IMF–TOOL

A TOOL FOR BROWSING AND EDITING OF IMF PACKAGES

The development of this tool has kindly been supported by Netflix, Inc. and other companies

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Abstract

IMF-Tool is a Qt GUI application for browsing and editing of IMF App #2 / App #2E, App #4 and App #5 packages: Users can preview video and subtitles, browse metadata, edit CPLs, delete tracks, add audio and subtitle tracks.

The modified IMP can be written back to disk as either full package (Complete IMP) or supplemental package (Supplemental IMP).

IMF-Tool features a timeline visualization of CPLs, a resource browser, metadata editors TTML preview, image decoding and video playback.

IMF-Tool is written in C++ / Qt and builds under Linux, Mac OS X and Windows using CMake build configuration.

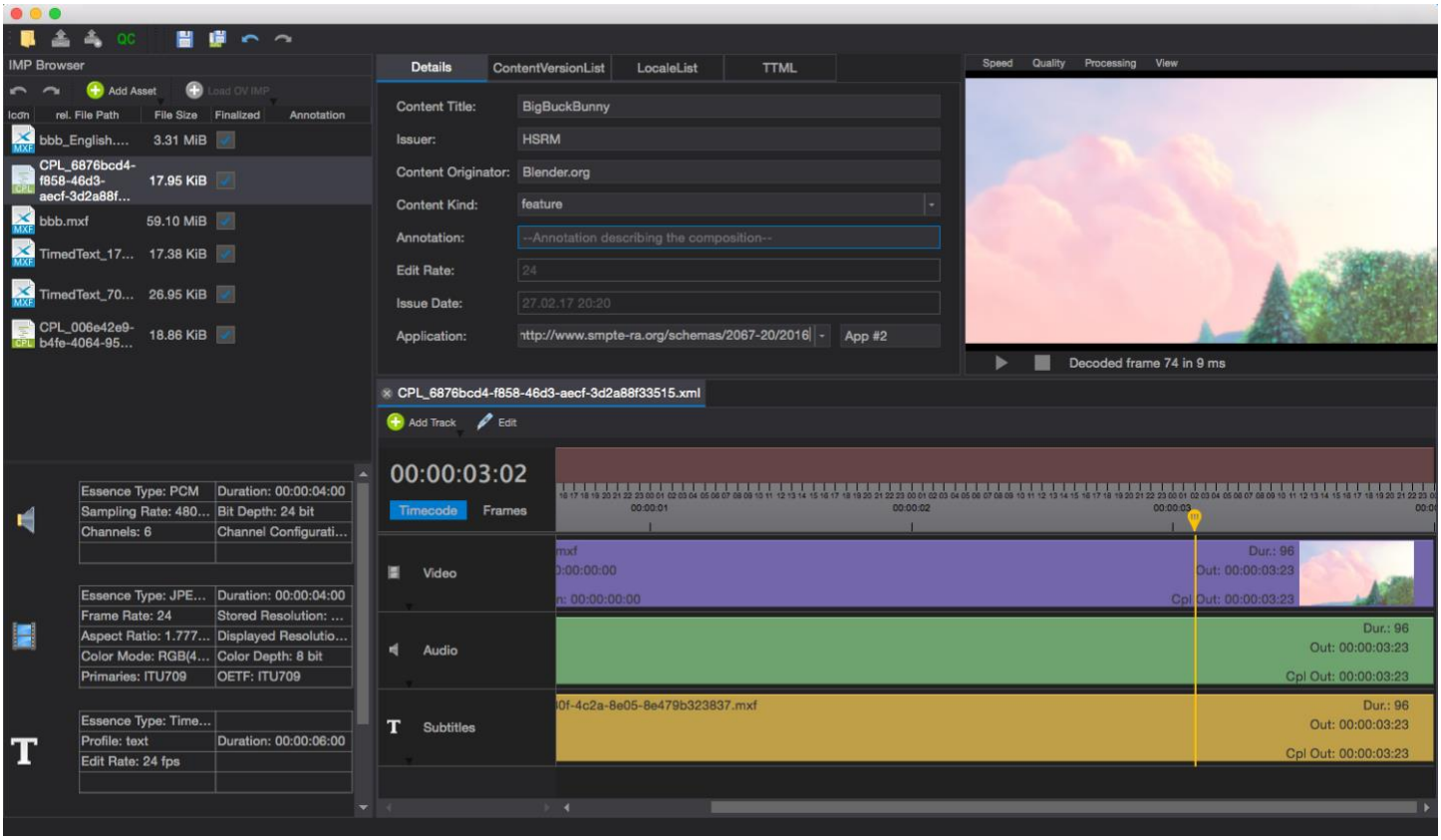
IMF-Tool is available under GPLv3 (GNU Public License Version 3) at http://www.github.com/IMFTool.

Supported workflows

- Opening an IMP, opening one or more CPLs, timeline visualization, video preview and subtitle rendering
    - Supported Codecs: JPEG 2000, High-Throughput JPEG 2000, ACES
- Create an IMP from scratch, import MXF track files, create and edit CPL(s)
- Editing CPL metadata
- Adding Audio (PCM) or Timed Text (IMSC 1.0 or 1.1) resources to an IMP
- Duplicating an existing CPL and modifying it by
    - Adding one or more audio track
    - Adding one or more subtitles track
    - Adding a marker track, adding markers, editing the marker annotation
- Adding resources to a track by
    - Dragging & dropping assets from the IMP browser into the timeline
- Modifying tracks
    - Visually editing EntryPoint and Duration on the timeline
    - Creating edit points (cuts)
- MXF metadata and essence descriptor inspection
- Generate a Photon QC report
- Open an IMP and CPLs upon startup using command line options
- Adding Sidecar Assets
- Editing and Viewing Sidecar Asset Maps
- Adding a Photon QC report as Sidecar Asset
- Additional features for IMF App#5 ACES
    - OpenEXR ACES preview and playback
    - Target frame export in IMF Tool
    - SubDescriptor processing and visualization

Overview of the GUI

Picture 1 shows the GUI with an IMP opened and a CPL on the timeline. The individual elements of the GUI will be explained below.



Picture 1: IMF-Tool GUI

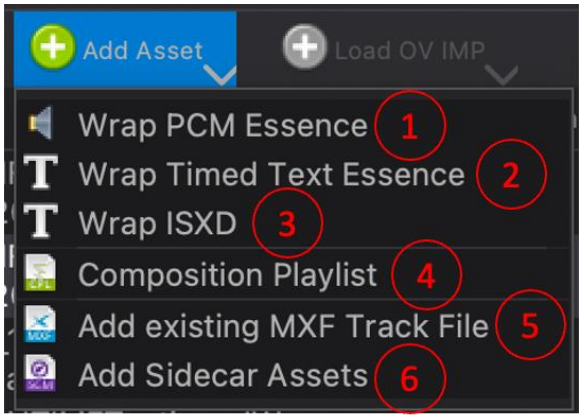
Toolbar

Element #	Function	More details
1	Open IMF package	Opens a file browser to select a folder with an IMP.
2	New IMF Package	Opens a file browser to select the folder where the new IMP is created. The folder may contain existing MXF files, which can be imported into the IMP Browser subsequently. See also: Add existing MXF Track File
3	Write IMF package	Writes the modified package to the original location. Attention: ASSETMAP.xml will always be overwritten! A new PKL will be created and the former PKL will be kept (but not be referenced any more)
4	Write Supplemental IMF package	All files created in addition to an Original IMP will be written to a new folder. The Original IMP will remain untouched. Hint: This is the safest way to export your changes without modifying the original IMP.
5	Generate QC Report	Generate a QC report using Photon. QC report will be displayed in a pop-up window and can be copied into the clipboard.
6	Save CPL	Saves the CPL currently visible in the timeline. Users will be alerted if an existing CPL is about to be overwritten. Button is only available when a CPL has been modified.
7	Save as new CPL	Save the CPL currently visible in the timeline with a new UUID under a new file name. The formerly edited CPL will still be present in the timeline.
8	Undo	Undo last CPL editing operation. “Save CPL” and “Save as new CPL” cannot be undone!
9	Redo	Redo last CPL editing operation

IMP Browser

Element #	Function	More details
1	File names of assets	To open a CPL in the timeline editor, double-click on the CPL asset or right-click and select “Edit CPL”.
2	File size of assets	“Not finalized” indicates that a freshly added asset has not been written to disk yet. It can be written selecting “Write IMF package” from the control panel.
3	AnnotationText from Packing List	Only if AnnotationText element is present in Packing List
4	Add Asset	See section below for details!.
5	Undo / Redo	Undo / redo last operation in the IMP browser.
6	Load Original Version	This button is active for Supplemental (Partial) IMPs only: It allows for additionally loading one or more ancestor IMPs for proper timeline preview. If versioning of Supplemental IMPs is intended, all ancestor IMPs must be loaded before starting the Outgest!

Add Asset Dialog

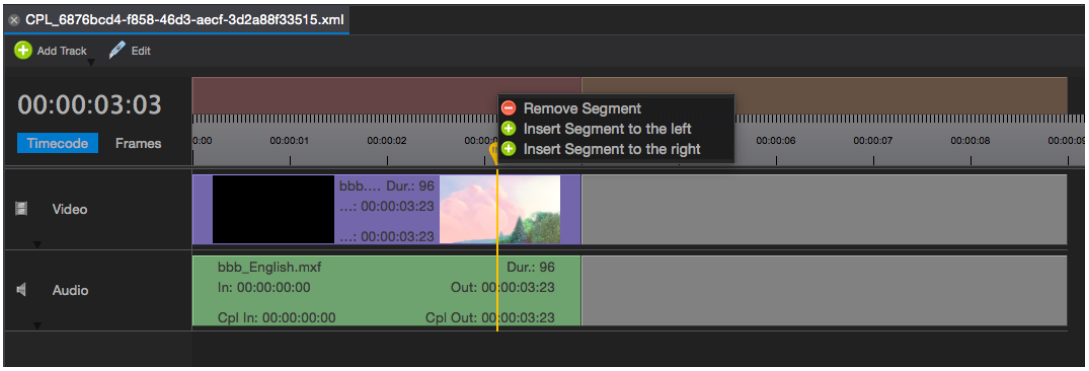


Element #	Function	More details
1	Wrap PCM essence	Allows to select a “PCM resource” (WAV File) to be wrapped into MXFThe selected essence file will be wrapped into MXF and appear as MXF asset in the IMP browser.
2	Wrap Timed Text Essence	Allows to select a “Timed Text Resource” (IMSC File) to be wrapped into MXF. In addition, an empty IMSC1 resource can be created which may be used for filling gaps on the timeline. The selected essence files will be wrapped into MXF and appear as MXF asset in the IMP browser.
3	Wrap ISXD	Wrap a sequence of XML Files into MXF. The selected essence files will be wrapped into MXF and appear as MXF asset in the IMP browser.
4	Add Composition Playlist	Create a new CPL and add it to the IMP.
5	Add existing MXF Track File	Allows to add an existing MXF file to the IMP. The MXF file must upfront be copied into the IMP folder, or in a subfolder. Essence types JPEG 2000, J2K-HT, ACES, PCM Audio, IAB, MGA S-ADM, ADM Audio and Timed Text are supported. If the modified IMP is exported as a Supplemental IMP, the imported MXF file(s) will be moved to the Supplemental IMP’s location.
6	Add Sidcar Assets	Will open a wizard for adding sidecar assets to an IMP. For further details see below.

Note on Importing MXF Track Files:
When dragging&dropping imported MXF Track Files into the timeline of an existing Virtual Track, essence homogeneousness will be checked and related warnings or errors issued.
Since IMF Tool may not cover all potential essence descriptor conflicts, a Photon check of the resulting IMP by using the “QC” button, is highly recommended.
[Photon] https://github.com/Netflix/photon

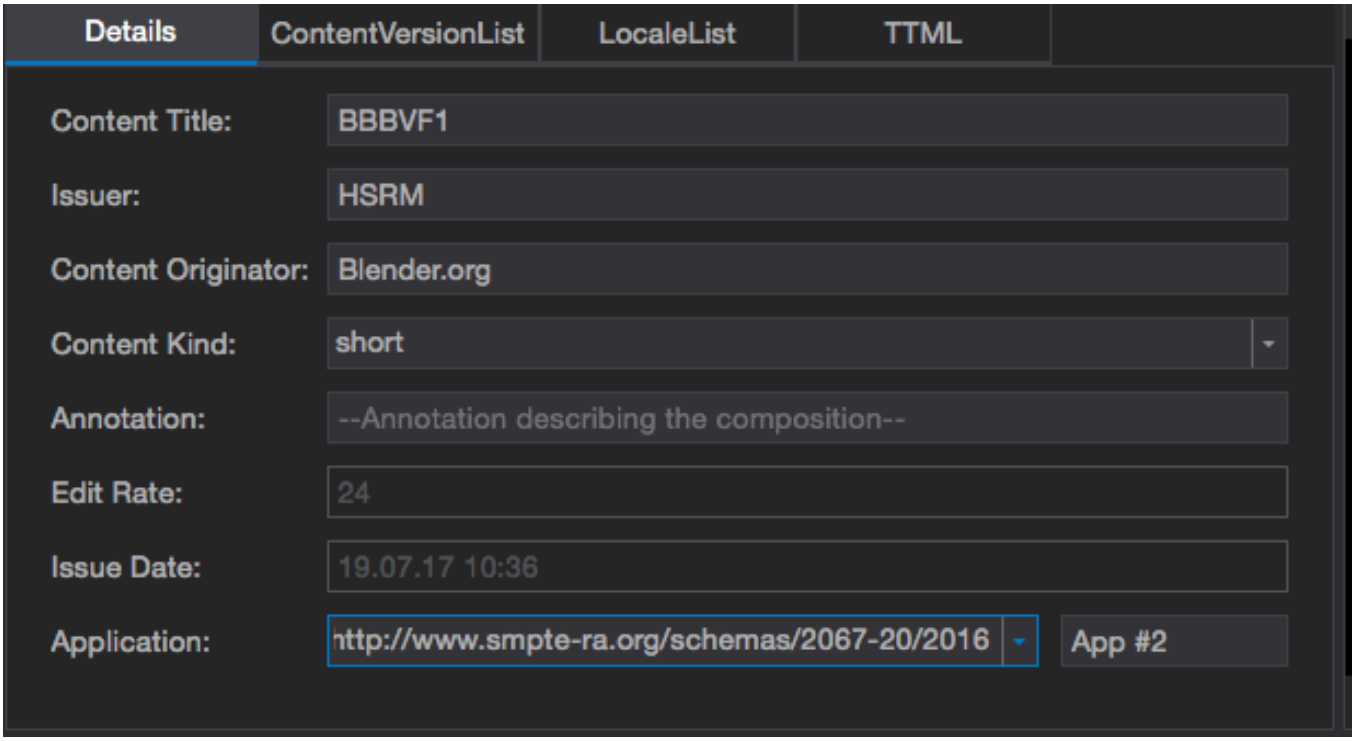
Adding segments

By right clicking into a segment, a new segment can be added to the left or right:



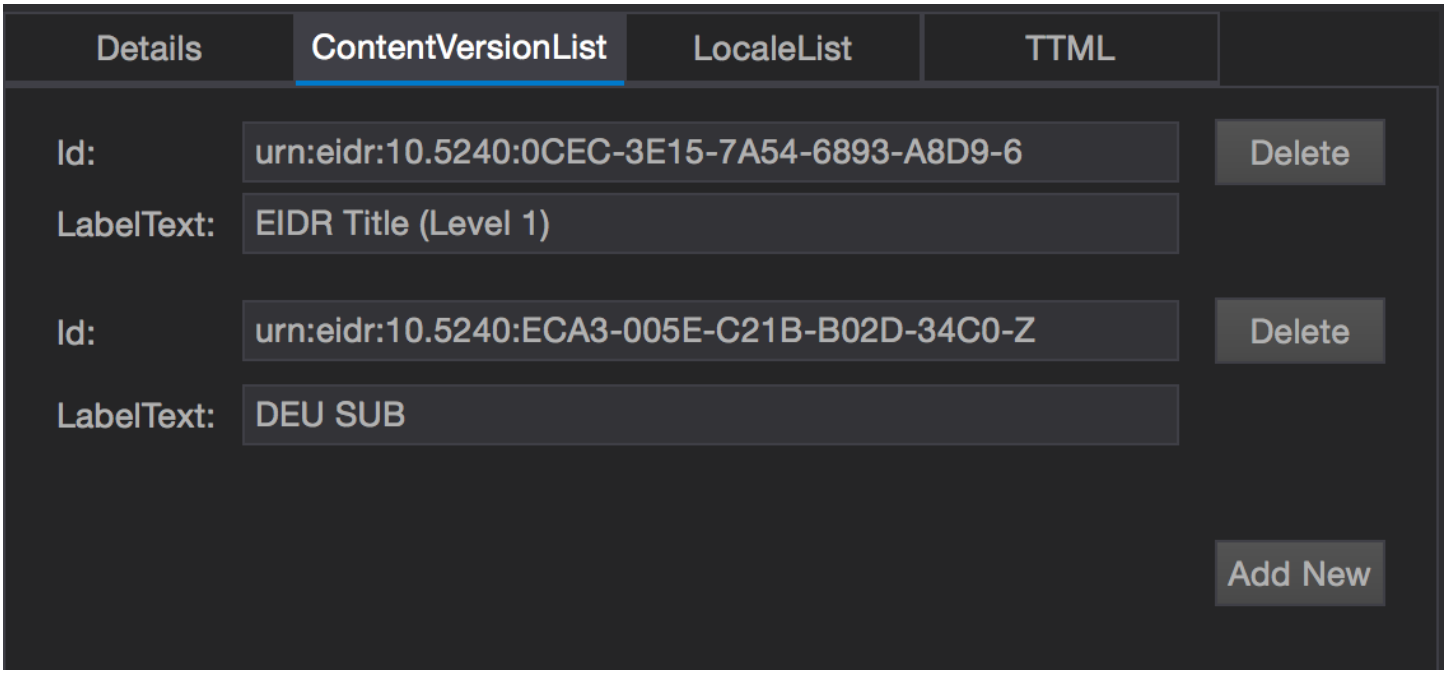
The segment will have a default length, and will be trimmed by adding resources.

CPL metadata editor



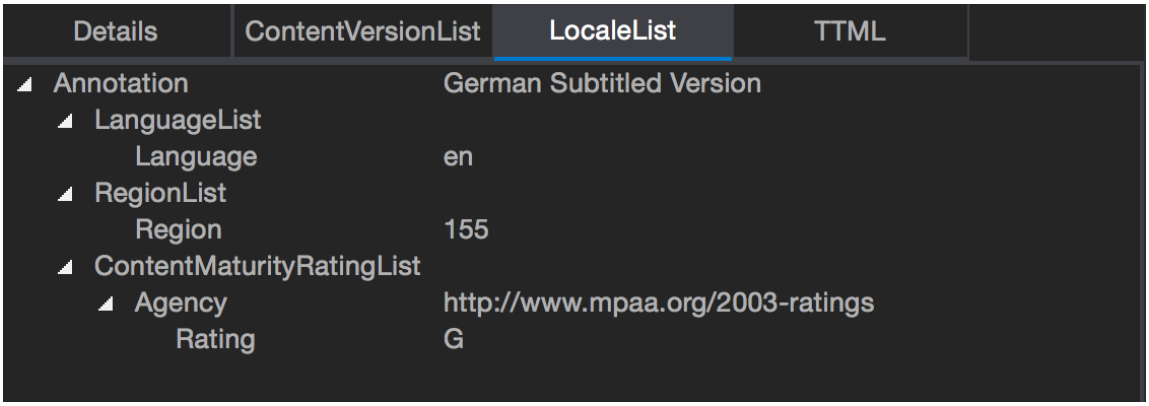
Edit the metadata of the CPL currently visible on the timeline. Content Kind, Edit Rate and Issue Date cannot be edited.

Content Version List Editor

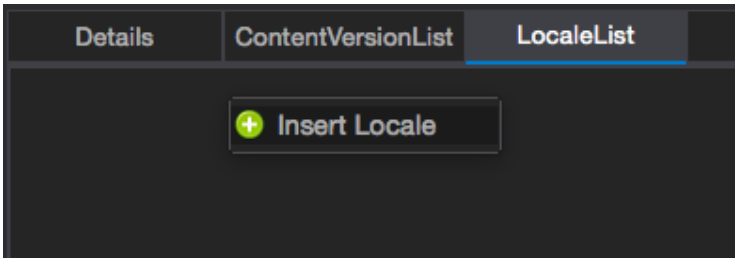


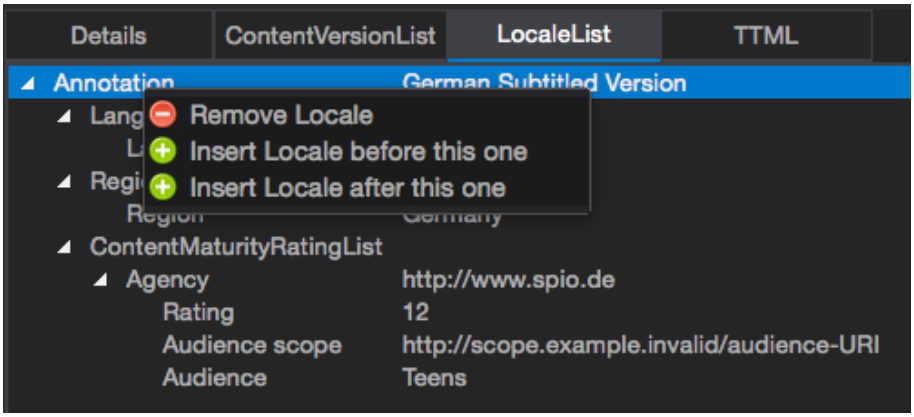
Edit the Content Version List. Items can be deleted and added to the Content Version List.

Locale List Editor

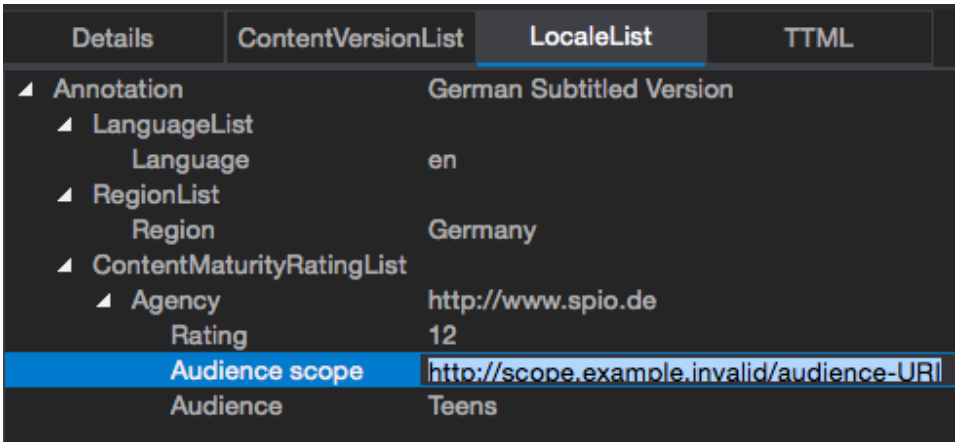


Items can be added or deleted from the Locale List by using right-click context menus:

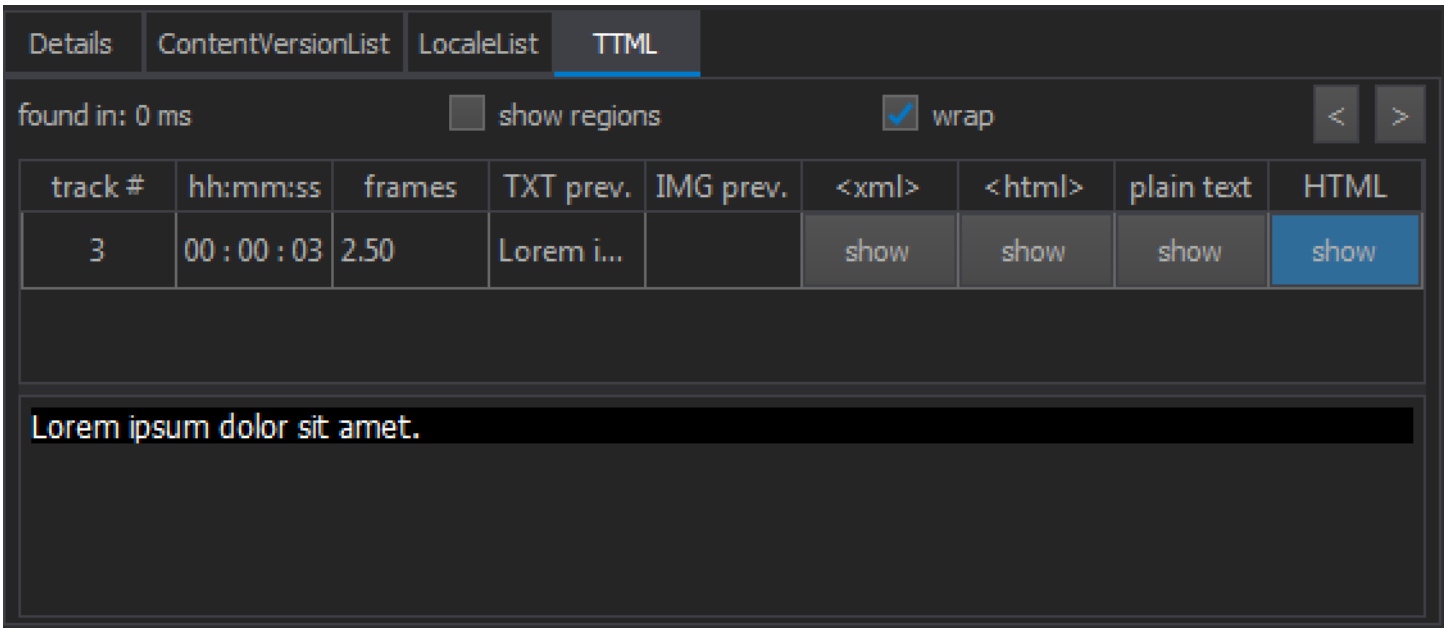




Values in the second column can be edited by double-clicking:



TTML Preview



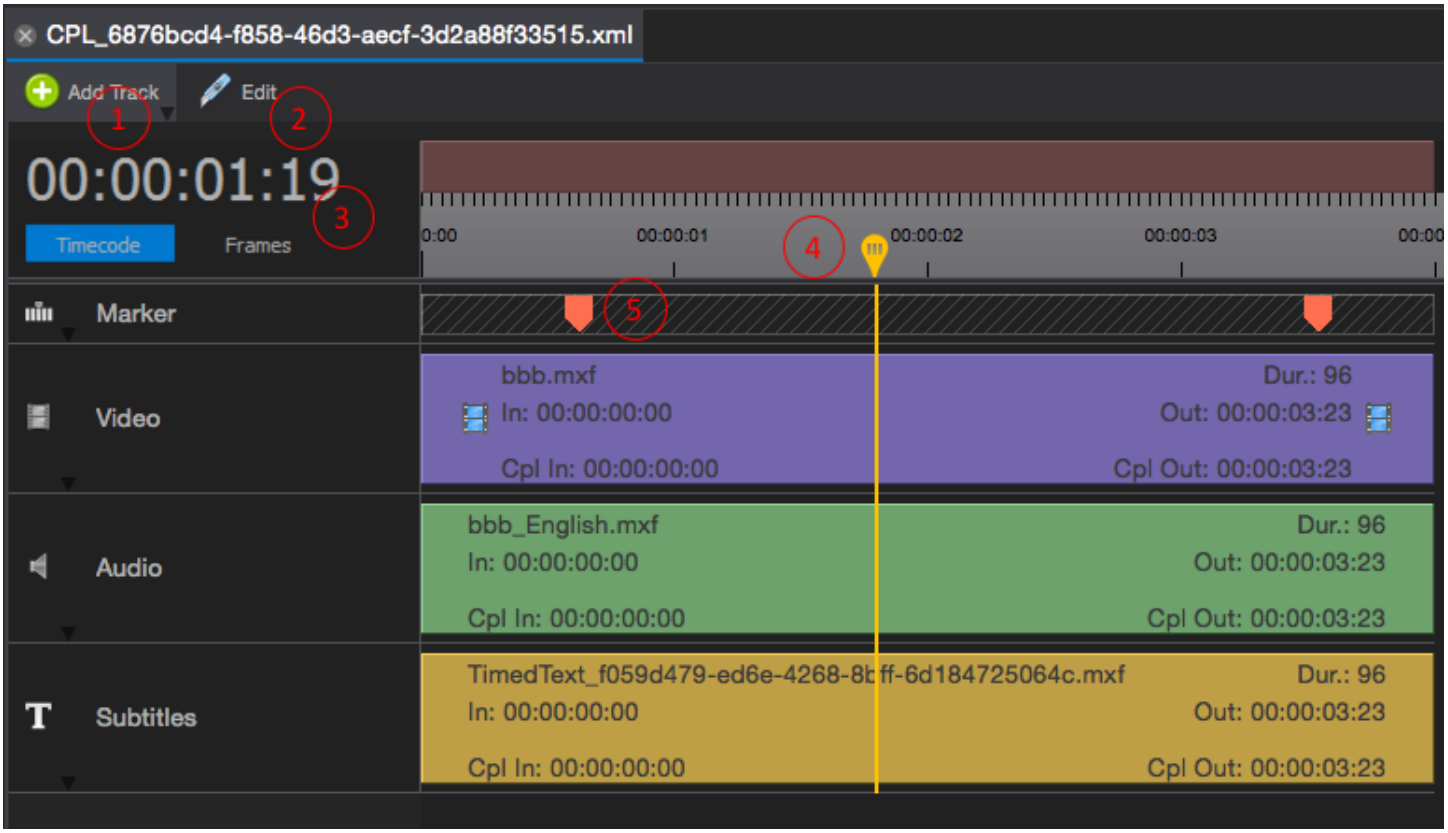
This tab shows a preview of timed text tracks conforming to the IMSC1 text profile. The “<” and “>” buttons jump to the preceeding and the following timed text instance, respectively.

The following preview options are available:

Button	More details
<xml>	Show the entire IMSC1 file. Hint: Mark all and copy into text editor.
<hmtl>	Show the HTML representation of the current instance. (text profile only)
plain text	Show the current instance in plain text.
HTML	Show the rendered HTML representation of the current instance. (text profile only)

Note: IMSC1 resources conforming to the image profile will be overlaid to the image preview!

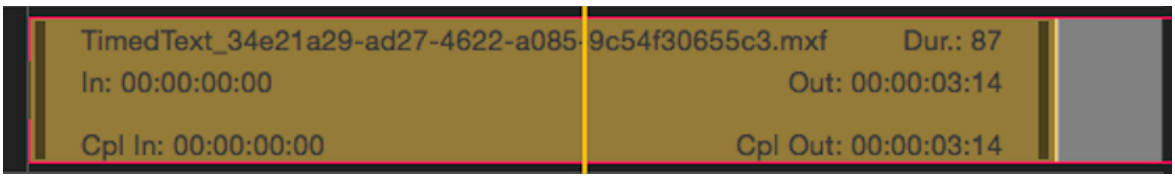
CPL Editor: Overview



Element #	Function	More details
1	Add an additional track	Multiple **audio tracks** and multiple **subtitle tracks** can be added. If not already present, a single **marker track** can be added.
2	1st click: Create a cut for the currently selected resource 2nd click: Create a cut for all other resources	The resource currently selected will be cut at the current timeline position, i.e. it will be divided into two resources, both referencing the same track file with adapted EntryPoint and Duration. Can be undone using the "Undo" button on the control pane. Clicking "Edit" twice will also cut all other resources at the very same timeline position
3	Media time code	Toggle between timecode HH:MM:SS:FF and frame counter representation. Note: For CPLs with fractional frame rates, non-drop frame NTSC time code will be shown!
4	Timeline cursor	
5	Marker editing	Right-click to add or remove markers on an (optional) marker track. (Add marker track first → 1, if not present.)

CPL Editor: Editing EntryPoint and Duration of a resource

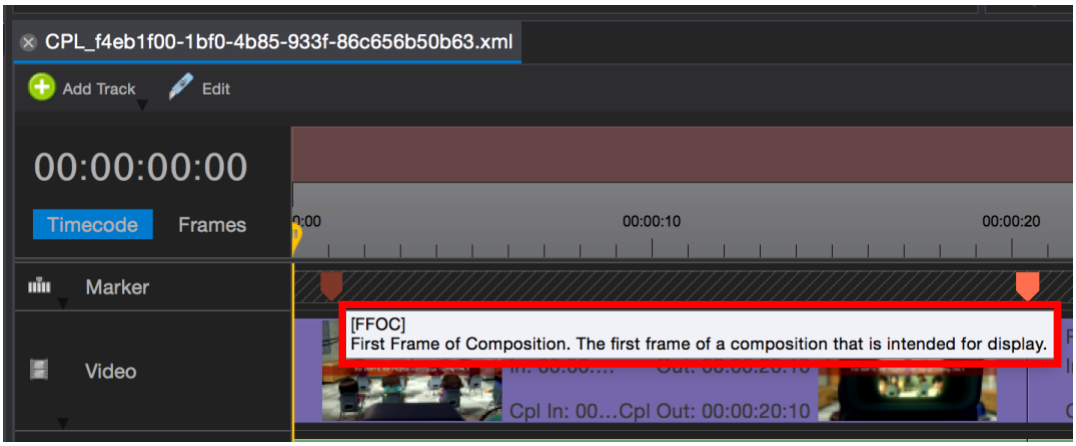
EntryPoint and Duration can be edited by dragging and moving the IN or OUT point of a resource, respectively:



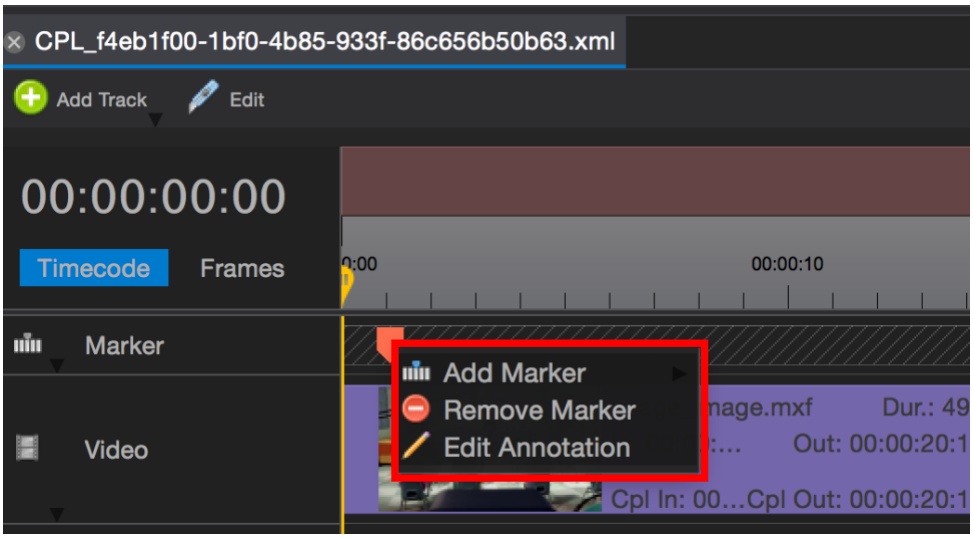
In this example, the duration of the timed text resource has been reduced to 87 frames by moving the OUT point.

CPL Editor: Editing a Marker Annotation

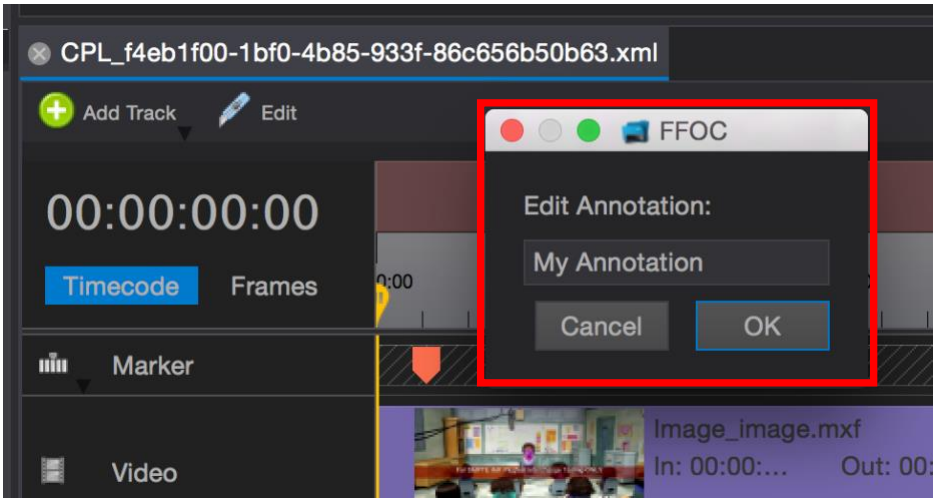
Mouse-over shows Label and Description, if no Annotation is present:



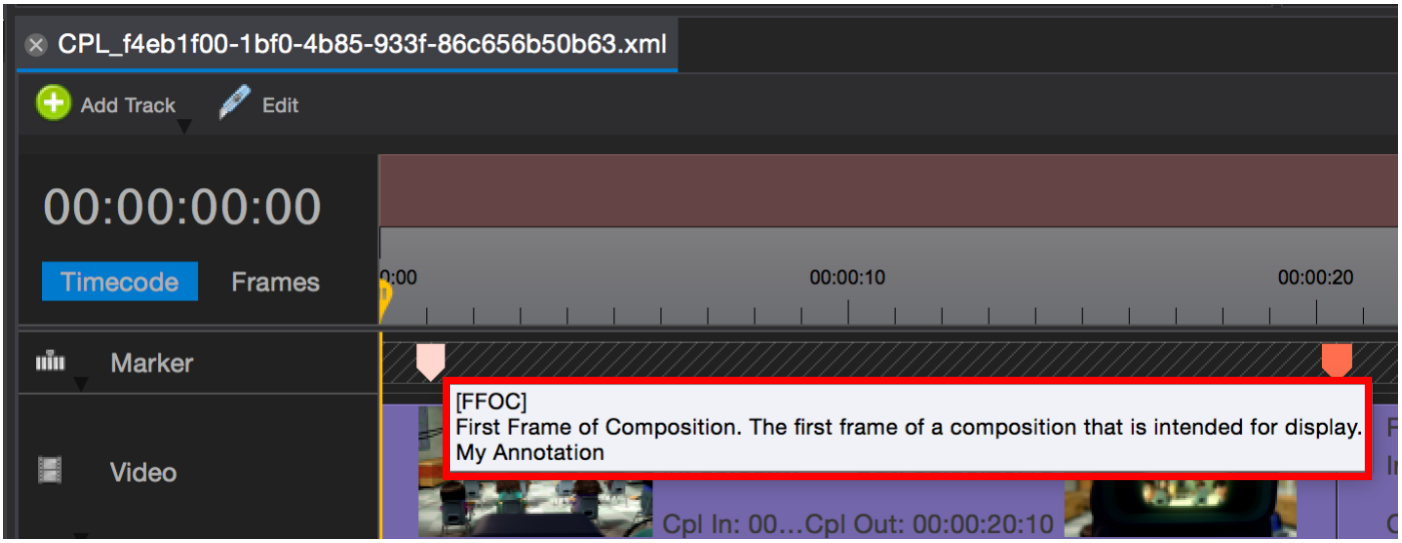
Right-Click menu:



Edit Annotation:



Mouse-over shows Annotation, if present

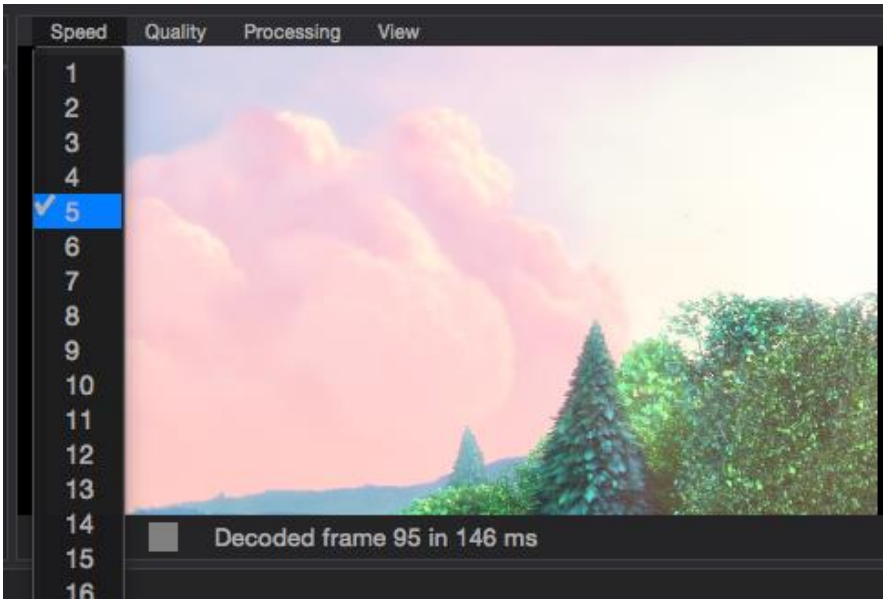


Note:

Annotation edits are added to the Undo Stack and can thus be reverted easily.

Image Preview

Image Preview: Speed Options

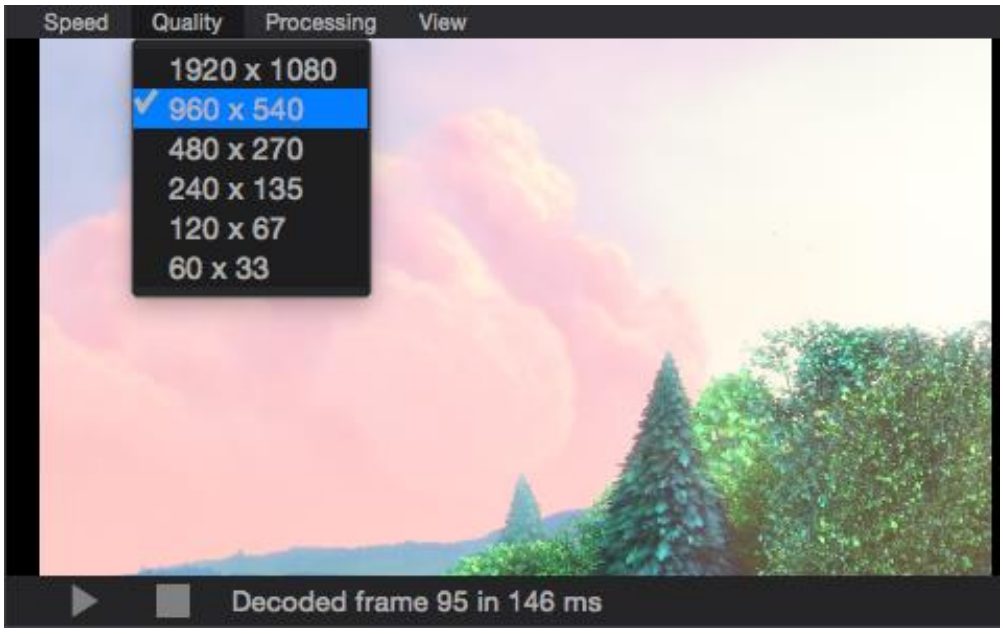


Chooses the playback frame rate.

If the processing option “Real speed” is NOT checked: Determines the playback frame rate (lower than or identical to the CPL Edit Rate).

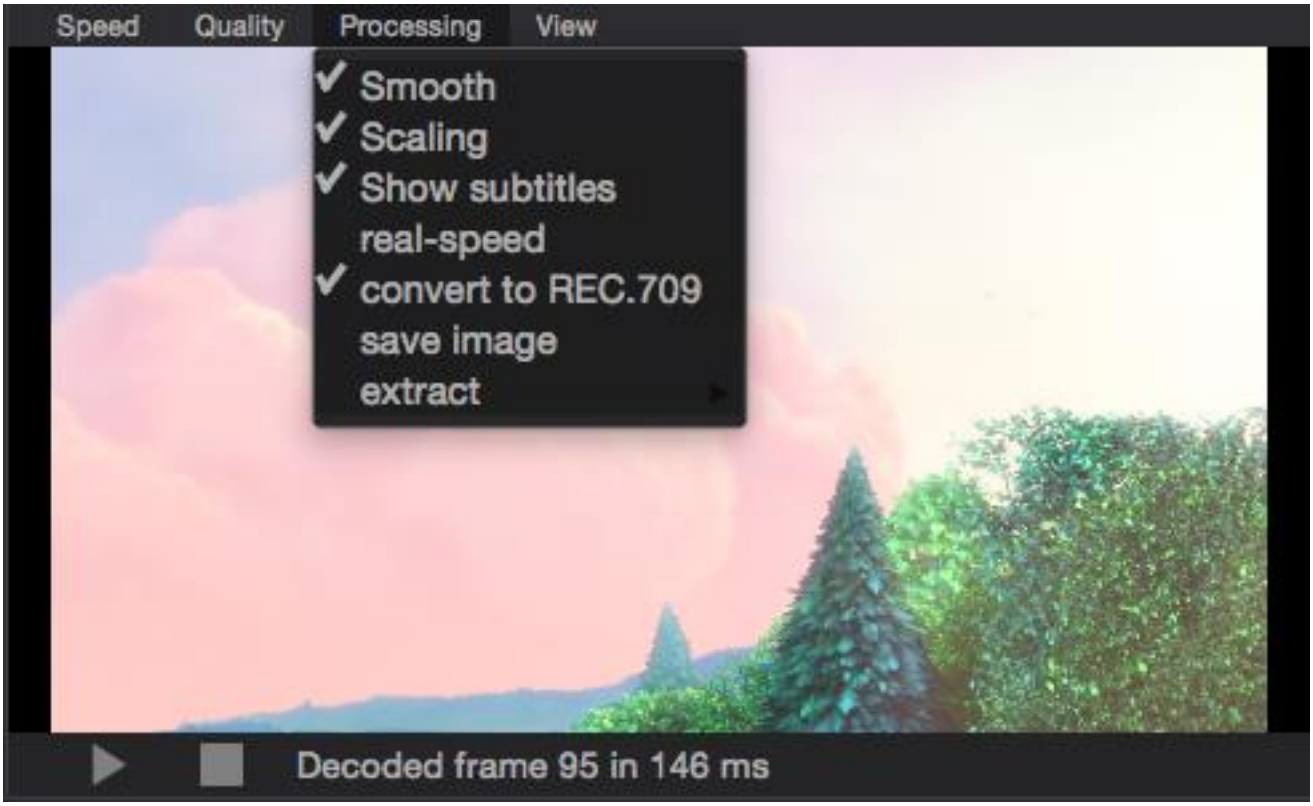
If the processing option “Real speed” is checked: Determines the real number of frames per second being decoded while the timeline proceeds in real time. (i.e. frame dropping will occur if lower than CPL Edit Rate)

Image Preview: Quality Options



Choosing a lower resolution reduces the decoding time and improves playback speed.

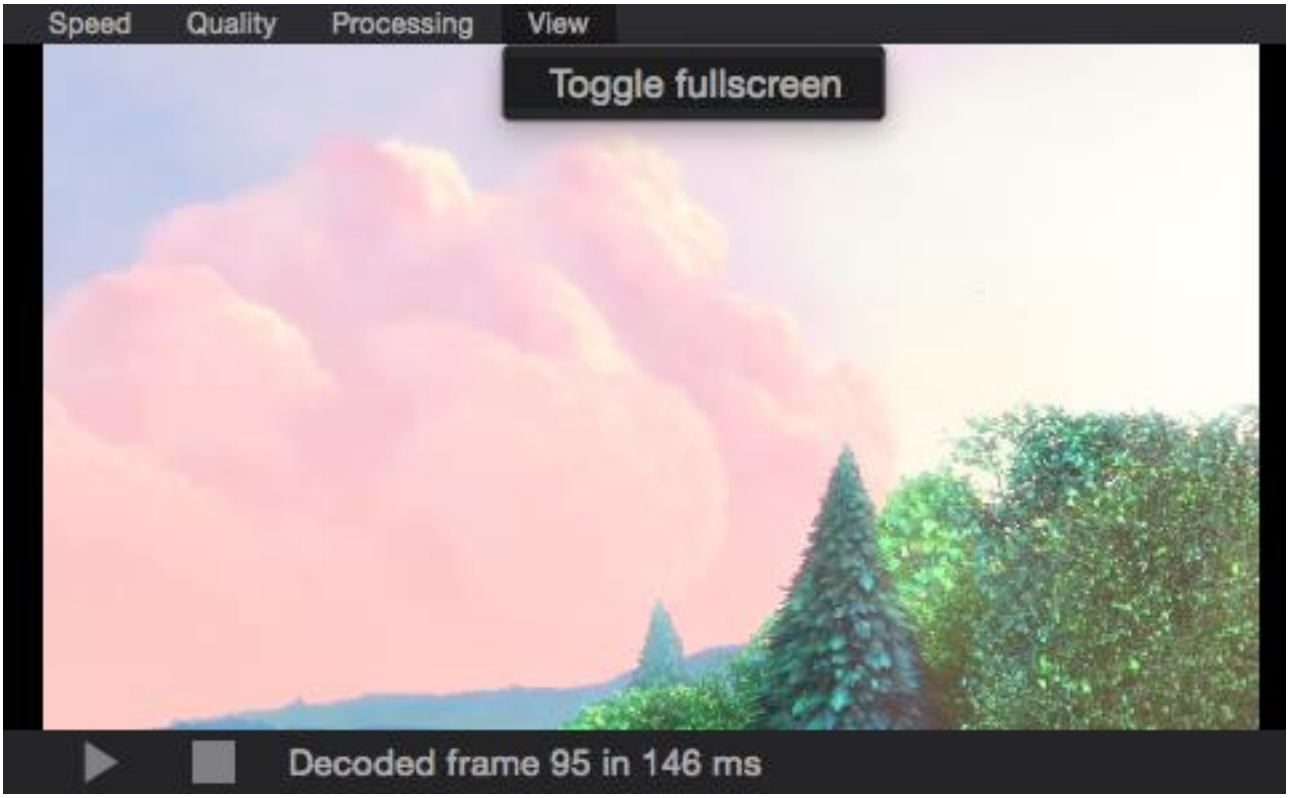
Image Preview: Processing Options



The following options are available:

Option	More details
Smooth	Apply a smoothening filter to reduce artifacts for low-res images.
Scaling	Scale image to the size of the preview widget
Show subtitles	Overlay subtitles for IMSC1 resources conforming to the image profile. Note: Overlay of text-based subtitles is not supported!
Real speed	Playback at the nominal CPL Edit Rate. Frames will be dropped in order to maintain playback speed.
Convert to REC.709	Images in color spaces other than BT.709 (E.g. BT.2020 or P3D65) will be converted to Rec.709. Note: No tone mapping is applied, just simple clipping.
Save image	Allows for saving the image currently display to disk. Format will be BMP and the bit depth will be 8 bit only.
Extract	Display only a part of the image (sub-options available)

Image Preview: View Options



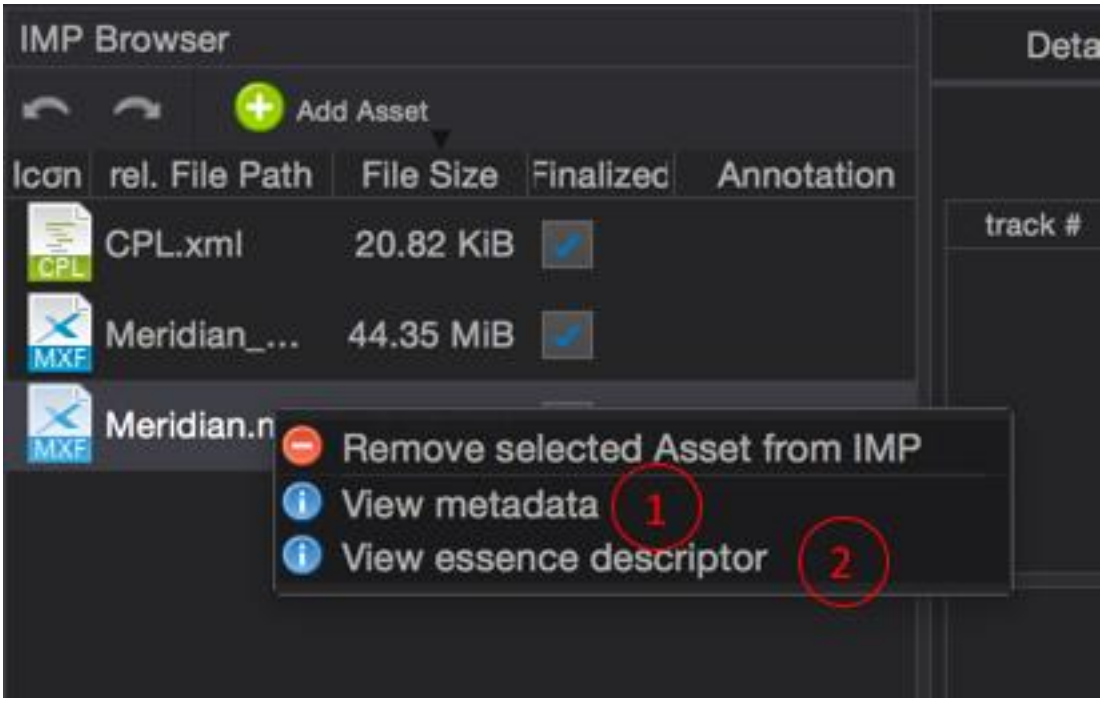
“Toggle fullscreen” enters / leaves full screen mode.

NOTE: In case of a dual-monitor machine, full screen will always go to the second monitor.

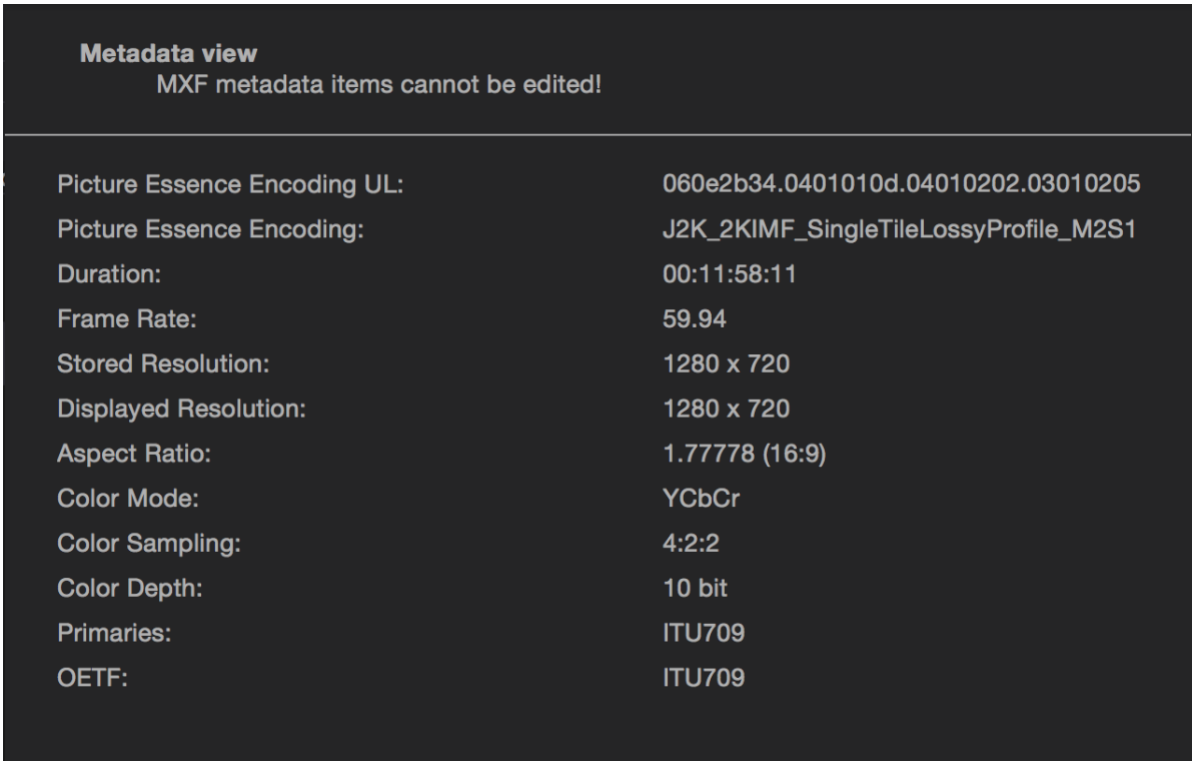
The following hot keys are available for controlling view and playback:

Key	Action
Space	Start / stop playback.
Cursor-Left	One frame forward
Cursor-Right	One frame backwards
K	Pause playback
L	Resume playback
ESC	Leave full screen (in full screen mode only)
Double-click	Toggle full screen

MXF metadata and essence descriptor inspection



Element #	Option	More details
1	View metadata	Shows additional metadata items for the selected MXF asset. Example for a Video Asset see below. This option is only available for MXF assets. For newly added assets, the Metadata wizard will open instead. The metadata view can also be opened by double-clicking on the MXF asset icon.
2	View essence descriptor	Shows the essence descriptor for the selected asset in XML format. Example see below. Note: This option is not available for newly added assets, which have not been finalized yet. The essence descriptor is extracted from the MXF file using regxmllibc [1]. [1] https://github.com/sandflow/regxmllib



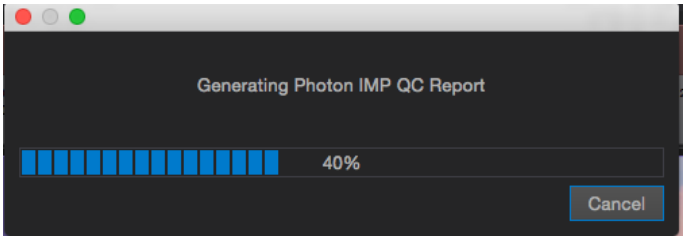
Sample metadata view

Sample essence descriptor view

Photon QC report

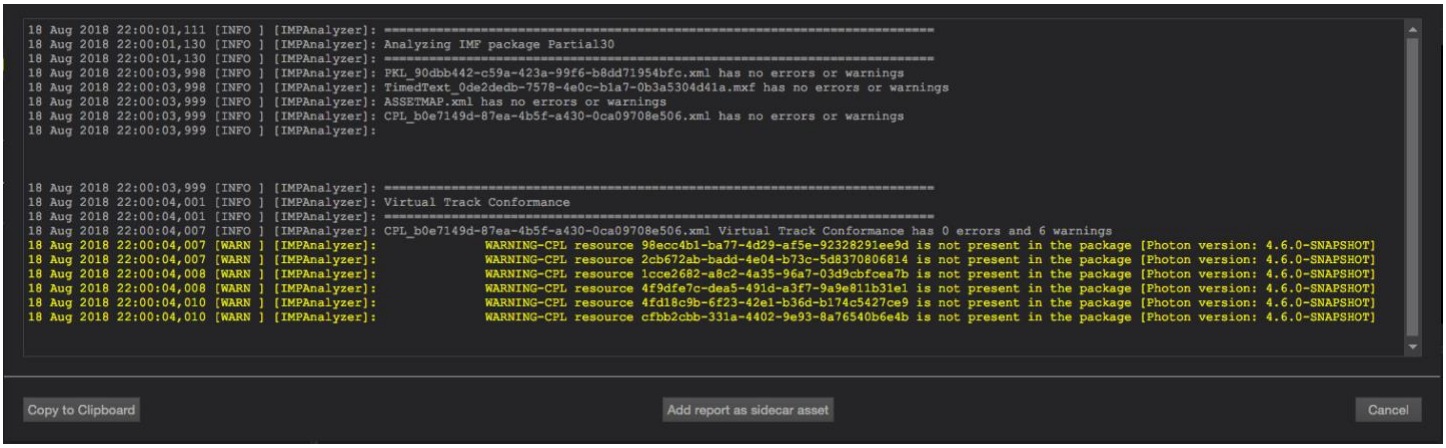
The QC button is available in the main window, once an IMP has been opened in the IMP browser.

When generating a QC report, a progress bar is shown:



Depending on the complexity of the IMP, the report may require several minutes to be generated.

A sample QC report looks like this:



Important: Generating a QC report requires Java™ Runtime Environment Version 1.8 to be installed!

If an appropriate Java™ runtime is not available, an error message will pop up.

Note: The Photon source code is available under Apache License 2.0 at https://github.com/Netflix/photon

Command line options

For advanced workflow integration, IMF Tool supports command line options:

```
Usage: IMF-Tool [options]
IMF-Tool

Options:
  -h, --help                          Displays this help.
  -v, --version                       Displays version information.
  -i, --imp-directory <directory>     Open IMP in <directory> upon startup.
  -a, --open-all-cpls                 Open all CPLs from <directory> in Timeline View.
```

Sidecar Assets and Sidecar Composition Map

The Option “Add Sidecar Assets” opens a wizard for creating a Sidecar Composition Map and adding the sidecar assets to an IMP. Sidecar Assets must be copied to the IMP directory by the user upfront.

Once a sidecar asset has been selected, one or more CPLs must be associated with the sidecar asset. Finally, an Annotation Text and an Issuer string can optionally be added.

Sidecar Composition Maps (SCMs) can be viewed and edited using IMF Tool. Please use the respective context menu (available via right-click) in the IMP Browser for viewing or editing a SCM.

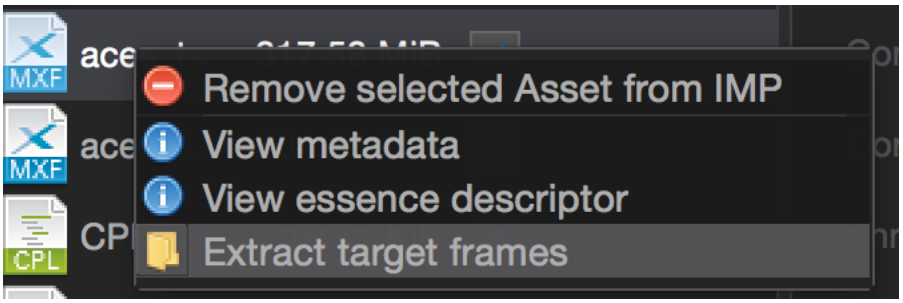
As a specific option, the “QC” wizard allows for adding a Photon QC report as sidecar asset. This step will create a Sidecar Composition Map referencing the QC report and assigning it to all CPLs in the IMP.

Note that it is recommended that the QC report and the related SCM are exported as “Supplemental IMP” to a different location. Otherwise, the Original IMP would be altered, thus making the QC report less useful because e.g. the PKL would have changed.

Features specific to App#5 ACES

SMPTE ST 2067-50 supports Target Frames to be wrapped along with the ACES image essence. IMF Tool supports preview and extraction of such Target Frames from the IMP Browser.

Right-clicking on an ACES MXF Track File shows the “Extract Target Frames” dialog:



Annex A: Use case: Repairing IMF packages

This annex explains how certain defects in legacy IMF packages can be fixed. “Legacy” in that context refers to packages that are not compliant to the latest SMPTE standards. Legacy packages may also be missing certain metadata items like the CPL Essence Descriptor List, Multichannel Audio Descriptors etc.

WARNING

Make a backup copy of your IMF package before conducting any of the tasks below!

Tasks

- Updating the CPL(s) of an IMF package to SMPTE ST 2067-3:2016
- Editing CPL metadata: Content Title, Issuer, Content Originator, Annotation, Issuer, Content Version List, Locale List
- Re-wrapping of Audio Track files to include MCA descriptors and MCA metadata fields
- Re-wrapping of Timed Text track files

All workflow elements listed above are optional.

Users are encouraged to save CPL changes as new CPL (including a new UUID), although IMF-Tool also allows for saving modified CPLs under the same UUID.

Warning: Saving modified CPLs with the same UUID they had before applying changes may lead to significant issues when using a Media Asset Management System and is strongly discouraged.

Updating CPLs to SMPTE ST 2067-3:2020

IMF-Tool modifies all CPLs being opened to be ST 2067-3:2020 compliant, as soon as any change has been applied. E.g. editing of a single metadata field in the “Details” tab is sufficient.

The CPL can subsequently be saved as a new CPL (encouraged) or it can be saved overwriting the existing CPL and keeping the former CPL UUID (discouraged). After saving as a new CPL, the former CPL can (and probably should be) deleted by using the right-click “Remove” option available in the IMP browser or pressing “Delete” on the keyboard.

The new CPL will also contain all Essence Descriptors. No manual step is needed to create Essence Descriptors.

Editing CPL metadata

Open a CPL and use the Tabs “Details”, “ContentVersionList” and “LocaleList” to modify CPL metadata. Again, the CPL can be saved as a new CPL (encouraged) or it can be saved overwriting the existing CPL and keeping the former CPL UUID (discouraged). After saving as a new CPL, the former CPL can (and probably should be) deleted by using the right-click “Remove” option available in the IMP browser or pressing “Delete” on the keyboard.

Re-wrapping of Audio Track files to include MCA descriptors and MCA metadata fields

Step 1: Extracting the WAV files out of the MXF files

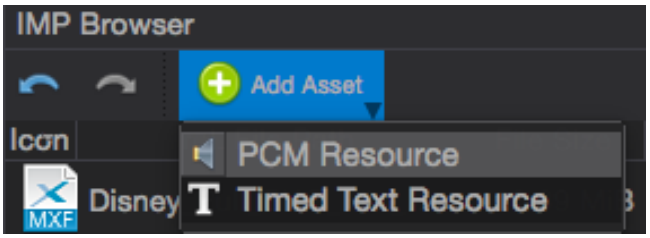
For this task, a third-party un-wrapper is required. We recommend `as-02-unwrap` from the asdcp Library [1]. You may also use any other common editing tools.

Using this tool, unwrapping on the command line works as listed as an example in Figure 2.

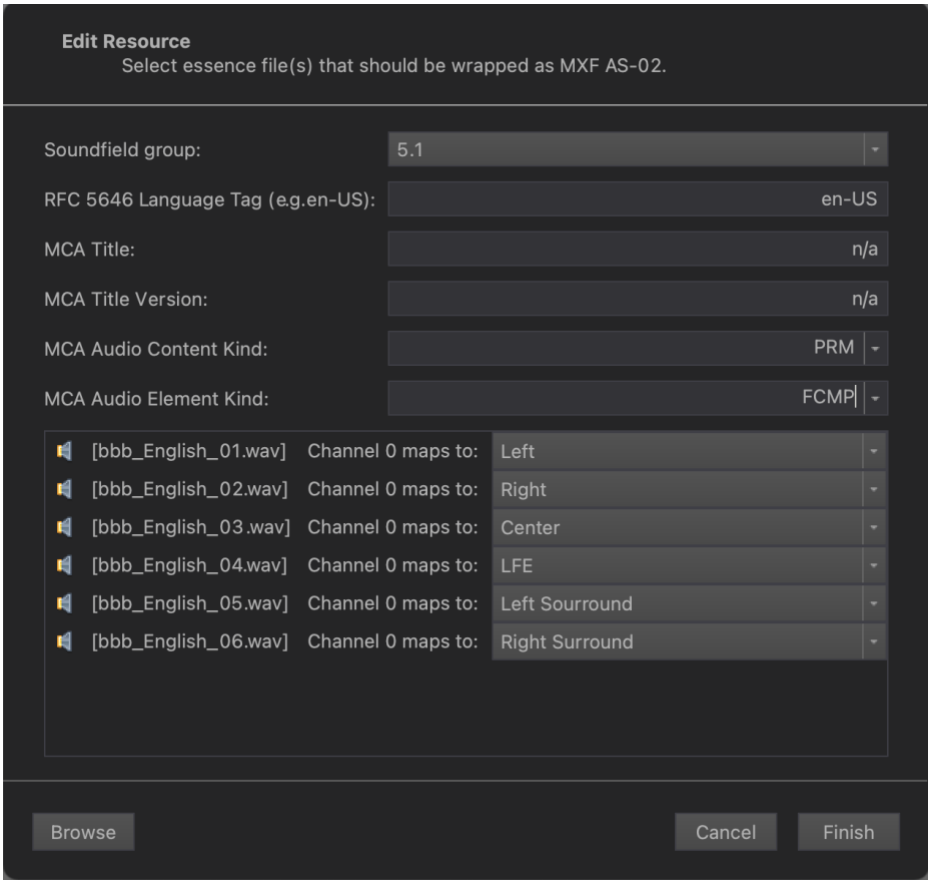
```
$ as-02-unwrap -1 bbb_English.mxf bbb_English_unwrapped
$ ls bbb_English_unwrapped*
bbb_English_unwrapped_01.wav  bbb_English_unwrapped_03.wav  bbb_English_unwrapped_05.wav
bbb_English_unwrapped_02.wav  bbb_English_unwrapped_04.wav  bbb_English_unwrapped_06.wav
```

Step 2: Creating new Assets using the WAV files from step 1.

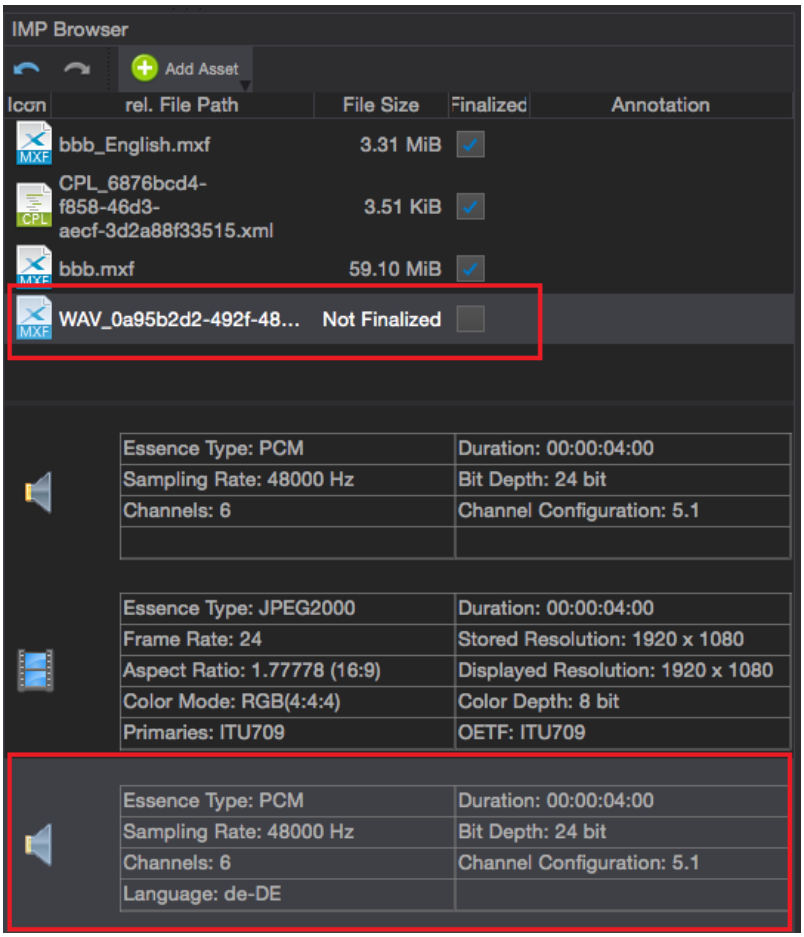
Open the IMF package, add a new PCM Asset:



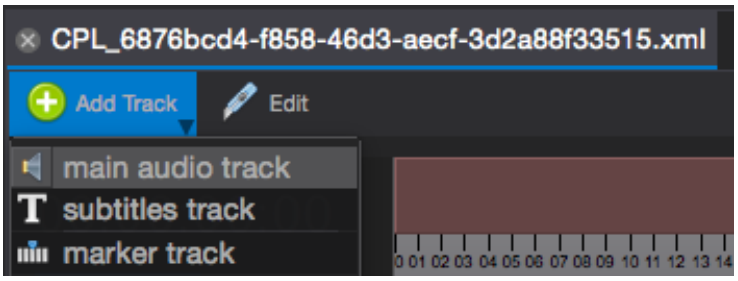
Browse for the WAV files, fill in all metadata fields. Make sure you correctly assign the channels to the WAV files!



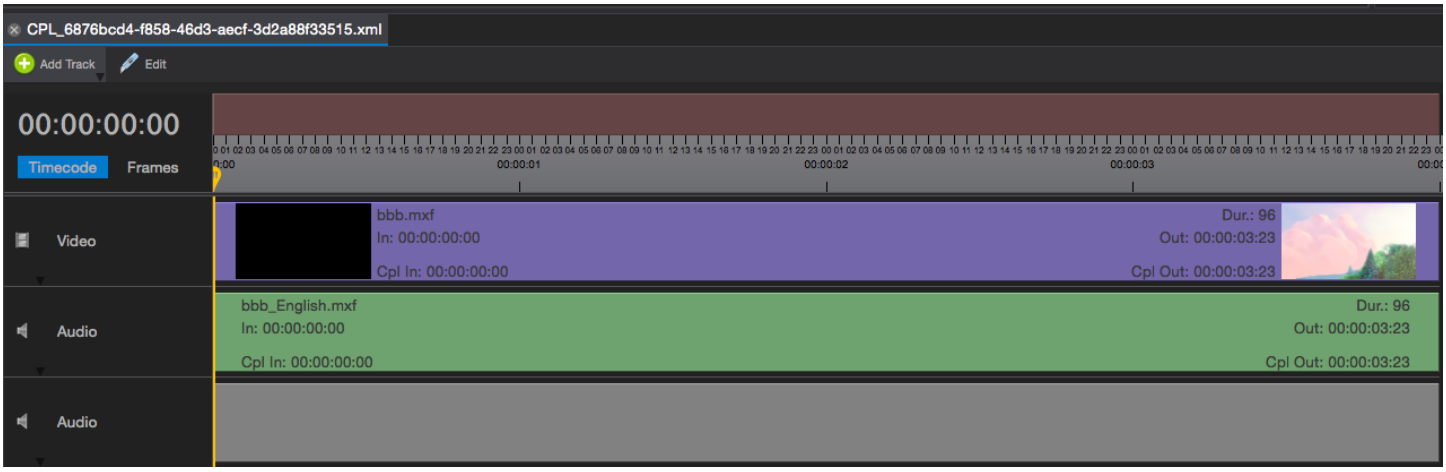
After pressing “Finish”, the new Asset appears in the IMP browser:



Add a new audio track to the CPL:

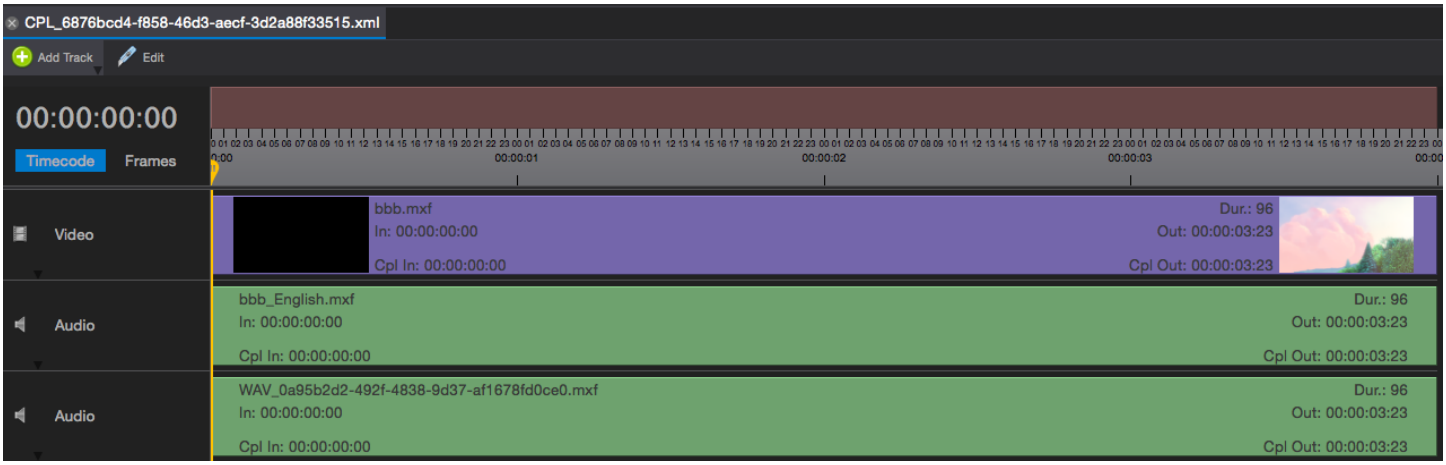


Your timeline looks like this, the new track will initially be empty:

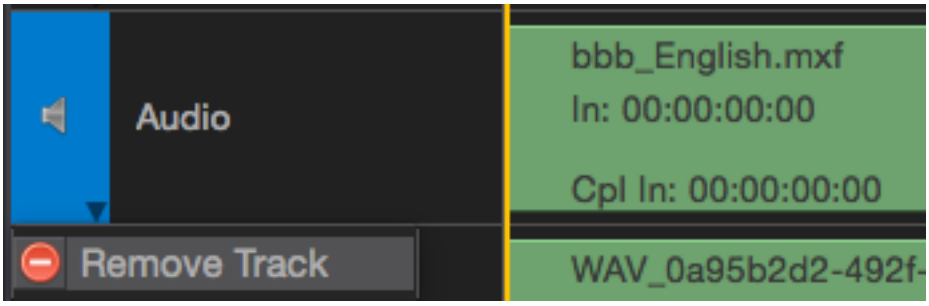


Drag & Drop the WAV Asset from the IMP browser into the timeline:

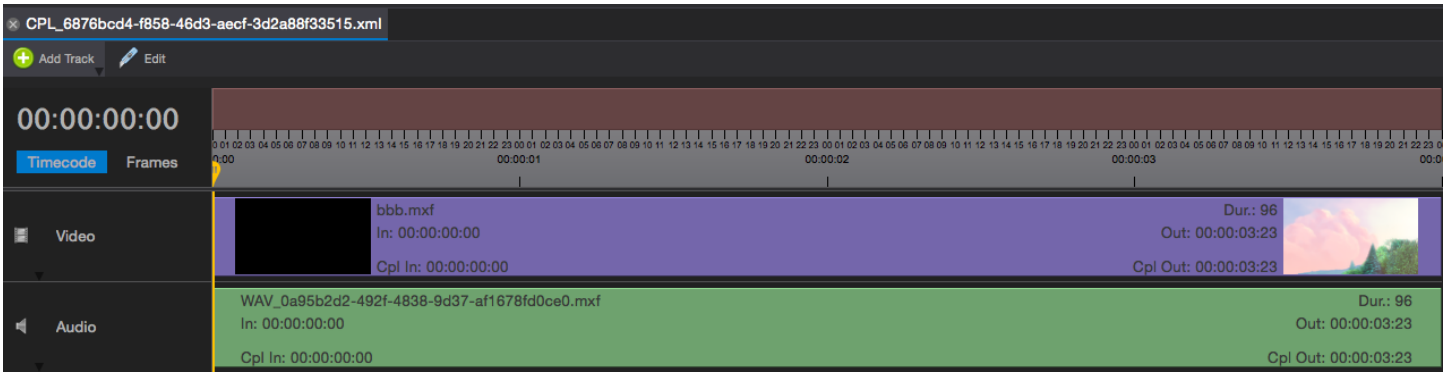
Note: Make sure to set entry point and duration by trimming like they were set before!



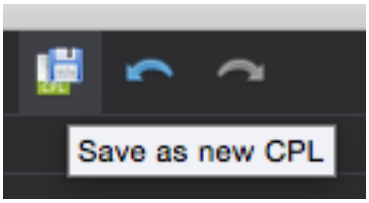
Remove the former audio track:



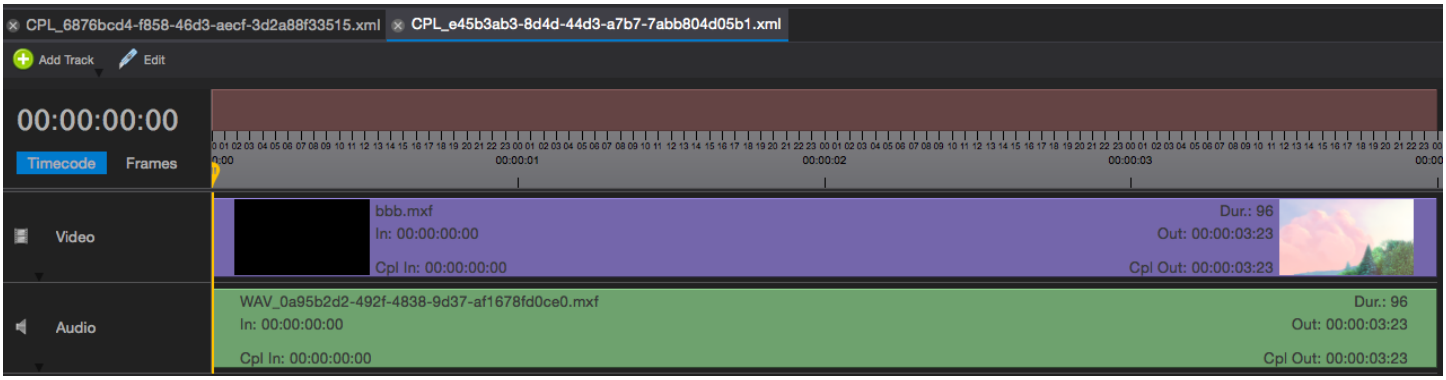
Your timeline looks like this:



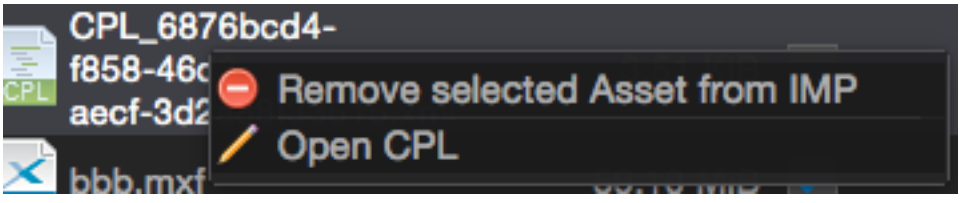
Save the timeline as a new CPL:



The new CPL appears in the second tab:



It is advisable to remove the old CPL from the package:



Finally, write the modified package to disk!

Note: The former CPL and the former audio track file will still exist on disk, although they are not referenced in the ASSETMAP and the PKL: You may safely delete them manually.

Re-wrapping of Timed Text track files

Works similar to the task for audio track files detailed above.

Notes

IMF Tool does not support video wrapping.