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| *Title:* | **MV-HEVC/SHVC HLS: reference picture list construction for motion only dependent picture** | | |
| *Status:* | Input Document to JCT-VC and JCT-3V | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes an interlayer reference picture set (RPS) which is used for non-sample dependency reference pictures. It is proposed to define a motion only inter layer RPS as RefPicSetInterLayer2 and insert it not in the temporal reference picture list (RefPicListTempX) but in the extended part of reference picture list (RefPicListX). It is asserted that it is beneficial to avoid reference picture list modification. Additionally, the range of list\_entry\_LX is confined to the conventional part of reference picture list to exclude the motion only pictures. The bit amount of list\_entry\_LX could be reduced. In this contribution, the main part of reference picture list, whose length is defined by num\_ref\_idx\_lX\_active\_minus1, excludes motion only pictures, which reduces bit amount of ref\_idx\_LX and weighted prediction values. colPic can be indicated with the extended part of RefPicListX, which includes motion only pictures.

# Introduction

The current MV-HEVC/SHVC mostly uses common reference picture model and creates two interlayer reference picture set, RefPicSetInterLayer0 and RefPicSetInterLayer1.

The reference picture scheme is designed to have flexibility for future extension by having indicator of direct\_dependency\_type and ScalabilityID. However it is not efficient in the case where motion only picture is used or depth is coded with texture:

* The motion only picture, which is used for motion prediction but not used for pixel prediction, may be included in relatively former part of reference picture list. Then reference list modification would be necessary.
* The bits of list\_entry\_lX(reference list modification syntax, or Ceil( Log2(NumPocTotalCurr)) increases because NumPocTotalCurr includes motion only reference pictures.

To address the issues, the followings are proposed:

# Proposal

for Common part (SHVC/MV-HEVC)

**list\_entry\_l0**[ i ] specifies the index of the reference picture in RefPicListTemp0 to be placed at the current position of reference picture list 0. The length of the list\_entry\_l0[ i ] syntax element is Ceil( Log2((nal\_layer\_id ? NumPocTotalCurr – NumActiveRefLayerPics2 : NumPocTotalCurr)) ) bits. The value of list\_entry\_l0[ i ] shall be in the range of 0 to (nal\_layer\_id ? NumPocTotalCurr – NumActiveRefLayerPics2 - 1, NumPocTotalCurr – 1), inclusive. When the syntax element list\_entry\_l0[ i ] is not present in the slice header, it is inferred to be equal to 0.

**list\_entry\_l1**[ i ] specifies the index of the reference picture in RefPicListTemp1 to be placed at the current position of reference picture list 1. The length of the list\_entry\_l1[ i ] syntax element is Ceil( Log2((nal\_layer\_id ? NumPocTotalCurr – NumActiveRefLayerPics2 : NumPocTotalCurr)) ) bits. The value of list\_entry\_l1[ i ] shall be in the range of 0 to (nal\_layer\_id ? NumPocTotalCurr – NumActiveRefLayerPics2 - 1, NumPocTotalCurr – 1), inclusive. When the syntax element list\_entry\_l0[ i ] is not present in the slice header, it is inferred to be equal to 0.

**collocated\_ref\_idx** specifies the reference index of the collocated picture used for temporal motion vector prediction.

When slice\_type is equal to P or when slice\_type is equal to B and collocated\_from\_l0 is equal to 1, collocated\_ref\_idx refers to a picture in list 0, and the value of collocated\_ref\_idx shall be in the range of 0 to (nal\_layer\_id ? NumRpsCurrTempList0 – 1 : num\_ref\_idx\_l0\_active\_minus1), inclusive.

When slice\_type is equal to B and collocated\_from\_l0 is equal to 0, collocated\_ref\_idx refers to a picture in list 1, and the value of collocated\_ref\_idx shall be in the range of 0 to (nal\_layer\_id ? NumRpsCurrTempList1 – 1 : num\_ref\_idx\_l1\_active\_minus1), inclusive.

It is a requirement of bitstream conformance that the picture referred to by collocated\_ref\_idx shall be the same for all slices of a coded picture.

**H.8.1.3 Marking process for ending the decoding of a coded picture with nuh\_layer\_id greater than 0**

Output of this process is:

– a potentially updated marking as "used for short-term reference" for some decoded pictures.

The following applies.

for( i = 0; i < NumActiveRefLayerPics0; i++ )   
 RefPicSetInterLayer0[ i ] is marked as "used for short-term reference"

for( i = 0; i < NumActiveRefLayerPics1; i++ )  
 RefPicSetInterLayer1[ i ] is marked as "used for short-term reference"

for( i = 0; i < NumActiveRefLayerPics2; i++ )  
 RefPicSetInterLayer2[ i ] is marked as "used for short-term reference"

**G.8.3.4 Decoding process for reference picture lists construction**

The list RefPicList0 is constructed as follows:

for( rIdx = 0; rIdx <= num\_ref\_idx\_l0\_active\_minus1; rIdx++) (‑2)  
 RefPicList0[ rIdx ] = ref\_pic\_list\_modification\_flag\_l0 ? RefPicListTemp0[ list\_entry\_l0[ rIdx ] ] :  
 RefPicListTemp0[ rIdx ]

for( rIdx2 = 0; rIdx2 < NumActiveRefLayerPics2 && rIdx < NumRpsCurrTempList1; rIdx++, rIdx2++)  
 RefPicList0[ rIdx ] = RefPicSetInterLayer2 [ rIdx2 ]

When the slice is a B slice, the list RefPicList1 is constructed as follows:

for( rIdx = 0; rIdx <= num\_ref\_idx\_l1\_active\_minus1; rIdx++) (‑4)  
 RefPicList1[ rIdx ] = ref\_pic\_list\_modification\_flag\_l1 ? RefPicListTemp1[ list\_entry\_l1[ rIdx ] ] :  
 RefPicListTemp1[ rIdx ]

for( rIdx2 = 0; rIdx2 < NumActiveRefLayerPics2 && rIdx < NumRpsCurrTempList2; rIdx++, rIdx2++)   
 RefPicList1[ rIdx ] = RefPicSetInterLayer2[ rIdx2 ]

for SHVC

**H.8.1.2 Decoding process for inter-layer reference picture set**

The lists RefPicSetInterLayer0 and RefPicSetInterLayer1 are first emptied, NumActiveRefLayerPics0 and NumActiveRefLayerPics1 are set equal to 0 and the following applies:

for( i = 0; i < NumActiveRefLayerPics; i++ ) {  
 if( there is a picture picX in the DPB that is in the same access unit as the current picture and has  
 nuh\_layer\_id equal to RefPicLayerId[ i ] ) {  
 an interlayer reference picture rsPic is derived by invoking the subclause with picX and  
 RefPicLayerId[ i ] given as inputs

if( ( !SamplePredEnabledFlag [nuh\_layer\_if][ RefPicLayerId[ i ]] **||**  ScalabilityID [nuh\_layer\_if][0] != ScalabilityID [RefPicLayerId[ i ][0] ]) {  
 RefPicSetInterLayer2[ NumActiveRefLayerPics0 ] = picX  
 RefPicSetInterLayer2[ NumActiveRefLayerPics0++ ] is marked as "used for long-term reference"  
 } else {  
 RefPicSetInterLayer0[ NumActiveRefLayerPics0 ] = rsPic  
 RefPicSetInterLayer0[ NumActiveRefLayerPics0++ ] is marked as "used for long-term reference"  
 }  
 }  
 } else  
 RefPicSetInterLayer0[ NumActiveRefLayerPics0++ ] = "no reference picture"  
}

Note: ScalabilityID [nuh\_layer\_if][0] != ScalabilityID [RefPicLayerId[ i ][0] ] means DepthFlag is not equal to DepthFlag of RefPicLayerId[ i ].

If the current picture is a RADL picture, there shall be no entry in the RefPicSetInterLayer0 or RefPicSetInterLayer1 or RefPicSetInterLayer2 that is a RASL picture.

for MV-HEVC

**G.8.1.2 Decoding process for inter-layer reference picture set**

Outputs of this process are updated lists of inter-layer pictures RefPicSetInterLayer0 and RefPicSetInterLayer1 and the variables NumActiveRefLayerPics0 and NumActiveRefLayerPics1.

The lists RefPicSetInterLayer0 and RefPicSetInterLayer1 are first emptied, NumActiveRefLayerPics0 and NumActiveRefLayerPics1 are set equal to 0 and the following applies:

for( i = 0; i < NumActiveRefLayerPics; i++ ) {  
 if( there is a picture picX in the DPB that is in the same access unit as the current picture and has  
 nuh\_layer\_id equal to RefPicLayerId[ i ] ) {

if(  !SamplePredEnabledFlag [nuh\_layer\_if][ RefPicLayerId[ i ]] **||**  ScalabilityID [nuh\_layer\_if][0] != ScalabilityID [RefPicLayerId[ i ][0] ]) {

RefPicSetInterLayer2[ NumActiveRefLayerPics0 ] = picX  
 RefPicSetInterLayer2[ NumActiveRefLayerPics0++ ] is marked as "used for long-term reference"  
 } else if( ( ViewId[ nuh\_layer\_id ] <= ViewId[ 0 ]  &&  
 ViewId[ nuh\_layer\_id ] <= ViewId[ RefPicLayerId[ i ] ] ) | |  
 ( ViewId[ nuh\_layer\_id ] >= ViewId[ 0 ] &&  
 ViewId[ nuh\_layer\_id ] >= ViewId[ RefPicLayerId[ i ] ] ) ) {  
 RefPicSetInterLayer0[ NumActiveRefLayerPics0 ] = picX  
 RefPicSetInterLayer0[ NumActiveRefLayerPics0++ ] is marked as "used for long-term reference"  
 } else {  
 RefPicSetInterLayer1[ NumActiveRefLayerPics1 ] = picX  
 RefPicSetInterLayer1[ NumActiveRefLayerPics1++ ] is marked as "used for long-term reference"  
 }  
 } else  
 RefPicSetInterLayer0[ NumActiveRefLayerPics0++ ] = "no reference picture"  
}

If the current picture is a RADL picture, there shall be no entry in the RefPicSetInterLayer0 or RefPicSetInterLayer1 or RefPicSetInterLayer2 that is a RASL picture.

# Conclusion

It is proposed to generate motion only interlayer picture set as RefPicSetInterLayer2 and inserted it in the last position of reference picture lists. The motivation is to remove reference picture list modification for motion only picture case. It is recommended to adopt this method in MV-HEVC and SHVC.

# Reference

[1] O. Nakagami, T. Suzuki (Sony), MV-HEVC/SHVC HLS: On initialization process of reference picture lists for HEVC extensions, JCTVC-N0082

[2] Andrey Norkin, Usman Hakeem, Thomas Rusert, MV-HEVC/SHVC HLS: Initial inter-layer reference picture list construction, JCT3V-E0239

# Patent rights declaration(s)

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