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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  24th Meeting: Geneva, CH, 26 May – 1 June 2016 | Document: JCTVC-X0065 |

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| *Title:* | **Comments on Conversion and Coding Practices for HDR/WCG Video** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Information | | |
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# Abstract

The current draft of the “Conversion and Coding Practices for HDR/WCG Video” technical report (JCTVC-X0079) provides a detailed workflow description of the video signal format conversion between linear R,G,B primary component samples into HDR signal format (Y’CbCr NCL 4:2:0) represented in Main10 HEVC bitstreams. In its current draft stage as of May 2016, the document currently provides specification style formulae for the conversion steps, but does not provide the level of explanation provided, for example, by the HEVC reference encoder Test Model developed over the past five years in JCT. It is suggested that more background be provided for those steps, perhaps also referencing to external publications such as tutorials and book chapters. It is suggested that between now and the next few meeting cycles (Chengdu, China, October 2016 and Geneva, January 2017) that the encoder sections be developed to equal depth of the format conversion stages, rivaling the traditional (SDR) reference encoder test model, but only covering the details that differ from the encoder test model (latest draft: JCTVC-W1002). The technical report should provide the reader with a strong sense of how HDR coding and signal conversion differs from traditional SDR.

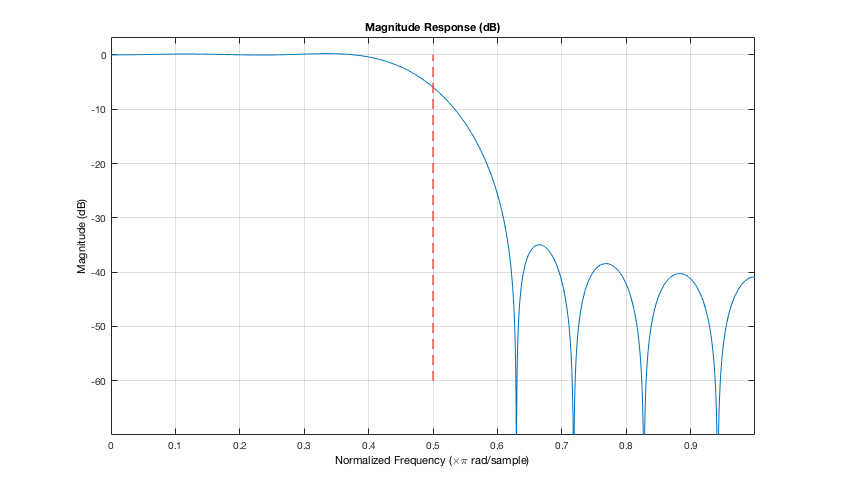
# List of comments

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| **Topic** | **Suggested action** |
| Statement why this Technical Report document exists | Explain by how much overall HDR practices differ from SDR. In signal format workflow, HDR may be much more complex than SDR for consumer electronics platforms, but HDR and SDR signal processing are already very similar in professional 32-bit float linear light workflows for the past decade. Difference between HDR and SDR mode computational steps and their sequential operational order in HEVC Main10 encoders should be small, with perhaps 98% code step execution overlap. |
| Encoder step descriptions | Provide Test Model style encoder step detail as if a delta document to the existing (SDR) reference encoder test model (TM): JCTVC-W1002. Or, should the TM be updated with HDR operational “mode” ? |
| Reference encoder | Use x256 as an example. Most readers are not researchers, and are not active in JCT and therefore do not have the inclination to use the HM. |
| HDRTools | Provide small tutorial (or a reference) on how to use HDRTools in an Annex of the TR [1] and HDRTools script examples attached to the zip archive of the TR ? |
| Difference between HDR and SDR processing | Convey importance of HDR recommended steps that differ from traditional (SDR) practices. Statements or statistics on the likelihood or impact of recommended practice steps such as luma adjustment (micro-grading). Include histograms conceptualizing some behavioural difference between SDR and HDR. |
| How HDR signals differ from SDR. | Statement to the effect of how much HDR/WCG HEVC coding differs from SDR. Example histograms, and pixel level edge profiles may help convey the essential differences to the reader. Extreme cases should be qualified by there rarity. Important to note that average light levels for most scene types (indoor, outdoor cloudy, etc.) are very similar in HDR and SDR. |
| micro-grading background | Intuitive explanation of micro-grading (luma adjustment). Where it is visibly or coding efficiency-wise useful. Statistics on number of pixels affected. |
| Chroma leakage | Explain this phenomena; define “chroma leakge” (should it be *chrominance* leakage, not chroma leakage?) |
| Content | Characterise the content (dynamic range, color gamut, noise level) and displays used in verification that the recommended practices are based and/or tested upon, such as luma-average dependent Qp offset process, luma adjustment (micro-grading).  The test clip content in the HDR/WCG prior studies conducted in MPEG and VCEG (now moved into JCT) that were not derived by a computational photography or CGI process have up to 3 least significant bits (LSBs) of noise or film grain. Most content tested during the development of HEVC from the year 2010 and beyond have had noise levels within a single LSB. |
| Chroma Qp offset | Background on why negative chroma Qp offset is recommended. Some example image patches would be useful (many were given in 2015 input contributions to the MPEG HDR/WCG adhoc) |
| Luma-average Qp offset | Explain S-curve relationship that makes PQ signal behave more like a signal formatted by the gamma transfer functions (gamma=2.2. or 2.4), where +Qp luma offsets in dark picture blocks reduce noise and film grain, and –Qp offsets in bright blocks concentrates more bits much like the BT.1886 transfer function assigns relatively more code levels for such intensities. The S-curve is essentially a composite function that converts PQ to gamma (BT.1886). A plot comparison between PQ, BT.1886, and the average-luma Qp offset table reveals this. |
| Why process in linear light? | The TR draft [1] mentions that filters such as image scaling (including chroma resampling) can be executed in linear light. Should the TR provide its own explanation of the benefits of linear light processing, and/or refer to external documents such as [4] ? |
| Look up table (LUT) design concepts | OpenIOColor provides a comprehensive library of LUT design, such as log10 pre-shaper followed by a 1-D LUT. |
| Long-tap chroma resampling FIR | Show why longer tap filters create visible artifacts on particular content patterns. Show how ripples are related to the side-lobes in the filter’s magnitude vs. frequency response graph. Would post de-ringing filters provide sufficient reduction of the ripple artifacts on HDR content? (include the Balloon ringing example provided by Ericsson). |
| Soft 4:4:4 to 4:2:0 FIR filters. | Recommend practice is hinting that, for HDR signals, chroma 4:4:4 to 4:2:0 filter should effectively behave like a critical subsampling filter that retains significant spatial frequencies above half-Nyquist. Explain the benefits of this, such as: reduces chance of the filtering process creating false hues that did not exist in the local original 4:4:4 pixel neighborhood. |
| Non-linear chroma upsampling filters | Provide examples of non-linear chroma resampling filters that complement critical subsampling filters, such as NNEDI3 referenced in JCTVC-X0048 at this meeting. |
| Reference tutorials on various HDR/WCG topics | Example: PQ seminar [2][3]. |
| SEI’s | Explain the purpose of Mastering Display Color Volume and Content Light Level SEI’s. List how different systems (DVB, BluRay Disc, OTT systems) apply and restrict these SEI’s. |

# Discussion on longer tap chroma resampling filters

In section of 7.1.3 of JCTVC-W1017, an explanation why long-tap separable FIR filters can create problems for HDR video might provide some insight for the reader. For example:

Longer filters, with taps greater than 3, such as Kaiser-windowed sync function [5] for co-sited 4:2:0 pixels (as per BT.2020 and BT.HDR) shown below can have ripples that can occasionally create visible ringing. The first ripple in the plot below peaking at -36 dB would be visible, where a few least significant bits in non-linear light of ripple would be visible, such as a dark smooth area near a bright edge, or an extreme color transient next to a smooth hue area or gradual hue ramp. The technical report [1] should also include image patch examples.



**“Gary Filter” from JVT-I018 [5] – Overall freq. Response for p=0.0, D=2, N=4, K=30, β = 2.75**

# References

[1] JCTVC-[X0079](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10551), “Suggestion for new draft version of Conversion and Coding Practices for HDR/WCG Video”, May 2016.

[2] S. Miller, “A Perceptual EOTF for Extended Dynamic Range Imagery”, SMPTE Webinar, 6 May 2014. <https://www.smpte.org/webcasts/EOTF>

[3] handout to [1]: <https://www.smpte.org/sites/default/files/2014-05-06-EOTF-Miller-1-2-handout.pdf>

[4] G. Demos, “Filtering in a High Dynamic Range (HDR) Context”, SMPTE Annual Technical Conference & Exhibition, 22-24 October 2013.

<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7269415>

[5] JVT-[I018](http://wftp3.itu.int/av-arch/jvt-site/2003_09_SanDiego/JVT-I018r1.doc), “Color format downconversion for test sequence generation”, September 2003.