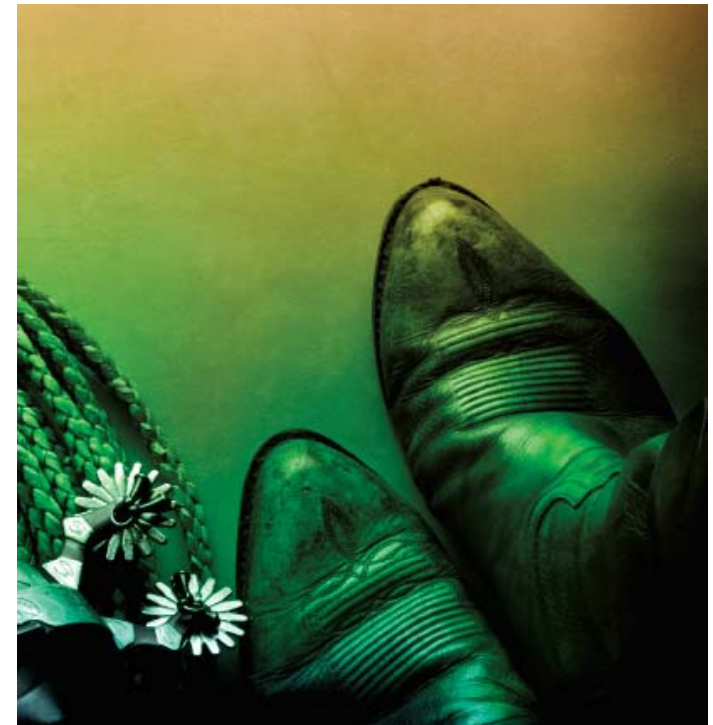


ICC profiles: features vs. versions

Jack Holm
TARKUS  IMAGING





Background questions

- **Why did the ICC create the v4 profile spec?**
—And what happened to v3?
- **What are the intended benefits of v4 profiles?**
- **What are the ancillary benefits of v4 profiles?**
- **In what situations is a v2 profile better than a v4 profile?**
- **How can ICC color management be simplified?**
- **How can ICC color management be used to provide extended capabilities?**
- **What ICC specification should be the primary ICC reference?**



Why create the v4 specification?

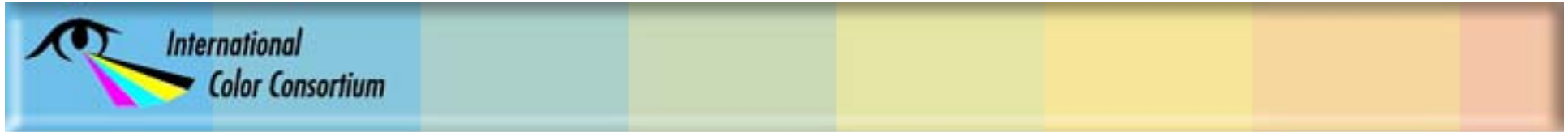
- **Interoperability problems and specification issues**
 - Inconsistent medium white point encoding and use
 - Inconsistent medium black point encoding and use
 - Inconsistent chromatic adaptation
 - Perceptual intents from different manufacturers often don't work well together
 - Destination profile rendering intent choice depends on source profile
 - No standard method for profile identification
 - Specification technical and editorial problems result in chronic misunderstandings
- **The ICC working group that was primarily responsible for developing the v4 specification was the *Interoperability WG***



Secondary motivations

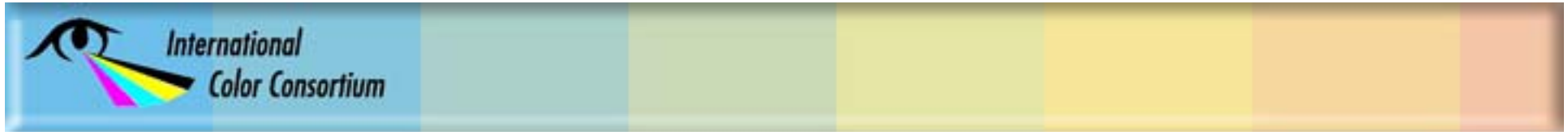
Solving the interoperability problems requires a major revision, so what else would be helpful?

- **Improved transform forms**
 - lutAtoB
 - Parametric curves
- **Support for CMM adaptation and color rendering**
 - Chromatic adaptation tag required
 - Colorimetric intents measurement based
- **Unicode support**
- **Profile ID**
- **Device N-color support**
- **Colorant lay-down order**



v4 add-ons

- **Since the v4 specification was first released, a number of other issues have been identified and support added through optional tags**
 - Perceptual Reference Medium Gamut
 - Motion Picture technology tags
 - Floating Point Device Encoding Range
 - Profile Sequence Identifier tag
 - Colorimetric Intent Image State tag
 - Dictionary type and Metadata tag
- and one deletion*
- media Black Point tag



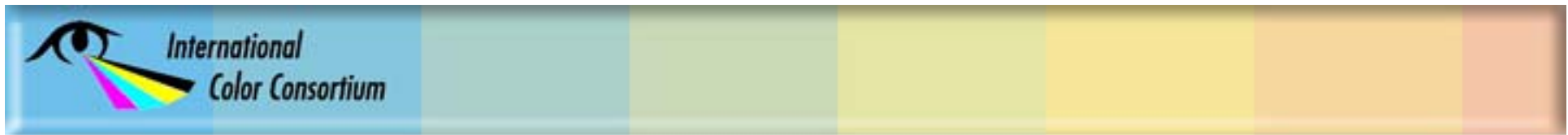
The ISO 15076-1 standard

The ICC conducted an exhaustive review of the v4 specification, and addressed a large number editorial issues

The result of this work will soon be published as ISO 15076-1 Edition 2

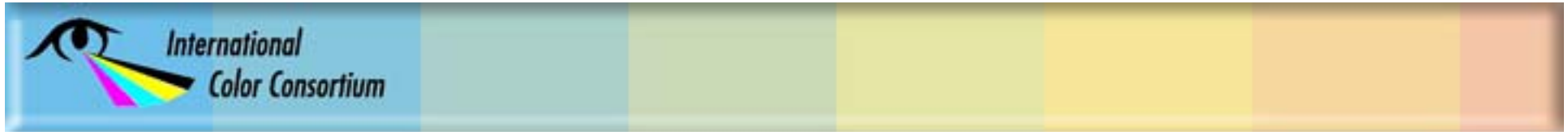
This standard is the authoritative reference for ICC color management

The ICC has also developed a number of white papers to further understanding



If v4 is so much better, why doesn't everyone use it?

- **Familiarity with v2 specification**
 - some people learned color management based on v2 and are reluctant to change practices
- **v4 profiles can be harder to make**
 - more complex transform forms
 - perceptual color rendering
- **v4 not necessary for many use cases**
- **Concerns that files will at some point encounter a system element that doesn't support v4 profiles**
- **Lack of support for v4 profiles in some PDF file types**
- **v4 interoperability requirements preclude making special purpose profiles for closed workflows**
- **v4 optional tag support not required**



A common misconception

v4 adoption has also been hindered by the common misconception that v4 ICC color management is supposed to *improve image quality*

ICC color management is not supposed to enhance images

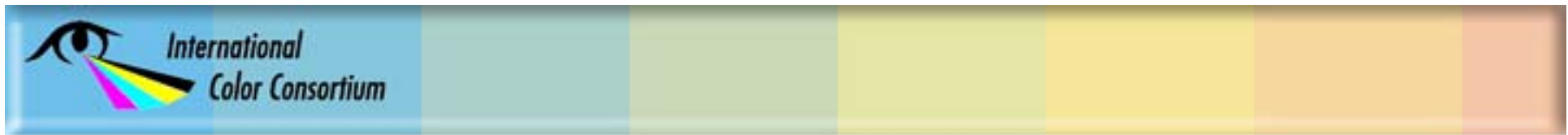
- Source profiles assume the source image is perfect and provide at least one colorimetric interpretation of the source data
- Destination profiles assume the PCS colorimetry is perfect and try to produce device values that will reproduce it with minimal degradation

Assigning different profiles to an image to see if it looks better is an editing process that is outside ICC color management



When will v4 produce better results than v2?

- **When v2 profiles are used in systems where problems with absolute colorimetric intent consistency or perceptual intent interoperability arise**
 - assuming the v4 profiles are made correctly
- **When profile size is constrained and the transform forms are complex**
- **When a smart CMM that needs to have accurate measurement-based colorimetric data will be used**
- **When the extended functionality offered by the v4 optional tags is needed**
 - and is supported in the workflow



When will v4 help me, but not by producing better results?

- When it is desirable to specifically identify profiles using the Profile ID
- When I need to use Unicode
- When I need additional information to select the best ICC profile to use for a particular situation
- When I would like to know the profile sequence used to create a device-link profile
- When I would like to specify the colorimetric intent image state
- When I need an authoritative ICC reference to answer a question about ICC color management

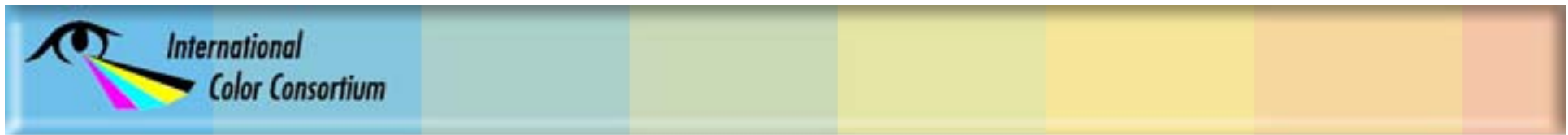


When should I use v2 profiles?

- **When v2 profiles produce satisfactory results**
 - abscol and perceptual rendering intent problems do not arise
 - lutA2B and parametric curve types are not needed to make accurate profiles of acceptable sizes
 - v4 optional tags are not needed, or are supported as v2 private tags
 - Profile ID is not needed
 - Unicode is not needed
- **When some aspect of the system does not support v4 profiles**

Making v2 profiles with v4 interoperability

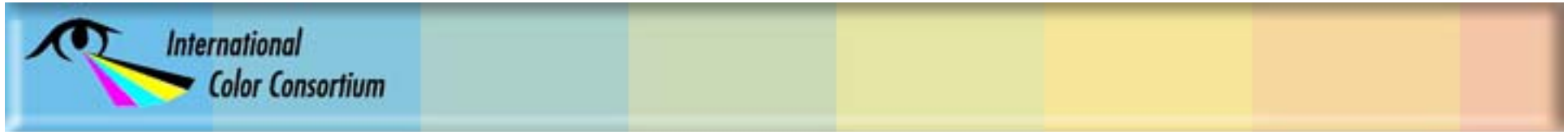
- **Most of the changes required to address the v2 interoperability problems are restrictions on the profile construction**
 - some v2 profiles are not compliant with these restrictions, hence the v4 major revision
- **It is possible to make valid v2 profiles that meet the v4 interoperability requirements**
 - such profiles will typically function identically to v4 profiles, while avoiding concerns about v4 support
 - but still need to ensure ICC support
- **v2 profiles that meet v4 requirements do not cause problems in v2 systems**
 - but if the profile is v2, there is no guarantee it meets v4 interoperability requirements



ICC profiles that do not meet v4 requirements...

...fall into three classes:

- **necessary variations**
 - display profiles without complete adaptation to the display white point
 - use of a non-standard perceptual reference medium
- **convenience variations**
 - perceptual rendering intent not to v4 perceptual reference medium
 - no chromatic adaptation tag
 - PCS colorimetry black scaled to zero
- **erroneous profiles**
 - media white point or PCS colorimetry not chromatically adapted to D50

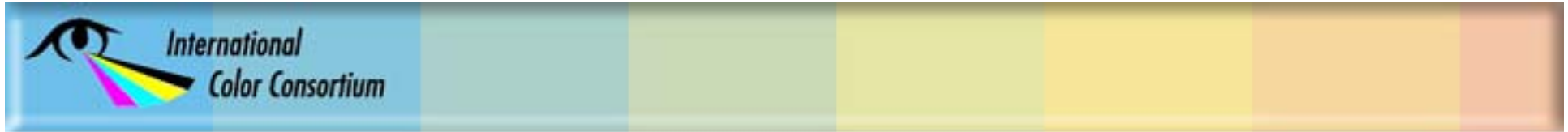


Whether to use v2 or v4 with non-conformant profiles

- The necessary and convenience variations listed on the previous slide do not violate v2 requirements, so if v2 is used the result is still a valid v2 profile
- In some cases some v4 features will be needed but the v4 requirements will not be met

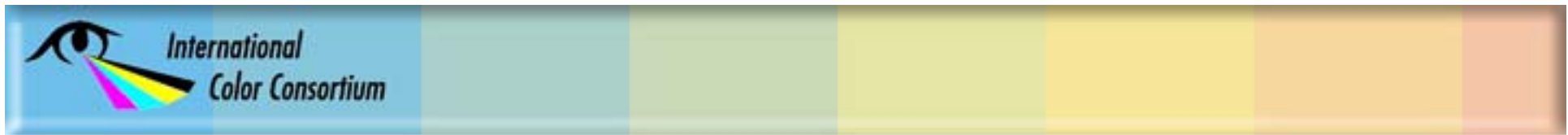
Preferred profile priority

- 1. If the use case can be supported with conformant v4 profiles, use them**
- 2. If the use case can be supported with v2 profiles that meet the v4 requirements, use them**
- 3. If the use case can be supported with v2 profiles that meet the v2 requirements, use them**
- 4. If the use case requires v4 profiles that do not meet the v4 requirements, or v2 profiles that do not meet the v2 requirements, keep the profiles in a closed workflow and include only the elements necessary for the workflow**
 - it is good if the profile is flagged as invalid when used outside the closed workflow



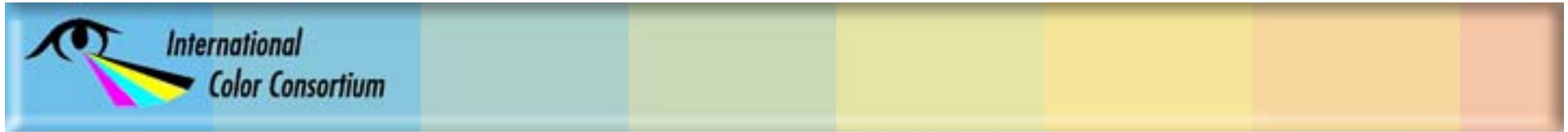
Motion picture use case

- **In the motion picture industry, the reference medium is typically the projected image in a high-quality screening room**
 - this is quite different from the ICC perceptual reference medium



The question of simplicity

- Most users (and many developers) do not understand color management, or worse have an incorrect understanding
- Virtually all users (and most developers) think color management is too complicated
- **IF** all necessary v4 profiles are available and v4 can be used, it provides the simplest user solution
 - rendering intent is decoupled from source encoding
 - interoperability should be good
 - accuracy should be good
 - automated profile selection and unambiguous profile identification are supported
- **BUT v4 profiles tend to be harder to make than v2 profiles**



Preflight testing

- **Another route to simplicity is simply to pre-test all expected use cases**



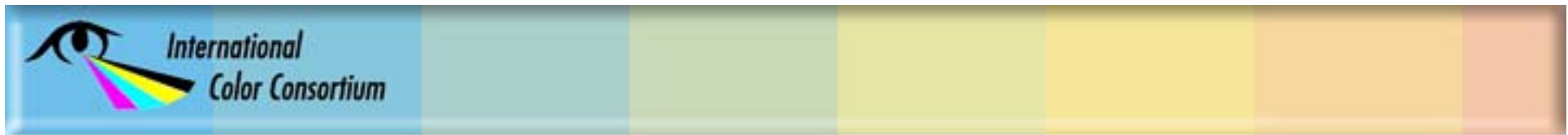
Convergence of understanding

- **Read the spec**
- **Improve UIs and user instructions**
 - Color management happens all the time



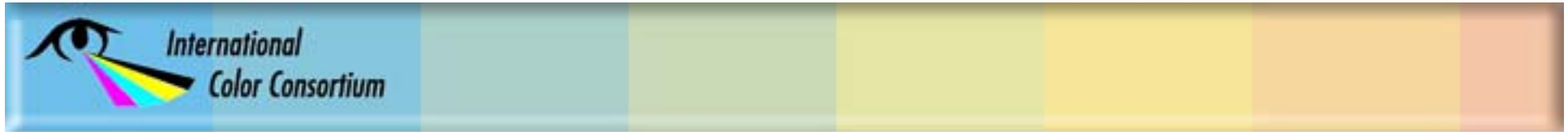
What's next for the ICC?

- Recommendations for assessing the quality of ICC profiles
- Enumerated color space profiles?
- Characterization data color management?
- Identification of tested preflight combinations?
- Recommendations for automated workflows?
- More configurable transform forms?
- An identifier for non-compliant ICC profiles for closed workflows?
- A CMM requirements spec?
- A new ICC v2 standard document?
- I think I'd rather have a v8?



Summary

- **ICC v4 is intended to provide improved interoperability and more functionality, not better quality**
 - in some cases v4 profiles can be smaller than equivalent quality v2 profiles
- **When making decisions about whether to use ICC v2 or v4, an analytical approach should be used**
- **The simplest user experience is provided by an all v4 environment, BUT**
 - v4 profiles are harder to make
 - some use cases are not well addressed by v4
- **More consistency is needed in:**
 - understanding color management
 - user interfaces
 - handling exceptional cases



Request

The ICC needs people to carefully read the new version of ISO 15076-1 (which will be available for free on the ICC web site) and provide feedback on where the ICC should focus its efforts



Questions for the audience:

- **Should the ICC rewrite the v2 specification to clarify current use and best practices?**
 - Discussion
- **Should the ICC work on standardizing color management user interfaces?**
 - Terminology
 - User controls
- **Other suggestions?**