High Dynamic Range Working Group meeting

Online meeting

October 19 2020

The meeting was opened at 04:00 UTC by William Li, ICC chair. After a sound check and self-introductions he handed over to Luke Wallis, chair of HDR WG. The agenda was agreed as follows:

1. Welcome and self-introductions.
2. Minutes from June meeting posted on the WG.
3. HDR WG charter.
4. HDR tags – open discussion.
5. Future work of HDR WG.
6. AOB.

3. HDR WG charter

The charter for the WG [see attached] had been approved by the Steering Committee and posted on the HDR WG page on color.org

4. HDR tags

Mr Wallis introduced a discussion on adding tags to v4 and v5 to address HDR content [see attached]. The v4 parametric curves were a good basis for HDR transfer functions, but need extending to HDR-specific functions. Tone mapping is also needed – the mapping to SDR in the HLG specification is not suitable, and something could be added to the ICC specification.

Lars Borg stated a preference for simply adding enumerated ID tags rather than model tags, as this is what happens in video workflow. Wallis confirmed that knowing the type of content is sufficient to construct the workflow, and in Apple the ICC profile can be extended to handle conversion based solely on the ID and connect to the appropriate specification to handle the conversion. He envisaged this being hierarchical, so that the preferred rendering can be defined at a high level.

Chris Lilley stated that the ID does not provide enough information to handle content mastered at different luminances. Wallis responded that the choice was whether to make the profile content-specific. The specification defines what the luminance is, but different developers handle the math differently. For example, in Rec. BT.1886 there are different gamma options and the developer makes a custom selection; this should be embraced by ICC. Borg suggested that one goal might be to match the appearance on an HDR TV. It was necessary to define the rendering goals, rely on conversions used in video and define interoperability requirements.

Portrait Displays calibrate displays for individual vendors, and Tom Lianza saw a need for a P3-based wide gamut specification for still images. Today even low end displays can exceed 1000 cd/m2 and match PQ primaries – if properly mapped it is possible to handle interoperability with video.

The meeting discussed encoding and file formats for HDR. ISO TC42 has an NWI for ISO 22028-5 on colour encoding strategies for different file formats, which Canon are already implementing.

Borg noted that the vector+raster AVIF format has been adopted by Netflix, and is a top contender for still HDR content. Details are at https://aomediacodec.github.io/av1-avif/ 'AVIF for Next-Generation Image Coding' https://netflixtechblog.com/avif-for-next-generation-image-coding-b1d75675fe4
and 'AVIF has landed' (Jake Archibald, Chrome developer) https://jakearchibald.com/2020/avif-has-landed/

An issue on ICC profiles interacting with AVIF CICP enumerations in AVI bitstreams has been posted on Github at https://github.com/AOMediaCodec/av1-avif/issues/84

CTM is also used for HDR still images; this defines metadata but not conversion methods, and interoperability is a challenge.

It was agreed that it would be better for ICC to encode CICP enumerations and only the parameters for the transform rather than the complete transform. This would also allow the transform can be accelerated in hardware. For an ICC-based fall-back Borg had made a v4 profile which could be extended with a new parametricCurveType, but was probably good enough for 8-bit data.

HDR colour space enumerations could be standardised in ICC. Preferred tone mapping (e.g. scene- or display-referred) would be a level down, followed by specific tone mapping. The parametricCurveType would need to be revised to support advanced tone mapping operations, such as HDR-to-SDR conversion in BT.2446.

Complex transfer functions can be encoded in iccMAX, and there is an example HLG profile in RefIccMax.

An option would be to add metadata tags to specify CTM and HDR10 metadata. The metadata needs to be documented in order to support interoperability with SDR, and it is important that compositing and blending work.

It was agreed that Wallis and Borg will work towards defining a metadata container tag to support HDR conversion. This could be based on the VUI tag, with the ICC profile providing a fall-back HDR-to-SDR conversion. VUI is a 3-byte structure which has enumerations for the primaries, matrix coefficients and transfer function for both camera and display.

5. Future work of HDR WG

It was agreed that a problem definition was needed in order to clarify what the focus of HDR WG should be. Luke Wallis agreed to initiate this, with support from Lars Borg, Craig Revie and Chris Lilley (Chris Needham from the BBC will also be invited to participate). A telecon will be held in the first half of December to discuss this. Phil Green undertook to provide a template for a votable proposal.

There being no other business, the meeting closed at 06:00 UTC.

The following action items were agreed:

HDRWG-20-04 Propose a metadata container tag for ICC profiles to support HDR conversion, to be based on VUI (Wallis, Borg)

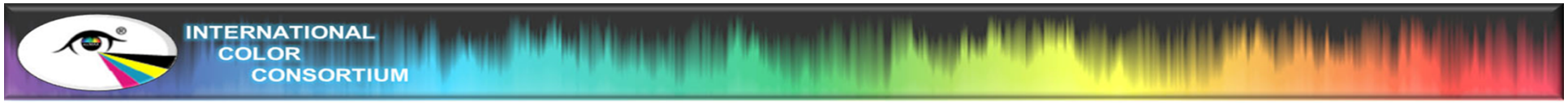
HDRWG-20-05 Propose an HDR problem definition for HDRWG to address (Wallis, Borg, Revie, Lilley)

HDRWG-20-06 Provide Word version of ICC header to Wallis and Borg (Green)

HDRWG-20-7 Initiate Doodle poll for telecon to discuss problem definition in the first half of December (Wallis, Green)

Open from previous meeting:

HDR-20-03 Prepare draft white papers/proposals addressing current limitations and proposing solutions (Wallis, Derhak, Lianza, Bai, Lilley, Staten, Kunkel)



ICC HDR Working Group

Chair: Luke Wallis

Teleconference

October 20, 2020

Agenda

1. Welcome and self-introductions.
2. Minutes from June meeting posted on the WG.
3. HDR WG charter.
4. HDR tags – open discussion.
5. Future work of HDR WG.
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ICC HDR Working Group Charter

The HDR Working Group exists to promote the use of ICC color management in High Dynamic Range (HDR) imaging.

Specifically, this group will:

- **Identify issues and limitations with the current specifications, implementations and use of color management in HDR imaging.**
- **Work with implementers of HDR color management, other international standard bodies, and working groups in the adoption of ICC HDR in their own specifications.**
- **Develop proposals for how to include HDR in ICC workflows.**
- **Prepare white papers and other educational materials to aid developers and users in the appropriate application of color management to HDR.**
- **Propose revisions to ICC specifications where required to address the needs of HDR workflows.**

HDR Tags – open discussion

What should be included in HDR tag?

- **Unique identification of HDR data type (PQ, HLG, etc...).**
- **Steps for converting to SDR and other HDR (basic) formats.**
- **Supported transfer functions by enumeration and/or by formulas.**
- **Tone mapping method for SDR to HDR: display referred vs scene referred.**
- **Tone mapping method for HDR to SDR.**
- **Representation of tone mapping functions: enumeration and/or by formulas.**
- **Supported transfer functions by enumeration and/or by formulas.**
- **Primaries by enumeration and/or values.**
- **Custom tone mapping. Registered with ICC?**
- **… ?**

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ICC Votable Proposal Submission

Title of proposal

Coding-independent code points (CICP) for video signal type identification

To discuss:

- *Does this give us a robust workflow?*
- *Is ICC profile the right place? Versus a TIFF or PNG tag or XMP?*
- *Provide more workflow details*
- *√ Keep YCbCr!*
- *√ Call it CICP instead of VUI!*
- *√ Mention other equivalent color space types (SMPTE ULs…)*
- *Add links to background docs describing video workflows?*

Proposers:

Names and member companies of proposers

Lars Borg, Adobe
Chris Seeger, NBCU

Submission date:

Date of submission to ICC Technical Secretary for distribution to membership

TBD

1. Introduction

Outline of proposal, its motivation and context

A summary

This proposal enables the linking of an ICC profile with an equivalent video signal type identification (CICP) representation.

The problem to be solved

There is currently no best practice for linking the color space encoding represented by an ICC profile with an equivalent video signal type identification (CICP) used in video equipment compliant with ITU-T H.273 and ITU-T H.265 as defined by the International Telecommunication Union (ITU) or as defined by SMPTE Universal Labels.

There is no best practice for reliably exchanging still images between graphics workflows and video workflows using the correct color space.

There is no best practice for integrating ICC-tagged still images into video presentations and rendering these stills the same way as the video is rendered.

In video equipment, a video frame can be processed as scene-referred or display-referred as needed and as prescribed by video standards, but ICC profiles allow only one such processing option per ICC profile.

The solution

The proposal adds an optional CICP tag, which includes the Coding-independent code points (CICP) for the profile's effective color image encoding. The proposal is applicable to Input and Display profiles using the RGB or YCbCr color models.

The application

A processor receiving media with a CICP tag can use the CICP tag to switch its color processing from using the ICC profile to using its video color processor. This enables the processor to render ICC-tagged content the same way that untagged video is rendered, thus providing seamless integration with video-based processing such as gamut and tone mapping and other features of its video color processor.

A video frame grabber can save the video frame as RGB or YCbCr with an embedded ICC profile and embedded CICP tag.

When saving as YCbCr, the frame is in the same color space as the original video and can be re-inserted into the same video type without any loss. The ICC profile provides an approximate color rendering (typically display-referred) for non-video equipment, while the CICP tag provides the mapping back to the original video space.

When saving as RGB, the frame is typically converted from the video's narrow range YCbCr format to full range RGB of the same color space, placing black at 0. This facilitates editing in image applications. The ICC profile provides an approximate color rendering (typically display-referred) for the graphics application, while the CICP tag enables converting back to the original video space.

Issues

Identify shortcomings

What can go wrong?

- Using the CICP tag can result in a different color appearance versus using the ICC profile. What happens if this image and profile propagates into print publishing, PDF, web pages, where only some apps support the CICP tag?

2. The acceptance of this proposal will result in:

Summary of proposed changes to ICC specifications and (where required) CMM behavior

The proposal extends ICC.1 Version 4 by defining an optional Version 4 tag (cicpTag) and corresponding tag type (cicpType).

There are no required changes for CMMs.

3. Nature of the proposal

State whether tag or type(s) are being proposed, the effect on ICC resources such as registries, and consequence for ICC specification versions

The proposal extends ICC.1 Version 4 by defining an optional Version 4 tag (cicpTag) and corresponding tag type (cicpType).

This proposal does not impact ICC registries.

4. Votable Proposal

Full description of proposal

See next main section below.

5. Applications and Workflows

Usage scenarios envisaged as a result of the proposal

Workflow would include:

- Input to post-production editor, compositer, 3D software, still graphics editor
    - ICC CICP tag detected, transform applied to conform to the video space of the timeline or working space's color volume
- Input into Still Store (for static graphics playback)
    - ICC CICP tag detected, transform applied to preset still-store broadcast working space
- Input to web browser for compositing and rendering
    - ICC CICP tag detected from source graphic, broadcast video tag is detected, graphic is mapped properly into desktop working space

EXAMPLE:

Video - frame grab - PNG - editing, masking, adding text… - PNG - insert in video

File: CICP Votable Proposal 2020-12-08.docx

CICP Tag and Type proposal

√ *Change VUI to CICP! Retain YCbCr!*

1.1.1.1 Normative References

Recommendation ITU-T H.273 (12/2016), Coding-independent code points for video signal type identification, https://www.itu.int/rec/T-REC-H.273/en

1.1.1.2 Abbreviated terms

CICP Coding-independent code points for video signal type identification

1.1.1.3 cicpTag

Tag signature: 'cicp' (63696370h)

Permitted tag type: cicpType

This tag defines Coding-independent code points for video signal type identification (CICP).

The color image encoding specified by the CICP tag content shall be equivalent to the color image encoding represented by this ICC profile.

This tag may be present when the data colour space in the profile header is RGB or YCbCr, and the profile class in the profile header is Input or Display. The tag shall not be present for other data colour spaces or profile classes indicated in the profile header.

1.1.1.4 cicpType

The cicpType specifies Coding-independent code points for video signal type identification. The byte assignment and encoding shall be as given in Table 1~~Table 1~~.

Table 1 — cicpType encoding

Byte position	Field length (bytes)	Content	Encoded as
0 to 3	4	'cicp' (63696370h) type signature	
4 to 7	4	Reserved, shall be set to 0	
8	1	ColourPrimaries	uInt8Number
9	1	TransferCharacteristics	uInt8Number
10	1	MatrixCoefficients	uInt8Number
11	1	VideoFullRangeFlag	uInt8Number

The fields ColourPrimaries, TransferCharacteristics, MatrixCoefficients, and VideoFullRangeFlag shall be encoded as specified in Recommendation ITU-T H.273. Recommendation ITU-T H.273 provides detailed descriptions of the code values and their interpretation.

NOTE: Recommendation ITU-T H.273 describes the fields as follows:

The field ColourPrimaries indicates the chromaticity coordinates of the source colour primaries in terms of the CIE 1931 definition of x and y as specified by ISO 11664-1.

The field TransferCharacteristics indicates either:

- the reference opto-electronic transfer characteristic function of the source picture as a function of a source input linear optical intensity input with a nominal real-valued range of 0 to 1, or
- the inverse of the reference electro-optical transfer characteristic function as a function of an output linear optical intensity with a nominal real-valued range of 0 to 1.

The field MatrixCoefficients describes the matrix coefficients used in deriving luma and chroma signals from the red, green, and blue, or X, Y, and Z primaries.

The field VideoFullRangeFlag specifies the scaling and offset values applied in association with the MatrixCoefficients, with 0 (zero) indicating “narrow-range” encoding, 1 indicating “full-range” encoding.

EXAMPLES:

Examples for RGB images.

When the data colour space in the profile header is RGB, MatrixCoefficients is always 0 (zero) and VideoFullRangeFlag is often 1.

Codes	Interpretation
1-1-0-0	RGB narrow range representation specified in Recommendation ITU-R BT.709-6, Item 3.4
1-13-0-1	RGB full range color encoding specified in IEC 61966-2-1 sRGB
9-14-0-0	R’G’B’ narrow range representation specified in Recommendation ITU-R BT.2020-2, Table 5
9-16-0-0	PQ R’G’B’ narrow range representation specified in Recommendation ITU-R BT.2100-2, Table 9
9-16-0-1	PQ R’G’B’ full range representation specified in Recommendation ITU-R BT.2100-2, Table 9
9-18-0-0	HLG R’G’B’ narrow range representation specified in Recommendation ITU-R BT.2100-2
9-18-0-1	HLG R’G’B’ full range representation specified in Recommendation ITU-R BT.2100-2

Examples for narrow-range YCbCr or ICtCp images.

When the data colour space in the profile header is YCbCr, MatrixCoefficients is always non-zero, and VideoFullRangeFlag is usually 0 (zero). ICtCp images use the YCbCr data colour space in the profile header.

Codes	Interpretation
1-1-1-0	YCbCr representation specified in Recommendation ITU-R BT.709-6, Item 3.4
9-14-9-0	Y’Cb’Cr’ narrow range representation specified in Recommendation ITU-R BT.2020-2, Table 5
9-16-9-0	PQ Y’Cb’Cr’ narrow range representation specified in Recommendation ITU-R BT.2100-2, Table 9
9-16-14-0	PQ ICtCp narrow range representation specified in Recommendation ITU-R BT.2100-2, Table 9
9-18-9-0	HLG Y’Cb’Cr’ narrow range representation specified in Recommendation ITU-R BT.2100-2
9-18-14-0	HLG ICtCp narrow range representation specified in Recommendation ITU-R BT.2100-2

Bibliography

IEC 61966-2-1 + Amd.1, Multimedia systems and equipment – Colour measurement and management – Part 2-1: Colour management – Default RGB colour space – sRGB

Recommendation ITU-R BT.709-6, Parameter values for the HDTV standards for production and international programme exchange

Recommendation ITU-R BT.2020-2, Parameter values for ultra-high definition television systems for production and international programme exchange

Recommendation ITU-R BT.2100-2, Image parameter values for high dynamic range television for use in production and international programme exchange

Supplement 19 to ITU-T H-series Recommendations (10/2019) - Usage of video signal type code points