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| *Title:* | **Non-SCE4: Weighted Prediction Based Color Gamut Scalability** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Xiang Li  Vadim Seregin  Jianle Chen  Krishna Rapaka  Ying Chen  Marta Karczewicz | Tel: Email: | +1 858 658 3923 [lxiang@qti.qualcomm.com](mailto:lxiang@qti.qualcomm.com)  [vseregin@qti.qualcomm.com](mailto:vseregin@qti.qualcomm.com)  [cjianle@qti.qualcomm.com](mailto:cjianle@qti.qualcomm.com)  [krapaka@qti.qualcomm.com](mailto:krapaka@qti.qualcomm.com)  [cheny@qti.qualcomm.com](mailto:cheny@qti.qualcomm.com)  [martak@qti.qualcomm.com](mailto:martak@qti.qualcomm.com) |
| *Source:* | Qualcomm Inc. | | |

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# Abstract

In this contribution weighted prediction based color gamut scalability is proposed. The gain-offset parameters used for linear inter-layer color prediction are signaled under the framework of weighted prediction. In addition, a flag in PPS is further signaled to indicate that no weighted prediction will be applied for temporal references. It is reported that 6.5%, 6.0%, 4.0% and 3.5% luma BD-rate reduction was achieved for AI-10bit, AI-8bit, RA-10bit, and RA-8bit, respectively by the proposed method when compare to SCE4 anchor.

# Introduction

In [1], a linear prediction model (gain-offset model) was proposed for inter-layer color prediction when the color gamut of base and enhancement layers is different. For each channel a gain[c] and offset[c] are specified. The prediction is defined by

Pred[c][x][y] = (gain[c]\*In[x][y] + (1<<(numFractionBits-1))>> numFractionBits + offset[c],

where numFractionBits represents the number of fraction bits used in the calculation. The model parameters are signaled in PPS extension.

The method is simple and efficient. However, it introduces a new function module in decoding process for the inter-layer color prediction, which is not desired in high-level-syntax only SHVC.

# Proposed method

Weighted prediction is a tool already supported in HEVC and current SHVC draft. It can be used for the linear inter-layer color prediction so that no new decoding module is necessary. Note that in weighted prediction based color gamut scalability, weighted prediction is only applied to inter-layer reference, not to temporal references. Therefore, a new flag in PPS is introduced for indication to avoid unnecessary cost.

## Derivation of weighted prediction parameters

At encoder side, after generating the inter-layer reference picture RIL, the parameters of weighting prediction (weight *w* and offset o) are determined by minimizing the SSE distortion of weighted version of RIL and the source picture IO, namely

.

where the subscript (x,y) indicates the pixel at position (x,y), *W* and *H* represent the width and height of the picture. Please note that three sets of weighting parameters are derived for Y, U, and V components, respectively.

## Syntax and semantics of the indicating flag

As mentioned above, in weighted prediction based color gamut scalability, the weighted prediction is only applied to inter-layer reference pictures and no weighting information is needed for temporal references. Therefore, a flag weighted\_color\_gamut\_mode\_flag in PPS is further proposed to avoid unnecessary signaling and related cost.

|  |  |  |
| --- | --- | --- |
| pic\_parameter\_set\_rbsp( ) { | Descriptor | |
| **pps\_pic\_parameter\_set\_id** | ue(v) | |
| **……** |  | |
| **weighted\_pred\_flag** | u(1) | |
| **weighted\_bipred\_flag** | u(1) | |
| if( nuh\_layer\_id > 0 && ( weighted\_pred\_flag | | weighted\_bipred\_flag ) ) |  | |
| **ilr\_weight\_only\_flag** | u(1) |
| } |  | |

**ilr\_weight\_only\_flag** equal to 1 specifies that weighted prediction parameters for a reference picture of a current picture that refers to the PPS are not present in the syntax table pred\_weight\_table( ) if the reference picture belongs the same layer as the current picture . ilr\_weight\_only\_flag equal to 0 specifies that weighted prediction parameters for each referecne picture may be present in the syntax table pred\_weight\_table( ). When ilr\_weight\_only\_flag is not present, it is inferred to be equal to 0.

General slice segment header syntax

|  |  |
| --- | --- |
| slice\_segment\_header( ) { | **Descriptor** |
| … |  |
| if( ( weighted\_pred\_flag && slice\_type = = P ) | |  ( weighted\_bipred\_flag && slice\_type = = B ) ) { |  |
|  |  |
|  |  |
| if ( !ilr\_weight\_only\_flag | | inter\_layer\_pred\_enabled\_flag) |  |
| pred\_weight\_table( ) |  |
| } |  |
| … |  |
| } |  |

|  |  |
| --- | --- |
| pred\_weight\_table( ) { | Descriptor |
| **luma\_log2\_weight\_denom** | ue(v) |
| if( chroma\_format\_idc != 0 ) |  |
| **delta\_chroma\_log2\_weight\_denom** | se(v) |
| for( i = 0; i <= num\_ref\_idx\_l0\_active\_minus1; i++ ) |  |
| if(!ilr\_weight\_only\_flag | | nuh\_layer\_id of RefPicList0[ i ] != currLayerId) |  |
| **luma\_weight\_l0\_flag**[ i ] | u(1) |
| if( chroma\_format\_idc != 0 ) |  |
| for( i = 0; i <= num\_ref\_idx\_l0\_active\_minus1; i++ ) |  |
| if(!ilr\_weight\_only\_flag | | nuh\_layer\_id of RefPicList0[ i ] != currLayerId) |  |
| **chroma\_weight\_l0\_flag**[ i ] | u(1) |
| for( i = 0; i <= num\_ref\_idx\_l0\_active\_minus1; i++ ) { |  |
| if( luma\_weight\_l0\_flag[ i ] ) { |  |
| **delta\_luma\_weight\_l0**[ i ] | se(v) |
| **luma\_offset\_l0**[ i ] | se(v) |
| } |  |
| if( chroma\_weight\_l0\_flag[ i ] ) |  |
| for( j = 0; j < 2; j++ ) { |  |
| **delta\_chroma\_weight\_l0**[ i ][ j ] | se(v) |
| **delta\_chroma\_offset\_l0**[ i ][ j ] | se(v) |
| } |  |
| } |  |
| if( slice\_type = = B ) { |  |
| for( i = 0; i <= num\_ref\_idx\_l1\_active\_minus1; i++ ) |  |
| if(!ilr\_weight\_only\_flag | | nuh\_layer\_id of RefPicList1[ i ] != currLayerId) |  |
| **luma\_weight\_l1\_flag**[ i ] | u(1) |
| if( chroma\_format\_idc != 0 ) |  |
| for( i = 0; i <= num\_ref\_idx\_l1\_active\_minus1; i++ ) |  |
| if(!ilr\_weight\_only\_flag | | nuh\_layer\_id of RefPicList1[ i ] != currLayerId) |  |
| **chroma\_weight\_l1\_flag**[ i ] | u(1) |
| for( i = 0; i <= num\_ref\_idx\_l1\_active\_minus1; i++ ) { |  |
| if( luma\_weight\_l1\_flag[ i ] ) { |  |
| **delta\_luma\_weight\_l1**[ i ] | se(v) |
| **luma\_offset\_l1**[ i ] | se(v) |
| } |  |
| if( chroma\_weight\_l1\_flag[ i ] ) |  |
| for( j = 0; j < 2; j++ ) { |  |
| **delta\_chroma\_weight\_l1**[ i ][ j ] | se(v) |
| **delta\_chroma\_offset\_l1**[ i ][ j ] | se(v) |
| } |  |
| } |  |
| } |  |
| } |  |

**luma\_weight\_l0\_flag**[ i ] equal to 1 specifies that weighting factors for the luma component of list 0 prediction using RefPicList0[ i ] are present. luma\_weight\_l0\_flag[ i ] equal to 0 specifies that these weighting factors are not present. When luma\_weight\_l0\_flag[ i ] is not present, it is inferred to be equal to 0.

# Simulation results and discussions

To verify the performance of the proposed method, tests defined in SCE4 descriptions [2] were conducted. The results are summarized as follows. Please note that the timing information is not accurate.



On average, the coding efficiency is significantly improved.

# Conclusions

In this contribution, weighted prediction based color gamut scalability is proposed without decoding process change. Moreover, a flag in PPS is further introduced to indicate whether the weighted prediction is only applied to inter-layer reference pictures. Simulations show that significant coding gain is achieved by the proposed method. It is proposed to adopt it into SHVC draft and reference software.

# References

1. L. Kerofsky, A. Segall, S.-H. Kim, K. Misra, "Color Gamut Scalable Video Coding: New Results", JCTVC-L0334, Geneva, CH, 14–23 Jan. 2013.
2. Andrew Segall, Philippe Bordes, Cheung Auyeung, Xiang Li, Elena Alshina, "HEVC Scalable Extensions Core Experiment 4 (SCE4): Color Gamut and Bit-Depth Scalability", JCTVC-N1104, Vienna, Austria, Jul. 2013.

# Patent rights declaration(s)

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