Features which have changed when comparing version 4 to version 2 profiles.

Introduction

The main changes when developing the version 4 specification were made in an attempt to improve interoperability, so that when a particular pair or sequence of profiles is used consistency is improved - regardless of the CMM. Differing interpolation procedures may still result in small interpretation differences but these should be lower than before. Furthermore, increased specificity on the nature of the transforms contained in the profiles should allow improved cross-vendor interoperability when combining different profiles.

The main areas of change are:

- PCS definition and Rendering Intents
- Chromatic adaptation
- LUT structures
- Unicode
- N-colorant tags

PCS definition and Rendering Intents

Additional rendering intent instances are specified in 6.3 Table 20. Input, output, display, colorspace, and monochrome profile types are all defined with the full set of bi-directional rendering intents. Re-targeting and re-purposing use cases are supported through these extended rendering intent provisions. AToB is the dominant rendering direction in an input profile and the BToA perceptual rendering transform in that case is an UNDO of the AToB perceptual rendering transform. BToA is the dominant rendering direction in output and display profiles and in those profiles the AToB perceptual rendering transform is an UNDO of the BToA perceptual rendering transform. Colorspace and monochrome profiles describing input-referred image states should model perceptual rendering intent behaviour after the input profile case. Colorspace and monochrome profiles describing output referred image states should model perceptual rendering intent behaviour after the output profile case.

A clear distinction has been made between the Perceptual PCS and the Colorimetric PCS. (See Annex D). The Perceptual PCS provides a defined “colour-rendering target” for the perceptual Rendering Intent, with specified white and black, while the Colorimetric PCS is the“ measurement” path.

The distinction between the Perceptual PCS and the Colorimetric PCS deals primarily with image state. Rendering into PCS via the perceptual path must accomplish a colour-rendering image state transition to a reference print output referred image state, e.g., the perceptual changes necessary to colour-render an 'original' into print colorimetry ideally suited for the perceptual intent reference medium. The white point of the image in PCS is normalized to the PCS white point, and other colours are mapped to appropriate colours on the reference medium (e.g. the black point of the image in PCS is set to the reference medium black point). Rendering from PCS via the perceptual path must assume that the PCS image is in the reference print output referred image state. Note that rendering from PCS via the perceptual path may include a viewing environment adaptation if the target visualization environment is different from the reference medium viewing conditions.

On the other hand, rendering into PCS via the media-relative colorimetric path does NOT impose an image state transition, but rather accomplishes only an image encoding change, with a chromatic adaptation to the D50 PCS illuminant. Hence the media-relative colormetric paths into PCS may deliver an input-referred image (e.g., a hardcopy document scan), or an output-referred image to PCS. A media-relative colorimetric transform to PCS encoding must normalize the white point of the image medium to the PCS white point, keep the relationships between all in-gamut colours unchanged, and let the black point fall as a result. A media-relative colorimetric transform from PCS encoding also does NOT impose an image state transition, but again accomplishes only an image encoding change, with a chromatic adaptation from D50 to another viewing illuminant if required. Gamut clipping for out of gamut colors is the default assumption.

Note that for all perceptual and media-relative colorimetric transforms *from PCS*, the full range of L* must be handled, to accommodate 'perceptual in : media-relative colorimetric out' and other combinations.

The Perceptual PCS viewing condition has been specified to have an illumination level of 500 lux (ISO 3664 P2) - Annex D.1.4 – and a Reference Medium has been specified with a linear dynamic range of 287.9:1 – Annex D.1.5. The white point is defined to have 89% reflectance, which is specified to have L*a*b* = 100, 0, 0, whereas the black point is specified to have L*a*b* = 3.1373, 0, 0. For media colorimetric rendering the PCS white and black remain as L*a*b* = 100,0,0 and 0,0,0 respectively, but now the PCS colorimetry is required to be measurement based (although simulated measurements of a virtual medium are allowed). The black scaling has also been removed, so that now the measured black point of the medium (relative to the medium white point) is encoded in the PCS using its real measured value (which will have an L*>0). This defers black point compensation to the CMM (although when connecting v4 perceptual intents, the black points should match).

Clipping is specified between XYZ PCS and LAB PCS for the PCS encoding bounds – (Annex A.3).

The CIELAB encoding has changed - with the exception of the lut16Type and namedColor2Type tags - (See 6.5.9, 6.5.15, Annex A.1, A.2)

- L* = 100 is encoded as FFFFh (L* = 100 was encoded as FF00h)
- a*, b* = 127 is encoded as FFFFh (was encoded as FF00h).
- a*, b* = 0 is encoded as 8080h (was encoded as 8000h).

Chromatic Adaptation

When measurement data is made for illuminants other than D50 the Chromatic Adaptation matrix used to convert to D50 is required. The mediaWhitePointTag must be populated with the measurement illumination source value, adapted to D50 using the chromaticAdaptationTag matrix. In a Display profile - the mediaWhitePointTag must equal D50. The linear Bradford Chromatic Adapation matrix is recommended for general use. The chromaticAdaptationTag does not pertain to DeviceLink profiles.

LUT Structures

New LUT structures have been introduced (lutAtoBType and lutBtoAType) which consist (in the device to PCS direction) of: ACurves (1D LUTS), a 3D CLUT, MCurves (another set of 1D LUTS), a 3x4 matrix (to allow offsets), and BCurves (a third set of 1D LUTS) (see 6.5.11 and

6.5.12). A new parametricCurveType has also been added which in some cases may be used to replace the 1D LUTs of the lutAtoBType and lutBtoAType, and also TRC tags.

For matrix based input and display profiles, colorant tags are replaced by matrix column tags. (See 6.3.1.2, 6.3.2.2, 6.4.4, 6.4.22, and 6.4.41).

The semantics of the grayTRCTag is defined such that the first element is black and last element is white for all profile types. Values are defined: 0 represents black and 1.0 represents white for all profile types.

Unicode

Strings are now specified to conform to the Unicode Standard (see 6.5.14). Note that charTargetTag still uses textType because that is intended for use in character-based matching to the characterization registry.

N-colorant Tags
A new colorantTableTag specifies the colorants used in an output or NamedColor profile by a unique name and an XYZ or Lab PCS value. (See 6.4.14 and 6.5.3). A new colorantOrderTag provides control of colorant lay down order for N-colour or CMYK colour sets. (See 6.4.13 and 6.5.2).

Miscellaneous

All date/time values shall be in Coordinated Universal Time (UTC, also known as GMT or ZULU Time).

In addition to the above there are a number of situations where unused bits, such as the padding at the end of a tag to make it end on a 32 bit boundary, are not defined in v2 but are defined to be zeros in v4. The most significant ones are the rendering intent in the header and the header above the profile ID. The elimination of undefined padding bits or bytes enables encoding of the new Profile ID.

Summary of changes required to make a v2 profile v4 compliant.

Header Changes
- Version number
- Rendering intent: most significant 16 bits shall be set to 0. In version 2 the behaviour is undefined.
- Profile ID: This has to be set to zeros or calculated. In version 2 the behaviour of bytes 84 to 127 is undefined
- Bytes 100 to 127: These must be set to zero

Tag Changes:
A number of tags have been moved to the new Unicode only system i.e. multiLocalizedUnicodeType. These include:
- copyrightTag
- deviceMfgDescTag
- deviceModelDescTag
- profileDescriptionTag
- screeningDescTag

- viewingCondDescTag

of which only the profileDescriptionTag and the copyrightTag are mandatory.

If the illumination source for measurement is not D50 then the chromaticAdaptationTag must be present. The mediaWhitePointTag must be present.

The rendering intents need to be re-determined and encoded, to comply with the more clearly specified rendering intent definitions, the lack of black point scaling, the new CIELAB encoding and the PCS encoding bound clipping. In addition, the new LUTAtoB and BtoA types and/or parametricCurveType may now be used.