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THE IMAGE INTERCHANGE FRAMEWORK

Background and Overview

IIF 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 Organizations

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
- Existing standards are outdated, little (if any) metadata is exchanged
- Today's film stocks exceed the range of current 10-bit DI systems

Key IIF Components



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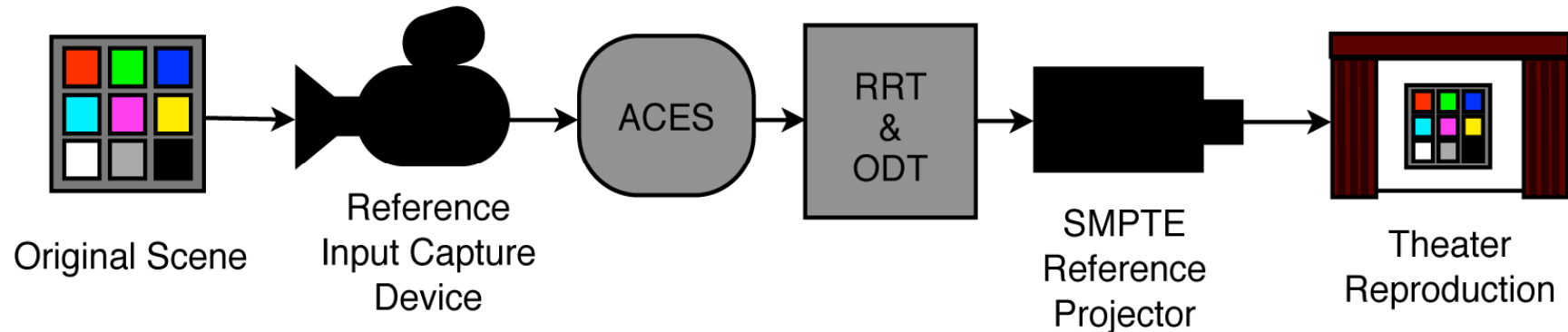
- Well-specified 16 bit image color encoding: ACES
- Well-specified 16 bit film density encoding: ADX
- Well-specified rendering transform: RRT
- Well-specified scanner/recorder characterization and calibration
- Well-specified data container, metadata
- Result: a suitable format for archiving

Academy Digital Source Master



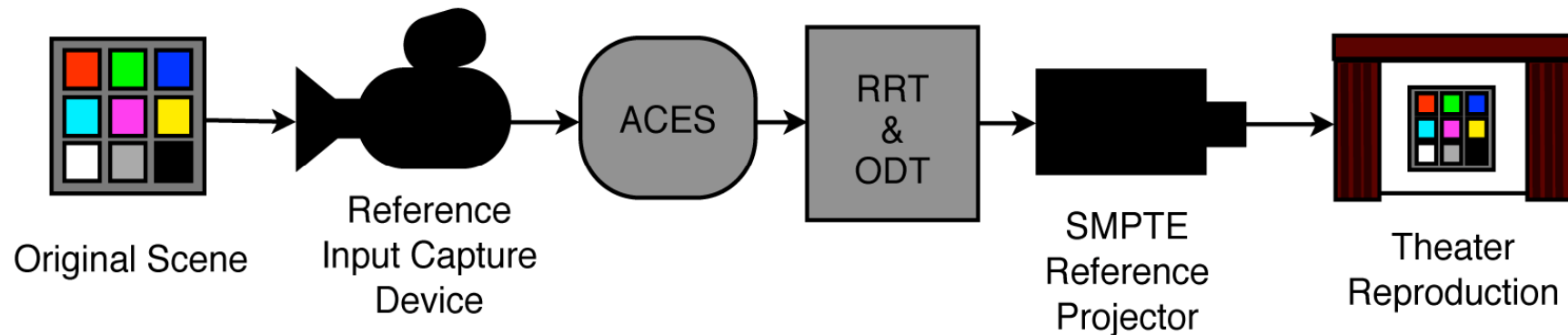
- Ideally:
 - Maintain the greatest possible fidelity from original source media
 - A destination for color correctors, digital cameras, renderers, scanners, telecines
 - Usable in as many parts of the digital workflow as possible, but still allows facilities to utilize their existing pipelines
- The Digital Source Master is an IIF deliverable

Brief Technical Overview



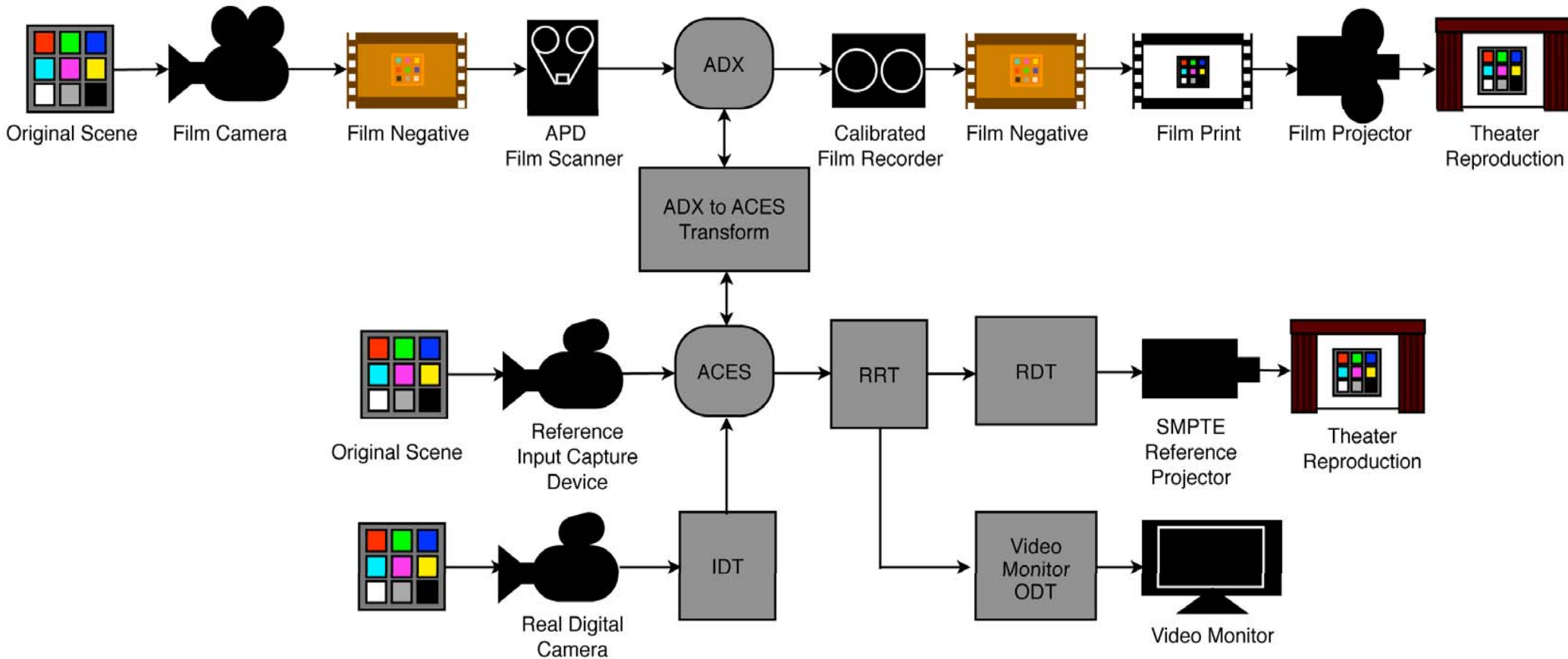
- Academy Color Encoding Specification (ACES)
 - A Radiometrically Linear Light Encoding
 - We provide methodology to get from any source (Film, Digital, etc.) into ACES

Brief Technical Overview



- Reference Rendering Transform (RRT)
 - Idealized replacement for Print Film Emulations
 - Extremely wide gamut and high dynamic range
 - Capable of supporting many looks, including those the outside the capability of the film system
- Output Device Transform (ODT) adjusts gamut and dynamic range to match display device

Idealized System



ACES Color Encoding Principles



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- Encodes scene exposures as they exist at the camera focal plane
- Creative effects of filters, exposure choices, lighting, etc. are maintained
- There will always be some inaccuracies in estimations of the scenes colors because there is no perfect capture technology
- Accuracy is important, but consistency is critical!

ACES Color Encoding Principles

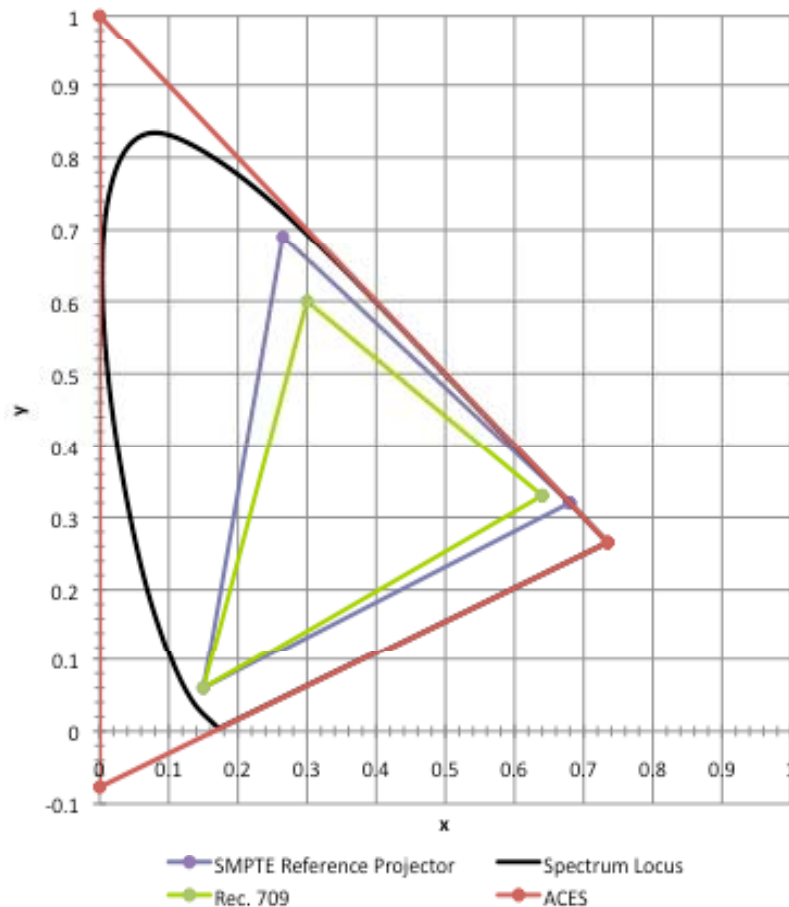


- Wide gamut encoding:
 - Encode all possible colors (cover the visible gamut)
 - RGB primaries to enable use as a working space
- High dynamic range
 - Greater than 25 stops encoded
- Floating point values
 - Preserves fidelity during artistic image manipulation

ACES Color Encoding Details

- Fixed RGB Primaries

CIE 2 Degree Chromaticity Diagram



	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 code values are valid
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}

Academy Digital Source Master



- Encoding: ACES
- Image container:
 - Constrained version of OpenEXR file format accessed via the normal OpenEXR libraries
- Contents of the file: ACES data + essential metadata

Academy Digital Source Master - 2



- Advantages of an ACES Master
 - Output referred data (i.e. rec709 or video) is limited to the capability of the output device thus cannot take advantage of new display technologies
 - Digital camera raw data and raw film scans don't represent the final movie. No digital effects, CGI, compositing, or final color correction. Can not be intercut
 - ACES is the final movie with the full fidelity of the original source material

Academy Digital Source Master - 3



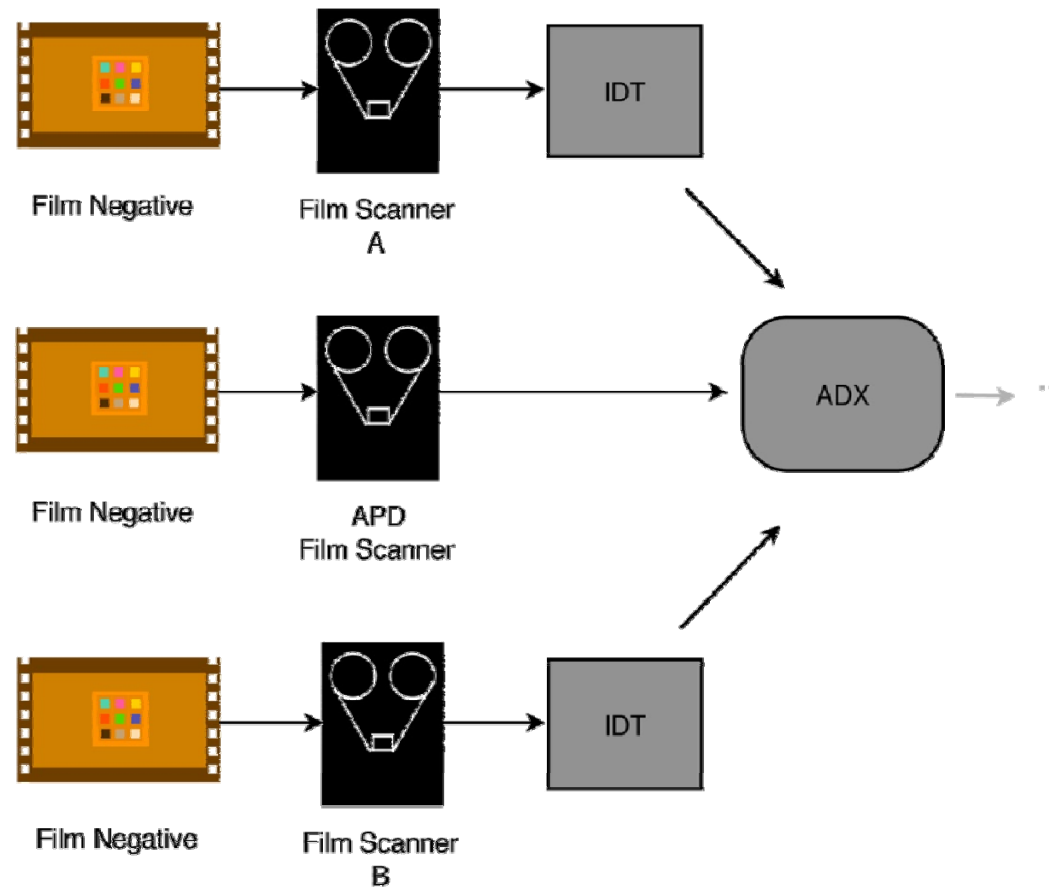
- New display technologies coming ...
 - Greater dynamic range
 - Greater color gamut
 - Higher brightness
 - All provide new creative tools for storytelling

ADX Density Encoding



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

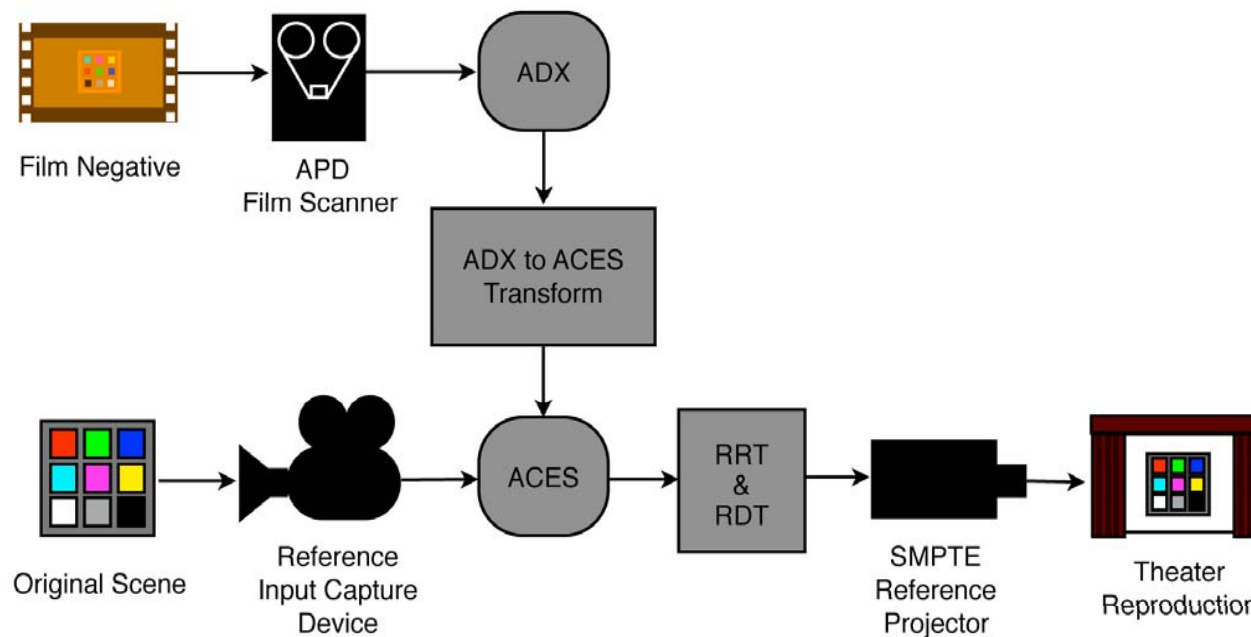
Input Methodology – Film Negative



Calibrate scanner and apply transform

Input Methodology – Film Negative

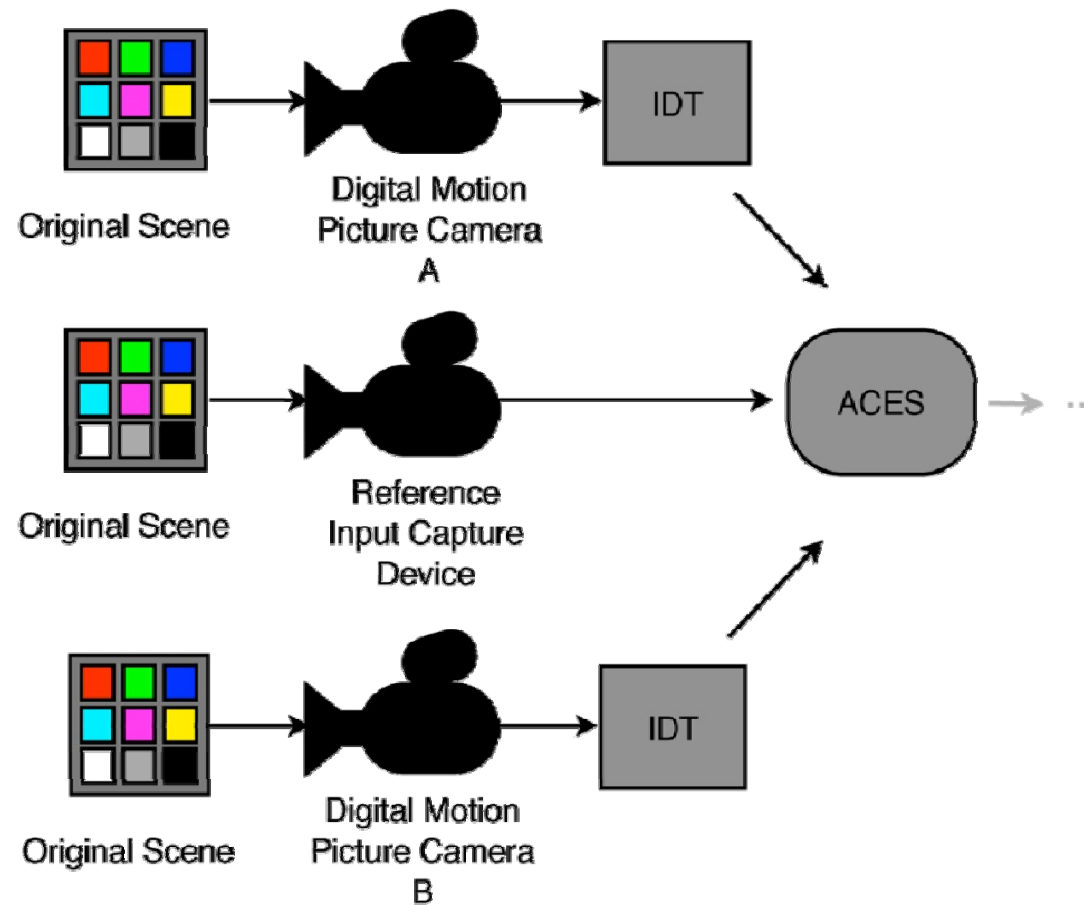
Converting ADX to ACES



An unambiguous transformation from film density (ADX) to scene exposures (ACES)

This allows the looks of the individual film stocks to be maintained

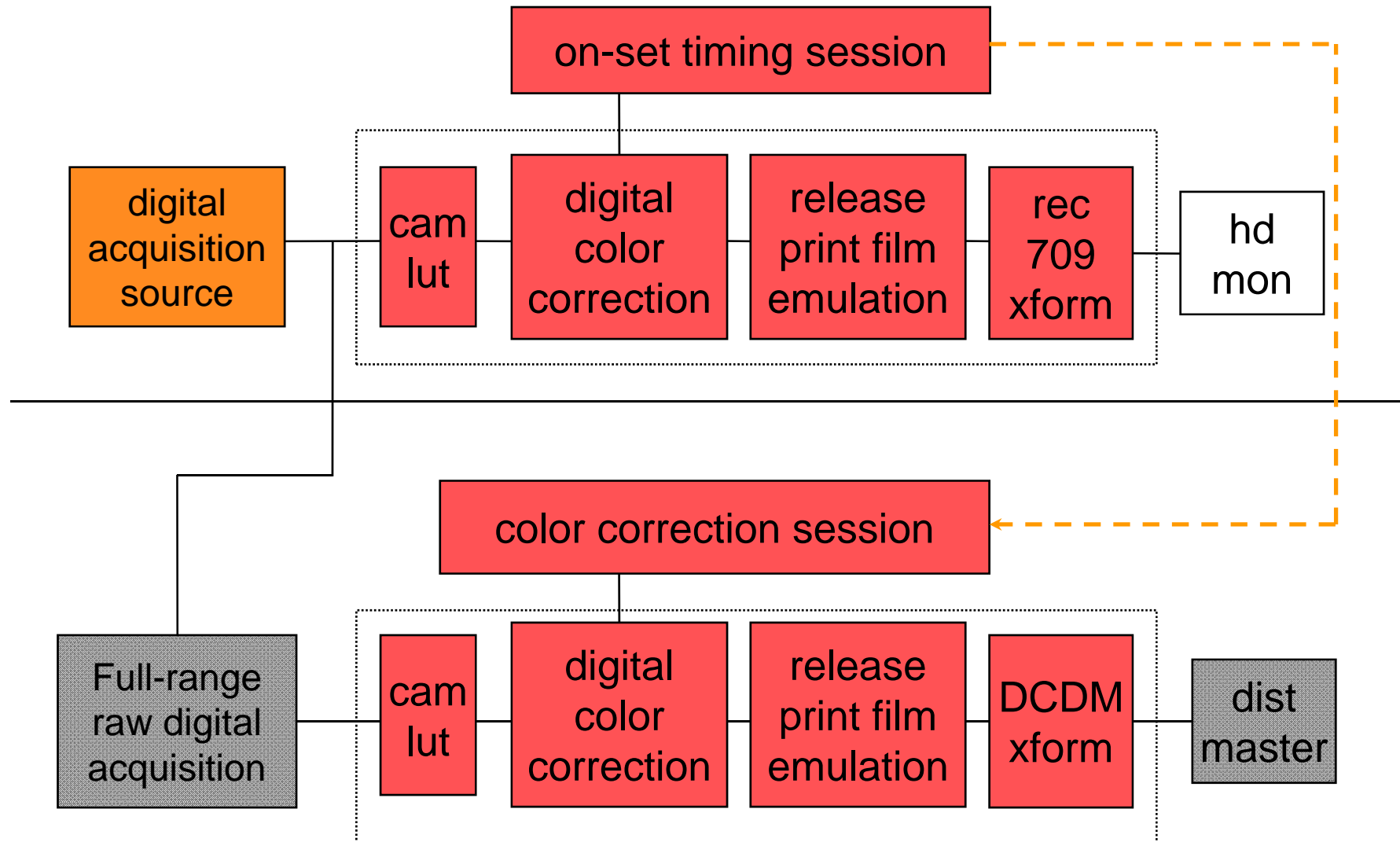
Input Methodology – Digital Camera



The DI System Today



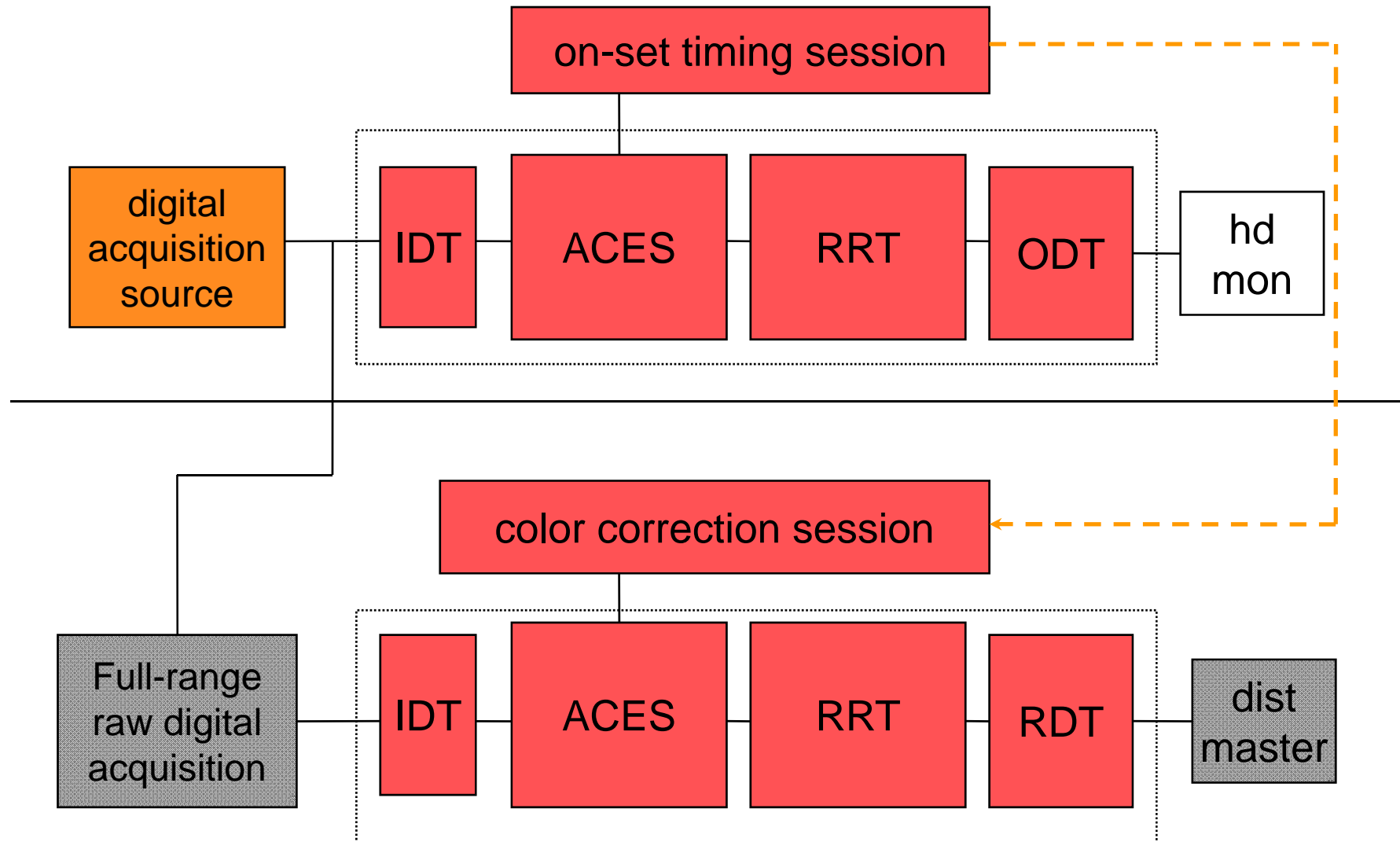
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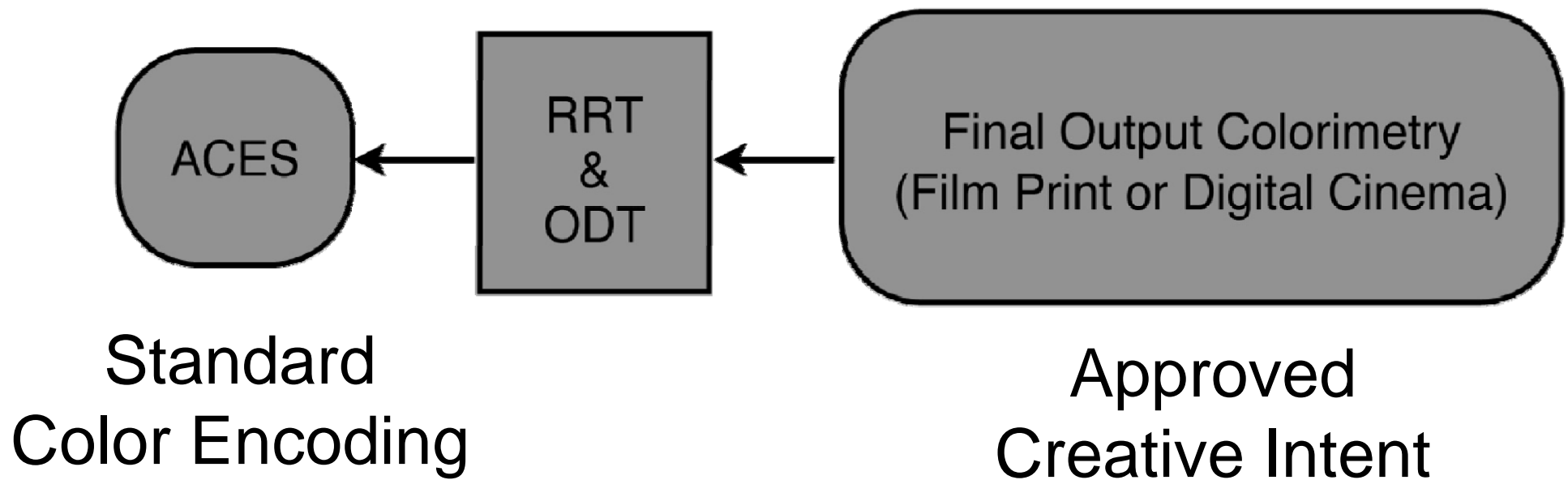
An IIF-Based System



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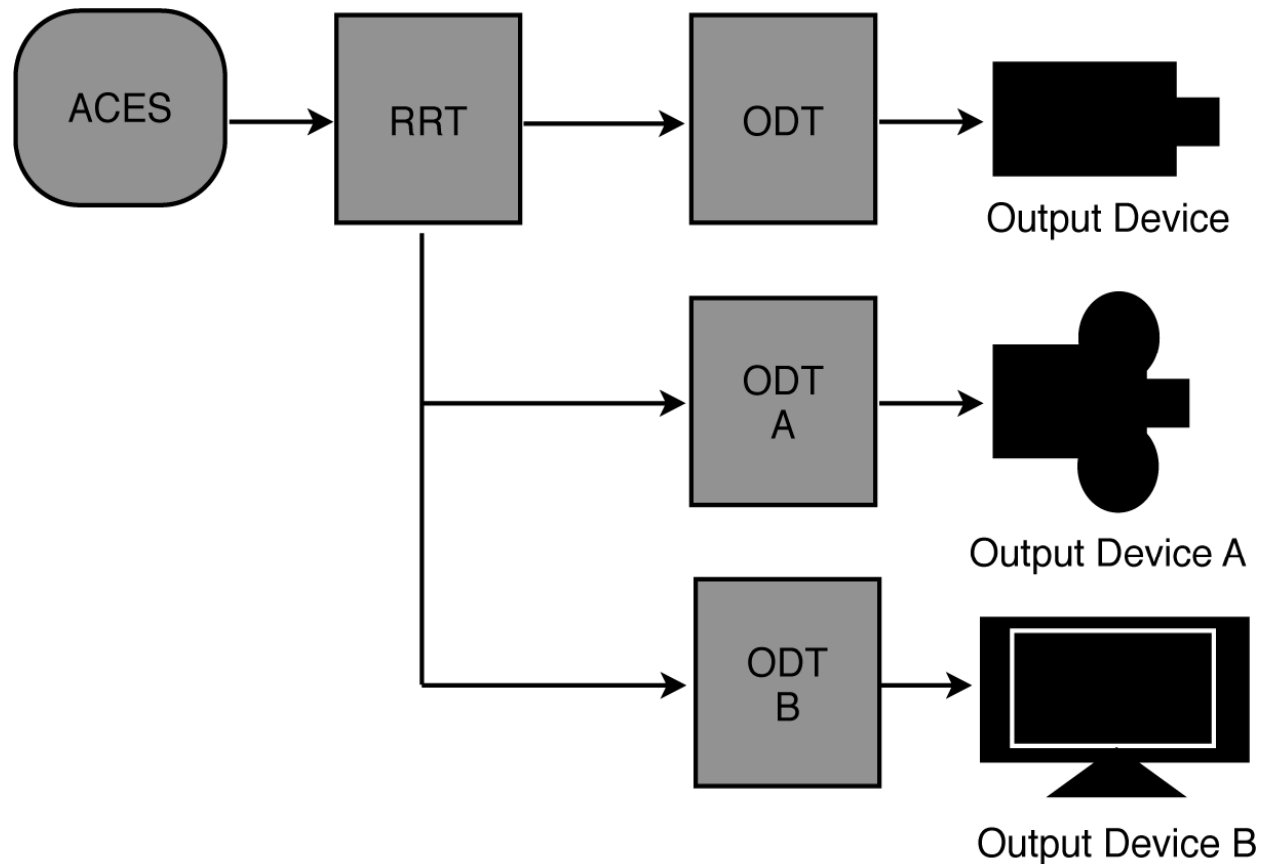
What If You Work “Output-Referred”?



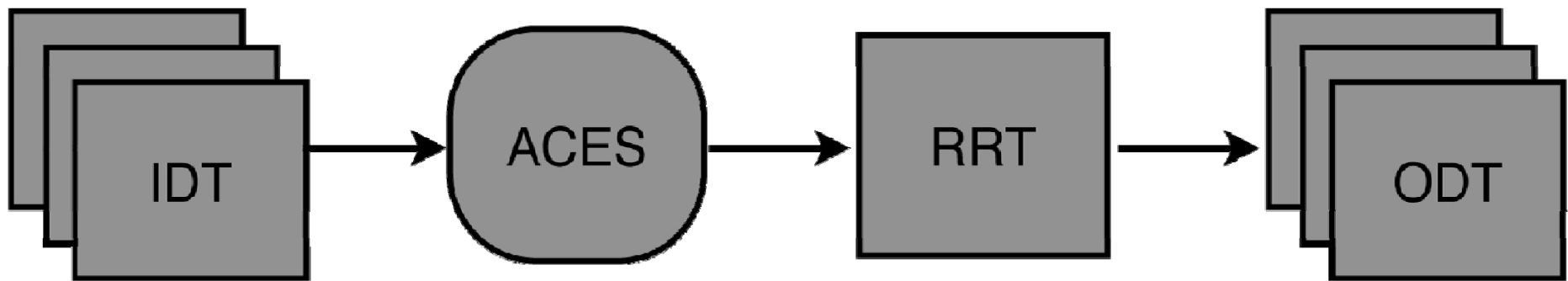
Fixed RRT, device-specific ODTs



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Important Distinction



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

IIF Benefits



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- Standardized encodings with fixed transforms
- Reduced conversion errors
- Improved color management, yet still allows custom workflows
- Enhanced multi-facility collaboration and communication
- Ensures consistent image input from multiple sources
- Simplifies consistent image output
- Enables future growth

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”
 - Provides a usable Archival Master in a digital form



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For more information, please visit <http://www.oscars.org>