

**Title:** On the use of chroma QP offsets in the VVC common test conditions

**Status:** Input document to JVET

**Purpose:** Proposal

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## Abstract

Since version 2 of the VTM reference software for the Versatile Video Coding (VVC) standard, chroma QP offsets of value 1 have been used for testing according to the common test conditions (CTC), but only in such (Intra) frames for which dual-tree coding has been enabled. This contribution illustrates that, in comparison with the HEVC reference software, HM 16.x, the current VTM 3.x version provides much higher BD-rate gains in the chromatic than in the luminance channel. To counteract this uneven distribution of the coding gain, which was found to be perceptually questionable, it is recommended to revert the CTC settings to the use of chroma QP offsets of 1 not only in dual-tree frames but in all frames. Note that this modification has virtually no effect on the all-Intra (AI) coding configuration (only the frame headers change by one bit) and does not require changes to the draft VVC syntax specification, as currently published in JVET-L1001.

## 1 Proposed Change

Version 2 of VTM, the reference encoder and decoder software for the development of the Versatile Video Coding (VVC) standard [1], introduced a *dual-tree* coding method which allows to code the luminance and chromatic channels of specific (random-access point, RAP) frames using separate block-partitioning trees [2]. For these frames, the use of Cb and Cr chroma QP offsets of value 1 was specified in JVET's common test conditions (CTC) for SDR video [3] to redistribute some of the improvement in chromatic coding gain, resulting from the use of the dual-tree approach, back to the luminance component. With VTM version 3.x, it can be observed that, especially due to the application of cross-component linear model (CCLM) prediction, the coding gain of VVC over its predecessor, High Efficiency Video Coding (HEVC) as implemented in the HM 16.x reference software, is still much higher in the chroma than in the luma channel. Specifically,

- for the all-Intra (AI) configuration, the BD-rate gain in chroma is about **7%** higher than that in luma,
- for the random-access (RA) configuration, the gain in chroma is about **11%** higher than that in luma.

Details (incl. low-delay results) are given in an Excel table included in the Zip file containing this document.

It is worth noting that, perceptually, the author is not aware of any evidence suggesting that, with the current CTC settings, the increased chromatic coding performance of VVC directly results in visual quality gains in the chromatic channels. In fact, JVET-K0206 reported on subjective testing of VTM 1 with activated QP adaptation based on a simple psychovisual distortion model [4], in which the redistribution of chromatic coding rate to the luminance component led to significant increases in visual quality on some sequences.

Therefore, it is proposed to change the default values of the *CbQpOffsetDualTree* and *CrQpOffsetDualTree* encoder configuration parameters from 1 to 0 (in source file *EncAppCfg.cpp*) and, instead, to use the setting

`--CbQpOffset = 1, --CrQpOffset = 1`

in JVET's CTC for VVC testing. With this modification and the same BD-rate measurements as above [5],

- for the AI configuration, the BD-rate gain in chroma remains **7%** higher than the gain in luma,
- for the RA configuration, the gain in chroma now is about **5–6%** higher than the gain in luma.

Again, detailed results are contained in an Excel file accompanying this document. More specifically, the reduced chroma BD-rate gain in RA due to the proposed modification is converted into an increase in luma BD-rate gain by about 0.7%. Notice that the change has virtually no effect on the AI coding configuration: only the header size of each frame changes by one bit, since the signaling of chroma QP offsets in all frames (instead of only selected ones) can be done *per-sequence* and, therefore, requires one bit less in each frame.

## 2 Summary and Conclusion

For perceptual reasons, this contribution recommends to resort to chroma QP offsets of 1 in all coded frames (not only dual-tree Intra frames) in JVET's common test conditions. The necessary changes were described. Note that the described modification does not change the VVC bit-stream syntax or algorithmic operation.

## 3 References

- [1] JVET/Fraunhofer, "VVCSoftware\_VTM," [https://vcgit.hhi.fraunhofer.de/jvet/VVCSoftware\\_VTM](https://vcgit.hhi.fraunhofer.de/jvet/VVCSoftware_VTM).
- [2] B. Bross, J. Chen, S. Liu, "Versatile Video Coding (Draft 3)," JVET-L1001, ver. 7, Macao, Dec. 2018.
- [3] F. Bossen, J. Boyce, X. Li, V. Seregin, K. Sühling, "JVET common test conditions and software reference configurations for SDR video," JVET-L1010, Macao, China, Oct. 2018.
- [4] C. Helmrich, H. Schwarz, D. Marpe, and T. Wiegand, "Improved Perceptually Optimized QP Adaptation and Associated Distortion Measure," JVET-K0206, Ljubljana, Slovenia, July 2018.
- [5] G. Bjøntegaard, "Calculation of average PSNR differences between RD-curves," VCEG-M33, 2001.

## 4 Patent Rights Declaration(s)

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