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Standards Update
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International Color Consortium

This issue of the Standards Update focuses on the work of the International Color Consortium (ICC), provides a look at the current status, and some of the issues with which they are currently struggling as they move forward. Although the ICC is neither a national or international accredited standard activity, but rather an industry consortium, it is nonetheless a key part of the larger standards effort within the imaging community. I am grateful to Tony Johnson, the Technical Secretary of the ICC, for assistance in preparing this issue of the Standards Update.

What is the ICC?

The ICC, formed in 1993, had 8 founding members. These were Adobe Systems Incorporated, Agfa-Gevaert N.V., Apple Computer, Inc., Eastman Kodak Company, FOGRA-Institute, Microsoft Corporation, Silicon Graphics Inc., Sun Microsystems, Inc. These have now grown to include over 70 companies and/or organizations. The scope or purpose of the ICC is :

"To create, promote, and encourage an open vendor-neutral, cross-platform color management system architecture and components. Results of the ICC shall be made available to the public and shall be submitted to the appropriate international standards organizations."

What the ICC produces is a specification for the format for color profile data. The official title of the current version is "Specification ICC.1:1998-09 File Format for Color Profiles". However, the larger contribution of the ICC to the imaging community is the color management architecture into which these profiles fit and being the forum which enables the ongoing refinement and extension of an open color management architecture.

Who is the ICC?

The leadership of the ICC is elected annually from within the membership. The current chair is Lars Borg of Adobe and the Vice-chair is Uwe Krabbenhoeft of Heidelberg. The work of the ICC is managed by a Steering Committee made up of the representatives of the founding members and representatives of seven additional company members elected annually. For 2001 these are Sony, Polaroid, Heidelberg, Hewlett Packard, Canon, Harlequin, R. R. Donnelley and Xerox.

In addition the ICC has a series of working groups focused on specific areas. The current Working Groups are Specification Editing, Graphic Arts Special Interest, Research Implementation, User Groups Support, PCS LAB, and Conformance Testing.

Application for membership in the ICC is open to any company or individual. There is a nominal annual fee involved to allow the ICC to be independent of any outside group or influence.

Administrative support is provided through an Administrative Secretary, Kip Smythe of NPES, and a Technical Secretary, Tony Johnson of the London College of Printing. Tony, who is familiar to many IS&T members, is newly appointed as the ICC Technical Secretary.

What is ICC Color Management?

For those not familiar with the ICC architecture a brief description is in order. Normally to convert color data from an input device, such as an RGB scanner, into the device code values needed by an output (rendering) device, such as a CMYK printer, a transform is needed to appropriately modify the data. As input and/or output devices are added, such a transform is needed between every new pair of devices - n^2 (IS&T Editor substitute a superscript 2 please) transforms. These transforms are based on characterization data for the individual devices (the relationship between device code values and the color either input to or produced by the device), the gamut adjustments necessary to accomplish the desired

appearance match between input and output, and any conversions (separations) between the working space of the input device and the output device.

The change introduced by the ICC was the concept that if transforms were provided between each input or output device and an intermediate or reference color space, then to move data between devices one would simply need to combine the appropriate transforms. Using this scheme only one set of transforms would be required per device and adding a device would only require the addition of one transform, or a total of n transforms or sets of transforms vs the n^2 required without a reference space. We say sets of transforms because the ICC has made provision for three different types of transforms called rendering intents which provide for different types of mapping of color into the available device gamut. These are colorimetric, perceptual, and saturation and allow the profile user to select the type of transform appropriate to their imaging application.

The name given to this intermediate color space is "Profile Connection Space" or PCS and the carrier for the transforms is called a profile. The computational engine that combines these profiles and then processes image data through the associated transforms is called the Color Management Module or CMM.

Simply put, the profile vendor uses the device characterization data and their color science/reproduction knowledge to build the appropriate transforms between the device and PCS. The intelligence is in the profiles. The CMM is simply a processing engine that is typically built into an output device (and therefore provided by different vendors) and the color image that results should be independent of the CMM used.

The Profile Specification is currently undergoing a revision which both clarifies existing features and add new features. The refinements include:

- Better definition of the encoding used with monochrome profiles,

- Clarification of the ICC uses of the CIELAB and CIEXYZ equations,
- A definition of the CIEXYZ and CIELAB encoding limits of the PCS,
- Better definitions for all of the rendering intents,
- Definition of the luminance level of the PCS viewing environment,
- A better explanation of the Profile Connection Space in which the black point for the perceptual rendering intent is defined and the colorimetric intents are clearly referenced to instrument measurements.

In addition several new features are being added which include:

- Support for N-color output profiles by identifying the colorants used and the order in which they are used,
- New lut (lookup table) types which provide a common structure for color transformations in all profiles.
- An extension of the use of the charTargetTag to provide a means for referencing characterization data that has been entered in the ICC Characterization Data Registry,
- Addition of a set of multilingual Unicode strings for better internationalization of profiles,
- Enablement of the use of multidimensional tables for monochrome profiles and provision for the use of all rendering intents in input, display, and color space profiles.

These will all be included in the next version of the ICC File Format for Color Profiles which will be available later this year.

However, there remain a number of issues – particularly for some workflows - that will require further refinement. Thus, the ICC also has several working groups looking at various remaining issues. Two of these are of particular significance to the future of the ICC. These are the Research Implementation Working Group (RIWG) and the Graphic Arts Special Interest Group (GASIG).

A Look at Two Working Groups

Research Implementation Working Group (RIWG)

The present ICC architecture is that designed by the initial charter members and represents their best thinking at the time the ICC was created. However, a number of ICC members have identified a need to look at new architectures that would allow color management to be more transparent to the user and that would allow an even more open architecture. The RIWG is the group that was created within the ICC to do that type of advanced thinking.

The RIWG has been studying a new architecture which has sometimes been referred to as an intelligent CMM or pipeline approach. Rather than simply combining the transforms provided within profiles, this new architecture would use specially prepared characterization data, and both color appearance and gamut mapping models to dynamically create the optimum transform between devices and then process the image data through this transform.

This work is still very conceptual and is being carried out in parallel with the main work of the ICC. However, by constantly challenging the current models from within, the ICC should be a stronger more forward looking organization.

The proposal for a new architecture is currently being evaluated against what vendors perceive as problems with the current architecture. User surveys are being carried out in Europe and the USA to understand the problems they find with the existing system. Anyone who wishes to submit any problems they feel are due to the use of ICC color management is asked to send them to Tony Johnson.

Graphic Arts Special Interest Group (GASIG)

The GASIG was created to allow those members of the ICC that had significant involvement with the printing and publishing industry to work together to insure that the ICC architecture and implementation scheme meets the needs of that industry.

A key focus for current discussions is the question of mechanisms to allow the sender or generator of data to also define the preferred output. Within the present ICC Architecture the input profile is typically associated with the input image data. However, the choice of output profile is typically left to the recipient of the data who will have knowledge of the output device and the desired reproduction. Within the ICC architecture it was expected that the output device should render the original image as faithfully as possible as allowed by its capabilities (color gamut).

Unfortunately, this is not the workflow used by a large segment of the printing and publishing industry. In this industry the preparer of the image data, the sender, anticipates (specifies) a particular reproduction capability and prepares a proof which is used to secure customer approval. The receiver of the data is expected to reproduce the image data to provide the best match to the proof prepared by the sender and used to get customer approval. This requires knowledge of selections made by the initial preparer of the data. Currently, the graphic arts accomplishes this by sending CMYK data. However, sending CMYK data defeats much of the flexibility that color management is intended to provide and eliminates many of the possibilities for repurposing (adjusting the image data for optimum rendering on an output device which has a different color gamut) or retargeting (adjusting the image data for optimum rendering on a different output device which has the same gamut) of the image data.

One possibility is to simply send along the output profile used to render the image for customer approval. However, this runs counter to the goal of an open color managed data flow. Looking at the perceptual transform of an output profile typically used for graphic arts reproduction, suggests it includes three separate functions – gamut mapping, tone scale mapping (often considered part of gamut map-

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ping), and color separation including black printer generation. At the last meeting of the ICC a key part of the GASIG discussions focused on alternate ways that this information could be conveyed with the image yet still retain independence from the output device.

A number of options are being studied by the ICC. The GASIG (and the ICC as a whole) is committed to finding ways to meet the needs of both the graphic arts and other application areas within the ICC framework.

Future Work

In some ways the ICC has largely met its initial objective. The specification and architecture they have defined has ensured a portability of color images that was not achievable prior to its publication of the first edition of the profile specification. However, as the above discussion shows, refine-

ment of the ICC architecture – particularly for specific workflows — is still desirable and necessary. It represents a fundamental aspect of the current discussions within the consortium. Thus the decisions made over the next few years should be of great significance to any group that finds that the current system too limiting in some way. To ensure that all views are fully represented within the discussions it is important that the consortium has as wide a membership as possible. For details contact Kip Smythe.

More Info?

More information about the ICC is available at the ICC website (www.color.org) or from either Kip Smythe (ksmythe@npes.org) or Tony Johnson (tony@colouruk.demon.co.uk).

Other Standards Notes

ISO/TC130, Graphic Technology, will be meeting in San Diego May 10-16. TC42/JWG21 on revision of the ISO 5 series of Densitometry Standards will also meet in San Diego on May 12. For information contact me or Mary Abbott (mabbott@npes.org)

CIE Div 1, the AIC, and ASTM E12 will all be meeting in Rochester, NY during the period of June 20-29. Contact individual organizations for details.

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For suggestions for future updates, or standards questions in general, please contact the Standards Editor at mcdowell@npes.org or mcdowell@kodak.com