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| --- | --- | --- | --- |
| Title: | High-level Syntax: **Improvements to weighted** prediction for B slices | | |
| Status: | Input Document to JCT-VC | | |
| Purpose: | Proposal | | |
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Abstract

This contribution proposes to add a new functionality to support explicit mode weighted prediction for both uni-directional and bi-directional predictions of a B slice. The proposed changes utilize weighted\_bipred\_idc which is a 2-bit syntax element, having the range of 0 to 2. To improve the performance of weighted prediction without the cost of any additional bits, this proposal suggests extending the range of weighted\_bipred\_idc value to 0 to 3. With the extended value, the proposed method supports using different weighting factors for uni-directional and bi-directional predictions of a B slice.

Given the design consistency of P and B slices and refinement of weighted prediction process without any cost for additional bits, it is suggested that the JCT-VC consider this proposal in refining the design of weighted prediction process.

# Introduction

In current HEVC specification (committee draft), weighted\_bipred\_idc, a 2-bit syntax element, is signaled at PPS and using the range of 0 to 2 to specify that the different type of weighted predictions for B slices. Based on weighted\_bipred\_idc value and prediction list utilization flags, predFlagL0 and predFlagL1, the explicit mode weighting factors for reference list 0 and reference list 1 are derived for both luma and chroma samples.

When explicit weighted prediction of a B slice is invoked, the same set of weighting factors is used for both uni-prediction and bi-prediction. Since B slice can support uni-directional and bi-directional predictions, applying only single set of weighting factors for both cases may limit its functionality and may not result optimized prediction values.

# Proposal

It is proposed to add the 4th value for weighted\_bipred\_idc syntax (i.e., weighted\_bipred\_idc = = 3) to provide the different weighted factors for uni-directional and bi-directional predictions of a B slice.

When weighted\_bipred\_idc is equal to 3 and when list combination is present (i.e., ref\_pic\_list\_combination\_flag = =1) in B-slice, the proposed method provides an option to use different weighted factors for bi-directional prediction (both reference list 0 and list 1 weights) and uni-directional (list combination weights). The conditions to derive the new weighted factors are as follows:

* If PredL0 is equal to 1 and PredL1 is equal to 0, derive new combined explicit mode weighted prediction for luma and chroma samples for reference list 0.
* Otherwise, if PredL0 is equal to 0 and PredL1 is equal to 1, derive new combined explicit mode weighted prediction for luma and chroma samples for reference list 1.
* Otherwise (if PredL0 and PredL1 are equal to 1), derive new explicit mode weighted prediction for luma and chroma samples for both reference list 0 and list 1.

Since B slices support both single and bi directional predictions, the proposed method allows selecting different prediction weights for two cases and improve the design consistency of P and B slices. .

# Conclusion

This contribution supports using different weighting factors for uni-directional and bi-directional predictions of a B slice without increasing any additional bits. Given the design consistency of P and B slices and refinement of weighted prediction process, it is suggested that the JCT-VC consider this proposal in refining the design of weighted prediction process.

# References

1. B. Bross, W.-J. Han, J.-R. Ohm, G. J. Sullivan, T. Wiegand, “CD: High efficiency video coding (HEVC) text specification draft 6,” JCTVC-H1103, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG 16 WP3 and ISO/IEC JTC1/SC29/WG11 8th Meeting, San José, CA, USA, 1–10 February, 2012.
2. [J. Xu](mailto:jun.xu@am.sony.com) , [A. Tourapis](mailto:alexis.tourapis@magnumsemi.com) , [E. Maani](mailto:ehsan.maani@am.sony.com), [A. Tabatabai,](mailto:ali.tabatabai@am.sony.com) “Differentiated weighting parameter sets for weighted prediction”, JCTVC-H0401, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG 16 WP3 and ISO/IEC JTC1/SC29/WG11 8th Meeting, San José, CA, USA, 1–10 February, 2012.

# Patent rights declaration(s)

Panasonic Corporation may have IPR relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).

Appendix: Proposed changes for HEVC WD6 (dk)

Proposed CD text is included below using the following text conventions:

* Unchanged text that is not shown here is indicated with "…"
* Removed text is shown in blue with ~~strikethrough~~.
* Newly added text is shown in yellow highlight.

**7.3.3 Slice header syntax**

|  |  |
| --- | --- |
| slice\_header( ) { | Descriptor |
| **first\_slice\_in\_pic\_flag** | u(1) |
| ... |  |
| if( ( weighted\_pred\_flag && slice\_type = = P) | |  ( (weighted\_bipred\_idc = = 1 | | weighted\_bipred\_idc = = 3) &&  slice\_type = = B ) ) |  |
| pred\_weight\_table( ) |  |
| ... |  |
| } |  |

**7.3.3.8 Prediction weight table syntax**

|  |  |
| --- | --- |
| pred\_weight\_table( ) { | Descriptor |
| … |  |
| if( slice\_type = = P | |  ( slice\_type = = B && (ref\_pic\_list\_combination\_flag = = 0 | | weighted\_bipred\_idc = = 3) ) { |  |
| for( i = 0; i <= num\_ref\_idx\_l0\_active\_minus1; i++ ) { |  |
| **luma\_weight\_l0\_flag** | u(1) |
| … |  |
| } |  |
| } |  |
| if( slice\_type = = B ) { |  |
| if( ref\_pic\_list\_combination\_flag = = 0 | | weighted\_bipred\_idc = = 3) { |  |
| for( i = 0; i <= num\_ref\_idx\_l1\_active\_minus1; i++ ) { |  |
| **luma\_weight\_l1\_flag** | u(1) |
| … |  |
| } |  |
| } ~~else {~~ |  |
| if( ref\_pic\_list\_combination\_flag = = 1) { |  |
| for( i = 0; i <= num\_ref\_idx\_lc\_active\_minus1; i++ ) { |  |
| **luma\_weight\_lc\_flag** | u(1) |
| if(~~luma\_weight\_l1\_flag~~  luma\_weight\_lc\_flag) { |  |
| **delta\_luma\_weight\_lc[** i **]** | se(v) |
| **luma\_offset\_lc[** i **]** | se(v) |
| } |  |
| … |  |
| } |  |
| } |  |
| } |  |
| } |  |

**7.4.2.2 Picture parameter set RBSP semantics**

…

**weighted\_bipred\_idc** equal to 0 specifies that the default weighted prediction is applied to B slices. weighted\_bipred\_idc equal to 1 specifies that explicit weighted prediction is applied to B slices. weighted\_bipred\_idc equal to 2 specifies that implicit weighted prediction shall be applied to B slices. weighted\_bipred\_idc equal to 3 specifies that explicit weighted prediction is applied to both uni-directional and bi-directional predictions of B slices. The value of weighted\_bipred\_idc shall be in the range of 0 to ~~2~~ 3, inclusive.

…

1. **Weighted sample prediction process**

…

In B slices, if predFlagL0 or predFlagL1 is equal to 1, the following applies.

– If weighted\_bipred\_idc is equal to 0, the default weighted sample prediction process as described in subclause is invoked with the same inputs and outputs as the process described in this subclause.

– Otherwise, if weighted\_bipred\_idc is equal to 1 and if predFlagL0 or predFlagL1 equal to 1, the explicit weighted sample prediction process as described in subclause is invoked with the same inputs and outputs as the process described in this subclause.

– Otherwise, if ~~(~~weighted\_bipred\_idc is equal to 2~~)~~, the following applies.

– If predFlagL0 is equal to 1 and predFlagL1 is equal to 1, the implicit weighted sample prediction process as described in subclause is invoked with the same inputs and outputs as the process described in this subclause.

– Otherwise (predFlagL0 or predFlagL1 are equal to 1 but not both), the default weighted sample prediction process as described in subclause is invoked with the same inputs and outputs as the process described in this subclause.

– Otherwise (weighted\_bipred\_idc is equal to 3), the explicit weighted sample prediction process as described in subclause is invoked with the same inputs and outputs as the process described in this subclause.

**8.5.2.2.3.2** **Weighted sample prediction process**

…

– Otherwise (weighted\_pred\_flag is equal to 1 in P slice or ref\_pic\_list\_combination\_flag is equal to 0 in B-slice) explicit mode weighted prediction is used as follows:

...

o1C = ChromaOffsetL1[refIdxL1][ iCbCr ] \* ( 1 << ( BitDepthC − 8 ) ) (8‑251)

* Otherwise (weighted\_bipred\_idc is equal to 3 and ref\_pic\_list\_combination\_flag is equal to 1 in B-slice) explicit mode weighted prediction is used as follows:

– If C is equal to L for luma samples,

logWDc = luma\_log2\_weight\_denom+ shift1

* If predFlagL0 is equal to 1,

w0C = ( (predFlagL1 = = 1 ) ? LumaWeightL0[refIdxL0] : LumaWeightLC[refIdxLC])

o0C = ( (predFlagL1 = = 1 ) ? luma\_offset\_l0[refIdxL0] \* ( 1 << ( BitDepthY − 8 ) ) : luma\_offset\_lc[refIdxLC] \* ( 1 << ( BitDepthY − 8 ) )

* If predFlagL1 is equal to 1,

w1C = ( (predFlagL0 = = 1 ) ? LumaWeightL1[refIdxL1] : LumaWeightLC[refIdxLC])

o1C = ( (predFlagL0 = = 1 ) ? luma\_offset\_l1[refIdxL1] \* ( 1 << ( BitDepthY − 8 ) ) : luma\_offset\_lc[refIdxLC] \* ( 1 << ( BitDepthY − 8 ) )

– Otherwise (C is equal to Cb or Cr for chroma samples, with iCbCr = 0 for Cb, iCbCr = 1 for Cr),

logWDc = ChromaLog2WeightDenom + shift1

* If predFlagL0 is equal to 1,

w0C = ( (predFlagL1 = = 1 ) ? ChromaWeightL0[refIdxL0] [ iCbCr ]) : ChromaWeightLC[refIdxLC][ iCbCr ])

o0C = ( (predFlagL1 = = 1 ) ? ChromaOffsetL0[refIdxL0][ iCbCr ] \* ( 1 << ( BitDepthY  − 8 ) ) : ChromaOffsetLC[refIdxLC][ iCbCr ] \* ( 1 << ( BitDepthY − 8 ) )

* If predFlagL1 is equal to 1,

w1C = ( (predFlagL0 = = 1 ) ? ChromaWeightL1[refIdxL1] [ iCbCr ]) : ChromaWeightLC[refIdxLC][ iCbCr ])

o1C = ( (predFlagL0 = = 1 ) ? ChromaOffsetL1[refIdxL1][ iCbCr ] \* ( 1 << ( BitDepthY − 8 ) ) : ChromaOffsetLC[refIdxLC][ iCbCr ] \* ( 1 << ( BitDepthY − 8 ) )