Cine-tal's cineSpace and the International Color Consortium (ICC) profiles.

Peter Polit
Cine-tal Systems, Inc.

October 20, 2008

One of the fundamental challenges in the production of motion picture and television content is creating predictable or matching results on the wide range of display technologies existing across all options for content distribution. The match targets may be two display monitors, or a combination of two different display technologies (for instance celluloid film and a digital projector). This paper describes techniques for accomplishing two industry-specific goals: ensuring that all displays at a given facility look as similar as possible, or making display devices look like a selected target. To meet this challenge, a number of mechanisms have been created to produce a profile of a display device, and a mapping mechanism enabling pre-distortion of visual material to allow for a match on a different device. This paper compares one such mechanism designed by Cine-tal Systems, Inc. – a cineSpace workflow and resulting profile[2], and a standard format frequently mentioned as potentially suitable to accomplish the same goal – the ICC profile[1].

1.0 Introduction

In this paper, we will focus on the elements of an end-end color management workflow for moving images. We will examine the framework generated by the International Color Consortium (ICC) for color management for still images[1], discuss the ongoing work to extend this framework to moving images, and contrast it with a complete functioning framework created by Rising Sun Research (now Cine-tal Systems, Inc.) for working with moving images in cineSpace application.

2.0 ICC and cineSpace

ICC has generated a framework which in theory makes it possible for a vendor to implement a color management system suitable for a range of applications (pictured in Figure 1: ICC color management architecture). Additionally, a Motion picture Working Group was established within the ICC to further adapt the framework to moving image applications.

The following two sections of this paper examine the current state of the ICC implementations on the market, and the path currently taken by implementers of a complete moving picture color management system.

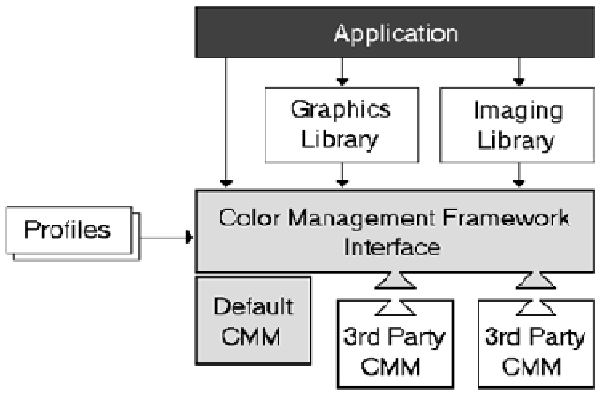

Figure 1: ICC color management architecture[1]

2.1 ICC profiles and implementations that work within the framework defined.

A number of software applications utilizing the ICC profile file formats are available in the still image and print area, making the functionality, file format, and associated naming recognizable in the marketplace engaged in color management. While ICC has historically focused on graphic arts, photography, and print media, it has formed in 2004 a Motion Picture Working Group with the following stated objectives[3]:

a. Identify a small number of significant color-critical Digital Motion Picture production workflows
b. Identify factors that make an open, vendor-neutral solution important
c. Identify any liaison relationships that need to be established, and establish these
d. Identify where predictability and consistency are required in the workflows and insure that the recommendations enable them to be achieved
e. Identify areas where the existing ICC Profile format is unable to provide the functionality required by these workflows
f. Propose improvements or additions to the ICC specifications or implied architecture that would make the workflows more efficient
g. Promote the use of ICC Profiles in Digital Motion Picture production workflows

A number of parties interested in developing applications working within the standard have engaged in this effort. Many others are tracking it closely (including Cine-tal Systems, Inc.) for potential adoption as one of the supported file formats. As of today, applications developed by various vendors that utilize ICC profile format are less complete in some areas of the motion picture market than they are in the print space, and in general not widely utilized for professional work at the high end of the market. These are designated as "3rd Party CMM" blocks in Figure 1: ICC color management architecture. As a result, color management for motion pictures is currently served by vendors providing complete end-end work flow solutions including Cine-tal Systems, Inc. with its cineSpace product.

The primary issue users find when attempting to find a standard, multi-vendor, ICC profile based solution is one of incomplete implementations. While some aspects of managing a facility with multiple displays, or managing a video-to-film process, may be addressed by available standard ICC format implementations, others are not. Key elements are missing, making workflow implementation challenging. No one vendor has implemented a complete workflow in this environment, and work continues to make this environment more encompassing per (e) above[4]. It is virtually certain that over time vendors will be able to offer more complete solutions within this growing framework, but this is likely to be a relatively slow process. Today, the following general issues persist with respect to ICC compliant color management system implementations for motion pictures:

h. Consistency of implementation between various vendors
i. Variety of support levels within various implementations (1-D LUT, matrix, 3-D LUT) while claiming ICC compatibility
j. Incompatibility of a typical ICC workflow (matching print to what you see on the screen) with motion image industry (attempting to see on the screen what you will get on printed film).
k. Relative lack of predictability for results using ICC profiles across different applications (no cross-vendor consistency testing)
l. Vendor- and implementation-dependent encapsulation of various profile elements that varies considerably
m. Limited vendor support

In order to address the very specific motion image customer needs, vendor-specific solutions have been developed with the primary objective of completeness. One such solution is cineSpace which aims to provide the highest quality complete workflow to meet the needs of a customer working with motion content.

2.2 Cine-tal cineSpace workflow.

Cine-tal's cineSpace application focuses on end-end solution for color management including tools for profiling display devices and film stock, creating sophisticated and accurate transforms between those profiles, and applying the transforms in both software and real-time multiple 3-D LUT engine hardware platforms manufactured by Cine-tal Systems, Inc.

CineSpace specifically addresses the functional areas listed by the ICC Motion Picture Working Group by creating a complete motion content workflow with tested outcomes and encompassing workflows. Time-to-market acceleration was accomplished by creating a vendor-specific implementation. Cine-tal Systems, Inc. is evaluating the ICC framework for potential future adoption as the target format for cineSpace profiles.

The complete cineSpace solution for end-end color management consists of the following applications:

cineProfiler
Measure accurate profiles of all displays, ready for loading into the calibration tools.

equalEyes
Match a single monitor or an entire facility to your reference color space using this standalone tool.

cinePlugins
Dedicated cineSpace™ support for Shake, Nuke, Fusion and Film Master, providing full 3D color transforms.

cineCube Visual
Produce 3D LUTs for precise film calibration within a wide range of industry tools.

Film Profiling
Custom profiling of your own unique film out path for optimal results - no guessing involved.

These tools can be combined in a workflow, with one example of a workflow pictured in Figure 2, providing a complete and proven process to accomplish the two goals at the center of this paper: ensuring that all displays at a given facility look as similar as possible, or making display devices look like a selected target. A detailed description of the mathematical approach for accomplishing the tasks can be found in [2].

3.0 Conclusion

Given the current state of open multi-vendor applications for color management using ICC (or any other format) profiles, a reliable, complete and timely workflow implementation for motion image color management can only be implemented today using a vendor-specific application. One such implementation is Cine-tal Systems, Inc. cineSpace. This application provides the user with a complete, integrated solution enabling effective color management for ensuring that all displays at a given facility look as similar as possible, or for making display devices look like a selected target.

As the standardization process continues, Cine-tal Systems, Inc. intends to monitor and participate. Cine-tal is evaluating the ICC framework for potential adoption as the target profile format for future implementations of cineSpace suite.

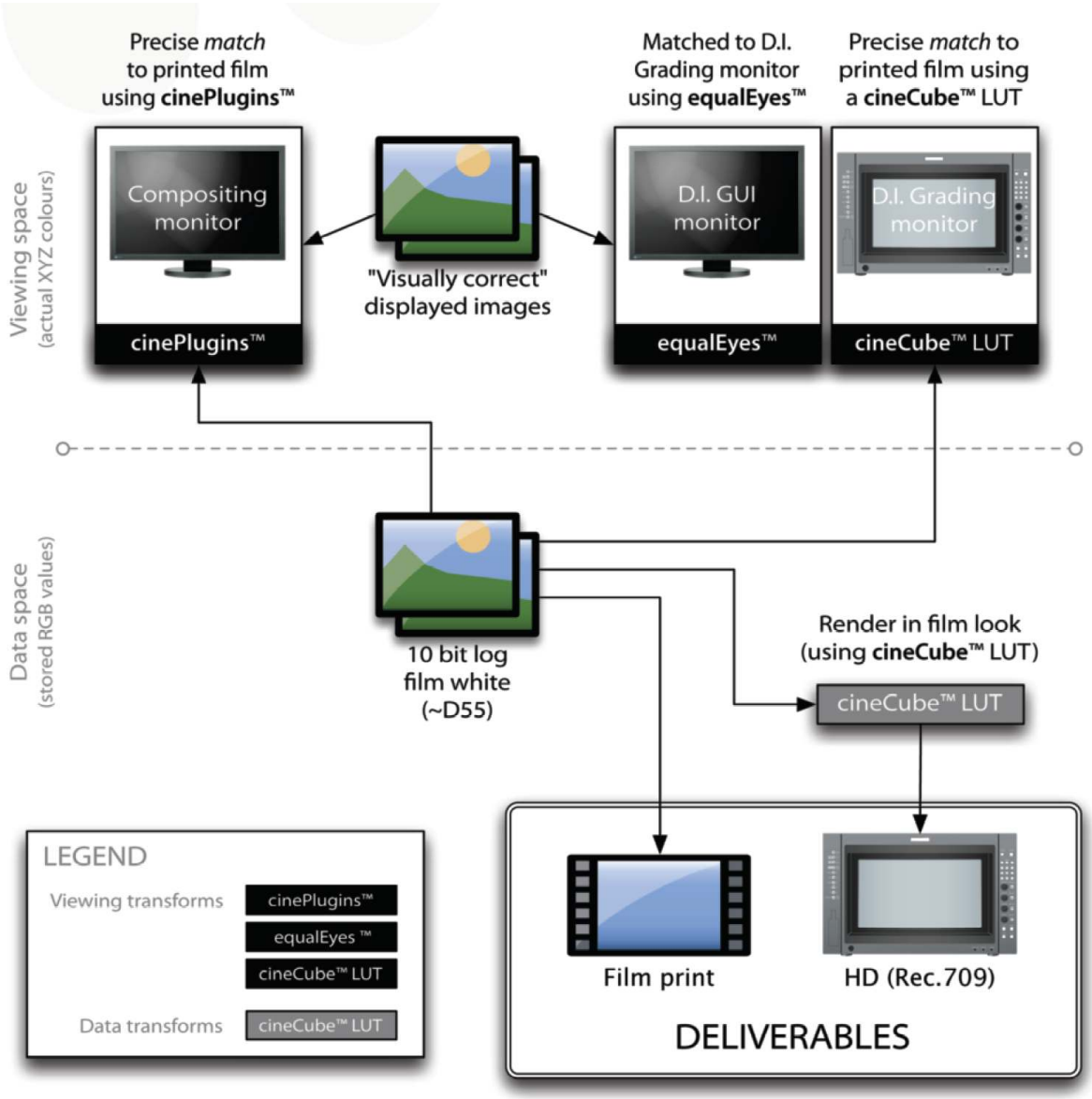

Figure 2: cineSpace color management workflow

Bibliography

[1] International Color Consortium, Specification ICC.1:2004-10 (Profile version 4.2.0.0*), Image technology colour management – Architecture, profile format, and data structure*, Errata incorporated 5/22/2006

[2] *Whitepaper: Colour management for film*, J. Pollard, Rising Sun Research, August 11, 2005, available at: http://cinetal.com/products/PDF/ColourManagement.pdf

[3] http://www.color.org/groups.xalter#digital2, September 16, 2008

[4] ICC Votable Proposal Submission, *New technology Signatures*, v1.1, Manish Kulkarni, Adobe Systems, Inc., May 3, 2006, Adopted by ICC in June, 2006.