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| *Title:* | **Bit depth of output pictures** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Ying Chen  Ye-Kui Wang  Xianglin Wang  In Suk Chong  Marta Karczewicz  5775 Morehouse Dr San Diego, CA 92121 USA | Tel: Email: | 1-858-845-6589 [cheny@qualcomm.com](mailto:cheny@qualcomm.com)  1-858-651-8345 [yekuiw@qualcomm.com](mailto:yekuiw@qualcomm.com)  1-858-651-5135 [xianglin@qualcomm.com](mailto:xianglin@qualcomm.com)  1-858-845-5477 [ichong@qualcomm.com](mailto:ichong@qualcomm.com)  1-858-658-5673 [martak@qualcomm.com](mailto:martak@qualcomm.com) |
| *Source:* | Qualcomm Incorporated | | |

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# Abstract

This document reproposes the proposal in JCTVC-G328.

In the current HEVC design, IBDI (Internal Bit Depth Increase) is supported in a way that the decoded picture and the output picture always have the bit depth as signaled in the bitstream (e.g., 10 bits), regardless of the bit depth of the input video (e.g., 8 bits). In this document, it is proposed that: 1) a conforming decoder outputs a decoded video sequence with a target output bit depth (signaled in the bitstream); 2) if the output bit depth is lower than the bit depth of the decoded pictures, better memory consumption can be achieved in a way that if a picture is never or no longer used for reference, it is converted to lower bit depth immediately.

# Introduction

In the HEVC WD1, if IBDI is used, the increased bit depth is signaled in the Sequence Parameter Set (SPS), and the input/output bit depth was already in SPS similar to the syntax element(s) in H.264/AVC with the same name(s). For example if the input/output bit depth is 8 bits and IBDI uses 10 bits internally, 8 is already signaled in SPS and the delta 2 is additionally signaled in SPS.

In the later versions of HEVC WD, only the bit depth of decode pictures is signaled. So in the above example, even the input to a specific HEVC encoder is 8 bits, the bit depth of the decoded picture is 10 bits. In such a scenario, only the bit depth of the decoded pictures, 10 bits, is signaled in the SPS. Since the intention of the encoder is to provide better coding efficiency of an 8-bit signal using IBDI, thus it may be ideal for the decoder to output 8-bit signal as well. However, the current HEVC decoder always output the pictures with the same bit depth as the bitstream bit depth and doesn’t output 8-bit in the above case.

If the ideal output bit depth is lower than the bit depth of the decoded pictures, further memory optimization can be achieved by signaling the target output bit depth, since not every decoded picture has to be stored in the buffer with a higher bit depth all the time.

# Proposal

Note that the proposed technique doesn’t apply to early potential profiles of HEVC which don’t support 10-bit coding, the proposed technique can apply to later profiles which supports bit depth higher than 8.

It is proposed that the output bit depth is signaled so that less required decoded buffer memory is needed for certain bitstreams for which the ideal output bit depth is less than the bit depth of the decoded pictures. An output bit depth shall be equal to or lower than the bit depth of the decoded pictures.

If an output bit depth (BitDepthOut) is lower than the bit depth of the decoded pictures (BitDepth), a non-reference picture after being decoded shall be converted from BitDepth to BitDepthOut before it is stored in DPB, and immediately after a reference picture is marked as “unused for reference”, the reference picture shall be converted from BitDepth to BitDepthOut.

## Sequence parameter set RBSP syntax

|  |  |
| --- | --- |
| seq\_parameter\_set\_rbsp( ) { | Descriptor |
| **...** |  |
| **bit\_depth\_luma\_minus8** | ue(v) |
| **bit\_depth\_chroma\_minus8** | ue(v) |
| **output\_bit\_depth\_decrease** | ue(v) |
| **...** |  |
| rbsp\_trailing\_bits( ) |  |
| } |  |

## Sequence parameter set RBSP semantics

**output\_bit\_depth\_decrease** specifies the difference between a bit depth of a decoded picture and the corresponding bit depth of the output picture. The value of output\_bit\_depth\_decrease shall be in the range of 0 to 4, inclusive.

The luma output bit depth BitDepthOutY is derived as equal to BitDepthY – output\_bit\_depth\_decrease. The chroma output bit depth BitDepthOutC is derived as equal to BitDepthC – output\_bit\_depth\_decrease.

## DPB management

If a decoded picture is a reference picture and is marked as “used for reference”, it is stored in the DPB with luma bit depth equal to BitDepthY and chorma bit depth equal to BitDepthC.

Otherwise (the decoded picture is a non-reference picture or is marked as “unused for reference”), it is stored in the DPB with luma bit depth equal to BitDepthOutY and chorma bit depth equal to BitDepthOutC .

When output a picture, the picture it is output with luma bit depth equal to BitDepthOutY and chorma bit depth equal to BitDepthOutC. In case BitDepthOutY is less than BitDepthY, the luma value of a sample is right-shifted to be of BitDepthOutY bits. In case BitDepthOutC is less than BitDepthC, the chroma value of a sample is right-shifted to be of BitDepthOutC bits.

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