\ ACADEMY COLOR ENCODING SYSTEM \

HPA 2019

Andy Maltz ◆ Annie Chang ◆ Joachim Zell ◆ Wolfgang Ruppel

Session Agenda

- ACESNext
- SMPTE IMF Application #5
- Academy Digital Source Master

ACADEMY COLOR ENCODING SYSTEM

ACESNext ◆ General Updates

Annie Chang

What's Happened Over the Last Year

- ACES 1.1 Release
- Primer
- Quick Start Guides

Quick Start Guides

- Available
  - Overview
  - Workflow Sample
  - DIT
  - VFX
- Planned
  - Colorist
  - Cinematographer
  - Post Production Supervisor
  - Producer
  - Director
  - Facilities Engineer
  - Editor
  - Archivist

ACES

ACES Project Checklist

Visual Effects Supervisors / Artists

This checklist is intended to help you organize your first couple of ACES projects, after which this should be second nature for you. Many of these step identify any ACES-specific questions you need to as answers.

Getting Started

- As ever, communication is key. While ACES simpli settings, there are still some decisions to be made viewing the image at various stages, and thorough be assured. This is the primary issue that ACES ai every step, and for every collaborator.

File Formats

- Discuss who is doing the VFX pulls, and the forma ACES2065-1 encoding or in the native color space the traditional 10-bit version should be avoided, as captured by modern digital cameras.
- The ACES standard for interchange is 16-bit uncor with the ***ACES Image Container*** flag set (defined uncommon for facilities to use ACEScg for internal should be taken to ensure that ACEScg files are n ACES Image Container flag should never be set fo for any external interchange.

Working with DI

- Test a round-trip back to DI and editorial, to ensure unaffected by the process, and exactly match thos for editorial. Make sure that any plate normalizatio be removed in final renders. Simple ASC CDL type communicating on-set looks to VFX and DI.
- Communicate with the colorist / DIT / dailies coloris ensure you apply them in the intended color space linear ACES2065-1 for CLF (Common LUT Format Look Modification Transforms or LMTs). The same look identical in the mid-tones and highlights, so ar immediately noticed, but the shadow handling will so that work-in-progress renders drop seamlessly
- Decide whether you are using LUTs which have th Device Transform or ODT) baked in or grade only eliminates the ability to switch Output Transforms t LUTs will also eliminate the option to toggle the gra

Compositing

- Make sure you have access to all custom Input Transforms (sometimes called Input Device Transforms or IDTs) for cameras used on the show, and make sure you have them in a form that can be used in your compositing software.
- If you are using software such as Nuke, a move to ACES will not have a significant impact on the way you work. Nuke was designed from the ground up to work with linear image data – the same as ACES. However Nuke's legacy color management does not specify a working color space, and it simply linearizes the image data with its current primaries, and uses 1D display transforms with no tone-mapping for values above 1.0. Recent versions use Open Color IO (OCIO) for color management. OCIO has options to mimic Nuke's legacy approach, but also includes a pre-built configuration for ACES.
- Software such as After Effects is geared towards working in a display-referred way, where the actual pixel values sent to the screen are manipulated. Display device color management is provided via ICC profiles which compensate for the difference between a standard and the actual display in use, although many people disable this feature. Moving to ACES will therefore involve a slight change of mindset, working on scene-referred image data, and viewing the result through an ACES Output Transform. This can be implemented in After Effects using the free OCIO plugin from Fnordware. Besides the standardization of input and output transforms that ACES brings, there are many other noticeable benefits to moving to scene linear, such as more realistic focus and exposure changes, without the need for 'cheats'.

CGI

- Some 3D software (e.g. Cinema 4D) works internally in a high dynamic range linear way, but the software's viewport treats this image data as display linear, offering only simple 1D view transforms that clip values greater than 1.0. The software may provide a highlight compression slider, but it is likely to use an unspecified algorithm that does not match the tone mapping of ACES. This means that rendering to an EXR (which generally requires a ***linear sRGB*** IDT in comp or DI) will result in an ACES image that does not match what was seen in the viewport. This difference must be accounted for when lighting and texturing, and the tendency to alter the scene to make it 'look right' through the viewport's simple sRGB view transform should be avoided. The need to use LUTs or ICC profiles to preview the ACES look is discussed in this thread on ACES Central.

Simple sRGB Viewer LUT

ACES sRGB Output Transform

- HDRI environment captures should easily drop into an ACES pipeline, as they are already high dynamic range scene referred data. The only consideration is whether the primaries need to be mapped to ACEScg (AP1) primaries, to match the rendering color space. Texture libraries or your own SDR texture captures will also need to be converted to ACEScg. In this case a simple inverse sRGB transform plus a matrix should be sufficient, as textures should not contain image data above diffuse white.

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ACES 1.0 Listening Tour Feedback

- 42 interviews with individuals or groups
  - Color/Image Scientists
  - Colorist
  - Content Owners
  - DITs
  - DPs
  - Manufacturers (Cameras, Software)
  - VFX Companies + RAE Paper
  - Other general users
  - Prior ACES Leadership
- Over 80 individuals (not including RAE authors and contributors)
- Nearly 450 comments to parse through
- 48 main points of feedback

ACES 1.0 Listening Tour Results

Top Ten (starting with the one with the most votes)

1. RRT needs to be invertible and separate the “look” from the RRT (put look in LMT)
2. ACESclip needs to be defined and implemented in tools
3. Need a way to exchange and archive LMTs; re-look at CLF and implement in all tools
4. Need to fix negative values issue (not just through an LMT)
5. CTL is good for prototyping and to define the intention, but because it’s not realtime, it isn’t viable in production; need to look other implementations
6. Allow for custom IDTs, including camera color gamut matching
7. Should be able to customize ODTs (including parametric) and publish them
8. Allow for color grading in non-ACES spaces (like the Original Camera Color Gamut and tonal curve). Must be able to document for archive
9. Should take a look at the AP0/AP1 gamuts including why AP1 red is outside of AP0, why AP1 does not equal 2020 and other issues
10. Remove modifiers from ODTs; make ODTs more like standard 709 and P3

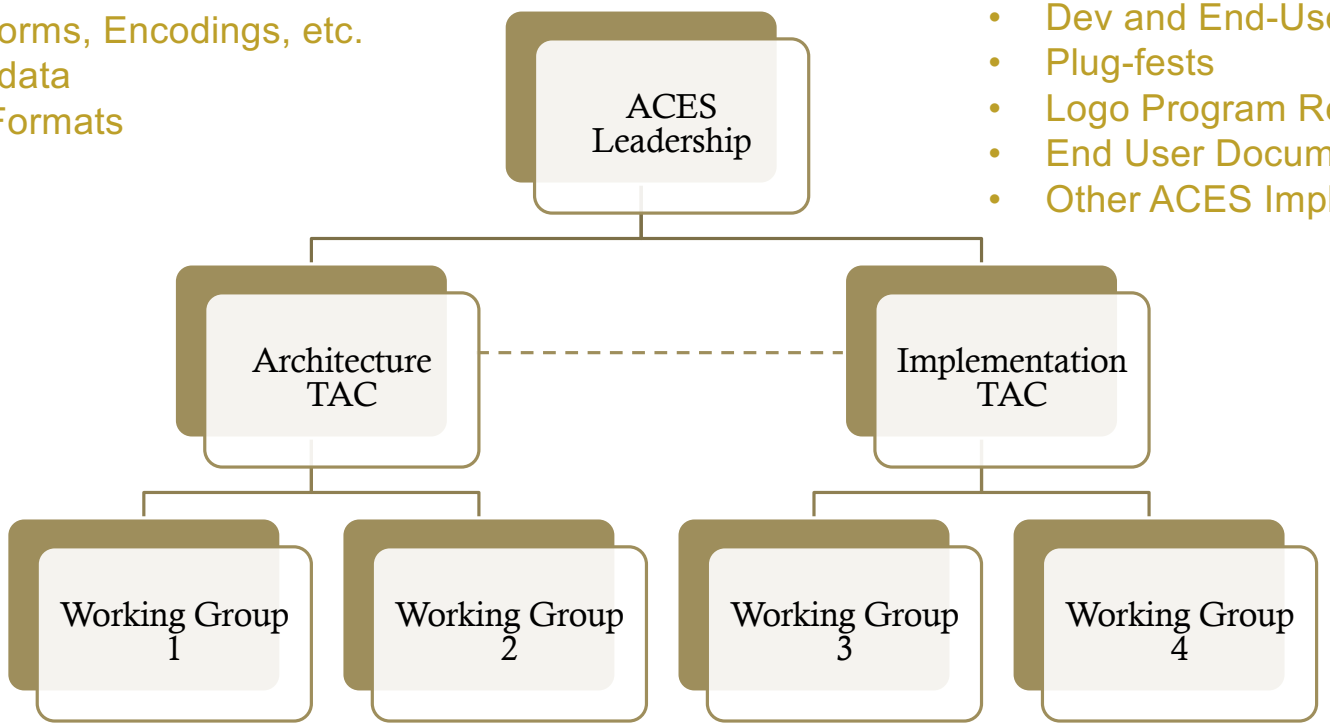
ACESNext Process Going Forward

- Governance
  - Work towards Open Source model
  - Similar structure as ASWF

ACESNext Structure

Architecture TAC Oversees
- Architecture Definition
- Core Transforms, Encodings, etc.
- ACES Metadata
- ACES File Formats

Implementer's TAC Oversees
- Reference Implementation
- Dev and End-User Tools
- Plug-fests
- Logo Program Requirements
- End User Documents
- Other ACES Implementation topics



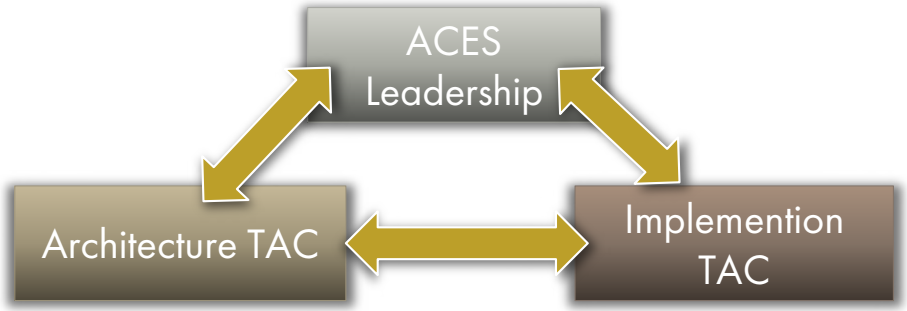
ACESNext Structure

Architecture TAC

- **Chair: Rod Bogart**
- Studio Representatives
- Color Science SME
- Archive SME
- Post-Production SME
- VFX SME
- Cinematography SME
- Editorial SME

Implemention TAC

- **Chair: Joachim Zell**
- Product Partners
- OCIO Representation
- Post Facilities
- VFX Facilities



ACESNext Structure

- Working Groups
  - Chair approved by TAC and ACES Leadership
  - Members: Anyone interested in topic
  - Scope: Defined by TAC on a per-topic basis
  - Short-lived, topic-based, pop up group
  - Results of work are presented to assigned TAC and then ACES Leadership
  - Communication through ACESCentral.com and other collaboration tools

ACADEMY COLOR ENCODING SYSTEM

ACESNext ◆ Current Work

Joachim Zell

Discussions - ACESNext

This category is for discussion of ACES system enhancements - referred to as the ACESNext efforts. ACES Virtual Working Groups (VWG) conduct their conversations here in these categories and share documents on this Document Workspace:

https://aces.mp/VWG_HOME

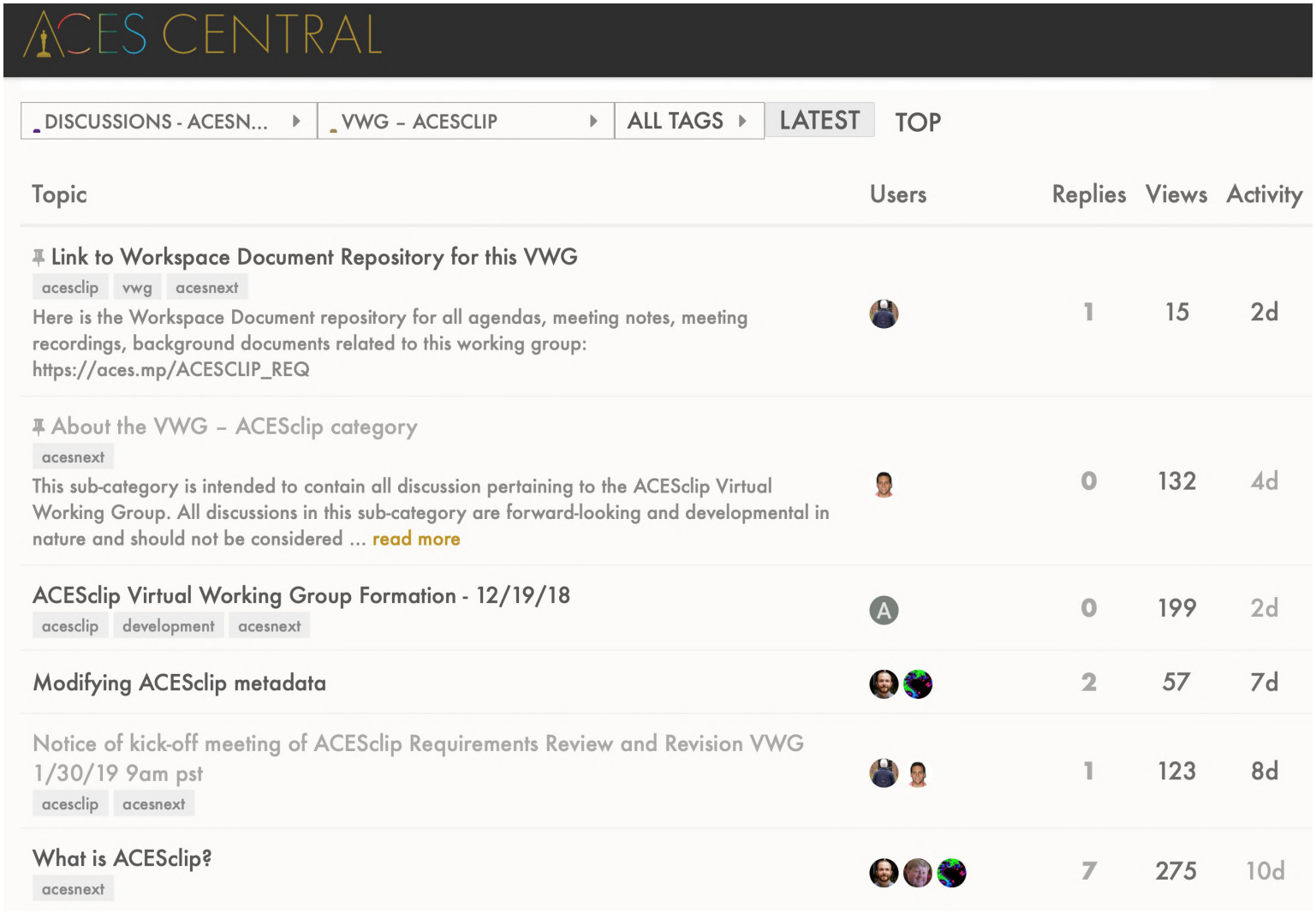
- VWG – ODT
- VWG – ACESclip
- VWG – Common LUT Fo...

Active Working Groups

Working Group	Chair	Purpose	Opened	Status	Next Meeting	ACESCentral Category (Discussions)	Workspace (Documents)
CLF Spec / Code Review	JD Vandenberg	• Review the CLF Spec and Code based to determine sufficiency	11/29/2018	Active	2/6/2019 9am pst	https://acescentral.com/c/aces-development-acesnext/vwg-clf	https://aces.mp/CLF_SPEC_VWG
CLF Implementation Review	JD Vandenberg	• Review how and where CLF is currently implemented and identify barriers to wide adoption	11/29/2018	Active	TBD	https://acescentral.com/c/aces-development-acesnext/vwg-clf	https://aces.mp/CLF_IMPLEMENTATION_VWG
ACESclip Requirements Review and Revision	Chris Clark	• Gather expectations and requirements from prospective users of ACESclip metadata • Explore which systems are responsible for the initial creation of ACESclip metadata, based on the requirements gathered above	12/20/2018	Active	TBD	https://aces.mp/ACESCLIP_VWG_HOME	https://aces.mp/ACESCLIP_REQ

Archived Working Groups

Working Group	Chair	Purpose	Opened	Status	Discussions	Workspace
HDR ODTs	Bill Mandel, Thad Beier	Determine the sufficiency of ACES 1.0 HDR ODTs and suggest improvements	11/2016	Archived 06/2017	https://acescentral.com/c/aces-development-acesnext/virtual-working-group-odt	None

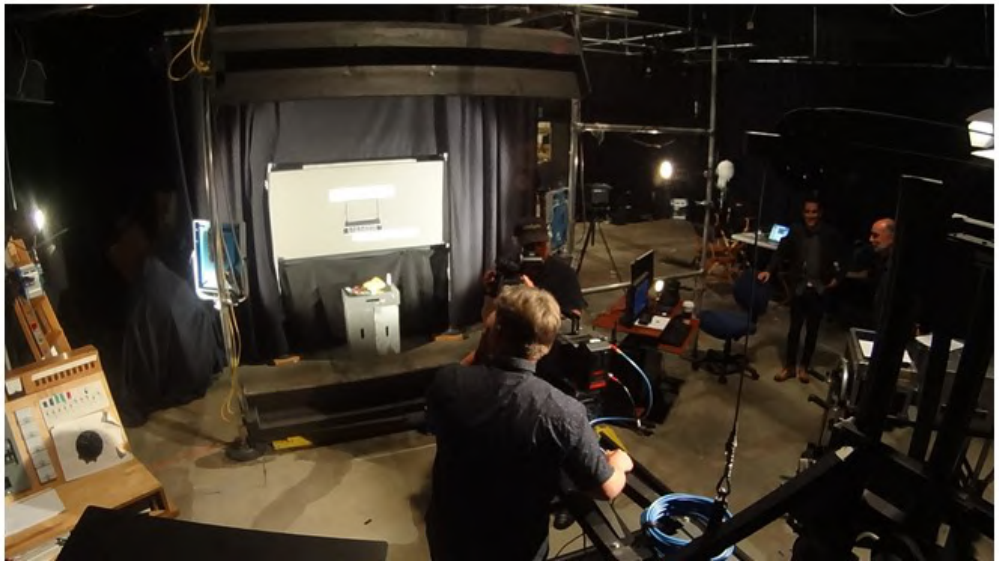

ACES CENTRAL
DISCUSSIONS - ACESN...
VWG – ACESCLIP
ALL TAGS
LATEST
TOP
Topic
Users
Replies
Views
Activity
Link to Workspace Document Repository for this VWG
acesclip vwg acesnext
Here is the Workspace Document repository for all agendas, meeting notes, meeting recordings, background documents related to this working group: https://aces.mp/ACESCLIP_REQ
1 15 2d
About the VWG – ACESclip category
acesnext
This sub-category is intended to contain all discussion pertaining to the ACESclip Virtual Working Group. All discussions in this sub-category are forward-looking and developmental in nature and should not be considered ... read more
0 132 4d
ACESclip Virtual Working Group Formation - 12/19/18
acesclip development acesnext
A
0 199 2d
Modifying ACESclip metadata
2 57 7d
Notice of kick-off meeting of ACESclip Requirements Review and Revision VWG 1/30/19 9am pst
acesclip acesnext
1 123 8d
What is ACESclip?
acesnext
7 275 10d

The AMPAS Esmeralda Room
IDT VWG

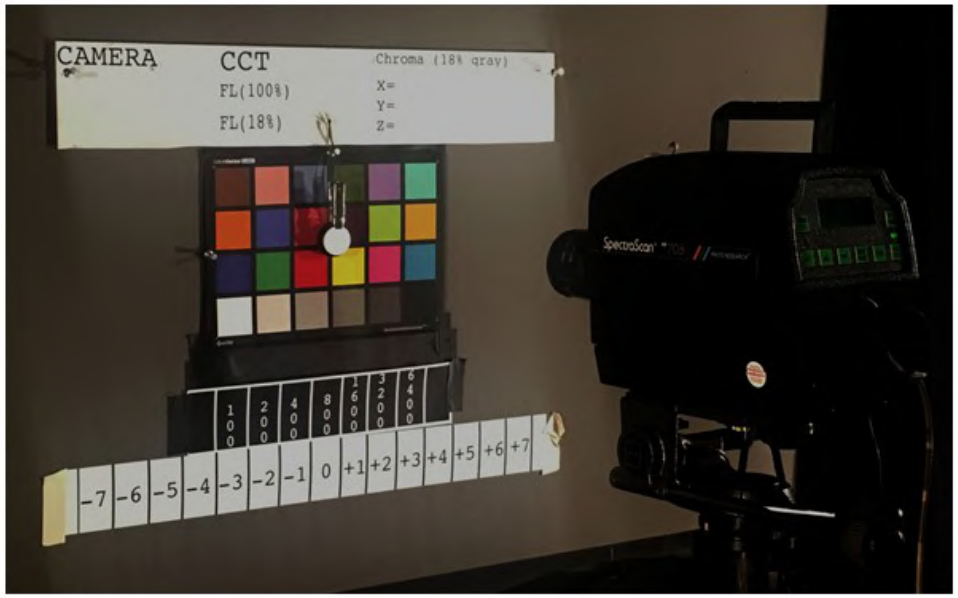
Steve Yedlin, ASC
Joshua Pines, Technicolor
Joachim Zell, EFILM

Academy “Esmeralda Room”

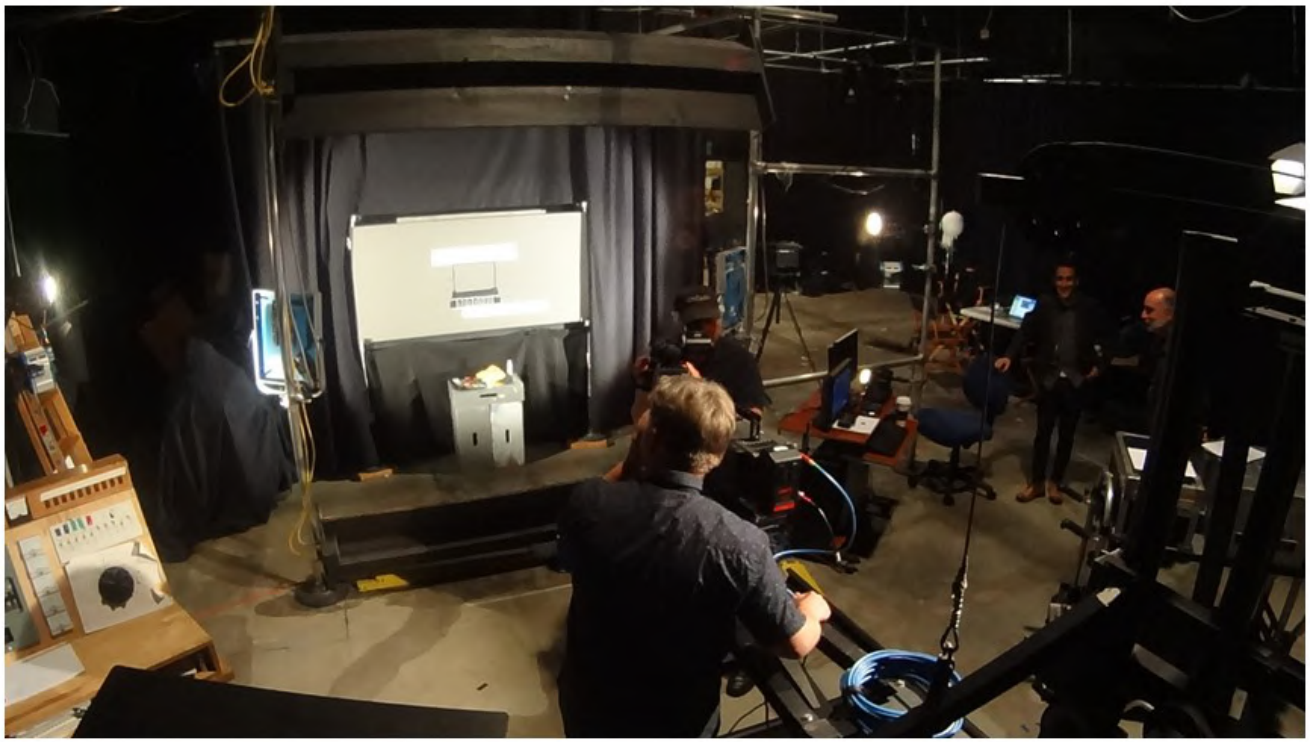
- chart square on
- chart is in the center of the frame
- camera's distance, chart one quarter of a 35mm frame



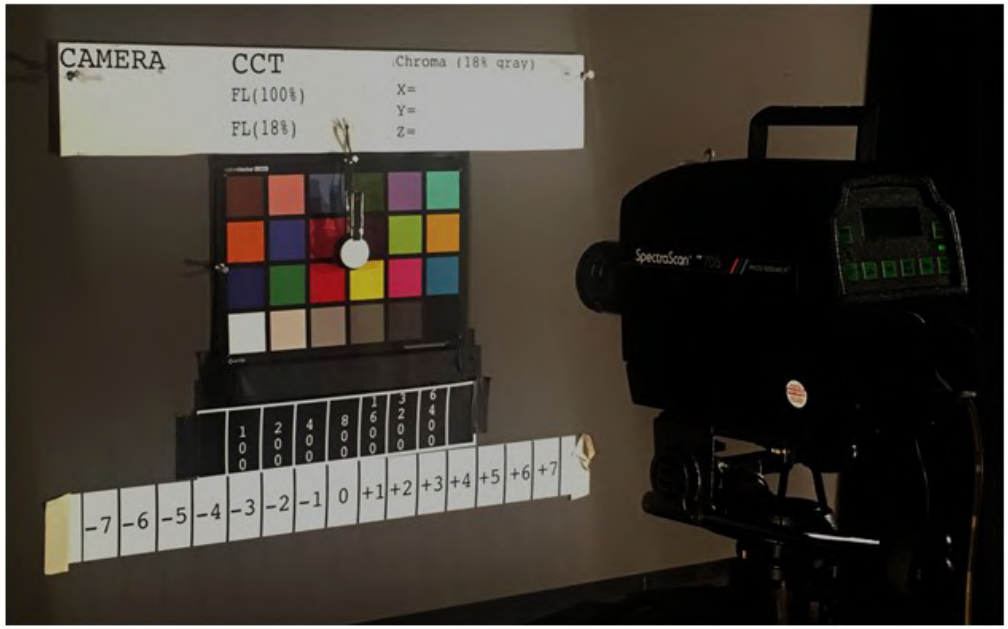
100 % luminance measured on a reference ceramic tile
Recording off a MacBeth chart and the R-27 18% gray card



the luminaires on either side of the camera are located 45 degrees off of the lens axis



The room status gets verified by a Photo Research Spectroradiometer
An exposure meter is used to set the cameras ISO, shutter angle, and frame-rate settings



For the Esmeralda Room recordings,
we decided to go for distance of 12′ between gray card and focal point of the camera

When setting the stop, start with the iris wide open and close down to the marked t/stop
don't start closed and open to your stop
(because lenses are marked to account for backlash in the mechanism).

To calculate the "over and under stops" @ 800 ISO,
We used the following formula:

stop = Log2 ((L * (S/N^2) * (1/F) * (A/360)) / K)

Where:
N is the f-number of the lens setting (in our case f5.6)
L is the average scene luminance in cd/m^2
(in this case the gray card luminance = 30 cd/m^2)
S is the ISO (in our case 800 ISO)
K is the calibration constant (which we're saying is 12.5 — that's what Sekonic and others use and seems to coincide with reality of how real-world exposures predict photographic results)
F is Frame Rate in FPS
A is the Shutter Angle

Shutter Angle	Frame Rate	Aperture	Stops @ 800ISO	
358	0.813	t/5.6	6	
180	0.813	t/5.6	5	
180	1.625	t/5.6	4	
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180	15	t/5.6	1	
90	15	t/5.6	0	
45	15	t/5.6	-1	
22.5	15	t/5.6	-2	
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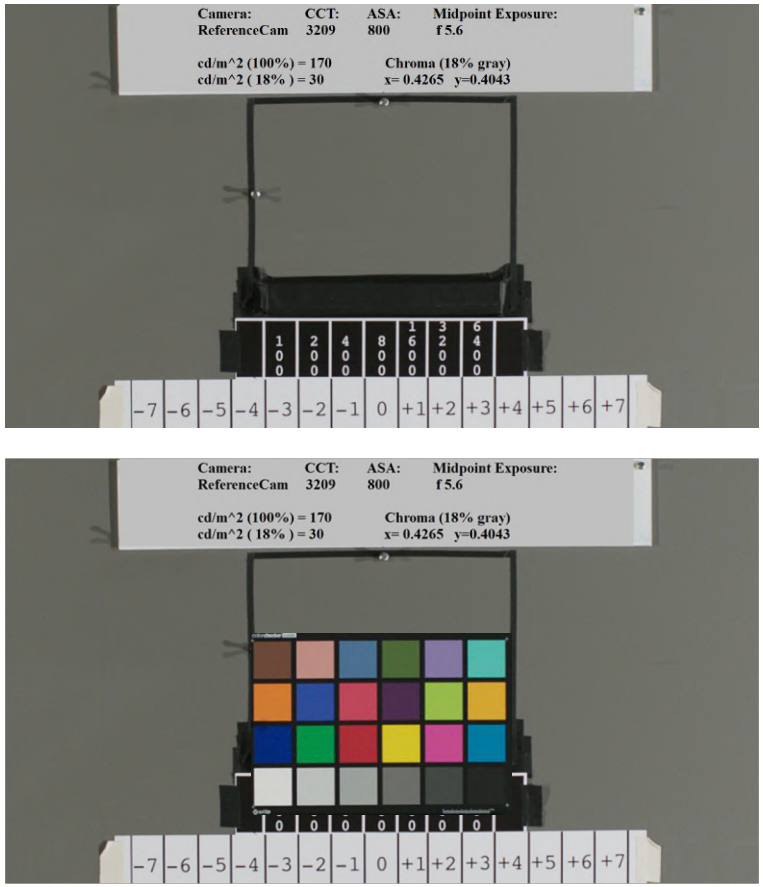

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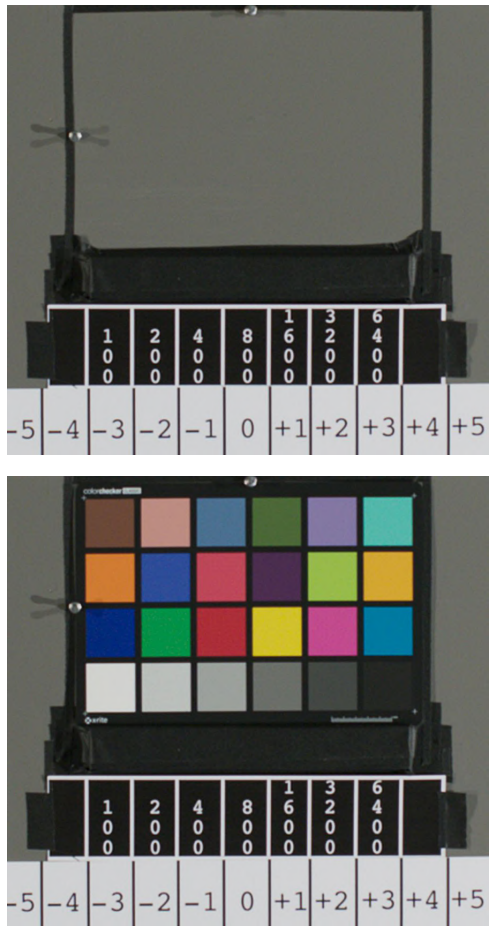

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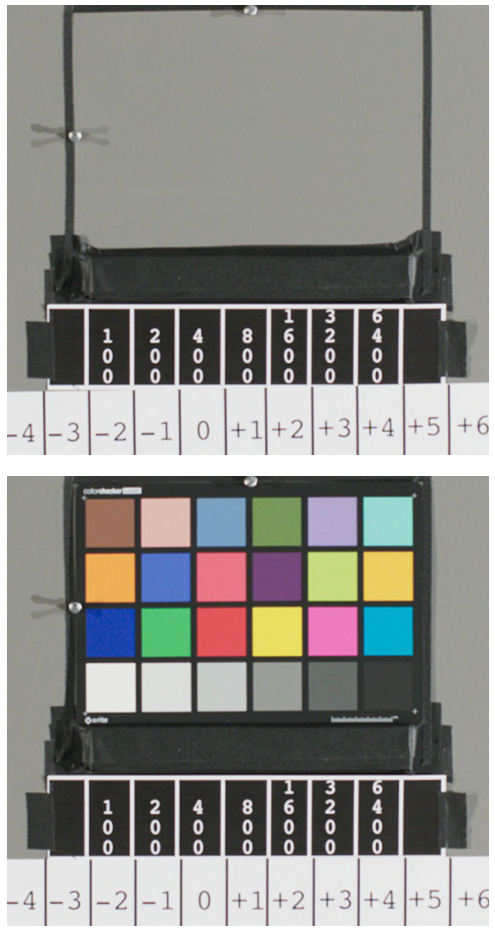

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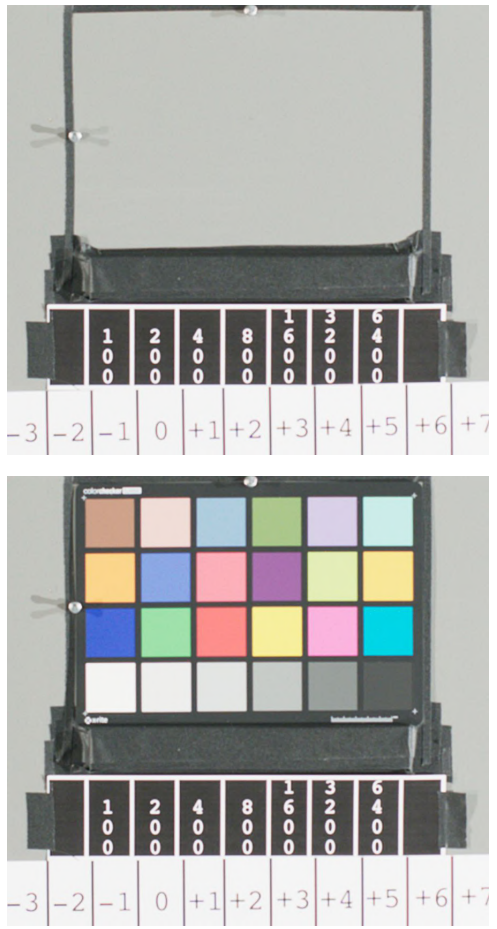

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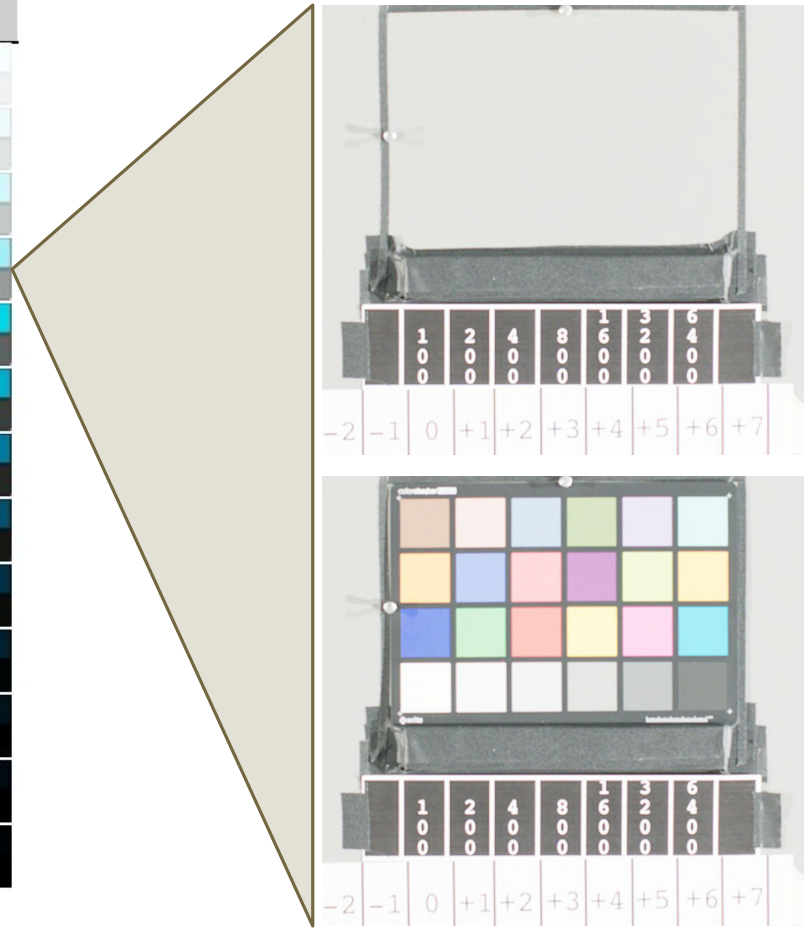

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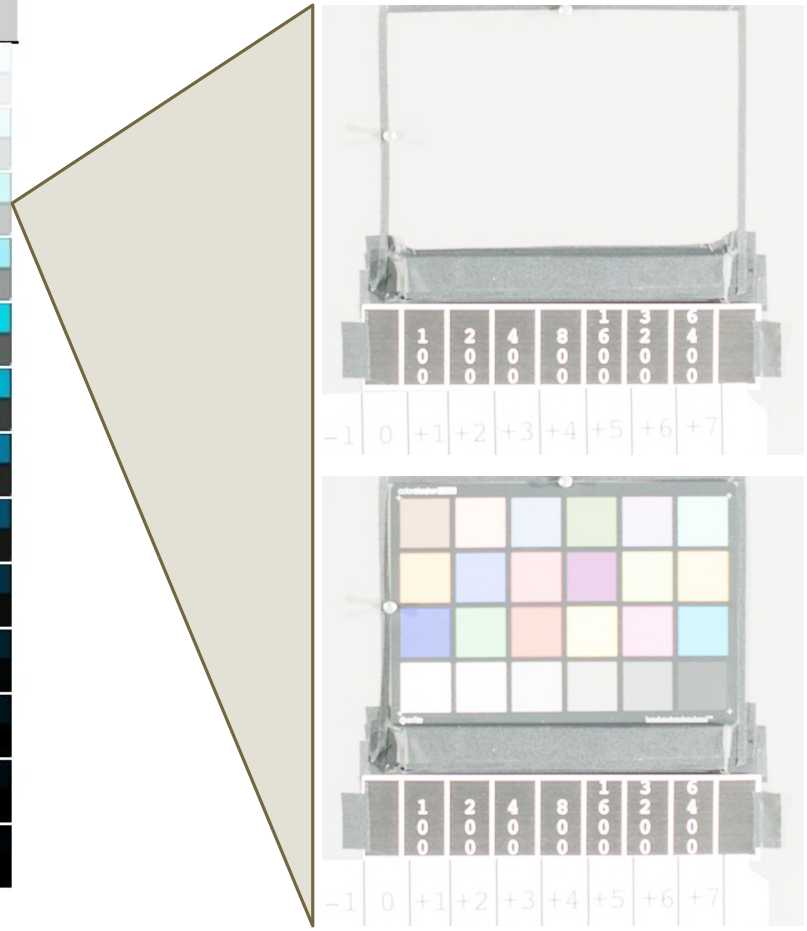

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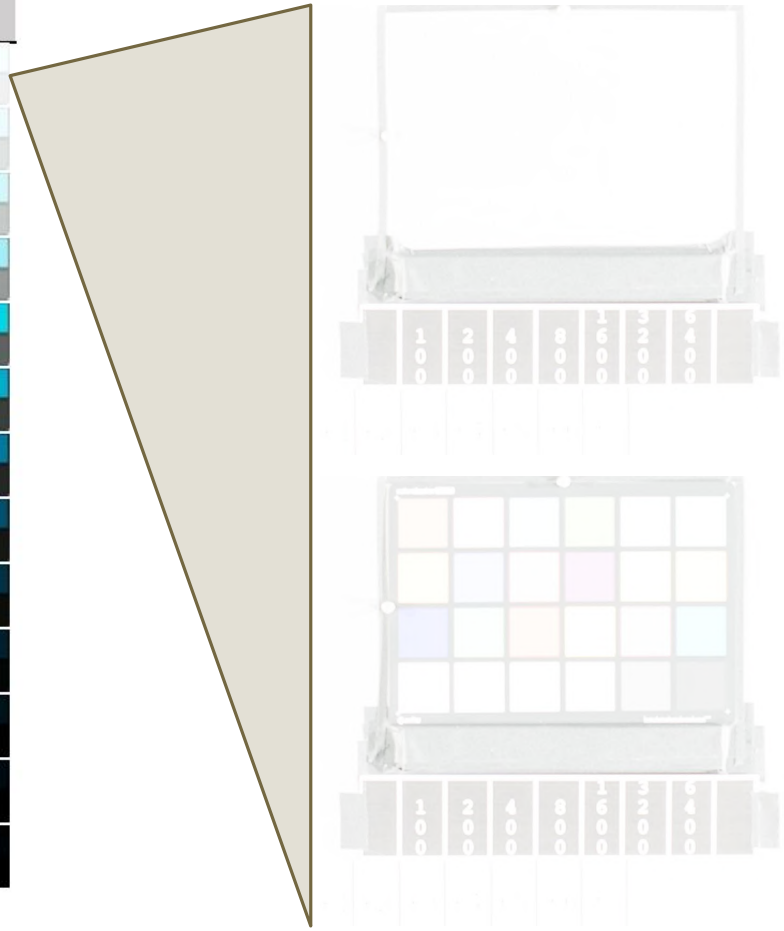

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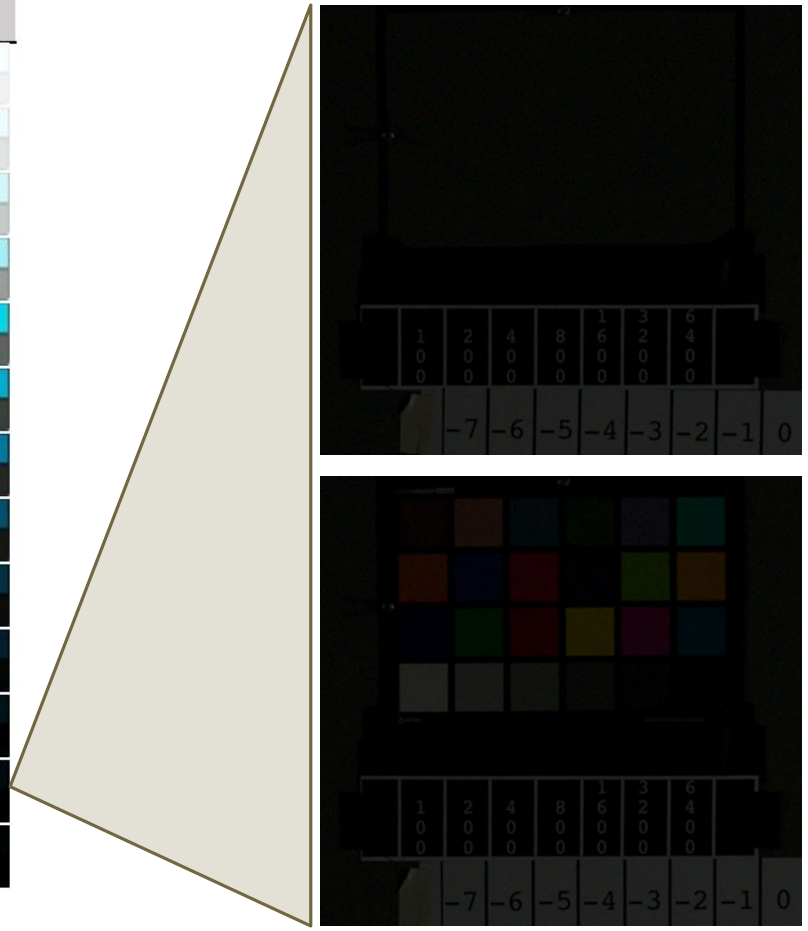

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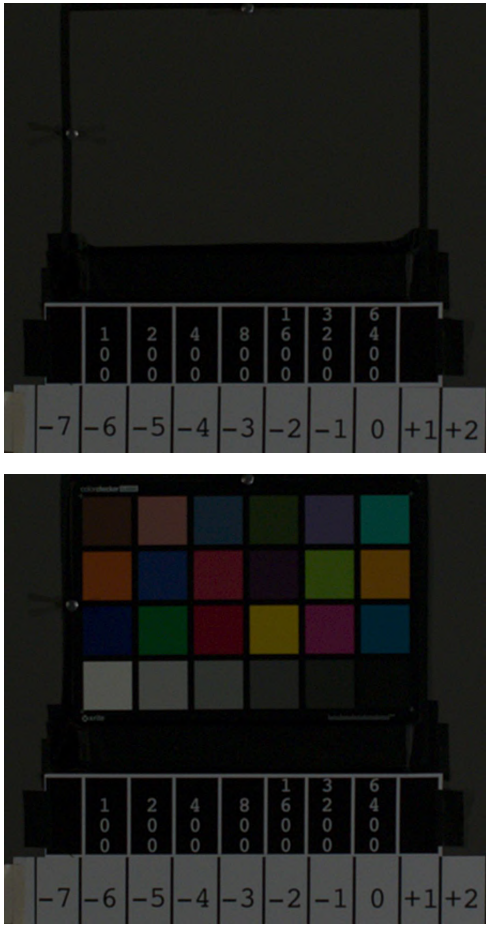
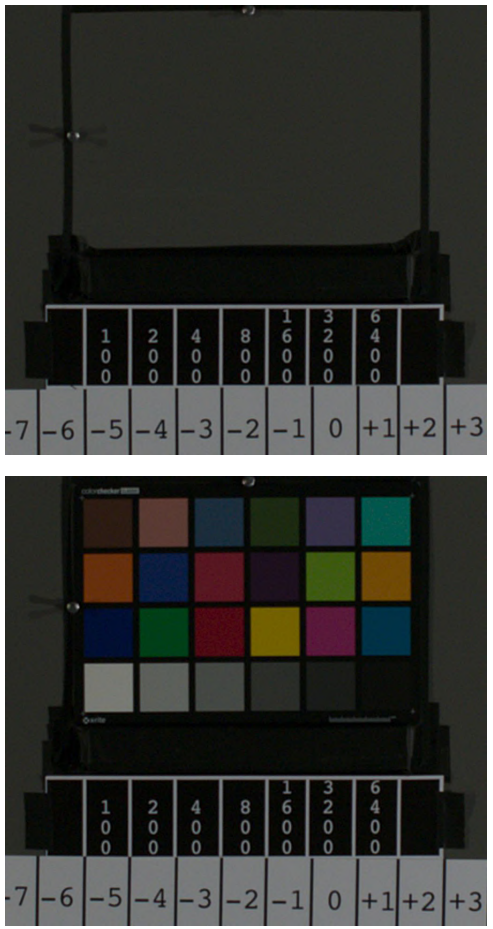
11.2	15	t/5.6	-3	
11.2	30	t/5.6	-4	
11.2	60	t/5.6	-5	
11.2	120	t/5.6	-6	



Shutter Angle	Frame Rate	Aperture	Stops @ 800ISO	
358	0.813	t/5.6	6	
180	0.813	t/5.6	5	
180	1.625	t/5.6	4	
180	3.25	t/5.6	3	
180	7.5	t/5.6	2	
180	15	t/5.6	1	
90	15	t/5.6	0	
45	15	t/5.6	-1	
22.5	15	t/5.6	-2	
11.2	15	t/5.6	-3	
11.2	30	t/5.6	-4	
11.2	60	t/5.6	-5	
11.2	120	t/5.6	-6	



Shutter Angle	Frame Rate	Aperture	Stops @ 800ISO	
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180	0.813	t/5.6	5	
180	1.625	t/5.6	4	
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180	7.5	t/5.6	2	
180	15	t/5.6	1	
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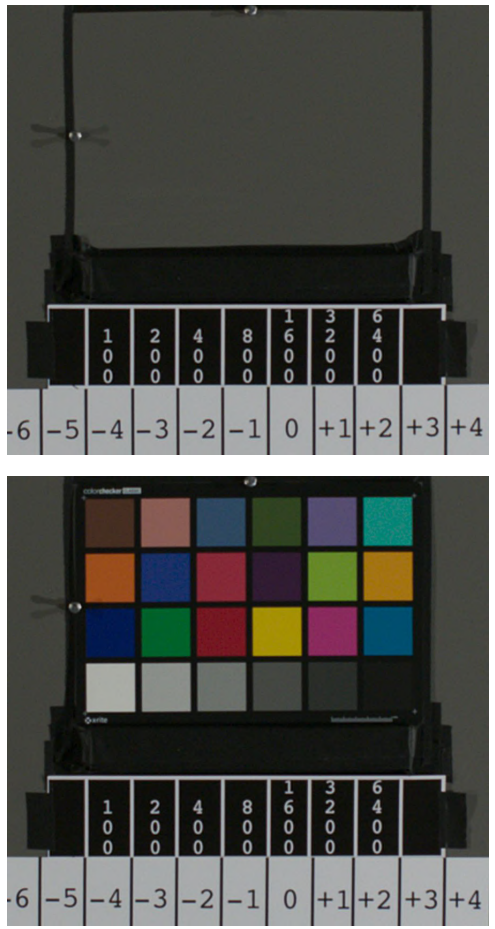
45	15	t/5.6	-1	
22.5	15	t/5.6	-2	
11.2	15	t/5.6	-3	
11.2	30	t/5.6	-4	
11.2	60	t/5.6	-5	
11.2	120	t/5.6	-6	



Shutter Angle	Frame Rate	Aperture	Stops @ 800ISO	
358	0.813	t/5.6	6	
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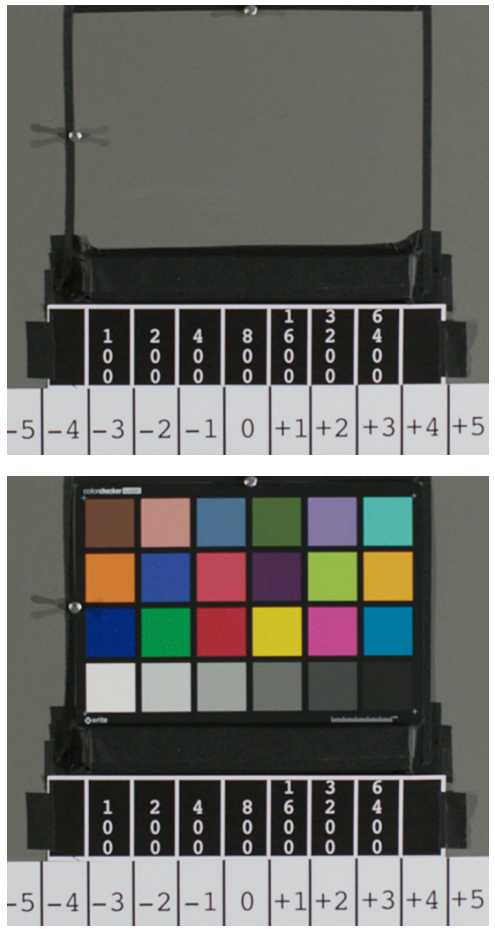
11.2	120	t/5.6	-6	



All of our Recordings are

Mit Ohne Sound

ACADEMY COLOR ENCODING SYSTEM

ACESCentral.com
@AcademyACES

The Academy Digital Source Master
A Future-Proof Deliverable

Dr. Wolfgang Ruppel
RheinMain University of Applied Sciences

Agenda

- What problem are we going to solve?
- IMF Application #5 ACES
- The Academy Digital Source Master Specification
- Status of implementation
- Conclusion

What problem are we going to solve?

For a given product you've got:

- Final ACES master files (textless) - ST 2065-4 (OpenEXR)
- Final ACES master files (localized) - ST 2065-4 (OpenEXR)
- Related metadata - ODT, RRT, LMT
- Audio soundfields - WAV, Immersive soundfields
- Data essence - Timed Text...

...and you want to deliver and archive all of that in one consistent package?

The Academy Digital Source Master specification, built on IMF App#5, does the job!

Outline of IMF App #5 ACES

- IMF Application #5 ACES is published as SMPTE ST 2067-50
  - Specifies SMPTE ST 2065-5 MXF wrapping for Image Track Files
  - Any frame rate and any spatial resolution is supported
  - Defines metadata structures

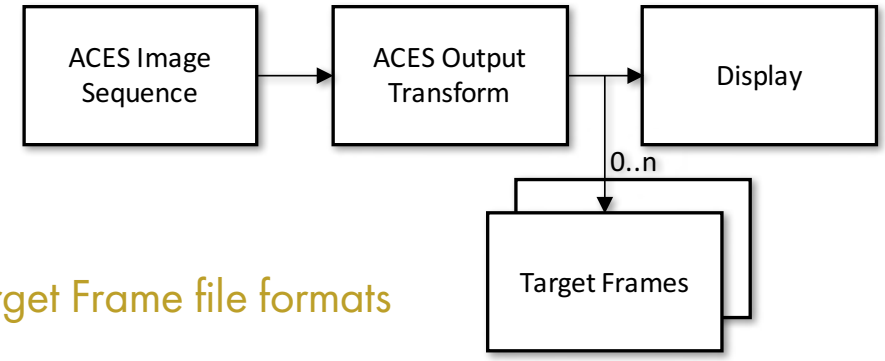
Metadata in IMF App #5 ACES

- ACES files are presented by means of an Output Transform

- **The challenge: How to document the Output Transform used in Mastering for delivery and archiving?**
- **The solution in IMF Application #5:**
  1. ACES Authoring Information metadata
  2. Mastering Display metadata
  3. "Target Frames" – Essence frames rendered in a display-referred color space

Metadata in App #5: Target Frames

- Target Frames are provided to calibrate the IMF package "playback" display system and environment to match the original mastering display system and environment



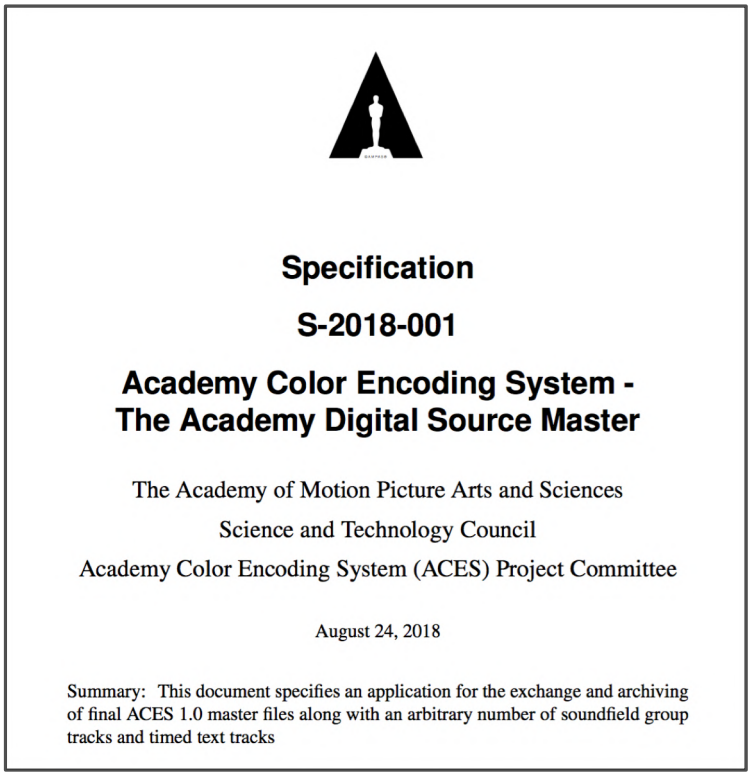
- PNG and TIFF supported as Target Frame file formats
- If the Target Frames visually or mathematically match the rendered images obtained from a particular workflow, it ensures that the particular playback display system and environment recreates the artistic intent applied during the mastering process of the original ACES Image sequence

Constraining and enhancing IMF App #5

- A normative requirement to provide Output Transform metadata
- A specification for Look Modification Transform metadata

Introducing...

The Academy Digital Source Master Specification



Specification

S-2018-001

Academy Color Encoding System -
The Academy Digital Source Master

The Academy of Motion Picture Arts and Sciences

Science and Technology Council

Academy Color Encoding System (ACES) Project Committee

August 24, 2018

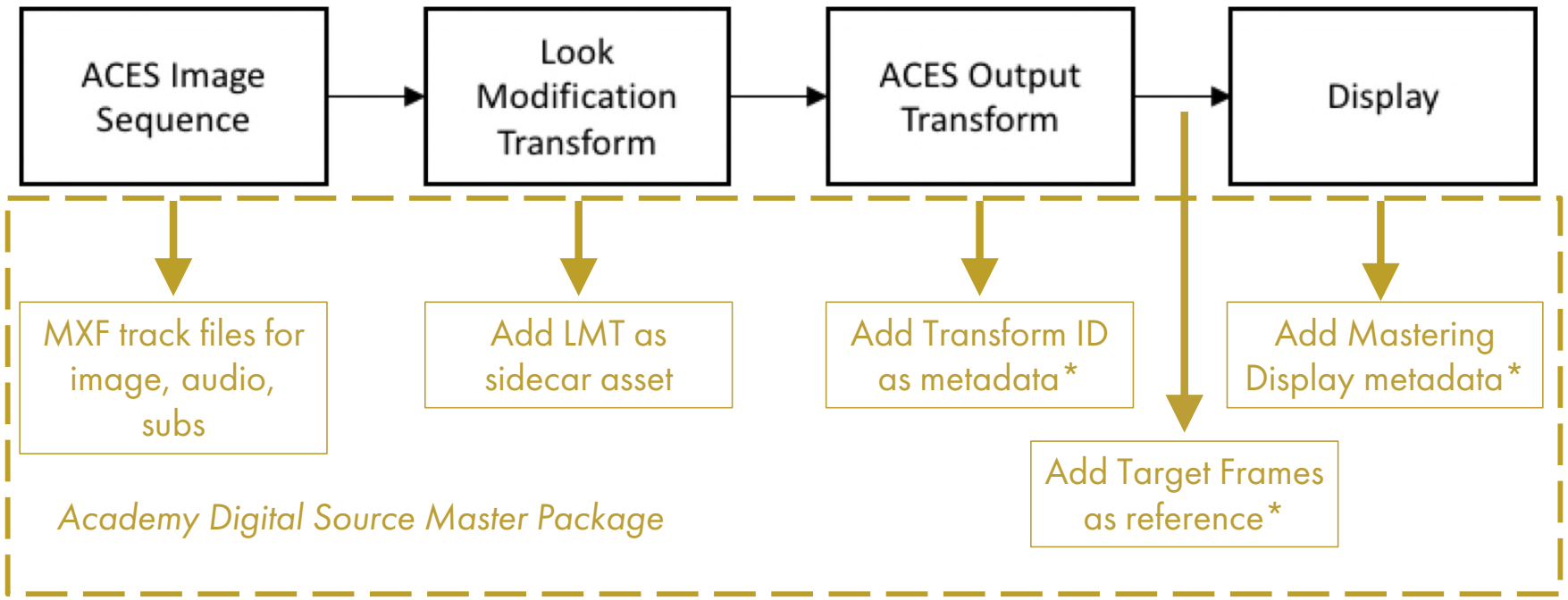
Summary: This document specifies an application for the exchange and archiving of final ACES 1.0 master files along with an arbitrary number of soundfield group tracks and timed text tracks

The Academy Digital Source Master specification

- Based on IMF Application #5 ACES (SMPTE ST 2067-50)
- Requirement to specify one (or more) Academy-provided Output Transform IDs as metadata
  - Example: `ODT.Academy.Rec2020_1000nits_15nits_ST2084.a1.1`
- Option to provide one (Global) Look Modification Transform in addition to an Output Transform
  - Technically, LMTs will be added to the IMF package as “sidecar assets”

The Academy Digital Source Master specification

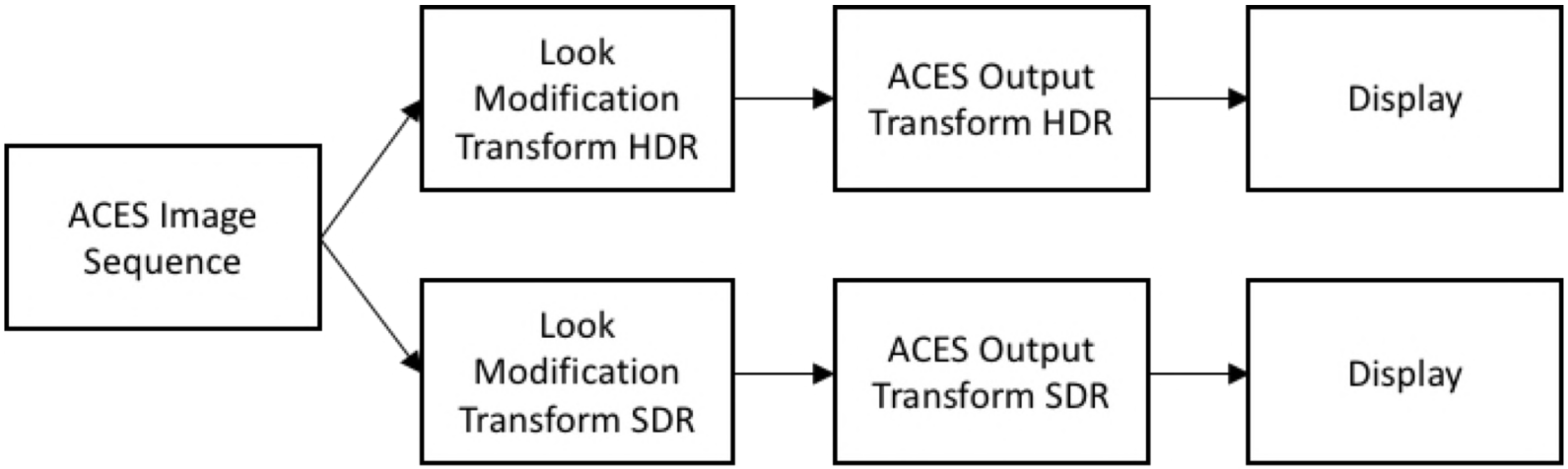
Enhanced workflow using Look Modification Transform (LMT)



**contained in ACES Image Track Files*

The Academy Digital Source Master specification

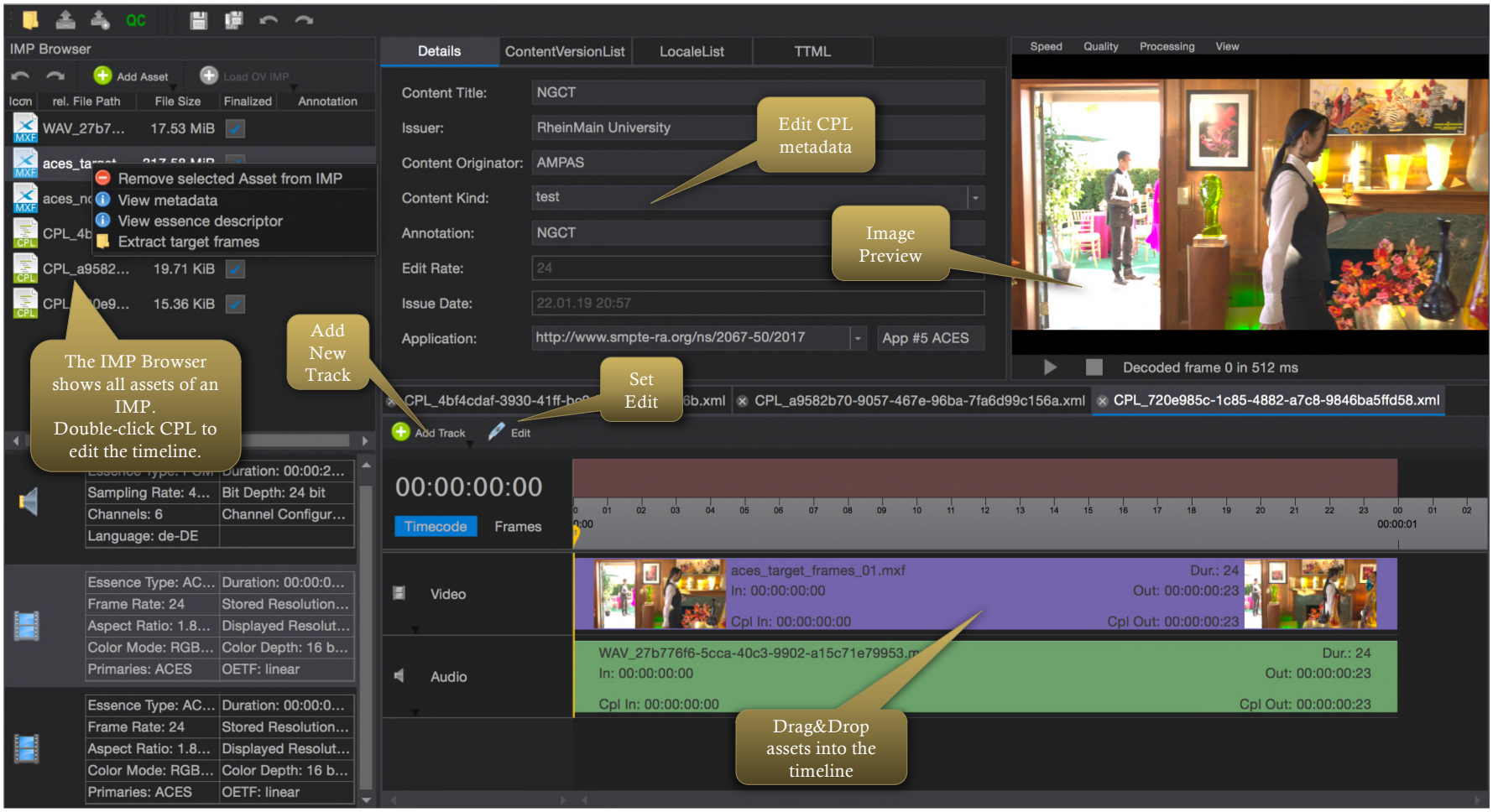
Future-proof, prepared for multiple device ACES master file sets (“Über-Master”)



Interoperability and implementations

- IMF vendors have demonstrated interoperability at the recent SMPTE IMF Plugfest in October 2018
- The SMPTE IMF Plugfest was hosted by the Academy
  - 10+ vendors participating
  - IMF App#5 was one of the test vectors
  - All IMF App#5 packages provided were compliant and fully interoperable

Open Source software: IMF Tool



Conclusion

- Academy Digital Source Master is the solution for delivery and archiving of ACES master file sets
- The Academy Digital Source Master specification defines a future-proof data structure
- Based on Industry Requirements of all Major Hollywood studios
- Vendors have demonstrated implementations & interoperability at a plug-fest in October 2018
- Open Source software (IMF Tool and C++ libraries) enables sustainable archiving and broad access

Resources

- The Academy Digital Source Master Specification
  - https://acescentral.com/t/academy-digital-source-master-draft-specification/
- IMF Tool supporting ADSM/IMF App#5
  - https://github.com/IMFTool/IMFTool
- asdcplib C++ Library supporting ADSM/IMF App#5
  - https://www.cinecert.com/asdcplib/

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