

*Title:* JCT-VC BoG report: Chroma format support  
*Status:* Input Document to JCT-VC  
*Purpose:* BoG report  
*Author(s):* David Flynn | [davidf@rd.bbc.co.uk](mailto:davidf@rd.bbc.co.uk)  
*Source:* BoG on chroma formats

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## Abstract

This report contains the summary of proceedings of the chroma format BoG meeting. The BoG was created to review contributions related to extending chroma format support beyond 4:2:0. The meeting was held on Monday 28th between 0900 and 1030. Approximately 20 delegates attended.

## Mandates

The mandates of the BoG are:

- Review and summarize input documents G967 and G862.
- Make recommendations to JCT-VC related to the input documents.

## Recommendations

The BoG recommended adopting the SPS syntax for `chroma_format_idc` from AVC. The WD text already references `chroma_format_idc` and `separate_colour_plane_flag` in the derivation of `SubWidthC` and `SubWidthH`.

## List of BoG related input documents with notes

### **JCTVC-G967 4:2:2 support in HEVC [K. Sugimoto, A. Minezawa, S. Sekiguchi (Mitsubishi)] [late]**

This contribution proposes support of 4:2:2 format in HEVC standard, which could expand opportunities of its market adoption especially in digital broadcasting area. The main point of this proposal is to introduce modifications as small as possible in order to accommodate 4:2:2 format. Modifications of the current specification to support 4:2:2 format is proposed.

Suggests support for 4:2:2 in HEVC, claiming minimal syntax changes, although with incomplete WD text and does not provide any software or simulation results. Modification to the SPS to include `chroma_format_idx` follows the AVC text. An attempt was made to modify HM-4, but it was found difficult due to implicit assumptions in the code. For 4:2:2 support,  $2N \times N$  TUs were suggested, with a prohibition on NSQT. It was pointed out that it is currently NSQT that provides the non-square transform for this. The proposal resolved a conflict with LM by disabling the mode. It was suggested to extend intra prediction to the non-square block. Chroma MC interpolation filters were adjusted for the 4:2:2 case but have not been tested.

### **JCTVC-G862 Advanced Resampling Filters For HEVC Applications [W. Dai, M. Krishnan, P. Topiwala (FastVDO)]**

Resampling filters are commonly used in a variety of image processing tasks. They are intimately related to two- and multi-channel filter banks, as well as to the well known Laplacian Pyramid. They arise in video coding applications in several instances: (a) spatial scalability, (b) resolution adaptation, and (c) color sampling, as part of 4:4:4 coding. All three application spaces are currently being explored in the HEVC project. We propose a single, general design methodology, and specific sampling filter instances, which can reportedly meet all

of these demanding applications simultaneously. This proposal builds on previous work proposed at the Torino meeting.

The contribution analysed a set of spatial conversion filters studied in SVC in addition to new filters. The new filter exploits aliasing to allow capture of higher frequencies when exploited by using a matched up-conversion filter. Experiments on spatial resampling of luma and chroma compared the SVC filters and those of G862 in the context of AVC. Taking 4CIF, down-sampling, encoding/decoding and up-sampling; and showing differences to the original. A consistent 1dB/frame gain with G862 filters over those of SVC was demonstrated. No BD-rate calculations were provided. No WD text was provided.

The contribution additionally analysed colour format conversions from RGB, proposing a new lifting based transform. Comparisons of various methods (KLT, Y'CoCg, Y'CbCr<sup>1</sup>, G862) were shown.

A combination of colourspace conversion combined with spatial resampling was also studied: RGB → Colour Transform → Down-conversion of chroma → Up-conversion → Colour Transform → RGB. With this chain, 4:4:4 RGB content may be encoded using a 4:2:0 codec. With this process, PSNRs in RGB were reported as 40dB for green, and sequence dependant low-mid-high 30's for red and blue. No compression was used in this chain.

It was remarked that the contribution is non-normative in the sense that this represents the input to the codec. Signalling of the colourspace would be required for correct display.

Concerns regarding concatenation if using this to address high quality 4:4:4 content were raised and these effects should be studied.

The proposed method does not solve the issue of material already in the Y'CbCr colourspace, particularly 4:2:2 content.

It was observed that the solution may be useful as an intermediate operating point for screen content coding for emission, over requiring decoders to support 4:4:4.

Recommend further study to compare the solution against a native 4:4:4 implementation and to examine the end-to-end concatenation effects.

### **JCTVC-G245 Non-CE6a: Use of chroma phase in LM mode [E. François, C. Gisquet, S. Pautet (Canon)]**

This contribution relates to the luma-based chroma prediction mode (LM mode) and consists of two proposals.

The first proposal generalizes the LM mode to handle generic chroma phase configurations. It consists of signaling in the SPS chroma phase information and to use this information in the luma interpolation process. The approach has been tested using new generated test sequences, corresponding to different chroma phase configurations. For the most favorable chroma phase configuration, average BD-rate gains of 0.5% AV\* (0.1% Y, 1.6% U, 1.7% V) AIHE and 0.4% AV\* (0.1% Y, 1.5% U, 1.5% V) AILC are reported. For the least favorable chroma phase configuration, average gains of 0.2% AV\* (0% Y, 0.6% U, 0.7% V) AIHE and 0.2% AV\* (0% Y, 0.4% U, 0.4% V) AILC are reported. RA configuration benefits are also reported to be in same range. Gains up to 1.1% AV\* (0.3% luma, 5.6% chroma) are reported on high resolution sequence classes.

The second proposal intends to reduce the number of operations involved in the luma interpolation mainly by removing right shift operations in the luma filtering process. In total, (W.H+W+H) right shifts, 2W additions and W multiplications by 2 (or left shifts) are removed when LM mode is applied, with W and H being the chroma block width and height. The impact on coding efficiency is reportedly negligible for AI, RA and LD configurations.

An abridged presentation was provided to raise awareness of chroma phase issues with LM with certain source formats. Signalling of chroma sampling position is currently in the VUI for AVC, and in the en-

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<sup>1</sup>Rec.601

hancement layer for SVC. Tests were conducted by adjusting the phase of the source material, comparing HM4 (including LM bugfix) with the same version including LM phase adjustments. Class A showed the highest chroma gains.

## **General discussion**

A question was raised as to the utility of `separate_colour_plane_flag`. It was noted that:

- the flag could be merged with `chroma_format_idc` if there is a desire to support alpha channels which are coded separately from a joint coded 4:4:4.
- the flag allows more encoder and decoder parallelism. However there is little evidence as to its widespread use. There are already numerous methods for parallelism, is another required? It was suggested that systems that would make use of this are operating at very high bitrates.

LM mode needs to be turned off for monochrome coding.

It was noted that there is no non-4:2:0 test material in the current test set. Offers were made for 4:2:2 and 4:4:4 material at 10bit. To discuss with AHG11.

Software: Refactored code exists for earlier HM versions and is being updated for HM-4.1. This should be released and updated to HM-4.2 following the meeting as a basis for further development.