

Desktop Color Photo Printing Example

Professional ICC solution for everyone

Case study of Mac OS X color management

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ICC Color Management Overview

- Problem:
 - Devices represent color in different spaces and different gamuts
- Goal:
 - Provide consistent and predictable color across devices
- Solution:
 - ICC profiles
 - Color Management Modules (CMMs)



ICC Profiles

- Describe how to transform colors between device color space and interchange space (PCS)
- Enable Color Communication
 - i.e. ability to predict color
 - creation of device specific color
 - device simulation (soft-proofing)

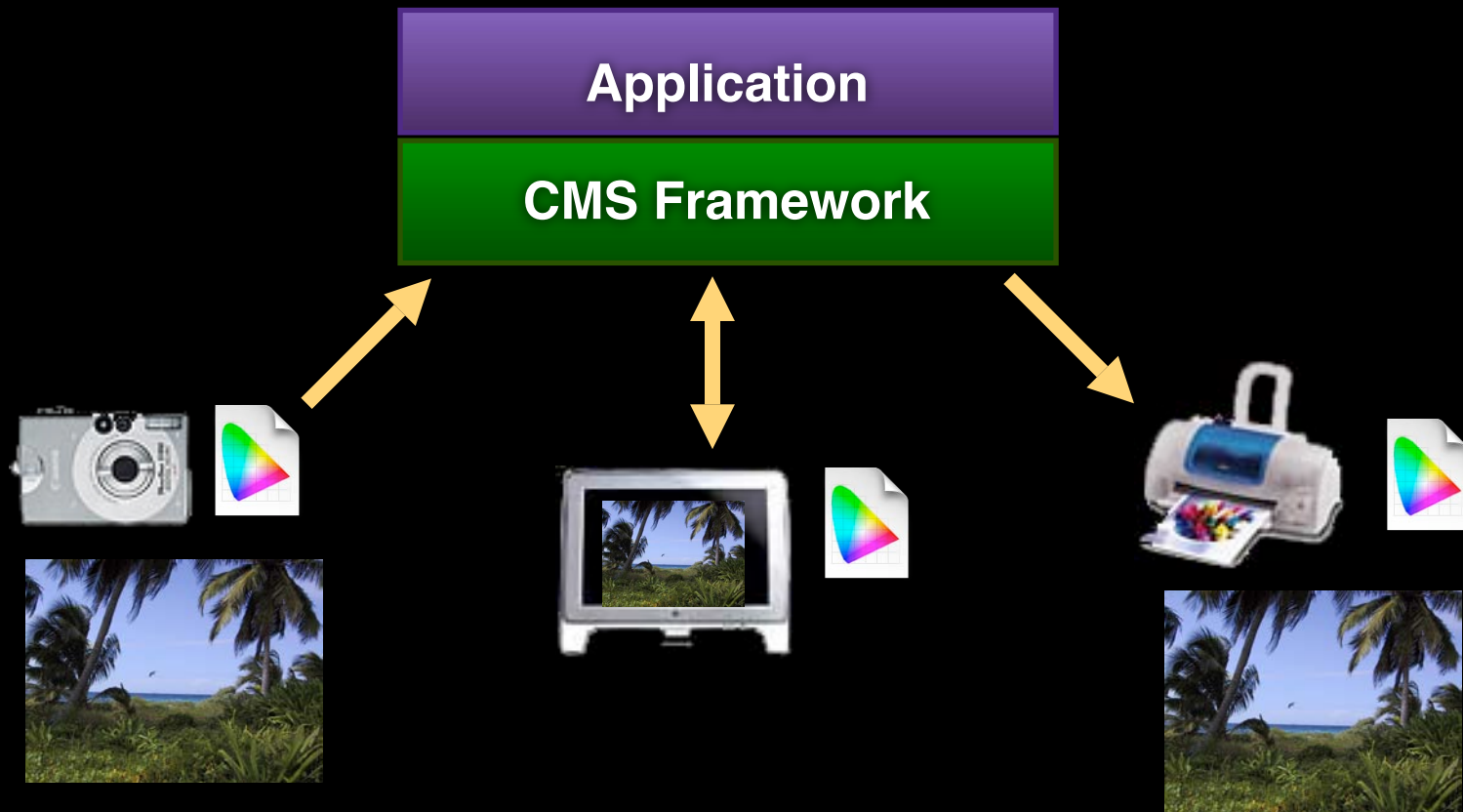


CMMs

- Provide the mathematical engine to perform color transformations



ICC Color Management System



Color Management in Mac OS X

- Functionality provided by ColorSync
 - Color defined by ICC profiles
 - Color conversions performed by CMM
 - ColorSync Device Integration database contains ICC profiles registered for color devices known to the system



Color Management in Mac OS X

- Integrated automatic color management
 - ICC profiles embedded in color data are used by the system for reading, displaying, printing and saving to files



ColorSync Device Integration

- Mac OS X has Device Managers for input, display and printing
- Device Managers are integrated with ColorSync
 - Provide awareness of devices and access to their profiles
- Device Integration services include:
 - Device and profile registration
 - Device profile access
 - Notifications



ColorSync Device Integration

- Device and Profile Registration
 - Device Managers detect presence of devices
 - Register profiles provided by device drivers
 - Can also build device (factory) profiles
 - e.g. based on EDID



ColorSync Device Integration

- API to access device info & profiles
 - used by application for custom color management
 - used by the system for automatic color management



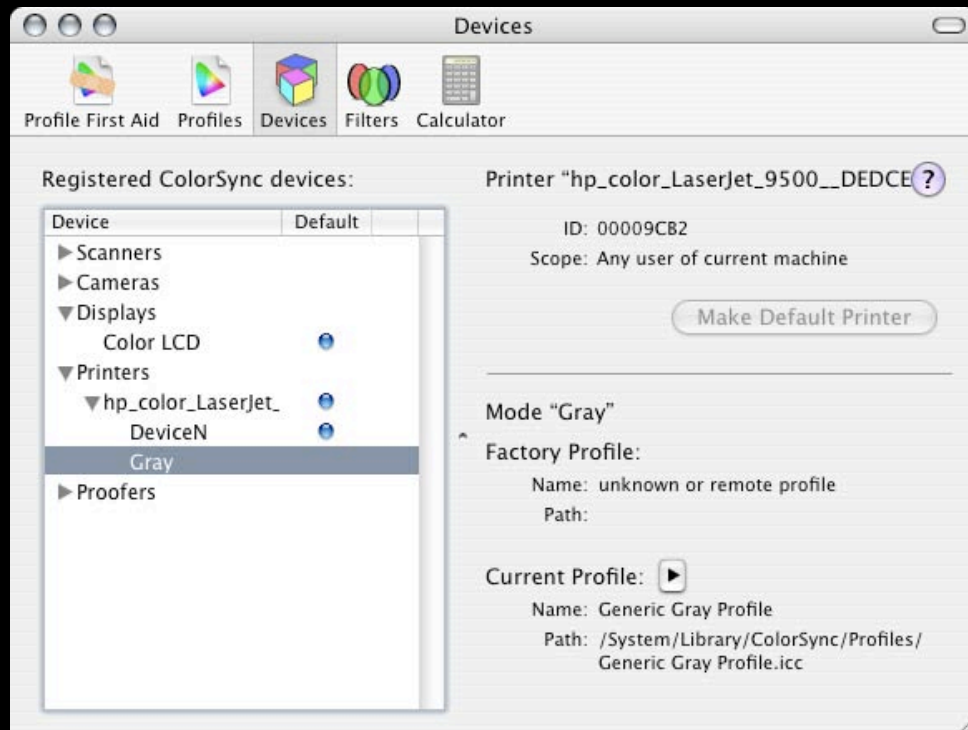
ColorSync Device Integration

- Notifications:
 - Can be received by any process
 - Notifications for:
 - Changes to the default device for a device class
 - Changes to a device factory or custom profiles
 - Changes to a device's default profile
 - Device registration/unregistration

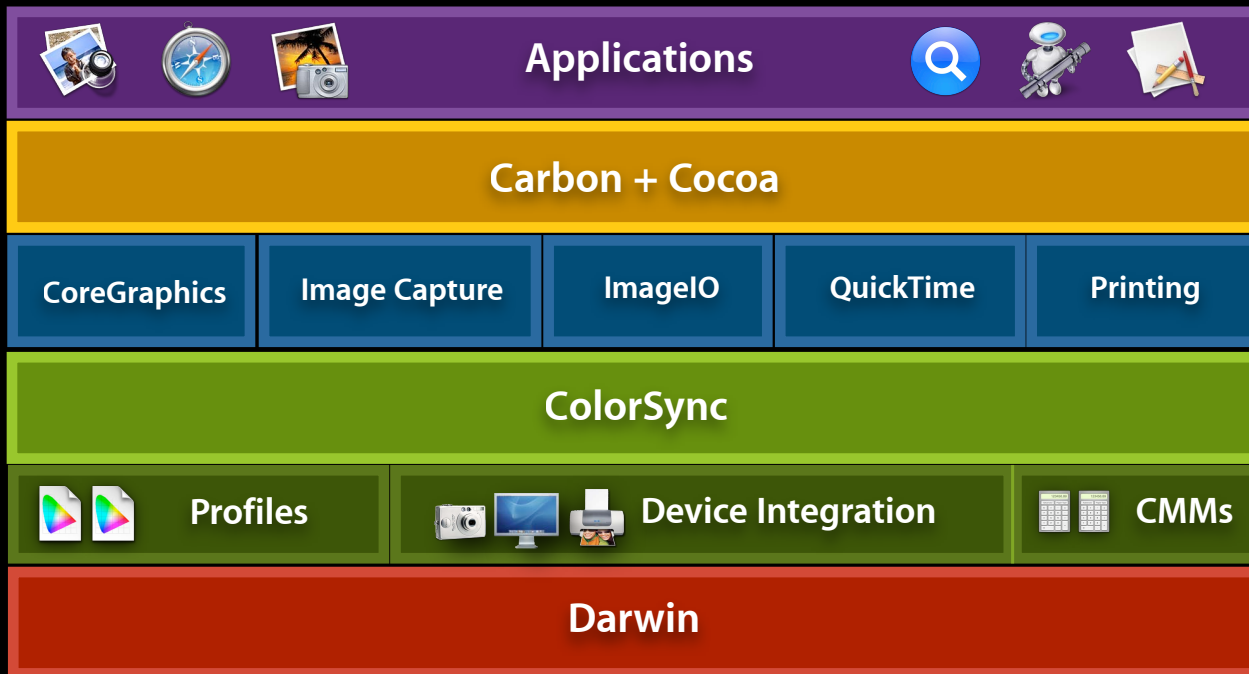


ColorSync Device Integration

- User can access ColorSync Device Integration database and assign custom profiles to color devices



Architectural overview



Sample Image Processing Application

- Sample code illustrating color image processing on Mac OS X
 - opening, displaying, color matching, correcting, saving and printing images

Visit:

<http://developer.apple.com/samplecode/ImageApp/ImageApp.html>

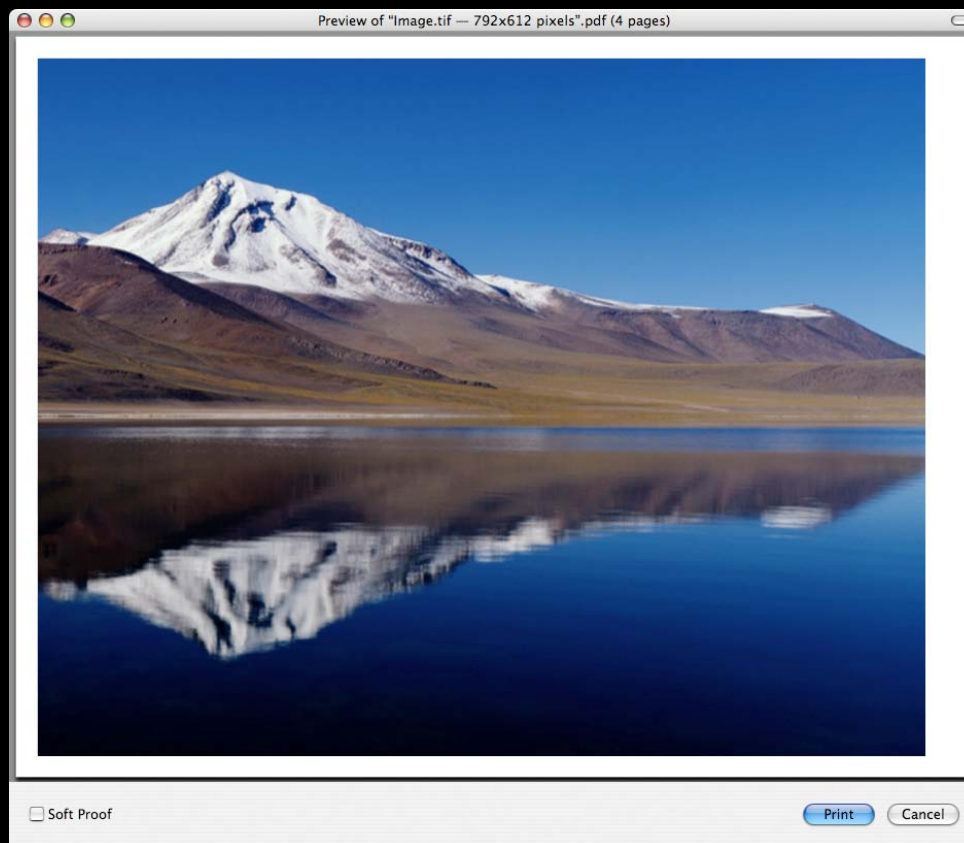


Color Management in Printing

- Main goals:
 - Reliable, consistent color
 - Printing to be a part of Color Communication
 - Ability to predict and preview color
 - Application and the system control color matching
 - Driver assures color consistency



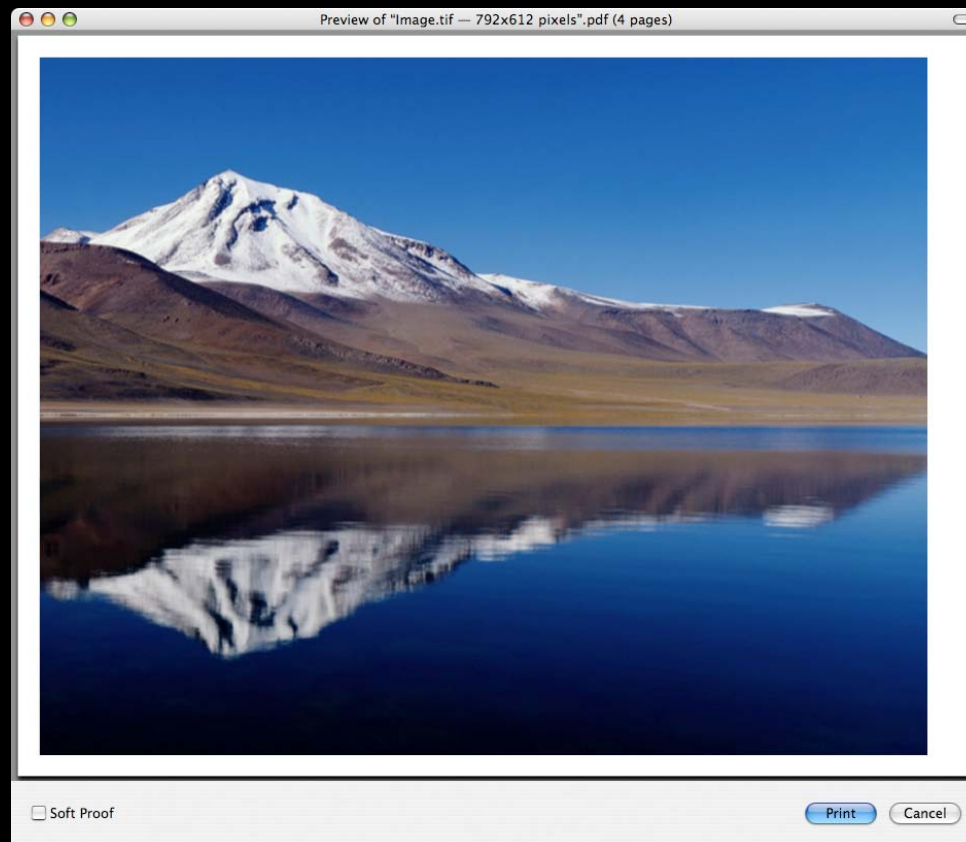
Color Communication in Printing



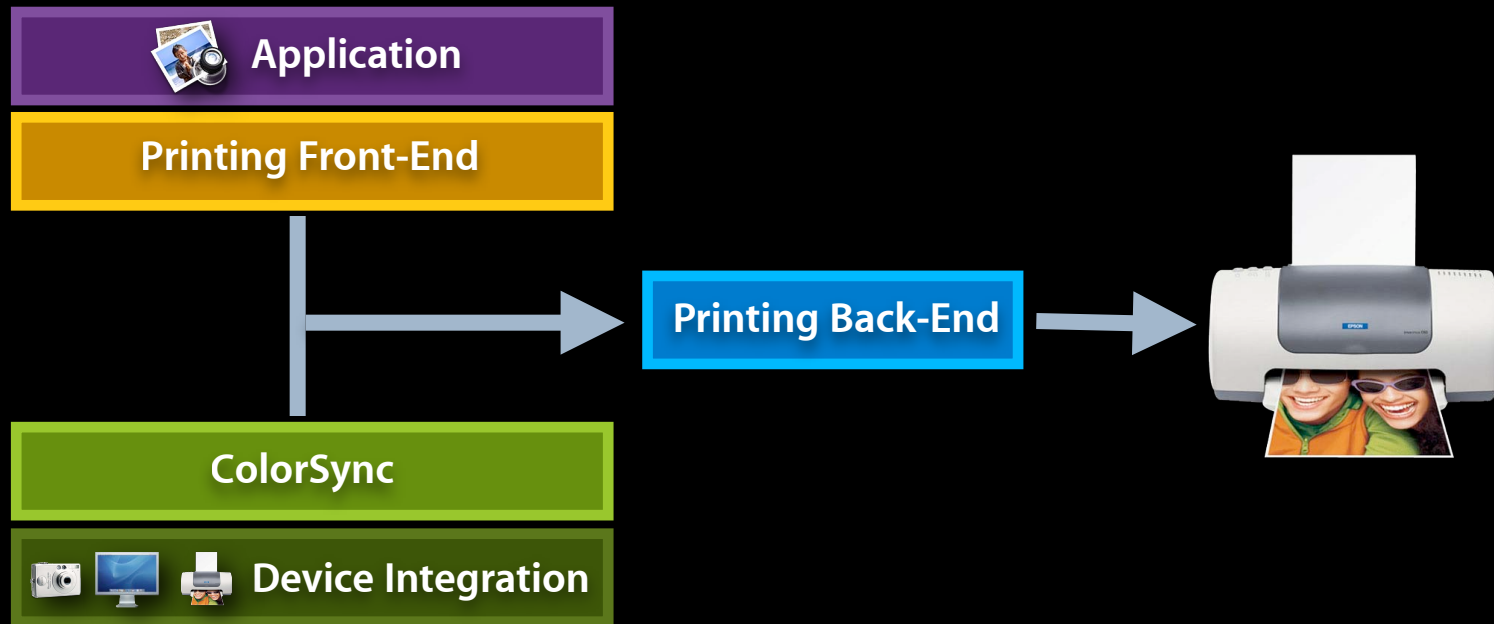
Color Communication in Printing



Color Communication in Printing



Mac OS X Printing Architecture



Mac OS X Printing Architecture

- Two main driver classes:
 - CUPS (PostScript and raster)
 - print options controlled by PPD
 - can specify ICC profiles linked to different printing conditions
 - Tioga (legacy, raster only)
 - print options controlled by the driver code
 - ICC profiles for different printing conditions are specified by a profile ID and stored in the job ticket



CUPS printer profile registration

- New keyword in PPD:

*cupsICCProfile ColorModel.MediaType.Resolution "profilename"
or

*cupsICCProfile ColorModel.XXXX.YYYY "profilename"

where XXXX and YYY are custom qualifiers.

For details visit: <http://developer.apple.com/qa/qa2004/qa1352.html>



Color Management in Printing

- Legacy:
 - Driver performs “last minute” color correction when the print job is handed off to the driver
 - driver color changes are not communicated back to the system or application



Application vs Driver Color Management

- Application (ColorSync) mode
 - Printing is a part of Color Communication
 - Color data is matched to the printer profile known to the system
 - Driver does not make any color adjustments
- Driver (Vendor) mode
 - Printing is excluded from Color Communication
 - Color data is matched to a known generic profile and handed off to the driver
 - Driver makes color adjustment based on custom color controls (color not communicated back to the system)



How should device drivers use ICC profiles?

- Provide factory profiles for their devices
 - Create basis for Color Communication in the system
 - Profiles should reliably and consistently represent device color capabilities
- Don't perform any additional color tweaking beyond that described by the profiles
 - critical for Application (ColorSync) mode
- Allow factory profiles to be replaced by user's custom profiles



Questions / Comments

Thank You!

<http://www.color.org/tokyomeeting2006.html>

