MARQUISE
TECHNOLOGIES

ACES WORKFLOWS

August 2018

Content

I. Introduction

Until not so long ago, two major workflows existed. One of them was exclusively targeting the post production of content for the cinemas (film workflow) and the other one was solely designed for production of content for television (video workflow). Each of these workflows used specific tools and constraints, especially in the handling of color processing.

Digital cinema cameras have completely shaken the production world and replaced almost all the legacy video and film capturing devices. Due to commercial competition and the fact that the technology for capturing images is improving day by day, these new devices often bring their characteristics into the workflows, challenging the color management once again.

Besides technology challenges, there are also changes in the way content is produced and post-produced. It is now quite common to have several companies involved at various stages of the making of a movie (be it for television or cinema). Obviously each of these facilities has its own set of tools, techniques and practices, rendering the exchange of information more complex than it was a decade ago.

The Academy of Motion Picture Arts and Sciences (AMPAS), after some intensive work, proposes a new mechanism for exchanging picture and color information between the various players involved in the making of a movie. This new mechanism named ACES, for Academy Color Encoding System, involves several concepts that are intended to overcome the challenges mentioned above, and especially the color integrity of the content, from production to archives.

Marquise Technologies was a very early adopter of ACES in its very first intent, and now that HDR is becoming a commercial reality, with the availability on the market of professional and consumer HDR display devices, and premium OTTs and high-end home video providers urging for HDR content masters, it became even more important not only to support ACES, but also to build the entire Color Management System of Marquise' products around ACES.
This new Color Management system allows color integrity from any source image to ACES, becoming the reference workspace.

Marquise Technologies is renowned for its Mastering solutions, in particular for DCI and IMF mastering. The way deliverables are now created, to satisfy worldwide theatrical releases shortly followed by availability of the content on VOD platforms have also dramatically evolved. Mastering content from an ACES workspace warrants standardized and reliable color transformation to the desired deliverables, could it be SDR or HDR.

II. Supporting products

Marquise Technologies has developed different products implementing ACES.
They are all supporting the latest version, ACES 1.1:

MIST

MIST is a Mastering solution, enabling the creation of any type of masters or file packages, including DCP and IMF, from any type and resolution of source media, including RAW image sequences.
Major ACES functionalities include the Preview and Look Management, the consistent Display of the color space, the process of HDR Wide-gamut data, an advanced Grade Portability and the Color Pipeline Configuration Portability. It is also able to apply ACES conversions during the transcoding process.

ICE

ICE is a Reference Player for DCP, IMF and many other formats, including broadcast deliverables and RAW data. It is able to validate and check the compliancy of DCP and IMF packages, analyze image colorimetry and display related metadata.
Major ACES functionality include the consistent Display of the color space.

TORNADO

TORNADO is a transcoding server. Major ACES functionalities include the process of HDR Wide-gamut data, and a basic Grade Portability.
It is also able to apply ACES conversions during the transcoding process.

III. ACES in MT Color Management System

III.1. Entering ACES mode

MT Color Management System (MT CMS) is extremely versatile and allows to toggle from native to ACES workflow at any time in the grading/mastering process.

Projects can be started as an ACES content from the Project Manager, or switched from Native to ACES from the TimeLine or reverse using the Composition settings.
This means that within one project you can manage different compositions, ACES or native.

III.2. Input Transform support

Using ACES workspace requires source image transformations from the native color space to ACES using the appropriate Input Transform (aka IDT).
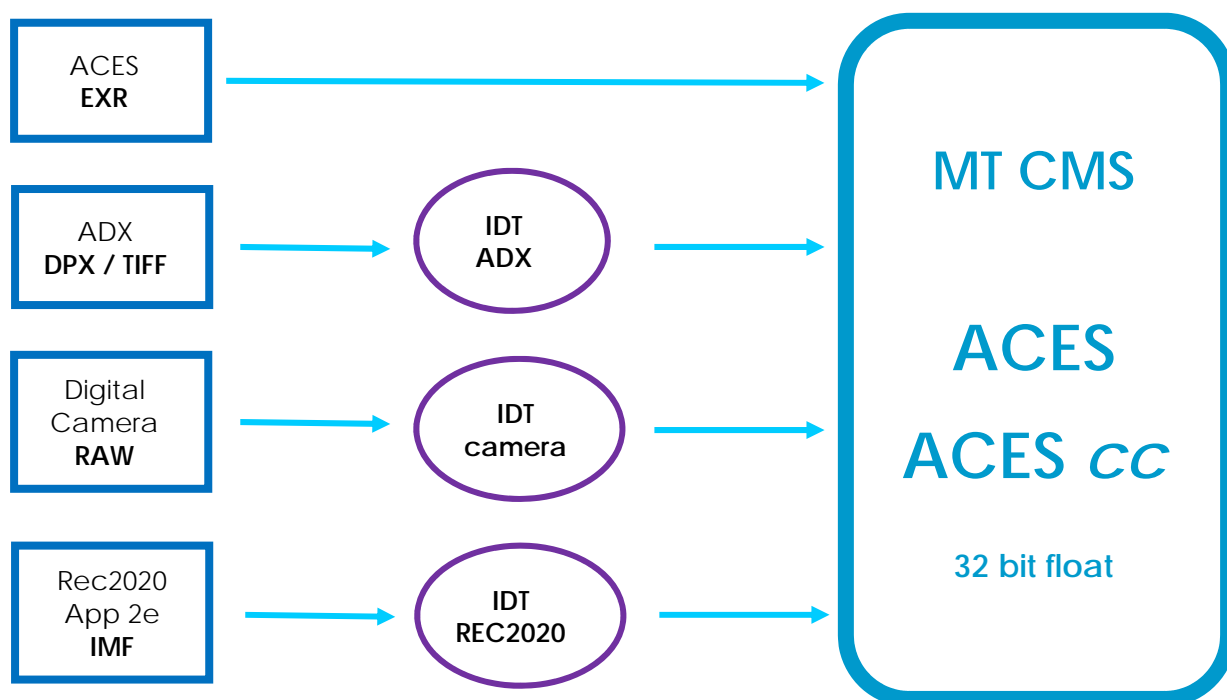
In MIST, the selection of the Input Transform is made in the Grade mode, under SOURCE tab.

Managing the ACES transform in the Grade module has several advantages. The first one is that you can mix sources in the same timeline and apply for each of them the right Input Transform. And of course should there be a need to add additional creative transformations, the rest of the color grading tools are immediately accessible.
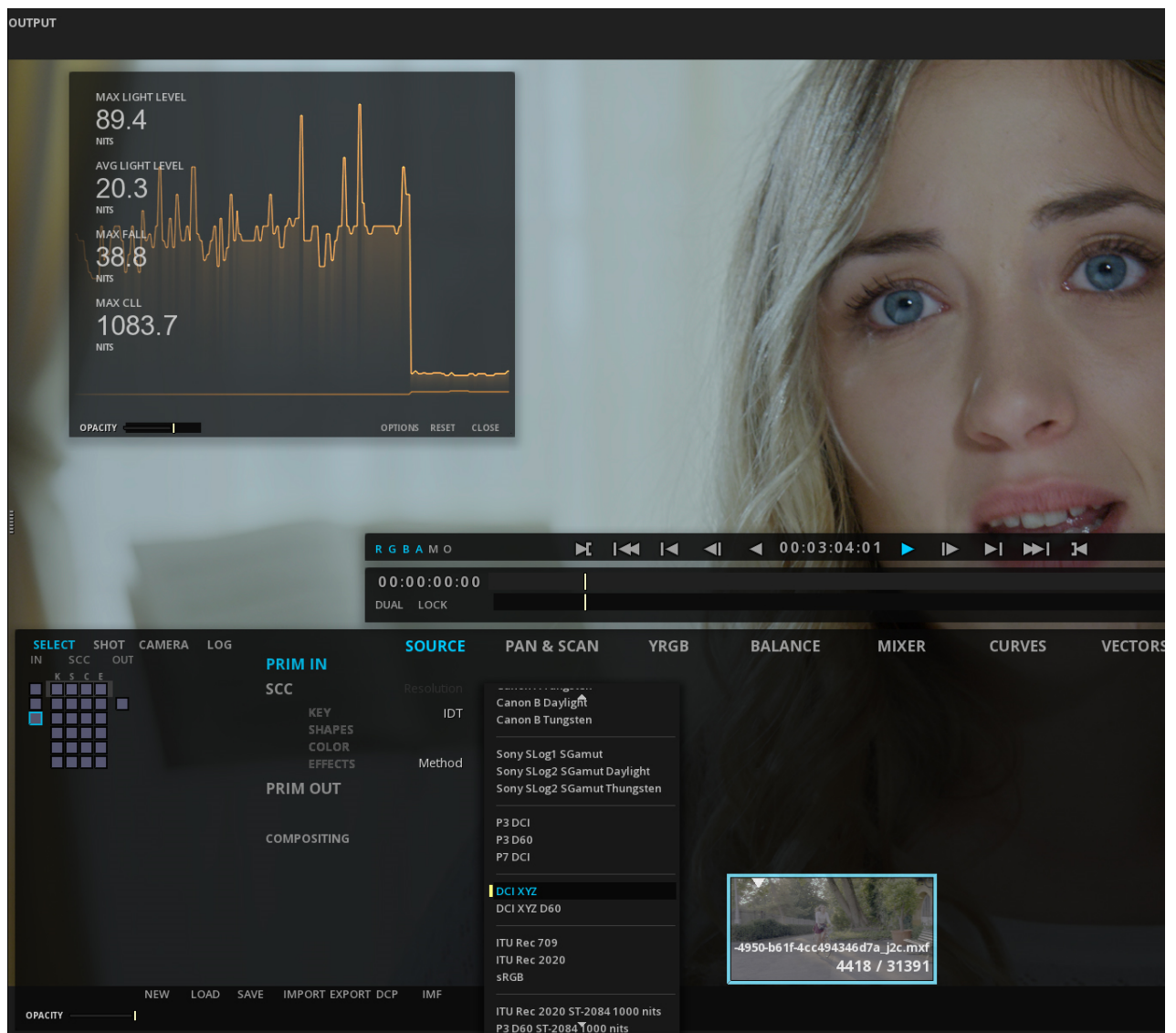
Selection of IDT in MIST

III.3. Grading in ACES

ACES is used to unify the color pipeline across different systems or service providers. This process usually starts when creating the dailies from the RAW images captured by the camera.

When used for creating dailies, MIST offers numerous powerful options for an easy creation process.

Different RAW images can be mixed on the timeline: if the project is started in ACES mode, MIST will detect the RAW format of each shot and will apply automatically the corresponding IDT. The only manipulation remaining is to select the ODT for monitoring (see III.5, Viewing ACES content).

Same simplicity of use applies for the other powerful color grading features available, they are automatically switched into ACES mode when the CMS is in ACES mode.

YRGB color corrections in ACES is available in 3 modes, Film, Video and ASC CDL. A lot more tools, including balance (midtones, shadow, highlights), curves, luminance controls or vectors and shapes are also available for a fine adjustment of the grades.
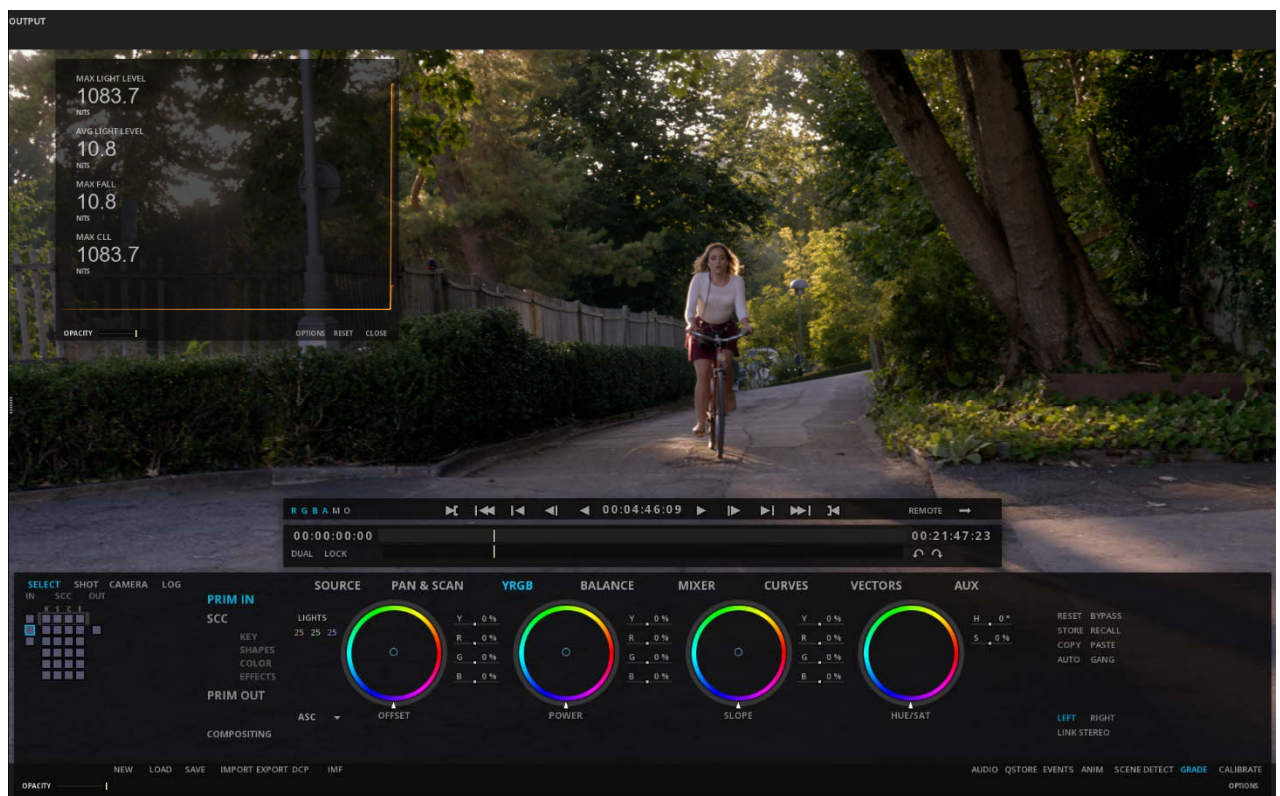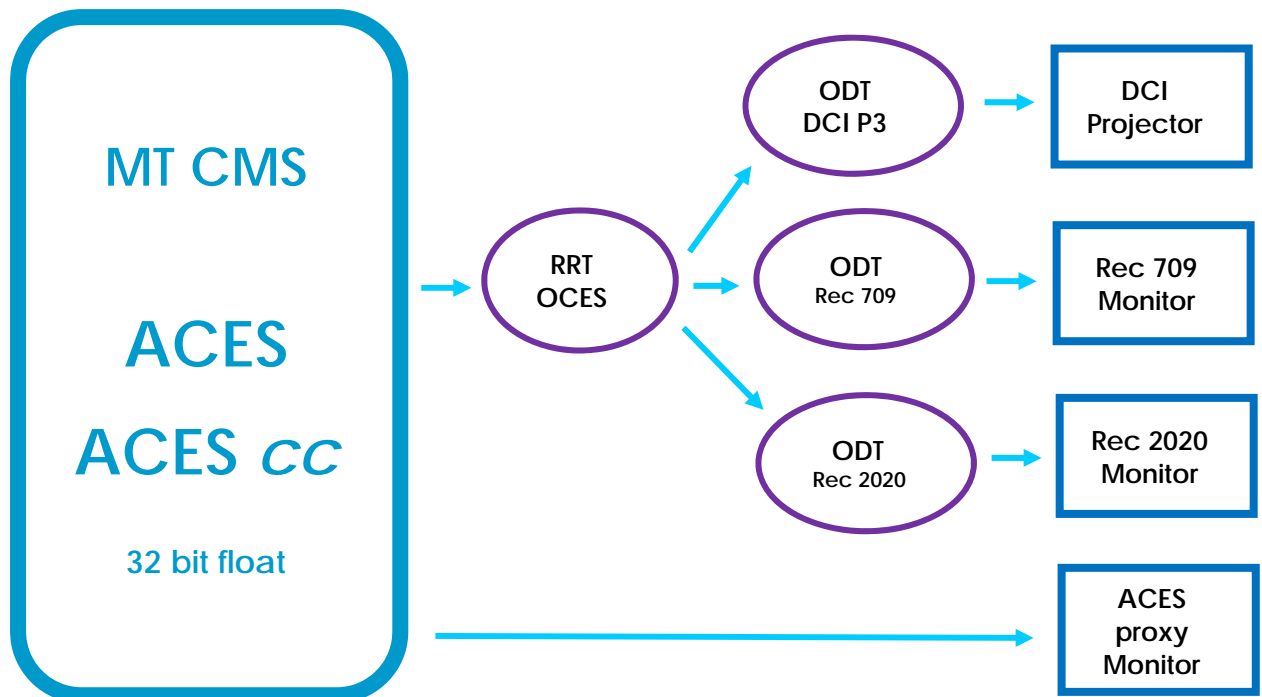
III.4. Previous ACES versions

In order to work with previous ACES content MIST also provides ACES' Look Modification Transforms (LMT) allowing a standardized conversion from ACES 0.1, 0.2 and 0.7 releases to ACES 1.0. and ACES 1.0.3.
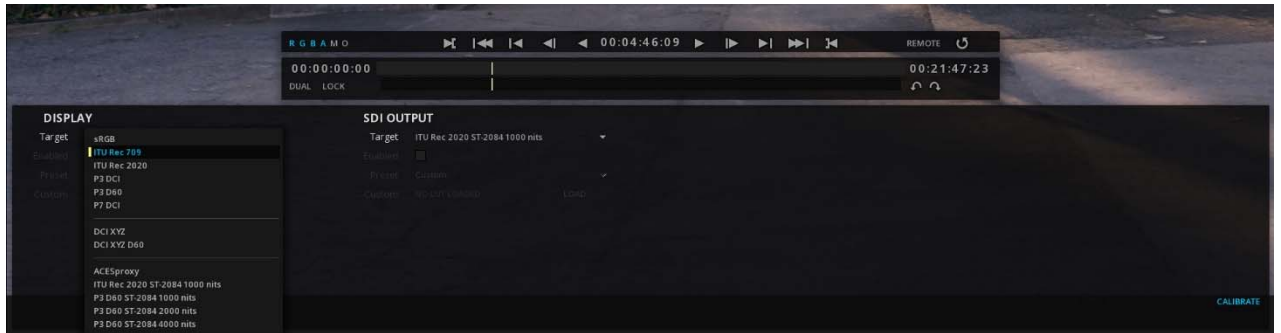
III.5. Viewing ACES content

Whatever the display device is, working is ACES permits a perfect viewing environment according to the image destination. This process is called Output Transform and combines a conversion into OCES using a RRT, and the choice of a specific Output Device according to the viewing environment.
Both MIST and ICE have ACES Output Transforms options.

MT CMS

ACES

ACES *cc*

32 bit float

RRT
OCES

ODT
DCI P3

DCI
Projector

ODT
Rec 709

Rec 709
Monitor

ODT
Rec 2020
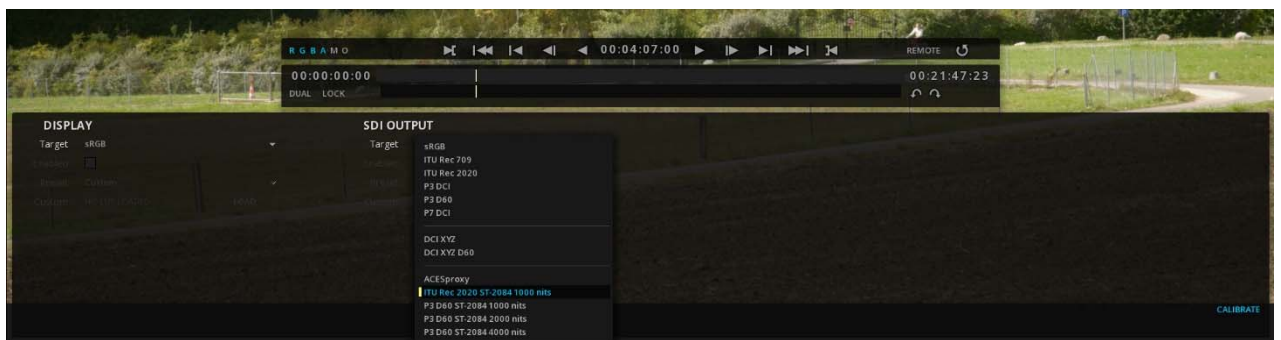
Rec 2020
Monitor

ACES
proxy
Monitor

III.5.1.   Viewing ACES content using MIST

In MIST the Output transforms are selected in the CALIBRATE mode.
2 different ODTs can be applied, one for the current display, and another one for the SDI output that will be linked to a reference monitor or projector.
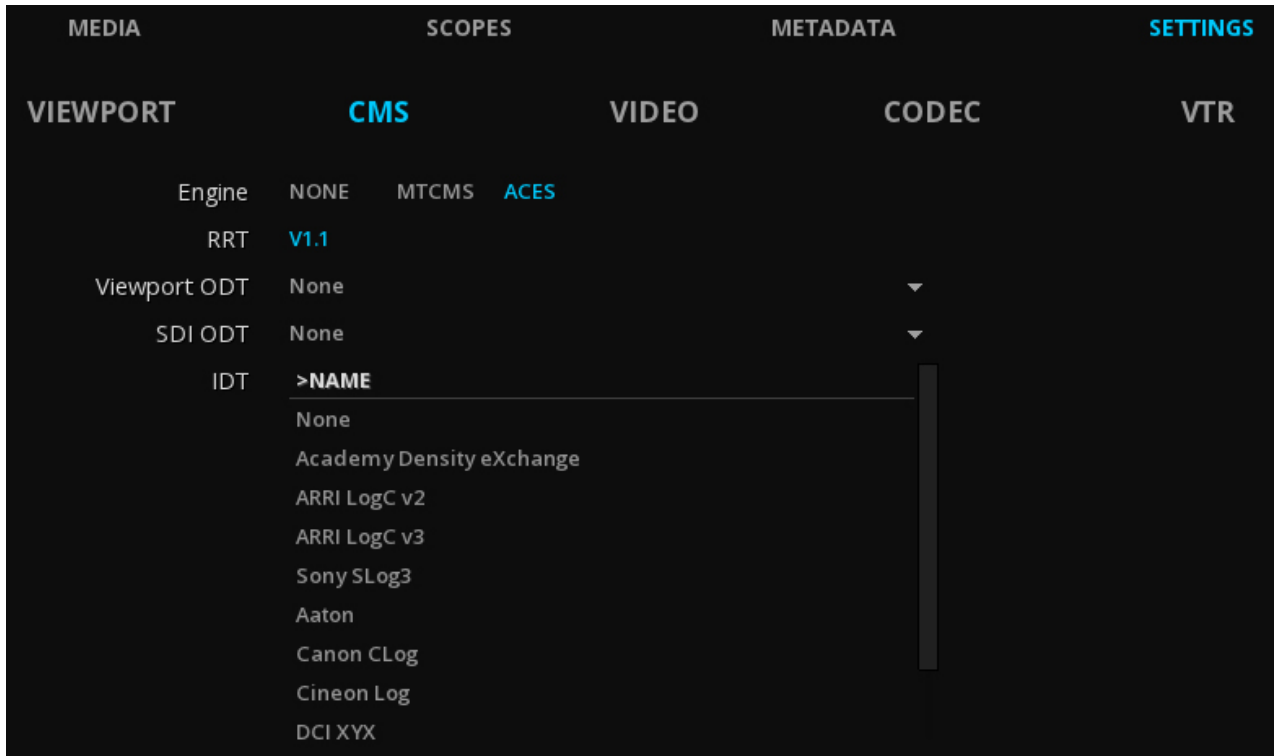

Selection of Display ODT in MIST

Selection of SDI Output ODT in MIST

III.5.2. Viewing ACES content using ICE

In ICE the ACES mode is activated from the Settings, using the CMS tab.

First step is to select the content IDT, then the ODT. Like in MIST, 2 different ODTs can be applied, one for the current display, and another one for the SDI output.


Selection of ODT and IDT in ICE

IV. Mastering in ACES

Creating masters from an ACES workspace allows the creation, individually or in parallel of any type of standardized deliverable as of today, ranging from HD video content in REC 709 to a DCP or an IMF package with HDR in REC 2020. Whatever standard is imagined and implemented in the future beyond Rec 2020, a content in ACES will always be of a higher quality, in terms of color gamut and dynamic range.

IV.1. Mastering from ACES content

The mastering phase starts when a color grading station has finalized the grading in ACES. This content can be imported in MIST either in OpenEXR or as a DPX or TIFF sequence encoded in ACEScc.

To create the deliverables, MIST uses the Render Flowgraph. This graph describes all the operations applied to obtain the content: resizing, color space transformation, pan & scan, etc. This system follows exactly the same philosophy as ACES, hence the declination of any deliverables from a very high quality source.
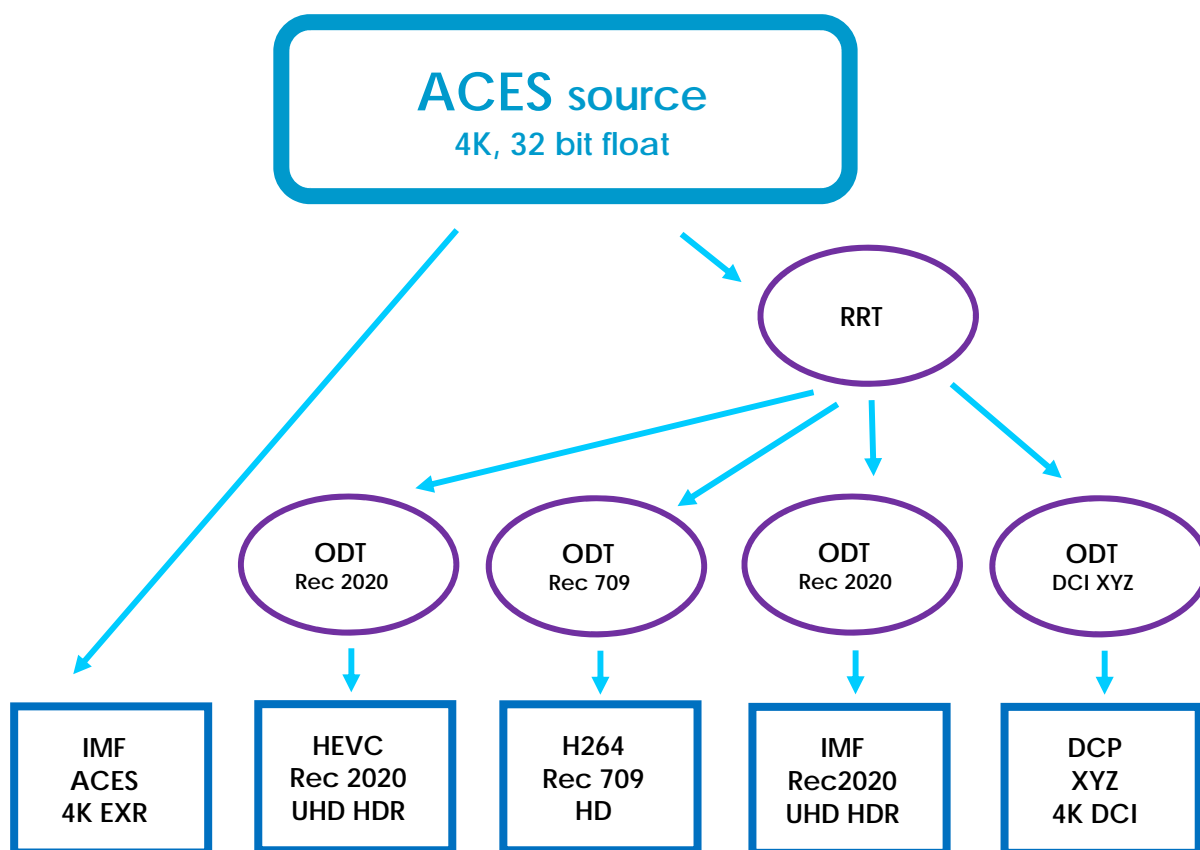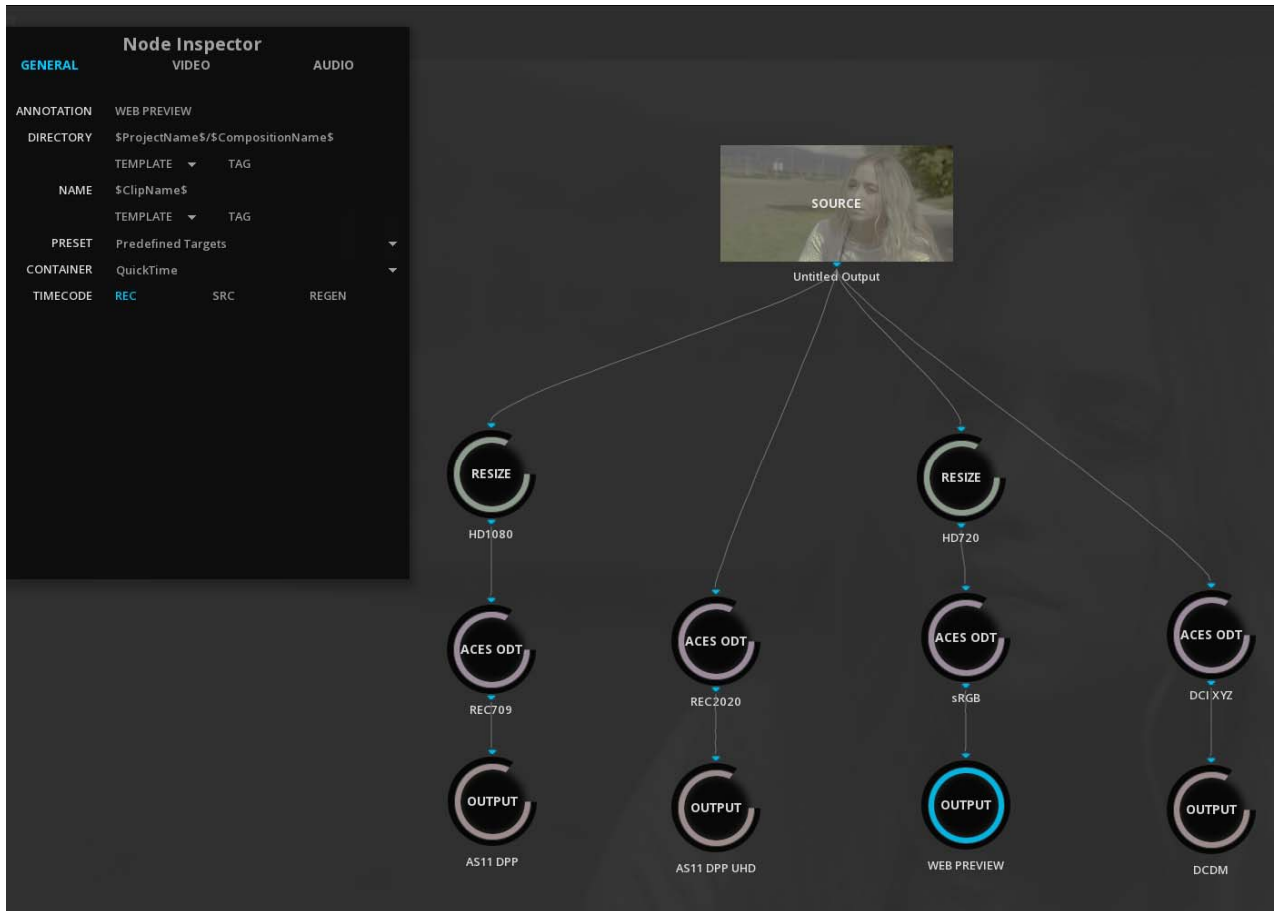
MIST rendering Flowgraph : multiple renderings from an ACES source content

IV.1.1. Creation of a DCP from an ACES content

The path from RGB color space to the DCI XYZ color space required for digital cinema is always subject to discussions and back and forth in the workflow in order to respect the color intention of the cinematographer. Custom LUT are often involved (the lab's "secret sauce"), and some software offers different chromatic adaptation algorithms, but the reality is, you barely know in advance how content will look like in projection.

The standardized ACES ODTs from a source color space to XYZ are offering a guaranteed color conversion, whatever the system used or the service provider chosen.

MIST is offering this possibility when creating the DCP from an ACES content.

MIST DCP export tool automatically recognizes the CMS mode, so with ACES content on the timeline, the source content is already identified as ACES, and all parameters are already set accordingly. No further manipulation is required. MIST will transparently apply all the ACES conversions to the DCI color space.
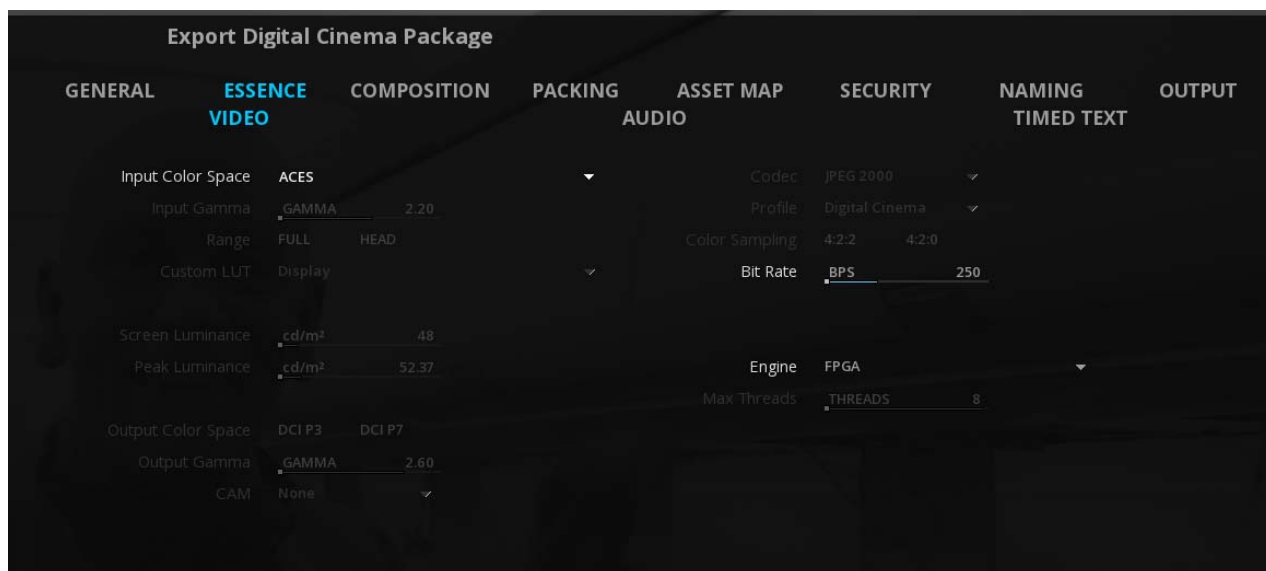
MIST Export digital cinema package tool with ACES source

Because flexibility is always important in our solutions, at this mastering stage it is still possible to modify the CMS and not using ACES transforms:
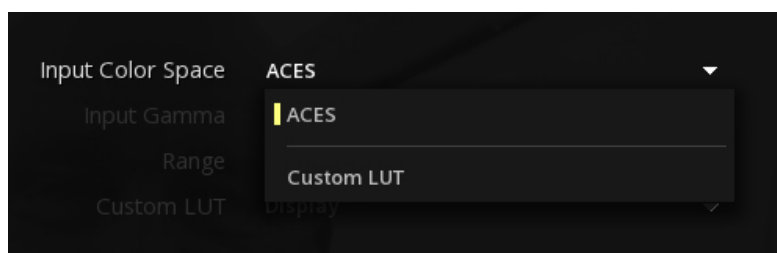
MIST Export digital cinema package tool: custom LUT

IV.1.2.   Creation of an IMF Master from an ACES content

If the IMF is a cousin of DCP in terms of structure, it is much more complex to work with because of the multiple aspects it may take (the multiple IMF Applications differs in color space, bit-depth, color range, etc.).

This make ACES workflows a very safe and efficient way for mastering those types of content.

Exactly like with a DCP, the IMF export tool recognizes the ACES content and will apply the chosen ODT.

With IMF, you first need to select the Application :

MIST Export IMF package tool with ACES source : App selection

According to the chosen options, MIST will only give you a choice a settings compatible with the App selected:
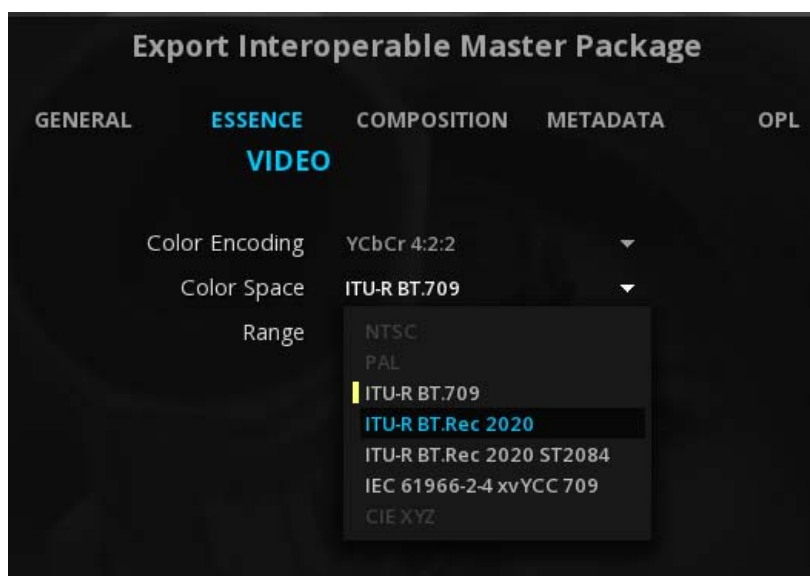
MIST Export IMF package tool with ACES source : color space selection

IV.2. ACES for HDR deliverables

The adoption of BT.2100 HDR TV standard, an extension of the UHD wide color space Rec.2020, changes the game and specifies HDR (High Dynamic Range) content encoded either with the PQ curve (Perceptual Quantization) used by ST 2084 and Dolby Vision, or with the HGL specification (Hybrid Log-Gamma, a gamma curve) meant for backward compatibility with standard dynamic range.

HDR content is now becoming a real business, and efficient tools must be used like for standard type of masters.

ACES colors space being much larger than the one needed by REC200 and BT.2100, it becomes the de facto ideal source format for creating multiple SDR and HDR versions from the same content.

In MIST, in order to guaranty the color integrity during these transformations, ACES is used as the reference workspace for any HDR workflow, including 4K HDR IMF or HDR HEVC.

This mastering process can be performed in a controlled viewing environment, using HDR reference display devices, including devices supporting ACES proxy.

IV.3. ACES for deliverables from non-ACES Master

Although this is not part of the best practices, in the real life service providers often need to create a deliverable not from the source content originated by a color correction system, but from an existing deliverable, like a DCP. This usually happens when some time has passed since the first master creation, and nobody has kept the sources.

Creating a TV air master from a DCP is a tricky process, because you not only need to change the codec, but also the color spaces. Again, for color spaces, custom 3DLUTs are often involved, changing the results of the conversion from one to one.

MIST offers to switch then into the ACES pipeline to guarantee the color conversions. The process is simple:
With a DCP on the timeline, switch the CMS to ACES, and choose in the Redering module the desired output, for example AVC Intra. You will then just need to add the Rec709 ODT in the Flowgraph.

| DCP XYZ 2K DCI | → | Inverse ODT XYZ | → | ACES | → | ODT Rec709 | → | AVC Intra Rec 709 HD |

V. Conclusion

Working in ACES has many advantages all along the post-production process.
It is a unique philosophy of work enabling a permanent control on the color pipeline, from end-to-end, notwithstanding the number of systems or service providers involved in the workflow.

In addition, the bridges to in and out the ACES workspace are standardized, so that the deliverables mastered from ACES will always have applied the same transformations, with no color shift from a system to another.

The adoption of such new way of working will only be successful if in the real life, the tools used for the process are understandable and easy to operate.

At Marquise Technologies, we have put great attention in the ACES implementation in our solutions, in order to keep it as transparent as possible, with a minimum of parameters to set up, to make it even smoother to work with than with native color space workflows.

VI.   Additional Information

More information about ACES and AMPAS goals can be found here :

http://www.oscars.org/science-technology/sci-tech-projects/aces

MARQUISE TECHNOLOGIES
Route des Avouillons 4
1196 Gland – Switzerland

www.marquise-tech.com