The History of ColorSync

Robin D. Myers
15 July 2012

The story of ColorSync starts at the beginning of October 1988 when I came to Apple Computer to work on color matching for a solid wax inkjet printer Apple was developing. At that time Apple had a Peripherals Division where monitors, printers, mice and scanners were developed. The manager of the solid wax inkjet printer project was Gary Starkweather, who had come from Xerox PARC where he invented the laser printer. I had met Gary when I worked at another Xerox company, Versatec, which made electrostatic printers.

While at Versatec I received a patent for inventing a color matching algorithm and when I learned that Starkweather had left Xerox for Apple, I applied, and was accepted, for a job doing color matching work for his inkjet printer project. At Apple I used the knowledge attained at Versatec to develop a new color matching algorithm. By the end of October 1988 the algorithm was giving results good enough to show others in the company.

After about a year, Gary Starkweather was promoted to Apple Fellow and transferred into Apple's research division, the Advanced Technology Group. As part of this transfer he brought myself and another engineer with him to form the Color Imaging Research group.

The original algorithm used profiles consisting of the XYZ tristimulus measurements of tone scales in each device's primary colorants, secondary colorants and the achromats (i.e. white to black). From this data the mixing amounts of the primaries were calculated to match the original's XYZ values. It is interesting to note that there was no consensus at the time as to white point but I favored D65 and used it for most of the development. Although when matching Munsell colors, such as those on the Macbeth ColorChecker, Illuminant C was used.

Matching was always from a source device, or definition, to a destination device. Tristimulus XYZ space was used for all the calculations and both the source and destination had to be defined for the algorithm to operate. In ICC parlance this would be a device link situation.

This algorithm offered the user two sets of options for the match. The first set related to the achromatic line, the second set dealt with out of gamut clipping.

When matching colors from one device to another, it is possible to get exact mixing ratios for colors within the overlapping region of the two device gamuts. However, the white points may still be different. For instance, a paper's white may be different from the reference D65 white of the specimen's measurement. The black point usually has a different color than the paper's white. The white and black points define a line in XYZ space and the first algorithm option allowed the user to leave the white points unmodified, or to align the destination achromatic line to the source's. This option was between "colorimetric" (no achromatic adjustment) and "perceptual" (achromatic adjustment). To all those that have questioned these two terms, this is where they started.

A colorimetric match produced a numerical equivalence between the calculated colorant mixture’s XYZ values and the original specimen’s XYZ values. A perceptual match adjusted the white and black points for the mix to the white and black points for the original. Expressed in modern equivalents this was a combination of perceptual rendering and black point compensation.

The second set of match options related to out of gamut colors. For out of gamut colors only two of the three properties of lightness, hue and saturation can be obtained. One option, the default, was to maintain lightness and hue, sacrificing saturation. The second option maintained hue and saturation, letting the lightness change. The first option was best for images, the second for business graphics.

Two software groups made implementations of the color matching algorithm; one in the Peripherals Division, the other was the QuickDraw GX group. The Peripheral implementation was a partial one, the GX one incorporated the full algorithm. Unfortunately, the Peripheral group's implementation won the internal political battle for incorporation into the system software. This version did not work as well as the full algorithm, so when it was released in January 1993 (yes, it took over 4 years to get this out) as ColorSync, I was too embarrassed by it to present any talks or papers. Instead I hoped that the release of QuickDraw GX, containing the full algorithm, would eventually replace the flawed one. This did not happen.

As I developed the matching algorithm, two members of the QuickDraw GX team made some improvements to the algorithm, specifically in relation to clipping, so I added their names to the patent application. They were Keith McGreggor and Robert Johnson. A fourth person, Konstantin Othmer was added for other reasons.

In 1994 or 1995, Michael Stokes was hired into the System Software Division to work on color management. He decided that for ColorSync 2 a table lookup method would be used, replacing the algorithmic ColorSync 1. Many companies using ColorSync wanted a more open system and this request was answered when Stokes set up the ColorSync Consortium. The ColorSync Consortium soon changed its name to the International Color Consortium (ICC) to emphasize the platform independent nature of their work. The ICC adopted the table lookup method because it was common practice in the industry at the time. In fact, engineers from one ICC member, Heidelberg, who had been selling their own proprietary table lookup systems, worked at Apple to create the Color Matching Method (CMM), the core transformation engine which performs the table interpolations for the Mac OS.

Prior to the advent of ColorSync, color matching was proprietary, offered by a few vendors at high costs. With ColorSync, then ColorSync 2, Apple was the first computer company to put color management into the operating system, allowing every user the ability to get accurate color images at low cost. Throughout Mac OS 7 through 9, a program's use of ColorSync was an optional choice, with many choosing to ignore it.

Beginning with Mac OS X, ColorSync color management is always active with every program, whether they wanted it or not. This is a great benefit to the user, since images are ubiquitous. They are included in word processing documents, spreadsheets, emails, just about everything.

Even Microsoft has added color management to Windows with their Integrated Color Management (ICM) system. Although Microsoft has chosen to take the path of making its use optional, with the result that color management is used by few Windows programs. Most windows users are unaware that ICM even exists in their OS, let alone how to access or use it.