International Color Consortium®

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History of the ICC

0 Before ICC

The origins of the ICC lie in the transition to open systems that began in the 1980s. In the graphic arts industry the high-end vendors of the early pre-press systems had developed sophisticated methods of translating photographic originals into the colorant amounts required to match them on printed materials, but as workflows became all-digital and users began to expect quality reproduction from relatively low-cost components, it became essential to have interoperability between the software and devices available from different vendors. Other image-based industries, including broadcast, motion picture and photography, all faced similar issues as digital technology and the World Wide Web enforced a move towards digital color reproduction based on open systems [1].

The exchange of color data via a CIE-based color space had been adopted within certain of the closed systems, along with the basic technologies of multi-dimensional look-up tables for print, and the curve/matrix transforms for display systems that could be modelled additively. Several vendors developed their own color management systems which incorporated these technologies, including Linotype Hell's DaVinci, Kodak's Precision Transforms and Kodak Color Management System (KCMS), Adobe's Color Space Arrays and Color Rendering Dictionaries in PostScript Level 2, and Apple's ColorSync. By the early 1990s these solutions were becoming widespread and more open, but were yet to offer full interoperability between vendors. Implementations were vendor-specific and differed in important details, such as handling of the media white point and the definition of the CIE-based intermediate space.

During the late 1980s different industry initiatives were seeking open solutions to the issue of color data exchange, and to avoid conflicts arising from the different intellectual property owned by each of the vendors. These initiatives included the Open Standards Color Association (OSCA). In addition the ANSI IT8 and CGATS standards Committees were developing standards that would facilitate this work. Key were CGATS.5 (Spectral measurement and colorimetric computation for graphic arts images), IT8.7/1 and 7/2 which defined characterization targets for transmission and reflection photographic materials and IT8.7/3 which defined input data for characterization of printing processes. These all became ISO TC130 standards.

ColorSync was the first color management system to be provided as part of the operating system (OS). It was initially developed by Apple's Color Imaging Research Group using an algorithm to mix the relative amounts of the primaries to yield XYZ tristimulus values [2], which could then be matched to another device using the inverse algorithm. Later Apple added Linotype-Hell technology

using look-up tables to ColorSync. Kodak had adopted technology originally developed by Eikonix in KCMS, which they licensed to Sun. Other operating system vendors were either developing their own integral color management or licensing technology from third parties.

In March 1993, Fogra invited a panel of experts from color management vendors to a Fogra Symposium on Advanced Digital Prepress in Munich to discuss how to color manage documents. At a panel meeting at this event chaired by James King of Adobe it became clear that there was no standard way to communicate the data needed to populate the transforms for different devices. The members of the panel agreed to work together to find a solution, and this led to the establishment of a group consisting of Linotype Hell, Agfa Graphics, Eastman Kodak, Apple Computer, Silicon Graphics and Sun Microsystems. After the first meeting in Munich, the group held a number of meetings, mostly in the US, over the following year and made rapid progress. In August 1993 Apple made their ColorSync technology public and offered free use of it to the group. Other OS vendors had also integrated CMS technology into their products, but after discussion it was agreed to adopt the ColorSync architecture and profile format as an open standard. By September Apple were able to define both the format specification the profile and an associated API.

This initial approach generated considerable debate. The main discussion of the group focused around the definition of the exchange space, now known as the Profile Connection Space (PCS). The choice was made to standardize a single, fixed PCS defined around the CIE 1931 standard colorimetric observer, the D50 illuminant and an assumed 0:45 degree measurement geometry. This choice did not please everyone, especially those from industries where D65 colorimetry was the norm, who anticipated exchanging data between one D65 device and another D65 device, and for whom the apparent additional step to chromatically adapt their data to D50 was unwelcome.

Another key point of the early discussions was whether to specify a reference viewing condition, it was eventually agreed that this was necessary, although later when the v4 specification was developed it was clarified that this was not essential for the Colorimetric rendering intents which were measurement-based.

1 Foundation of the ICC

By 1994 the group had agreed the main outline of the new color management architecture and formed the Inter-Color Consortium (later renamed International Color Consortium) as an open and vendor-neutral body, with a mission to standardize and promote this architecture and an associated profile format. Michael Has of FOGRA was appointed as the first technical secretary, and administrative support was provided by NPES (now known as APTECH) with Kip Smythe [3] the first secretary. The consortium moved to recruit other companies with an interest in color management, and adopted a set of procedures intended to ensure equality between the members [4], with an elected Steering Committee and officers. Michael Stokes (then at Apple Computer) and Todd Newman (then at Silicon Graphics) were elected as the first chair and vice-chair respectively. To avoid conflicts over intellectual property between members of the Consortium, a Promoters' Agreement [5] granting a license to all relevant patents prior to July 1996 was adopted and signed by all members. The initial membership was highly international, with delegates from companies in North America, Europe and Japan.

The first demonstration of ICC technology was given at a Seybold event in Boston in spring 1995, and details of the basic architecture and the profile format were publicly described in a number of papers published at conferences in 1994 and 1995 [6-9].

2 First published specification

The first published ICC specification was dated June 10 1994. It was initially made available by download from a Silicon Graphics FTP server, until ICC obtained the domain name color.org, and since then specifications have always been available from ICC [10]. Updates to the first published version were published in May and November of 1995.

In 1996 ICC adopted the common patent policy [11] used by ISO and other standards organizations to encourage early disclosure and identification of relevant patents, and has formal patent and technical reviews of changes to specifications. Although the profile format was open and free to use, the content of a profile is still the intellectual property of the profile creator. This sometimes led to restrictions in the use of profiles, or in the payment of licensing fees for their distribution. This was not popular amongst users and the color management consultants who used commercial profiling software to make profiles for clients. ICC now recommends a more open form of license for profiles [12].

Numbering of the specification has sometimes caused confusion. Internal iterations resulted in the first published specification having the number 3.0, and the 1995 updates were 3.01 and 3.2. Subsequent minor revisions were published as 3.3, 3.4, ICC.1:1998-09, ICC.1:1999-04 and ICC.1:2001-04. These are collectively known as the version 2 specification. The principle was established that a minor revision was one which did not require a change in the CMM, so that all profiles conforming to any v2 specification could be processed by any v2 CMM. The v2 specification incorporated much sound color science and engineering, based on the expertise of experience of those working in the member companies. However, over time it was realized that some details were potentially ambiguous and required a more substantial change to the architecture, which resulted in the v4 specification. Different profile creators had different interpretations of the colorimetry in the PCS, and to avoid this the PCS was more rigorously defined in v4 – in particular the requirement that all colorimetry, including the media white point, must be D50 (chromatically adapted if necessary). The ICC profile was always based on the concept of avoiding combinatorial explosion of custom device-to-device transforms via a one-to-many connection where the PCS was the single intermediate space. However, this disconnection of source and destination made it impossible for the profile creator to optimize the transform for a given source to destination, resulting in them having to guess what the gamut was likely to be at the other end of the transform. In the v4 specification a reference gamut was introduced for the Perceptual and Saturation rendering intents, so that source and destination profiles both have a common rendering target.

ICC continues to support the v2 specification, which is still referred to in some older international standards, but recommends that only the most recent v2 specification (ICC.1:2001-04).The co-publication arrangement between ISO and the ICC was both unusual and very beneficial to the ICC. It allows documents prepared by the ICC to be published as ISO standards through ISO TC130, and to be simultaneously published as ICC documents without violating ISO copyright restrictions. This has provided visibility for the ICC work and allowed the ICC to maintain a parallel distribution network and publication of addenda notes to provide corrections and updates between major revisions.

The first v4 specification was published in December 2001. In anticipation of a formal agreement between ISO and the ICC (adopted in 2002) to enable ICC specifications to be published as ISO TC130 standards, work was begun by Michael Haas and Dave McDowell, later aided by Tony Johnson (Technical Secretary 2001-2005) on writing the v4 specification in the language of

international standards. The document was extensively reviewed by ISO TC130, and the first ISO publication was ISO 15076-1:2005 (technically identical to ICC.1:2004-10). TC130/JWG7 is a joint working group between ISO TC130 and the ICC charged with supporting the publication of ICC work through ISO TC130.

Subsequently further revisions have been made that have incorporated proposals from members and addressed industry needs and emerging best practices. It remains a complex document, and small corrections are still being made and posted as Errata on the ICC web site.

3 iccMAX and the need for a new architecture

The v4 specification is well-defined and (despite an initial slow uptake) has been widely adopted. Since it was published many new requirements have emerged, such as the desire to handle appearance processing, spectral data, and non-D50 colorimetry. Since these were (and so far remain) minority needs, ICC decided that it would not address these through the previous model of making incremental revisions to the main specification through the mechanism of individual votable proposals, but instead it would develop a comprehensive new architecture that would extend v4 where needed, but not replace it. It also committed to providing a reference implementation to support developers in implementing the new architecture – the lack of which was thought to have been partially responsible for the slow uptake of v4. The work to develop a new specification was led by Max Derhak of Onyx Graphics, and resulted in publication of the ICC.2 specification both by ICC and by ISO as ISO 20677:2019.

4 Membership

ICC membership has fluctuated since founding; it grew at one point to over 70 members, and then fell somewhat as companies merged following the 2008 recession, and business models changed. Some of the recent growth has been in companies outside the traditional graphic arts sectors (such as medical imaging), and companies from more Asian countries (notably China and Chinese Taipei) have joined. Another welcome source of growth has been the honorary members, based at universities throughout the world, who have increasing brought academic and research insights and become more actively engaged in color management problems.

5 Working Groups

Beginning with the Graphic Arts Special Interest Group (GASIG), ICC formed working groups to enable focused discussion of specific topics. These included the following (with groups that have either completed their work and closed, or have been merged into other working groups, listed in italics):

- Profile Assessment WG
- Architecture WG
- *Conformance Testing WG*
- *Reference Implementation WG*
- *Digital Motion Picture WG*
- *Digital Photography WG*
- *Workflow WG*

- Intellectual Property WG
- Specification WG
- Medical Imaging WG

The charters and membership of the current working groups can be found on the ICC web site [13].

6 DevCon and other ICC events

From the beginning, ICC organized events to enable vendors to compare their implementations and ensure inter-operability between them. In 2005 ICC held the first Developer Conference (ICC DevCon), and continues to run these as a biennial event, with hands-on workshops and presentations on state-of-the-art technologies. Recent DevCons have focused primarily on the iccMAX technology.

Other public events are held, often in conjunction with the regular, tri-annual members meeting. Expert Days are a popular format, in which speakers from member companies and local bodies come together to review technologies and opportunities within the geographical region of the meeting or within a particular industry sector.

7 References

[1] Michael Stokes, The History of the ICC, Proceedings of the Fifth IS&T/SID Color Imaging Conference, 1997, p.266

[2] Robin Myers, The History of ColorSync, 2012
http://www.chromaxion.com/information/ColorSync_History.pdf

[3] http://www.color.org/kipsmythe.xalter

[4] International Color Consortium Membership Agreement, http://www.color.org/memdoc.xalter

[5] ICC Promoters' Agreement, http://www.color.org/proagree.pdf

[6] S. Gregory, R. Poe, and D. Walker, Communicating Color Appearance with the ICC Profile Format, Proc. 2nd IS&T/SID Color Imaging Conference Proceedings 1994, pp. 170–174.

[7] Michael Has and Todd Newman, Color Management: Current Practice and the Adoption of a New Standard, Proc. TAGA 1995 Vol 2.

[8] Color Management—Current Approaches, Standards and Future Perspectives, Michael Has, Proc. IS&T's 11th NIP, p. 441 (1995)

[9] George B. Pawle, Inside the ICC Color Device Profile, Proc. IS&T/SID 3rd Color Imaging Conference, p. 160 (1995)

[10] ICC Specifications, http://www.color.org/icc_specs2.xalter

[11] ITU-T/ITU-R/ISO/IEC Guidelines for Implementation of the Common Patent Policy

[12] ICC Profiles – licensing http://www.color.org/profiles2.xalter#license

[13] ICC Working Groups, http://www.color.org/groups1.xalter