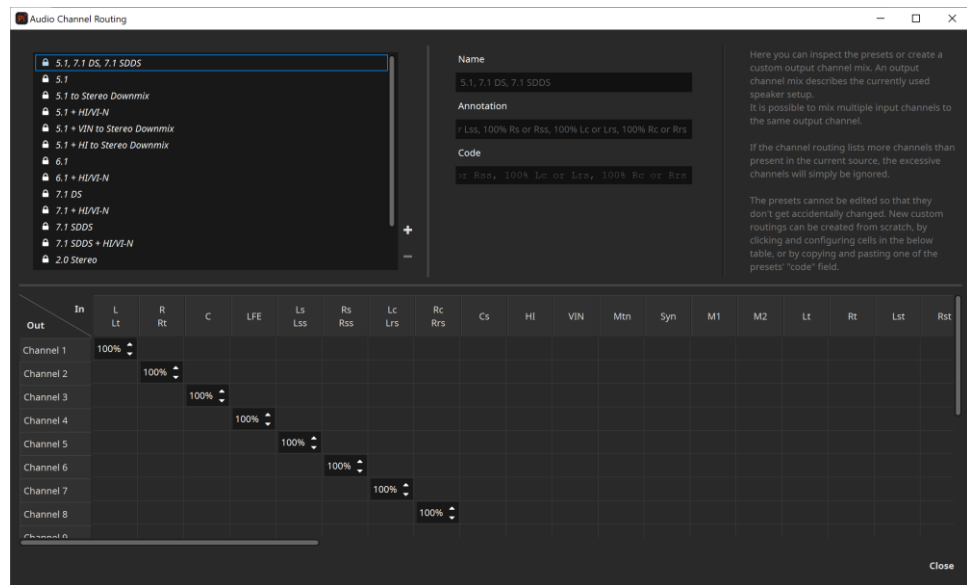



By default, several presets are available. For example “Wildtrack Format/ISDCF (HI/VI-N in 7/8)”, which is the most widely used format for Interop and SMPTE DCPs. New custom presets can be created from scratch by clicking and configuring the channels, or by copying and pasting one of the presets' “code”. The presets tagged with a lock cannot be edited, so that they don't get accidentally changed.



## Output Channel Mapping

Within the audio channel routing dialog (Options -> Audio -> Edit button next to Output Channel Mapping selection) the audio channel mix can be defined. An output channel mix describes the currently used speaker setup. It's possible to mix multiple input channels (in the screenshot below the header of the table) to the same output channel (e.g. 5.1 to Stereo Downmix, in the screenshot below the first column of the table). Optionally, an entire routing can be set to lossless. In this case the volume setting takes no effect. Additionally only a single input channel can be assigned to an output channel. If the channel routing lists more channels than present in the current source, the excessive channels will simply be ignored.



By default, several presets are available. New custom presets can be created from scratch by clicking  and configuring cells in the table below, or by copying and pasting one of the presets' "code" field. The presets tagged with a lock cannot be edited, so that they don't get accidentally changed.

The available audio channel symbols are listed in the following table:

Table 3 - Audio channel symbols

Symbol	Description	Package Type
L	Left	DCP
R	Right	DCP
C	Center	DCP
LFE	Low Frequency Effects	DCP
Ls	Left Surround	DCP
Rs	Right Surround	DCP
Lss	Left Side Surround	DCP
Rss	Right Side Surround	DCP
Lrs	Left Rear Surround	DCP
Rrs	Right Rear Surround	DCP
Lc	Left Center	DCP
Rc	Right Center	DCP
Cs	Center Surround	DCP
HI	Hearing Impaired	DCP
VIN	Visually Impaired Narrative	DCP

### 10.3 Behavior

If a Sound Track Files signals an audio channel configuration, this configuration is taken into account. If not, the configured Input Channel Order is used.

The output channel configuration is taken from the selected output channel mapping accordingly. If the number of channels exceeds the number of channels actually supported by the selected output device (e.g. soundcard), all channels exceeding this count remain unused.

If a package contains channels, for which there is no output channel configured, these channels are ignored and not played out. If no Lt/Rt output channels are specified, they are routed to the L/R output channels (if present).

## 10.4 Configuration and output examples

### 10.4.1 Using a standard 2.0/5.1 speaker setup

For this setup the already available presets should be sufficient. For input channel order choose the preset "Default Fallback: Wildtrack Format/ISDCF (HI/VI-N in 7/8)". For output channel mapping use "5.1 to Stereo Downmix" or "5.1".

The DCP Sound Track File contains the audio channel assignment label #4, which indicates "Wild Track Format". Since this configuration does not specify a discrete channel layout, the preset will be used for the number of channels present in the Sound Track File.

The input channels are then routed to the matching output channels, as specified in the output channel mapping preset.

### 10.4.2 Fixing swapped channels

Let's assume the Center channel and the LFE channel are mixed up in your output device. In that case, a new output channel mapping preset has to be created, based on the already existing one "5.1, 7.1 DS, 7.1 SDDS".

Original preset "5.1, 7.1 DS, 7.1 SDDS":

Out \ In	L Lt	R Rt	C	LFE	Ls Lss	Rs Rss	Lc Lrs	Rc Rrs
Channel 1	100%							
Channel 2		100%						
Channel 3			100%					
Channel 4				100%				
Channel 5					100%			
Channel 6						100%		
Channel 7							100%	
Channel 8								100%

New preset, where Center and LFE Channel are swapped:

Out \ In	L Lt	R Rt	C	LFE	Ls Lss	Rs Rss	Lc Lrs	Rc Rrs
Channel 1	100%							
Channel 2		100%						
Channel 3			100%					
Channel 4				100%				
Channel 5					100%			
Channel 6						100%		
Channel 7							100%	
Channel 8								100%

## 11 Command-Line Interface (CLI)

easyDCP Player+ can be used on the command line to perform a hash-check on a package. Additionally all options required to export or validate a package are available. For detailed descriptions of the available parameters, call the executable file with the parameter “-help”.

```
C:\Program Files\Fraunhofer IIS\easyDCP Player+ 4.0.0\bin>"easyDCP
Player+.com" -h

easyDCP Player+ 4.0.0 rev.104718

Usage: "C:/Program Files/Fraunhofer IIS/easyDCP Player+ 4.0.0/bin/easyDCP Player+.exe"
<source>

    A source can be the path to a DCP directory, CPL,
    Assetmap, easyDCP project file, QuickTime, MXF, J2C,
    any other supported still image, WAV file or M3U Playlist.
    Individual audio and video sources need to be separated with a space.
    When a KDM or digest is required to load the source, just provide it separated by a
    space.

Login parameters:
-username          Login username - optional if already stored
-password         Login password - optional if already stored

Optional parameters:
-stats            <statsfile.csv>
                 Write fps performance statistics to a file.
-log             <logfile>|CONSOLE
                 Enable log and write it to a file or the console
-hashCheck       Only perform a hash check

Playback options:
-play            Start playback immediately
-quitAfterPlayback Close the player after end of first asset is reached
-quality        <0 to 100>
                 specifies the quality for JPEG 2000 playback

Device management:
Select which devices should be used for playback or export
-deviceCpuOnly   Use only CPU for decoding
-deviceGpuOnly  Use most powerful GPU for decoding
                 For playback the most powerful GPU will be used, which
                 doesn't have a monitor attached
-deviceId       <device ID>
                 Use specific GPU, identified by device id

CUDA devices:
[1] [CUDA] "GeForce RTX 2080 Ti" (cc7.5, 68 x 128 processors, 11264 MB)
[2] [CUDA] "GeForce GTX 750 Ti" (cc5.0, 5 x 128 processors, 2048 MB)

Export parameters:

Attention:
In case an IMF package containing Dolby Vision metadata should be exported,
all color transform related parameters will be ignored.

--exportDirectory|-o <path to export directory>
    Sets the export directory. The directory has to exist.

[--exportType|-t Project|Sequence|Reel]
    Select export type:
        Unwrap easyDCP project
        Export a frame sequence
        Export reels

[--exportFilePrefixMode|-pm CplTitle|PklTitle|Custom]
    Specify which file prefix should be used for export.
    "Custom" can be used in combination with -p.
```

```

[--exportFilePrefix|-p <export file prefix>]
    Specify file prefix, e.g. "image_".
    Options:
        %1    Current date (yyyy-MM-dd)
        %2    CPL Title
        %3    PKL Title

[--exportVideo|-v DPX|TIFF|J2C|MOV|MP4]
    Select image file format for export sequence.

[--exportAudio|-a MultichannelWAV|WAV|MOV|MP4]
    Select audio file format for export sequence.

[--exportAudioOutputRouting|-aor]
    Set the audio output routing preset
    "5.1, 7.1 DS, 7.1 SDDS"
    "5.1"
    "5.1 to Stereo Downmix"
    "5.1 + HI/VI-N"
    "5.1 + VIN to Stereo Downmix"
    "5.1 + HI to Stereo Downmix"
    "6.1"
    "6.1 + HI/VI-N"
    "7.1 DS"
    "7.1 + HI/VI-N"
    "7.1 SDDS"
    "7.1 SDDS + HI/VI-N"
    "2.0 Stereo"
    "Lossless passthrough"
    "HI on all channels"
    "VI-N on all channels"

[--exportStartIndex|-from]
    Set start of sequence, 0 is the default.

[--exportStopIndex|-to]
    Set end of sequence, the last frame is the default.

[--exportStereoMode|-c left|right|leftandright]
    Select export channel for stereoscopic 3D assets.

[--exportRlvl|-rlvl]
    Set number of resolution levels to be discarded.
    Default is 0 for full resolution.

[--exportColorDepth|-bps 8|10|12|16]
    Select color depth 8, 10, 12 or 16. Default is the original color depth
    of the video asset.

[--exportColorTransformation|-ct]
    Set the color transformation XML preset to use.
    Default is no color transformation.
    "Brighter for Shutter Glasses"
    "X'Y'Z' -> R'G'B' (P3)"
    "X'Y'Z' -> R'G'B' (Rec BT.709)"
    "X'Y'Z' -> R'G'B' (Rec BT.709) (Brighter for Shutter Glasses)"
    "X'Y'Z' -> R'G'B' Legal Range (Rec BT.709)"
    "Y'Cb'Cr' Legal Range -> R'G'B' Full Range (Rec BT.709)"

[--exportSourceColorSpace|-ss]
    Set the input source color space. If a destination
    space is selected, a color transformation will be applied.
    "Eclair Color"
    "RGB (ITU-R BT.709 Full-Range)"
    "RGB (ITU-R BT.709)"
    "RGB P3 (D65)"
    "RGB P3 (DCI)"
    "Standard RGB (sRGB)"
    "XYZ (DCI)"
    "YCbCr (ITU-R BT.709)"

[--exportDestinationColorSpace|-ds]
    Set the desired output color space. If an input
    space is selected, a color transformation will be applied.
    "Eclair Color"
    "RGB (ITU-R BT.709 Full-Range)"
    "RGB (ITU-R BT.709)"
    "RGB P3 (D65)"
    "RGB P3 (DCI)"
    "Standard RGB (sRGB)"

```

```

    "XYZ (DCI)"
    "YCbCr (ITU-R BT.709)"

[--exportDolbyVisionTargetDisplayId|-dovitgtdsplyid]
    Specifies the target display, identified by id,
    to which the image should be mapped to

[--exportVideoBitrate|-b]
    Set the desired average video bitrate in kbit/s.

[--exportScaleX|-scaleX <width in pixels>]
    Set scaled width in pixels. If aspect ratio is different,
    the remaining pixels will be letterboxed.

[--exportScaleY|-scaleY <height in pixels>]
    Set scaled height in pixels. If aspect ratio is different,
    the remaining pixels will be letterboxed.

[--exportFourCC|-fourcc <FourCC>]
    Set one of the following FourCC codes for MOV, MP4 video export:

    Available codecs for container "MOV":
    "mpeg1video" (MPEG-1 video)
    "mpeg2video" (MPEG-2 video)
    "mpeg4" (MPEG-4 part 2)
    "dnxhd" (VC3/DNxHD)
    "prores" (Apple ProRes)
    "h264" (H264)

    Available codecs for container "MP4":
    "mpeg1video" (MPEG-1 video)
    "mpeg2video" (MPEG-2 video)
    "mpeg4" (MPEG-4 part 2)
    "h264" (H264)

[--exportVideoOutputProfile|-videooutputprofile <Profile>]
    Set one of the following profiles when using Apple Prores or H264 codec for video
    export:

    Available profiles for Apple ProRes:
    "apco" (Apple ProRes 422 Proxy)
    "apcs" (Apple ProRes 422 LT)
    "apcn" (Apple ProRes 422)
    "apch" (Apple ProRes 422 HQ)
    "ap4h" (Apple ProRes 4444)
    "ap4x" (Apple ProRes 4444 XQ)

    Available profiles for H264:
    "baseline" (H264 Baseline)

[--exportAudioFourCC|-audiofourcc <FourCC>]
    Set one of the following FourCC codes for MOV, MP4 audio export:

    Available codecs for container "MOV":
    "aac" (AAC (Advanced Audio Coding))
    "alac" (ALAC (Apple Lossless Audio Codec))
    "pcm_s16le" (PCM signed 16-bit little-endian)
    "pcm_s16be" (PCM signed 16-bit big-endian)
    "pcm_s32le" (PCM signed 32-bit little-endian)
    "pcm_s32be" (PCM signed 32-bit big-endian)
    "pcm_s24le" (PCM signed 24-bit little-endian)
    "pcm_s24be" (PCM signed 24-bit big-endian)
    "pcm_f32be" (PCM 32-bit floating point big-endian)
    "pcm_f32le" (PCM 32-bit floating point little-endian)

    Available codecs for container "MP4":
    "aac" (AAC (Advanced Audio Coding))

[--exportBurnInSubtitles|-burnsub]
    Burn in subtitles.

[--exportBurnInSubtitlesVOffset|-burnsubvoffs] <offset 0-100>
    Set additional vertical offset from bottom in procent 0-100.

[--exportBurnInSubtitlesType|-burnsubtype]
    Set one of the following codes:
    "OpenSubtitle"
    "MainSubtitle"
    "ClosedSubtitle"
    "OpenCaption"
    "MainCaption"

```

```

    "ClosedCaption"
    "MainClosedCaption"

[--exportBurnInSubtitlesLanguage|-burnsublang]
    Set specific language of subtitle.
    None (default) means all available languages for the given type are used.

[--exportBurnInTimecode|-burntc]
    Burn in time-code.

[--exportBurnInTimecodeVOffset|-burntcvoffs <offset 0-100>]
    Specify vertical offset from bottom in procent 0-100.

[--exportBurnInTimecodeColor|-burntccolor <color e.g. "red", "#RGB", "#RRGGBB">]
    Set color for burning-in time-code.

[--exportBurnInTimecodeFont|-burntcfont <color e.g. "arial">]
    Set font for burning-in time-code.

[--exportBurnInTimecodeFontSize|-burntcfontsize <font size in points>]
    Set font size for burning-in time-code.

[--exportBurnInText|-burntxt <text>]
    Burn in static text, e.g. "property of Fraunhofer IIS".

[--exportBurnInTextVOffset|-burntxtvoffs] <offset 0-100>
    Specify vertical offset from bottom in procent 0-100.

[--exportBurnInTextColor|-burntxtcolor] <color>
    Set color for burning-in text.
    Format can be "red", "#RGB" or "#RRGGBB"

[--exportBurnInTextFont|-burntxtfont] <color e.g. "arial">
    Set font for burning-in text.

[--exportBurnInTimecodeFontSize|-burntcfontsize] <font size in points>
    Set font size for burning-in text.

Validation parameters:

-validate
    Performs a validation of the provided package.

[--reportFile|-o <report.html>]
    Sets the path for the output file of validation. The directory has to exist.

    If the path is a directory, the package's folder name will be used as file base name.

    This way, all reports for a validation batch job can be conveniently stored in a
    single folder.

[--comment|-c <comment>]
    Write a custom comment to the quality report.

[--tests|-t <"1,2,3">]
    List of tests which should be executed. If no tests are selected, all available tests
    will be executed.

    Mutually exclusive with -skipTests.

[--skipTests|-s <"1,2,3">]
    List of tests which should not be executed. All other tests will be enabled.

    Mutually exclusive with -tests.

Available tests:
  Id Name
  1 File Sizes
  2 XML files' digital signature
  3 XML Schema
  9 File Hashes
  10 File Hashes (small files only)
  11 JPEG 2000 Code Streams
  12 JPEG 2000 Code Streams (probe only)
  13 JPEG 2000 Bit Rate
  14 Audio Buffers
  15 Digital Cinema Naming Convention
  16 Package Title
  17 Consistent Trackfiles
  18 XML Format

```

19 Fonts/PNGs Listed in Package  
20 Out of Bounds Timestamps  
21 Characters Available  
23 Fonts/PNGs Available  
24 Order of Time-in Timestamps  
25 Order of Timed Text Spot Numbers  
26 Open Subtitles Language  
27 Subtitle Burnin Overlap  
28 Number of Compositions  
29 Conformity  
30 Output Profile List  
31 Issuer Language  
32 Timed Text Usage  
33 Frame Rate Conformity  
34 Frame Rate Limit  
35 Subtitle Multi Usage  
36 Digital Cinema Naming Convention  
37 Audio Language Codes  
38 Track Edit Rates  
39 Track Frame Rates  
40 Subtitle Display Type  
41 Subtitle Language  
42 Resolution  
43 Image Subsampling  
44 Source Colorspace  
45 Audio Channel Configuration  
46 Audio Sampling Rate  
47 Audio Bits  
48 JPEG 2000 Properties  
50 Number of Sequences/Tracks  
51 Sequence Durations  
52 Sequence Edit Rates  
53 Subtitle Burn-in  
54 Subtitle Display Type  
55 Subtitle Language  
56 Subtitle Multi Usage  
57 Dolby Atmos  
58 Sequence Duration  
59 Audio Sequence Duration with NTSC Frame Rates  
60 Number of Entries  
61 Sound Language Code  
62 Intrinsic Duration  
63 Frame and Edit Rate  
64 Frame and Edit Rate Metadata  
65 Picture Track Subsampling  
66 Resolution  
67 Track audio padding  
68 Subtitle Track Source Document  
69 Subtitle Track Conformity  
70 Subtitle Track Schema Check  
71 Subtitle Track Semantics Check  
72 Subtitle Track Edit Rate  
73 Subtitle Track Resource  
74 Subtitle Track Encryption  
75 Subtitle Entries After Picture  
76 Frame Rate Conformity  
77 Subsampling Resolution  
78 Dolby Vision Metadata  
79 Dolby Vision Metadata Supplemental  
80 Equal Sound Count  
81 CPL contains Reel  
82 Contains CPLs  
83 Parsing OPLs  
84 Max Path Length of Package Files  
85 Valid color processing configuration  
86 Valid subsampling configuration  
87 Check for valid CPL metadata  
88 Check for CPL metadata extension sign language video  
89 JPEG 2000 Component Bit Rate Recommendation  
90 Subtitle Track ReelNumber  
91 SMPTE Subtitle Namespace Prefix



## 11.1 On Windows

On Windows, the command prompt or a script (e.g. a batch file) would typically be used pass command line parameters to easyDCP Player+. easyDCP Player+.exe was built using the Windows Subsystem and therefore their output is not visible in the command prompt. Instead, easyDCP Player+.com should be used. Since the executable file contains a space, enclose any calls into "", e.g.

```
C:\>"Program Files\Fraunhofer IIS\easyDCP Player+ 4.0.0\bin\easyDCP
Player+.com" -help
```

## 11.2 On Mac OS X

On Mac OS X, the terminal or a script (e.g. a shell script) would typically be used to pass command line parameters to easyDCP Player+. The easyDCP Player+ application is in truth a directory called "easyDCP Player+.app". The executable file which can be started and passed parameters is "easyDCP Player+.app/Contents/MacOS/easyDCP Player+". Since the executable file contains a space, enclose any calls into "", e.g.

```
Mymac:~ user$ "~/Applications/easyDCP Player+ 4.0.0.app/Contents/MacOS/easyDCP
Player+ 4.0.0" -h
```

## 12 Limitations

### 12.1 DCPs

DCPs split across multiple volumes (VolIndex) are not supported.

“E-Cinema” DCPs with MPEG2 essence are not supported.

DCPs containing sign language only in particular reels are not supported.

### 12.2 Timed Text

The timed text formats specified for Interop DCPs and SMPTE DCPs packages are supported.

Only a subset of the elements defined in DLP Cinema™ Projection Technology (“Interop timed text”) and SMPTE 428-7 (“SMPTE timed text”) are supported. This subset covers PNG as well as text subtitles or captions, rendered horizontally with or without custom fonts, outlines or shadows. A not exclusive list of ignored elements are ruby characters (Rt tag), attributes related to rotation, attributes related to scaling, attributes and related to stretching.

## 13 Frequently Asked Questions (FAQs)

please refer to FAQs at [www.easydcp.com](http://www.easydcp.com)

## 14 Disclaimer

The fact that easyDCP Player+ are able to playback a media asset, e.g. DCP, does not guarantee that another piece of software or Digital Cinema server, regardless which vendor, will also playback the asset.

Being a software solution, easyDCP Player+ does not contain a Secure Media Block (SMB). Therefore it does not comply with the DCI's security requirements being applied to playback servers used for commercial screenings in a theatre environment. easyDCP Player+ is designed to be a quality control tool.

## 15 Contact

We appreciate very much to have your feedback and your annotations about easyDCP Player+. In order to enhance the software and to optimize it for your applications, we are looking forward to your cooperation.

If you have any problems or questions, please contact us at the following addresses:

### **Sales & Technical Support**

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## 16 References

- [1] SMPTE ST 429-2:2011: D-Cinema Packaging – DCP Operational Constraints
- [2] SMPTE ST 429-2:2013: D-Cinema Packaging – DCP Operational Constraints
- [3] SMPTE ST 377-4:2012: MXF Multichannel Audio Labeling Framework
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- [6] <https://www.dolby.com/us/en/technologies/dolby-atmos.html>
- [7] SMPTE ST 2067-2:2013: Interoperable Master Format – Core Constraints
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