THE IMAGE INTERCHANGE FRAMEWORK

Academy of Motion Picture Arts & Sciences
Science and Technology Council

August 2010

Introduction

- Project goals
  - Enable seamless interchange of high quality motion picture images regardless of source.
  - Enable high dynamic range, wide color gamut, high precision (4K/16bit) workflows
  - Define the “Digital Source Master”
  - Define a path to an Archival Master
  - Co-exist with present practices and enable practical migration
  - Take results to appropriate Standards Development Organization(s)

Image Interchange Framework – Why?

- Film is no longer the primary exchange format used in production
- Increased need to interchange unfinished images in digital form
- There are many, many, image file formats and encodings
- Variable densitometric/colorimetric conversion and viewing transforms
- Existing standards are outdated, little (if any) metadata is exchanged
- Today's film stocks exceed today's 10 bit digital systems

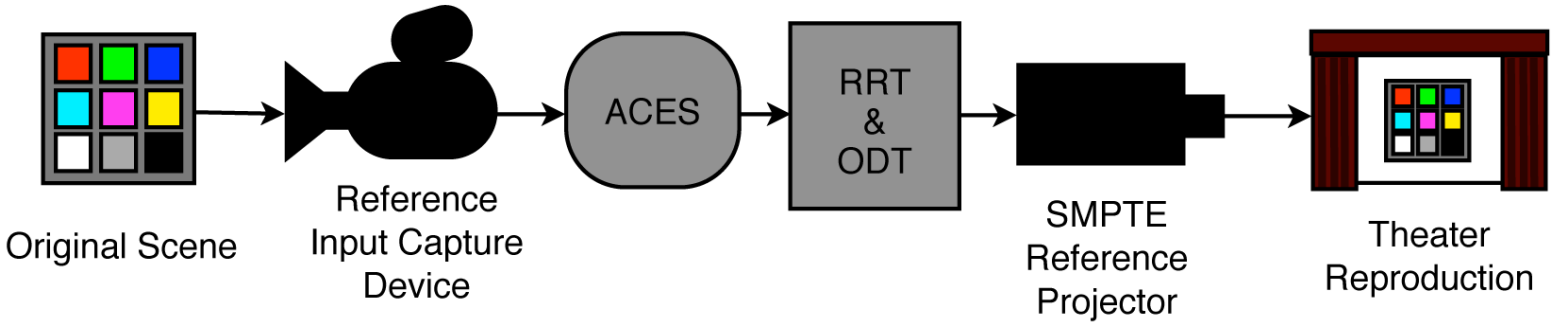
How We Plan To Get There

- Well-specified 16 bit image color encoding: ACES
- Well-specified 16 bit film density encoding: ADX
- Well-specified rendering transform: RRT
- Well-specified scanner/recorder characterization and calibration
- Well-specified data container, metadata
- Result: a suitable format for archiving

Academy Digital Source Master

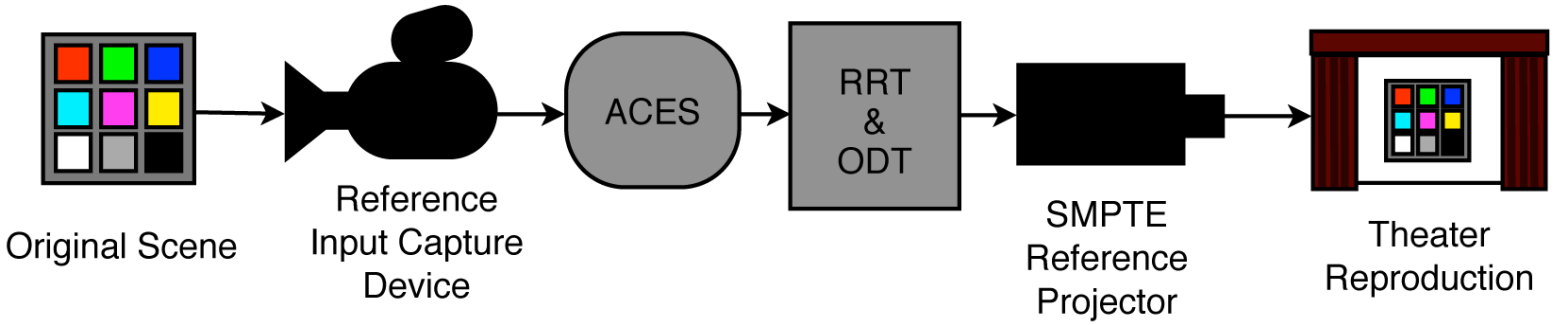
- Ideally:
  - Maintains the greatest possible fidelity from original source media.
  - A destination for:
    - Color correctors, digital cameras, renderers, scanners, telecines
  - Usable in as many parts of the digital workflow as possible, but allows facilities to keep using their own pipeline

Brief Technical Overview



- Academy Color Encoding Specification (ACES)
  - "Digital Negative" or as DCI calls it, the "Digital Source Master" (this is different than "IMF")
  - A Radiometrically Linear Light Encoding
  - We provide methodology to get from any source (Film, Digital, etc.) into ACES

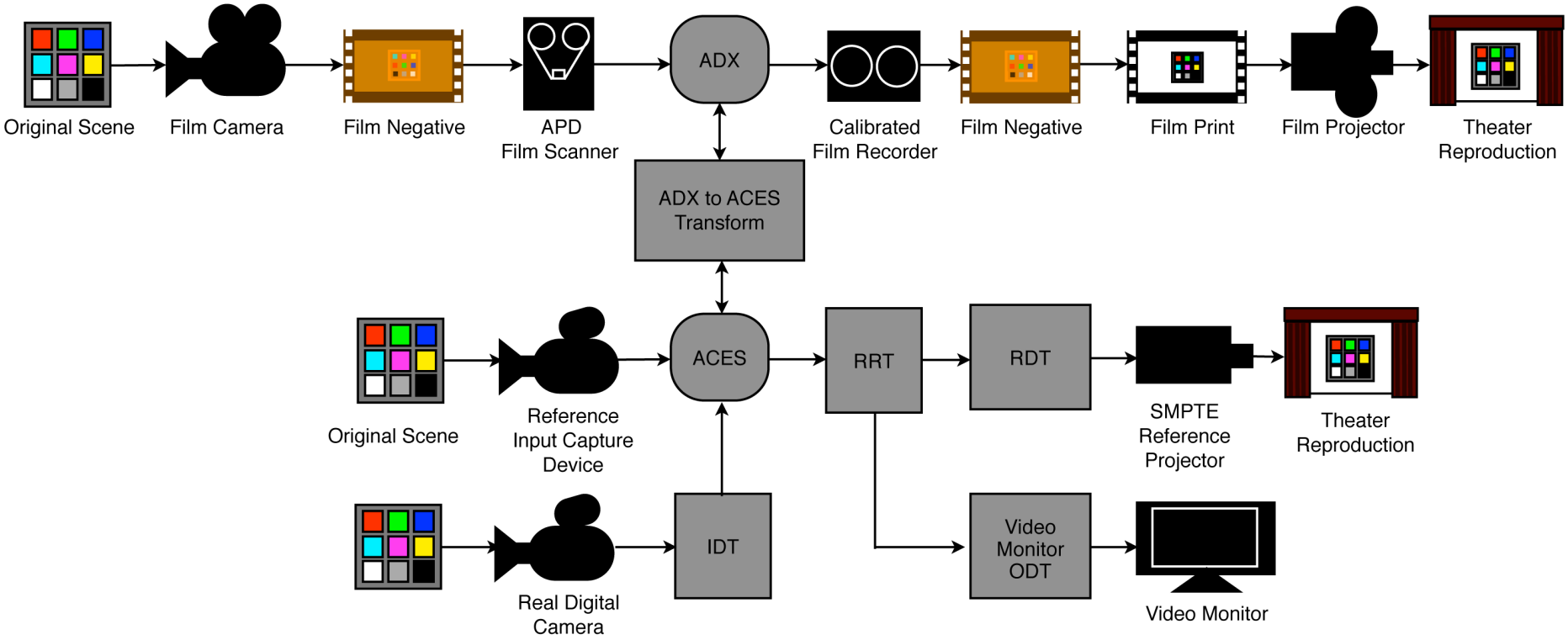
Brief Technical Overview



- Reference Rendering Transform (RRT)
  - Idealized Virtual Print Film
  - Extremely Wide Gamut and Dynamic Range

Idealized System

SCIENCE & TECHNOLOGY COUNCIL



ACES Color Encoding Design Principles

- Colors from scene exposures – important!
- There will always be some inaccuracy because there is no perfect capture technology
- More important to always get the same result rather than be super-accurate

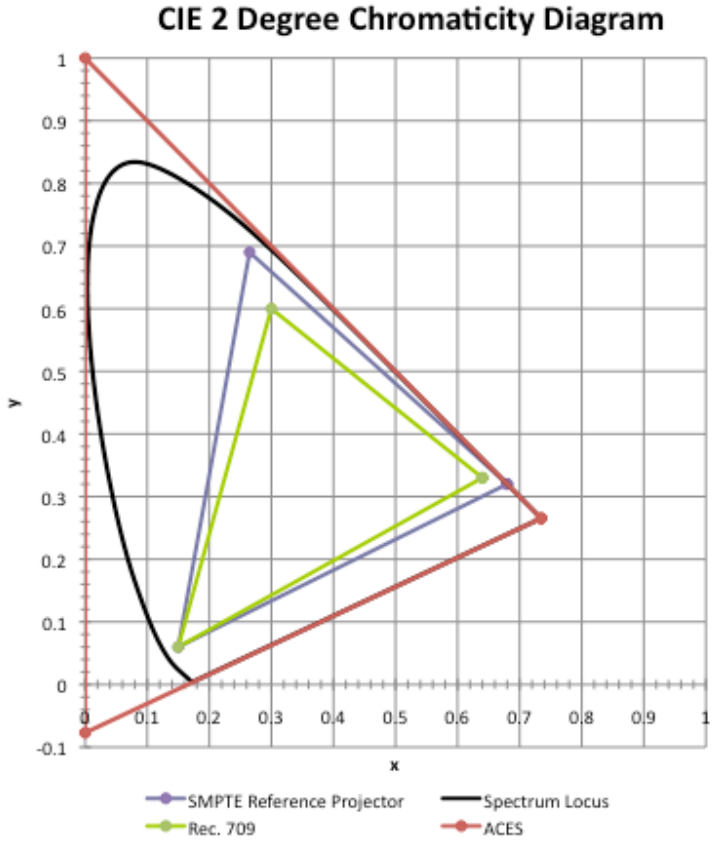
ACES Color Encoding Design Principles

- Wide gamut encoding:
  - Encode all possible colors (cover the visible gamut)
  - RGB primaries to enable use as working space
- High dynamic range
  - Greater than 25 stops encoded
- Floating point values
  - Provides improved precision over integer values when modified

ACES Color Encoding Details

SCIENCE & TECHNOLOGY COUNCIL

- Fixed RGB Reference Primaries



	CIE x	CIE y
Red	0.73470	0.26530
Green	0.00000	1.00000
Blue	0.00010	-0.07700

ACES Color Encoding Details

- 16-bit half-floats
  - Value range from -65504.0 to +65504.0
  - Negative values are valid codes, e.g. {0.14, 1.00, -0.55}
- Calculation Neutral Axis
  - CIE x = 0.32168, CIE y = 0.33767
  - Approximately CIE D60
- Reference Midpoint “Grey”
  - ACES {0.1800, 0.1800, 0.1800} = CIE XYZ {0.1715, 0.1800, 0.1816}

ACES = Academy Digital Source Master

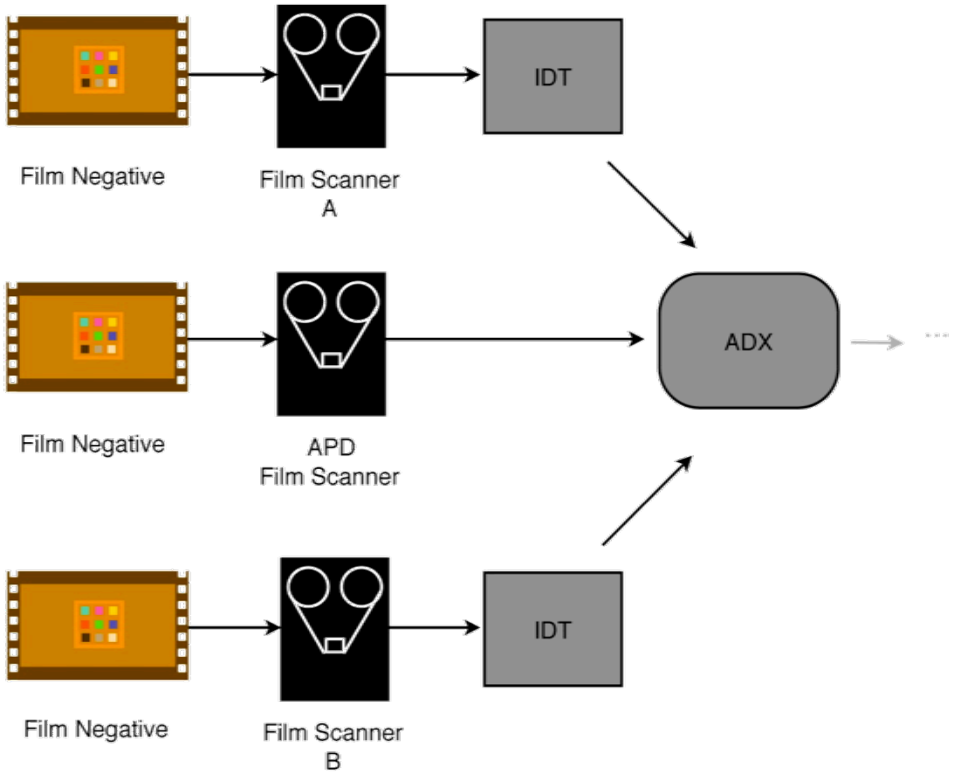
- Image container
  - Constrained version of OpenEXR file format accessed via OpenEXR API
- Contents of the file = ACES data + essential metadata

Density Encoding

- Academy Density Exchange Encoding for Density
  - Printing Density: how a film print “sees” the light that comes through a negative from a printer lamp house
  - Academy Printing Density (APD): a proposed scanner calibration standard that defines the “spectral responsivities”
  - Define a 10-bit encoding for compatibility
  - Define a 16-bit integer encoding to handle extended film negative ranges

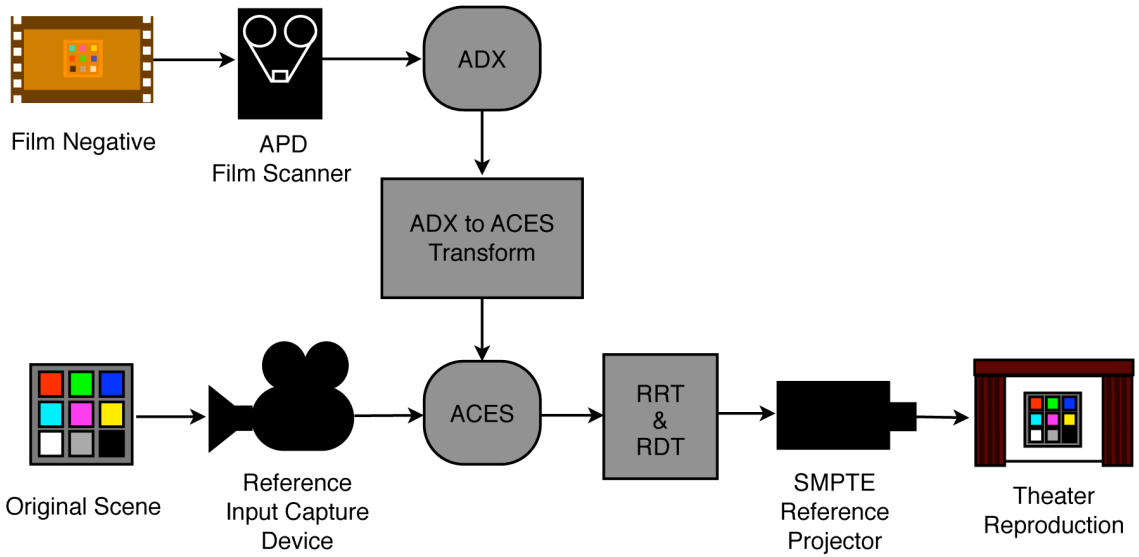
Input Methodology – Film Negative

SCIENCE & TECHNOLOGY COUNCIL



Calibrate scanner and apply transform

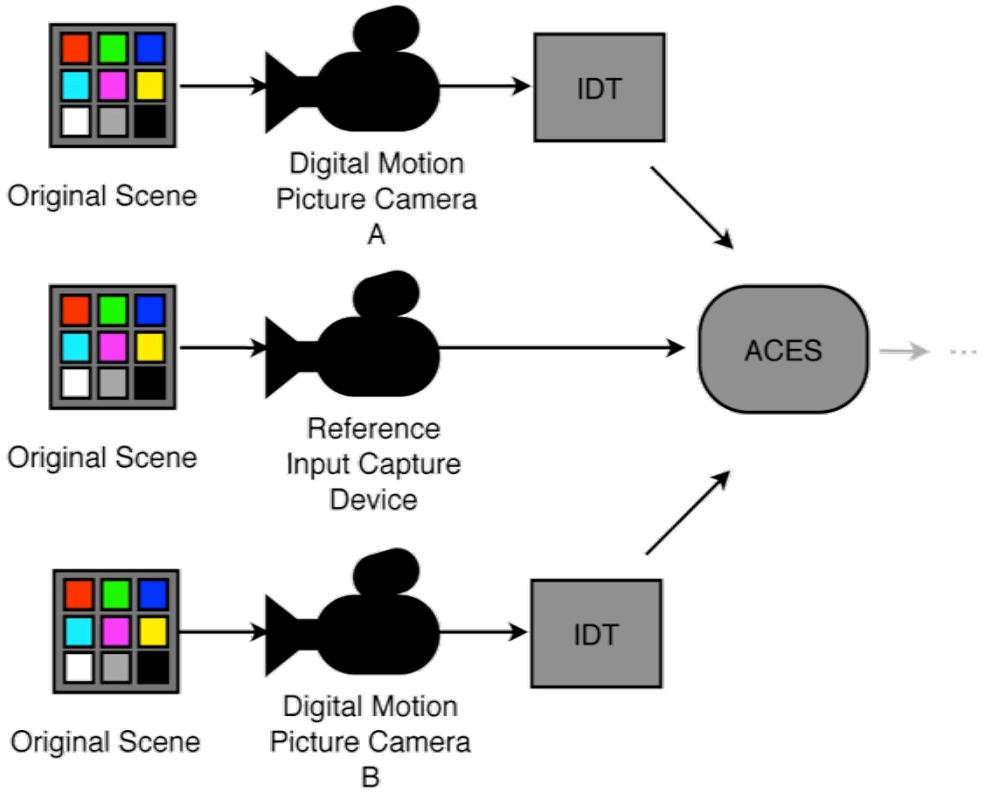
Input Methodology – Film Negative Converting ADX to ACES



Exact transformation from film density (ADX) to scene exposures (ACES) isn't as important as maintaining the relative relationships.
This allows relative film stock looks to be maintained.

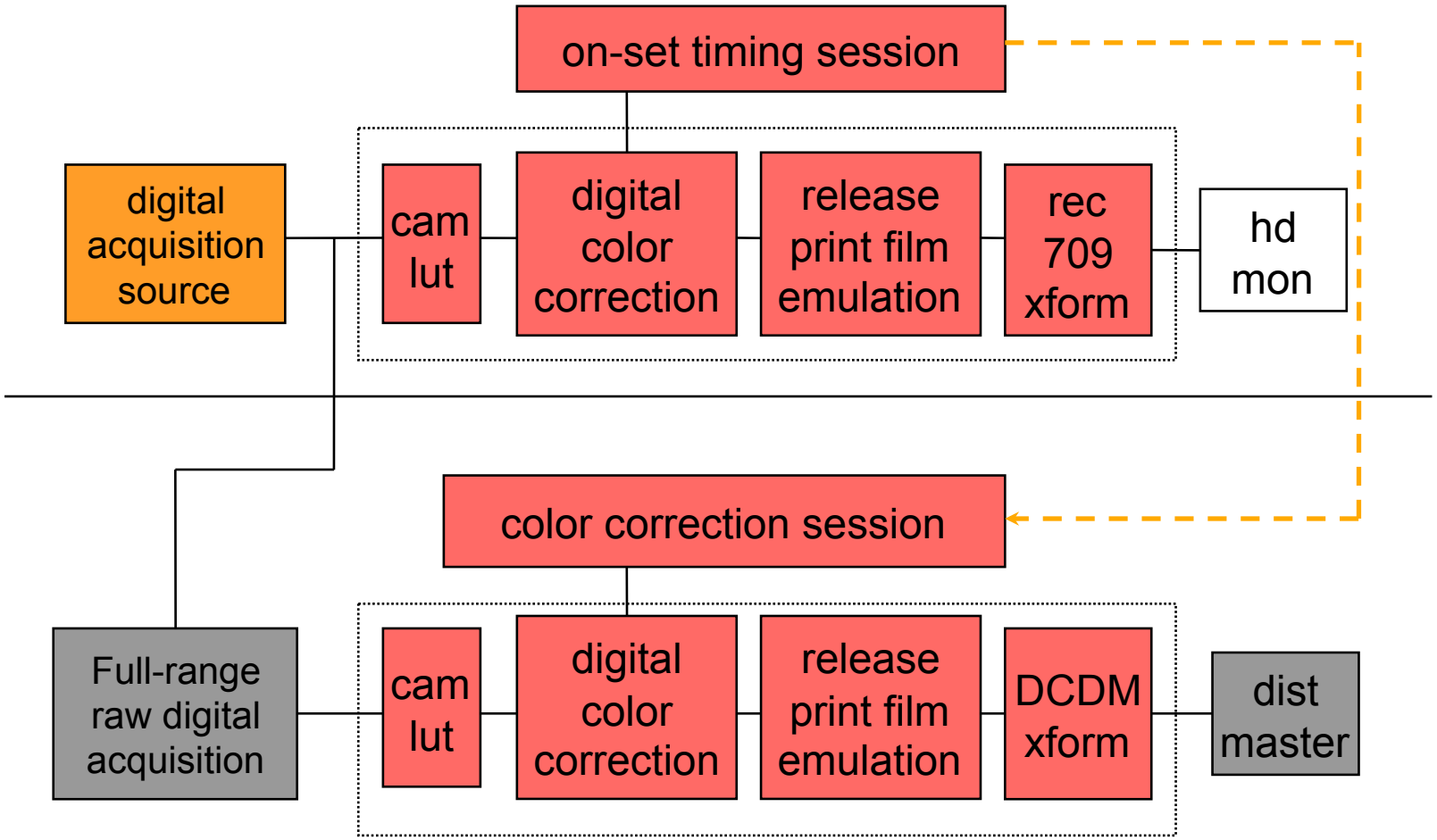
Input Methodology – Digital Camera

SCIENCE & TECHNOLOGY COUNCIL

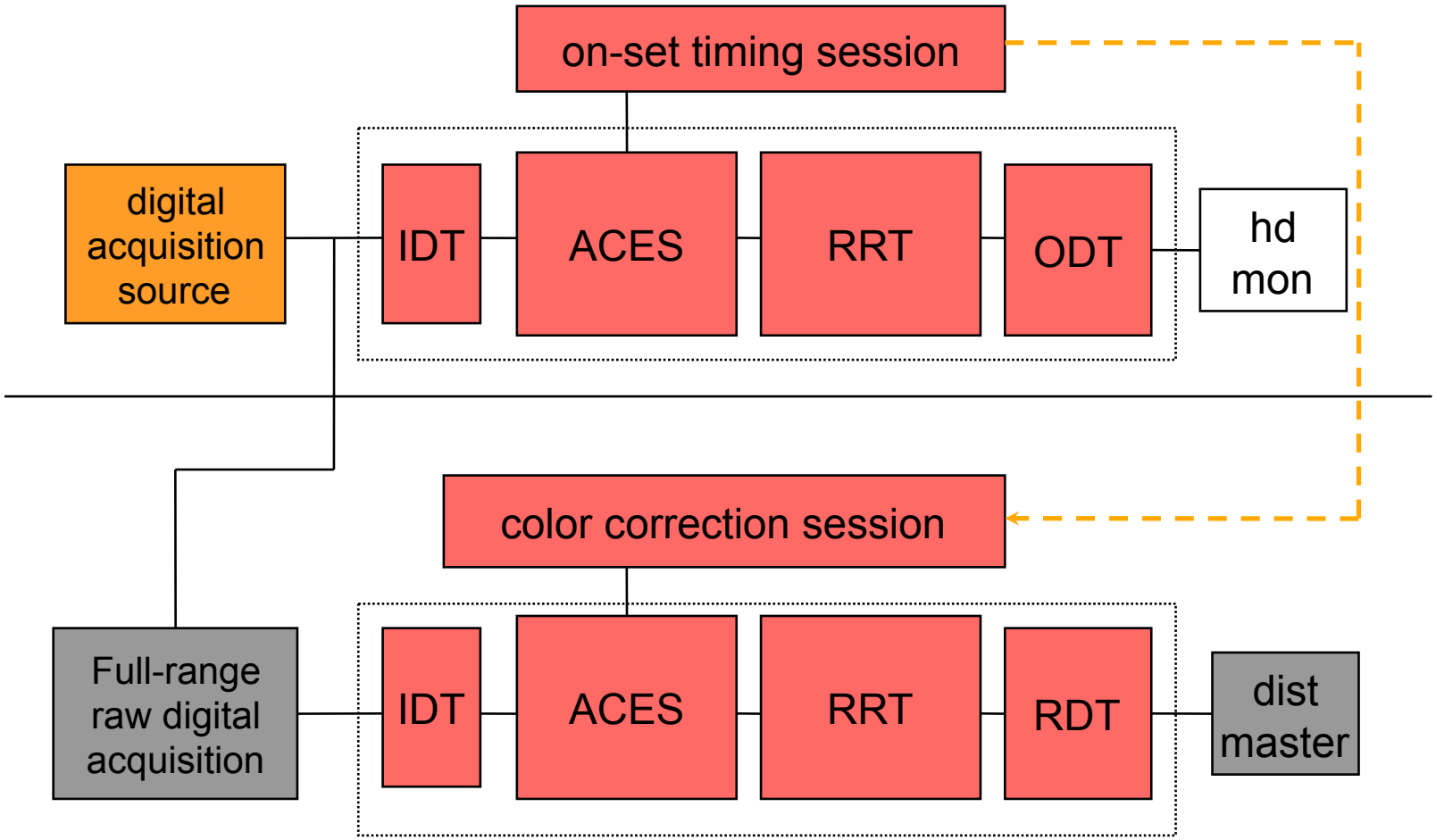


The DI System Today

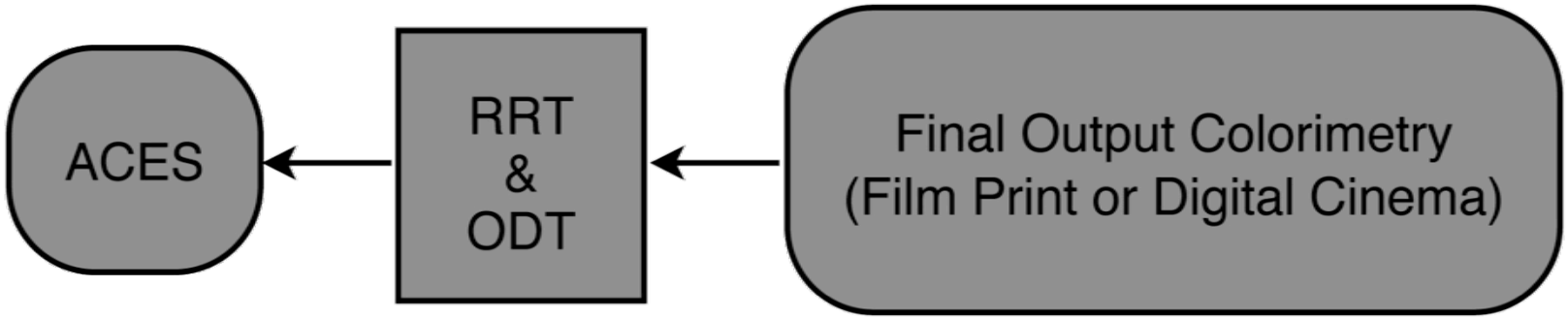
SCIENCE & TECHNOLOGY COUNCIL



An IIF-Based System



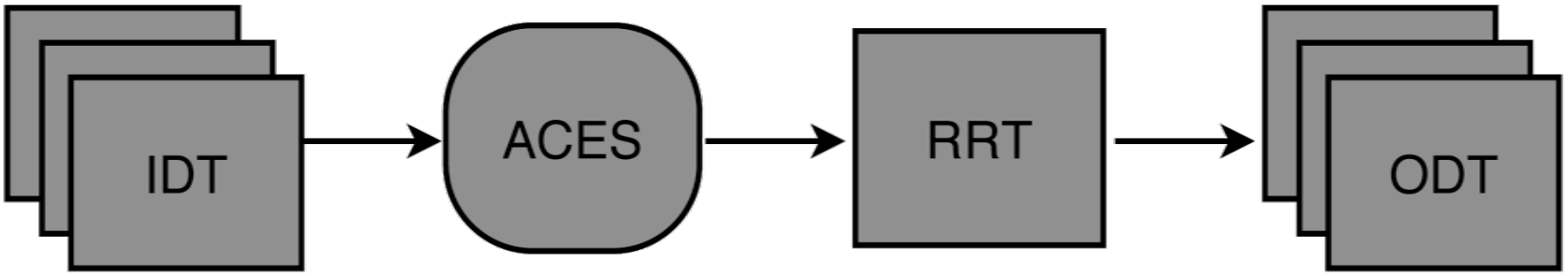
What If You Work “Output-Referred”?



Standard
Color Encoding

Creative Intent
Color

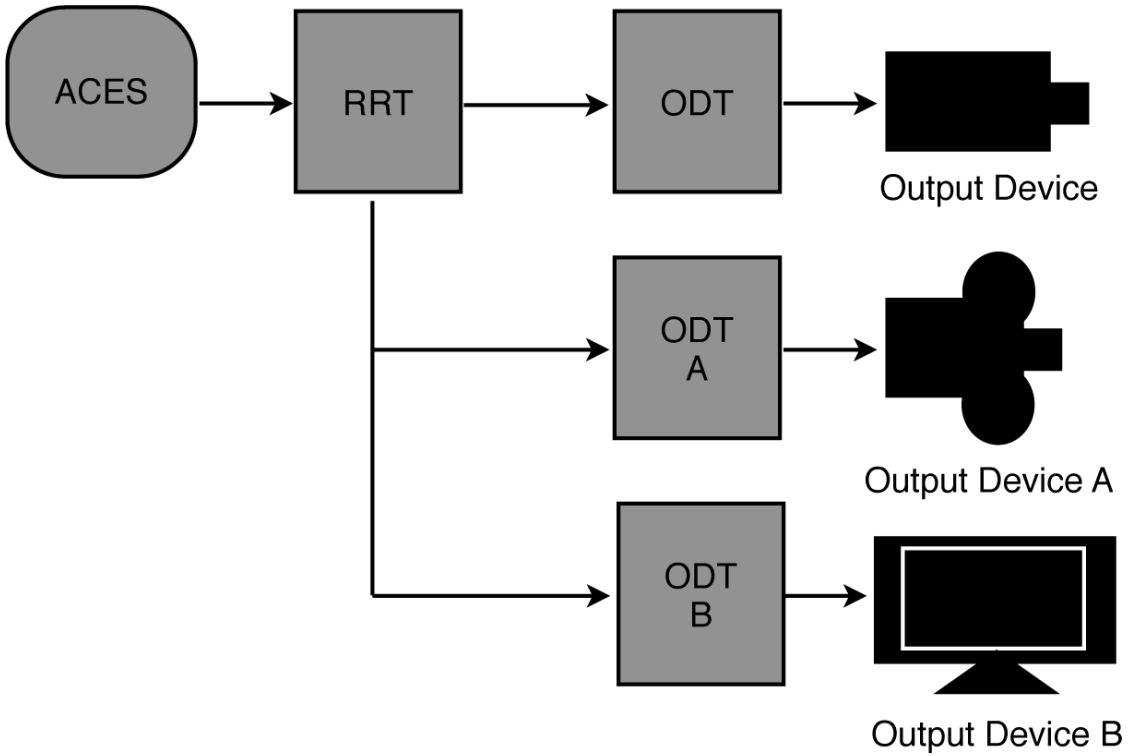
Framework Architecture Components



- Many Input Device Transforms (IDTs)
- Many Output Device Transforms (ODTs)
- One Interchange Encoding / File Format (ACES)
- One Reference Rendering Transform (RRT)

Using Other Types of Display Devices

SCIENCE & TECHNOLOGY COUNCIL



IIF Testing

- RRT Development and Specification
- ADX/ACES Conversion
- Reference Image Library Development
- Digital Camera IDT Development
- ADX & ACES Containers and Metadata
- Merged with Digital Archival Framework Project
- IIF essential header metadata being specified

Committee Work

- Standard transforms for most common operations:
  - Rec709 to ACES Input Device Transform (IDT)
  - Reference Rendering Transform (RRT)
  - Reference Device Transform (RDT) for Digital Cinema Projector
  - ADX/ACES Conversion
  - Video Monitor Output Device Transform (ODT)
  - Film Output Device Transform
  - Digital Camera IDT Creation Recommendations
  - Scanner and Film Recorder Setup Recommendations
- Software reference implementation
- Sharing our work with manufacturers
- Supporting Adoption

IIF Benefits

- Standardized encoding specifications (ACES & ADX) with fixed transforms reduces conversion errors, improves color management, and still allows custom workflows
- Multi-facility workflows and communication are improved with a well-defined vocabulary and Interchange Framework

IIF Benefits

- Methods to accept images from any source
- Ensure consistent image output
- Enables future growth and simplified introduction of future technology

IIF for Cinematographers and Creatives

- IIF Doesn't:
  - Dictate the look
  - Make it all automatic
  - Make it cheaper or faster
- IIF Does:
  - Allow the "convenience" of DI while preserving the level of quality now only achievable via "heroic efforts"
  - Provide a usable Archival Master in a digital form

Image Interchange Framework

SCIENCE & TECHNOLOGY COUNCIL

Visit
www.stcatp.org

Thank you