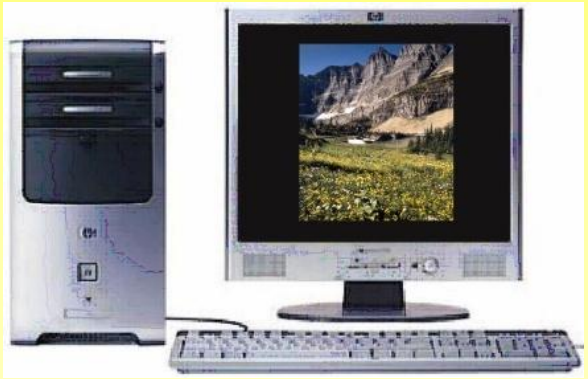
Color Management - Part II

Implementing Color Management



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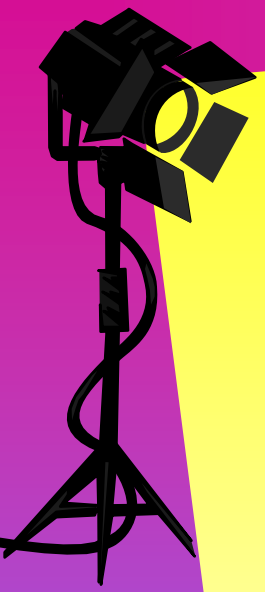
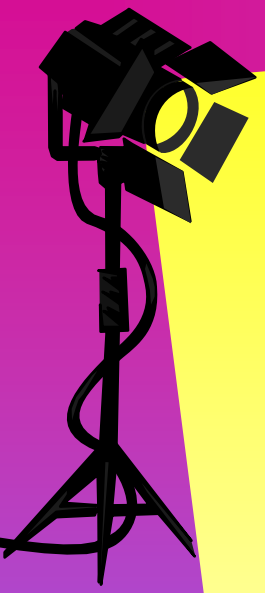


Session Goals

To provide an **practical** understanding of:

- Digital color
- Color space
- ICC profiles
- How to implement color-managed workflow



Review: Basic Concepts of Color Management

Color Perception

- Color perception has both **OBJECTIVE** and **SUBJECTIVE** components
- **Objective:** different viewing technology produces different results (printers, printer type, monitor, monitor type, printer paper, printer ink, etc.)
- **Subjective:** physical characteristics of the viewing environment (background lighting, type of lighting, intensity of lighting, color of viewing area, etc.)
- To get consistent color perception it is important to standardize and minimize the objective and subjective factors

Digital Imagery & Color

- Digital Images are captured and displayed on a variety of devices; each digital device captures or displays images in a unique manner
- Each pixel in a digital image encodes light in a combination of discreet RGB values; without context, the RGB values are meaningless
- The Color Space defines the context of the RGB values in an image file
- All digital images refer to a color space-- either explicitly via an embedded user-specified profile, or implicitly

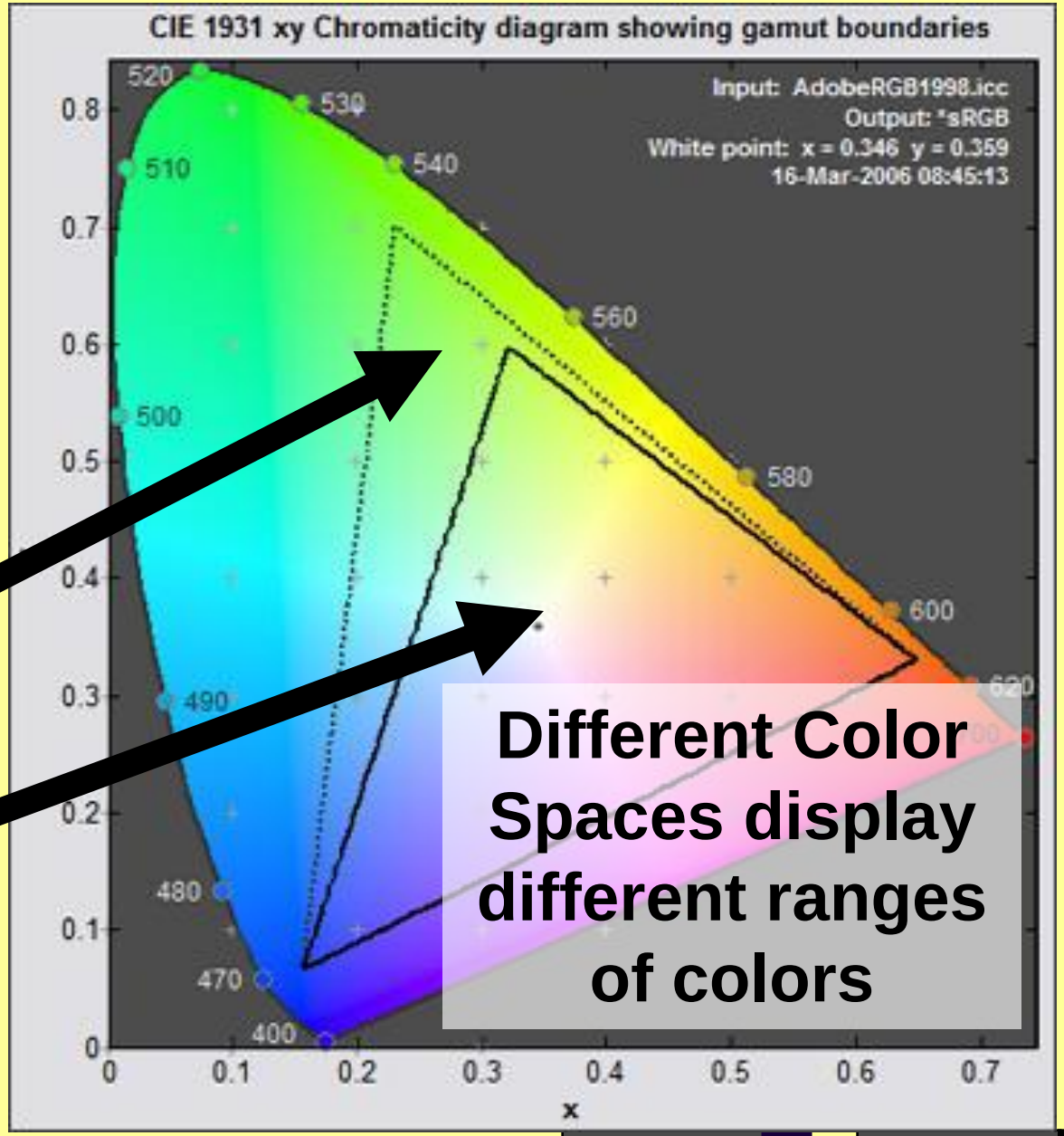
RGB Color

- Due to the wide variety and number of devices (cameras, film, scanners, monitors, printers, …) a large number of color spaces have been developed.
- The de facto standard for the Internet, sRGB, has a limited gamut and was developed to correspond to a typical CRT monitor. Other color spaces have larger gamuts; for example, Adobe RGB has a much richer color space than sRGB.
- Working color space refers to the color space of the digital image

Color Space Gamuts

Adobe RGB

sRGB



Different Color Spaces display different ranges of colors

Displaying Digital Images

- Digital Images can be displayed multiple ways (printer, monitor, projector, …)
- Each technology displays color differently; not better or worse just different
- Even different devices using the same technology do not display color the same
- The GOAL of color management is to enable the physical devices in a system to display the colors of an image as close to each other AND to the image's working color space ***AS POSSIBLE***

ICC Profiles

- Profiles are the standard for how digital devices (scanners, digital cameras, printers, etc.) communicate color information to each other
- Profiles define how each device displays color
- A color managed system uses the information contained in each profile to translate how the colors of an image in a working color space to the individual characteristics of attached physical devices
- Profiles are key to matching color and consistent results

Color Management Block Diagram

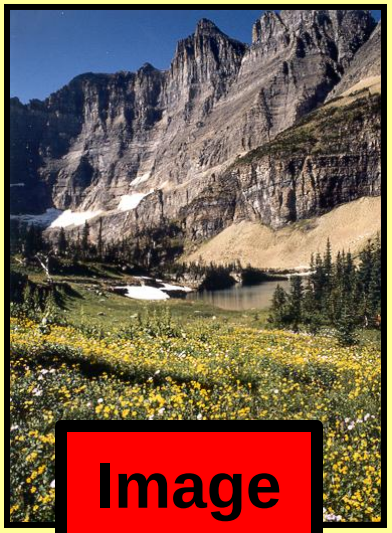


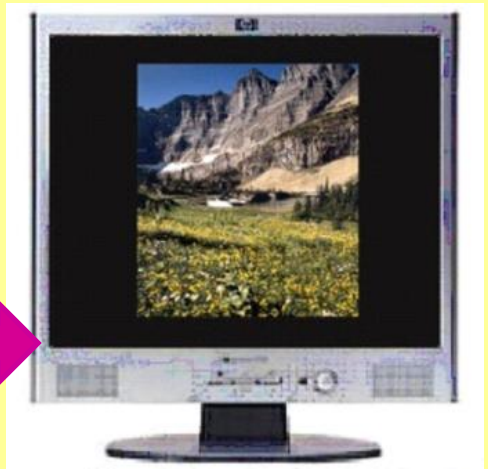
Image File

Image Profile

Working Color Space

Printer Profile

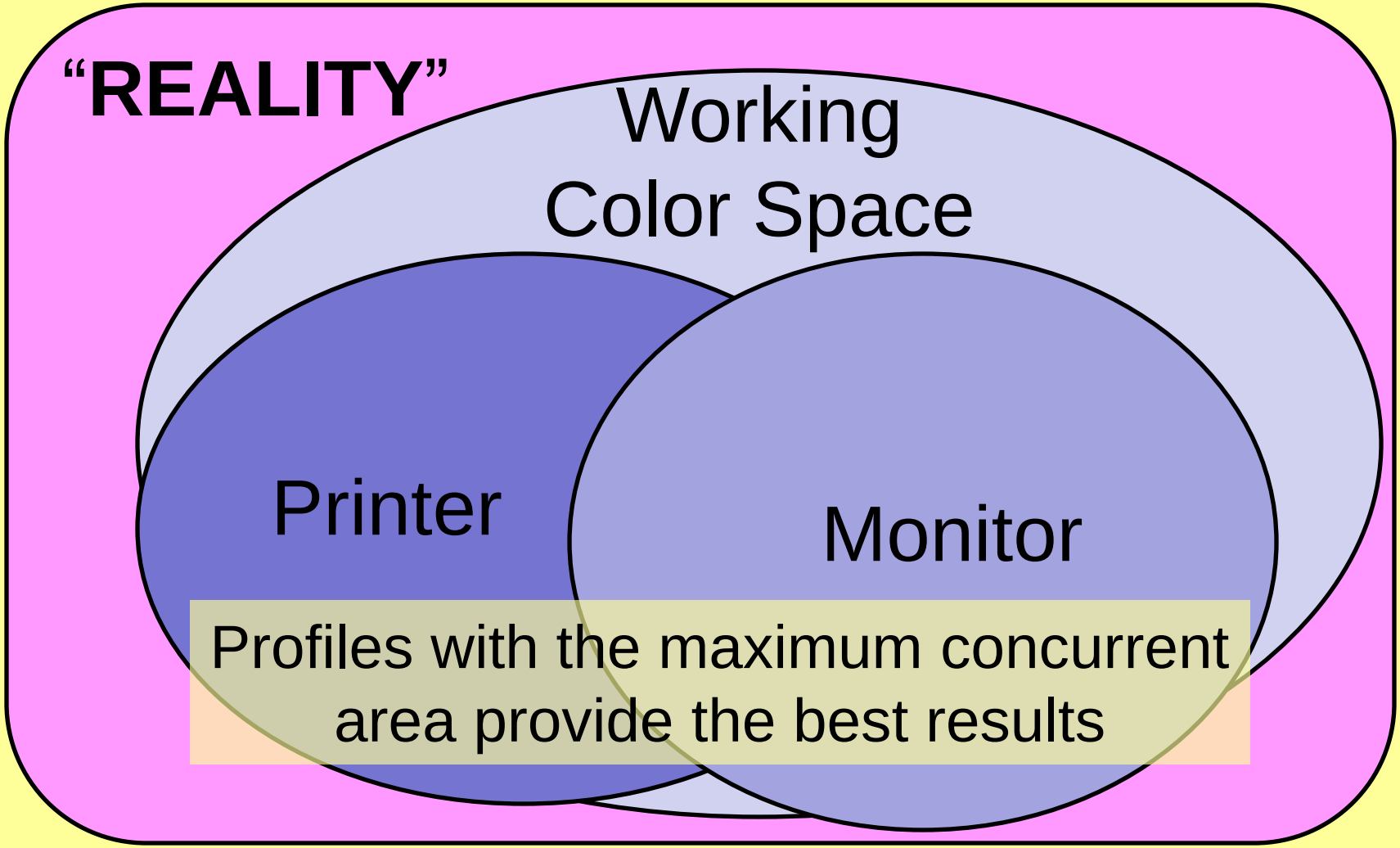
Monitor Profile

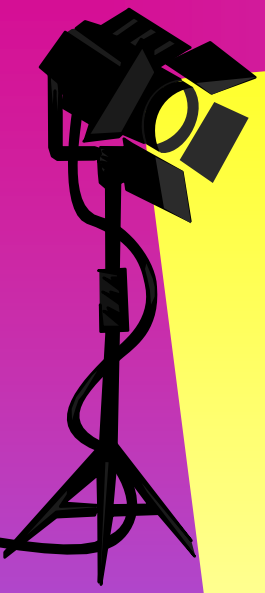


Profiles are KEY

- The image profile is the profile used in the Working Color Space (Abode RGB, sRGB,…)
- The monitor and printer profiles are device dependant; they can range from generic, device “generic”, company device supplied, to totally custom
- The profile for the monitor or printer **IS ONLY VERY RARELY** the same as the working color space; the best way to identify the right device profile is to look on the web.
- “Good” Color Management results in each device reproducing color as close to the working color space and to each of the other devices as possible

Profile Visualization





Implementing Color Management to Obtain Consistent Color

Color Management

- Establishes a methodology for:
  - a working color space for editing and storing images
  - handling images from input devices, such as scanners or digital cameras
  - handling image files that are untagged or have different color spaces
  - monitor profile and monitor rendering intent
  - printer profile and rendering intent.

Color-Managed Workflow

- The specifics of implementing a color managed workflow is highly dependant upon the imaging software used
- Implementation details often vary between different releases of the same software
- Key to color management is selecting the “right” profiles for each of the digital technology components AND implementing the profiles properly!

Image Profile/Color Space

- The “set-up” of the digital image acquisition device (camera, scanner, etc.) determines how the image is mapped into the color space
- “Set-Up” includes color profile/color space, bit-depth of the image (24 or 48 bit color) and image format
- Image appearance is also determined by all of the factors of digital exposure: resolution, exposure, brightness, contrast, color balance, saturation, etc.
- **Every image either has an embedded or an assumed profile/color space**

Monitor Calibration

- Monitor Calibration is THE most important component of Color Management – without a “viewing standard” all other results are suspect
- “Eye Ball Calibration” manually setting gamma, luminance, and color temperature
  - “Free”
  - Not Consistent
  - Only BARELY better than nothing!!!
- Hardware calibration device
  - Costs $ but it makes little sense to buy expensive camera gear and then skimp on how the same images are viewed
  - Objective and reproducible

Calibrating a Monitor

- In order to get consistent viewing, one must establish a suitable and consistent viewing environment before doing ANY monitor calibration
- Manual Calibration: use the help in the software used or search the web under “setting Gamma on a monitor”
- Calibration Tool: $100-300; two major sources
  - X-RITE
  - ColorVision
- The result is either manually set luminance, color temperature and Gamma, OR a custom profile developed for that specific monitor

Printer Calibration

- “Off the Shelf”: select the manufacturer supplied profile that most closely matches the printer, ink, and paper combination used
- Custom: use on-line tools to obtain a “custom” printer profile for the specific printer, ink, and paper used ($15-25 each)
- Printer Calibration Tool: hardware and software which can create configuration specific profiles on-site (very expensive)

Printer Profile/Calibration

- “Off the Shelf” printer profiles: historically poor but new high end printer profiles based on specific printer, ink, and paper combinations are quite good
- Custom: go on line, print test images and mail in. Great as long as that specific configuration is used
- Printer Calibration Tools: $1000+; two major sources
  - X-RITE
  - ColorVision
- Regardless of the method used any “good” solution is a profile unique to a specific printer, ink, and paper configuration. Any significant change to that printer configuration normally requires a new printer profile

Conceptually Implementing Profiles in a Color Management Workflow

- Step 1: Select and set the Monitor's profile
- Step 2: Open color managed software
- Step 3: Select and set the workflow policy and working color space of the image
- Step 4: Select and set the printer's profile and be sure to disable the profile in the printer driver

Color Managed Workflow Tips

- Establish a consistent viewing environment
- Make sure the right profiles are used:
  - Working Color Space (Adobe RGB, sRGB, etc.)
  - Monitor (manual/custom calibration)
  - Printer (device specific/custom/custom)
  - DO NOT USE ONE PROFILE EVERYWHERE!
- The “better” the device profile the better the results
- Establish a consistent method for working on images (a Color Managed Workflow)
- Attention to detail is critical
- Understand how much effort you are willing to expend for the results desired; it’s a trade off

Color Management References

- For more data and specific details on understanding and implementing color management workflow use the help in the software used or surf the web
- Two good sites for Color Management:
  - http://www.drycreekphoto.com/Learn/color_management.htm
  - http://www.normankoren.com/color_management.html
- Chromix and GamutVision provide good Color Space/Profile visualization software

Color Management Reality

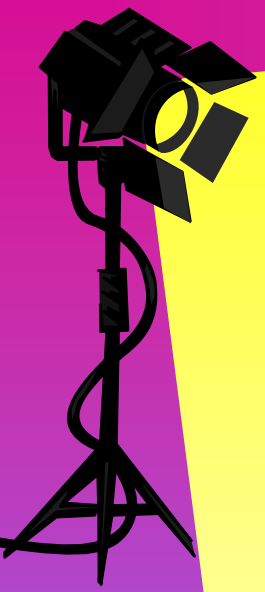
- Maintaining consistent color between different devices and color spaces **IS** possible but a lot of work
- A color managed workflow provides a practical solution to consistent color
- No matter how hard you try nothing can make two devices with different profiles display *exactly* the same colors; how close you get is dependant on how hard you are willing to work

Summary

- Color Management is the key to high-quality, consistent results
- Profiles define how devices display color; getting the right profiles is essential if color management is to work properly
- All digital results are based on what is seen on a monitor; without a properly calibrated monitor it is impossible to have quality color results regardless of who prints the image or how it is displayed

Final Thoughts

- Monitor Calibration tools are worth the $
- Printer Calibration Tools are currently not worth the $; either use custom services or use those that come with the printer (the newer the printer the better the profiles)
- Implementing color management concepts is simple: Calibrate the Monitor, Set the Working Color Space and Workflow, Set the Printer Profile and disable the profile in the printer driver
- The actual implementation of color management is dependant upon the software used; frequent knowledgeable use and attention to the detail makes color management easier
- Understand what are the results you want and do the cost-benefit analysis to determine how much effort is needed to get those desired results. Is it worth it?



Questions, Comments, or Suggestions?

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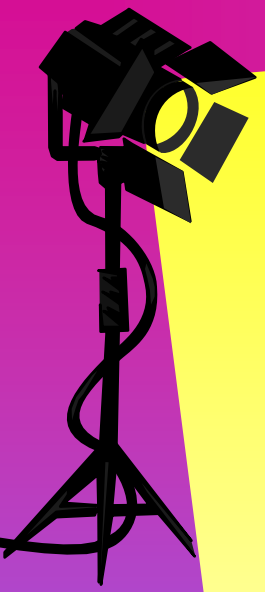

Schedule
(2nd Saturday of every Month)

Date	Description
6-09-07	Color Management Fundamentals Part II How to Implement Color Management
7-14-07	Digital Camera Picture Taking (how to get a good digital image)
8-11-07	Digital Camera Picture Taking Part II (more how to get a good digital image)
9-8-07	TBD
10-13-07	**NEW Series** **Photoshop Fundamentals by Ed Bunyan**