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| *Title:* | Signalling and restriction for scaled reference layer offsets | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes a modified signalling and restriction regarding scaled reference layer offsets. On the modified signalling, a present flag indicating whether to signal scaled reference layer offsets parameters is added, and a present flag for scaled reference layer offsets is added for each direct reference layer. On the restriction, a semantic restriction is proposed to restrict inter layer sample prediction outside or across the bounds specified by scaled reference layer offsets.

It is asserted that the signalling modification is beneficial to improve the coding efficiency and to simplify decoder implementation by removing additional boundary operation for scaled reference layer offsets.

# Introduction

At the last meeting, ROI (scaled reference layer offsets) signalling and related boundary operation were adopted [1]. However, we assert it has two issues.

1. On scaled reference layer offsets signalling in [1], the syntax **num\_scaled\_ref\_layer\_offsets** is redundant since the number of direct reference pictures for the target layer is already known after decoding video parameter set.
2. The specification allows the use of inter layer sample prediction outside or across the ROI bounds. This may cause degradations of coding efficiency since the samples outside the bounds in resampled reference layer picture are padded by the samples at the bounds.

# Proposed method

We propose a) a modified signalling to solve issue A and b) a semantics restriction for issue B.

## Modification signalling

We propose a modification of scaled reference layer offsets signalling as follows:

* Remove **num\_scaled\_ref\_layer\_offsets**.
* Add **scaled\_ref\_layer\_offset\_params\_present\_flag**.
* Add **scaled\_ref\_layer\_offset\_present\_flag** for each direct reference layer.

Table1: G.7.3.2.2.1 Sequence parameter set extension syntax

|  |  |
| --- | --- |
| sps\_extension( ) { | **Descriptor** |
| **inter\_view\_mv\_vert\_constraint\_flag** | u(1) |
| sps\_extension\_vui\_parameters( ) |  |
| **~~num\_scaled\_ref\_layer\_offsets~~** | ~~ue(v)~~ |
| if (NumDirectRefLayers[ nuh\_layer\_id ] > 1) |  |
| **scaled\_ref\_layer\_offset\_params\_present\_flag** | u(1) |
| for( i = 0; i < ~~num\_scaled\_ref\_layer\_offsets~~NumDirectRefLayers[ nuh\_layer\_id ] && scaled\_ref\_layer\_offset\_params\_present\_flag; i++) { |  |
| **scaled\_ref\_layer\_offset\_present\_flag** | u(1) |
| if ( scaled\_ref\_layer\_offset\_present\_flag ){ |  |
| **scaled\_ref\_layer\_left\_offset**[ i ] | se(v) |
| **scaled\_ref\_layer\_top\_offset**[ i ] | se(v) |
| **scaled\_ref\_layer\_right\_offset**[ i ] | se(v) |
| **scaled\_ref\_layer\_bottom\_offset**[ i ] | se(v) |
| **}** |  |
| **}** |  |
| } |  |

G.7.4.3.2.1 Sequence parameter set extension semantics

Semantic changes are highlighted in yellow.

**~~num\_scaled\_ref\_layer\_offsets~~**~~specifies the number of sets of scaled reference layer offset parameters that are present in the SPS. The value of num\_scaled\_ref\_layer\_offsets shall be in the range of 0 to 63, inclusive. [Ed. (JB): Should consider if this constraint should be further restricted. Is there a limit on the number of direct reference layers?]~~

**scaled\_ref\_layer\_offset\_params\_present\_flag** equal to 1 indicates that the scaled reference layer offset parameters for each direct reference layer are present in the SPS. scaled\_ref\_layer\_offset\_params\_present\_flag equal to 0 indicates that indicates that these offsets for each direct reference layer are not present. If not present and NumDirectRefLayers[ nuh\_layer\_id ] is equal to 0, scaled\_ref\_layer\_offset\_params\_present\_flag is inffered to be equal to 0**.** Otherwise(If not present and NumDirectRefLayers[ nuh\_layer\_id ] is equal to 1), scaled\_ref\_layer\_offset\_params\_present\_flag is inffered to be equal to 1**.**

**scaled\_ref\_layer\_offset\_present\_flag [ i ]** equal to 1 indicates that the scaled reference layer offset parameters between the luma sample of the i-th resampled direct reference layer picture with layer\_id equal to RefLayerId[ nuh\_layer\_id ][ i ] and the luma sample of the current picture are present in the SPS. **scaled\_**ref\_layer\_offset\_flag [ i ] equal to 0 indicates that these offsets are not present.

**scaled\_ref\_layer\_left\_offset**[ i ]specifies the horizontal offset between the upper-left luma sample of the resampled i-th direct reference layer picture ,with layer\_id equal to RefLayerId[ nuh\_layer\_id ][ i ], used for inter-layer prediction and the upper-left luma sample of the current picture in units of two luma samples. When not present, the value of scaled\_ref\_layer\_left\_offset[ i ]is inferred to be equal to 0.

**scaled\_ref\_layer\_top\_offset**[ i ] specifies the vertical offset between the upper-left luma sample of the resampled i-th direct reference layer picture, with layer\_id equal to RefLayerId[ nuh\_layer\_id ][ i ], used for inter-layer prediction and the upper-left luma sample of the current picture in units of two luma samples. When not present, the value of scaled\_ref\_layer\_top\_offset[ i ]is inferred to be equal to 0.

**scaled\_ref\_layer\_right\_offset**[ i ]specifies the horizontal offset between the bottom-right luma sample of the resampled i-th direct reference layer picture ,with layer\_id equal to RefLayerId[ nuh\_layer\_id  ][ i ], used for inter-layer prediction and the bottom-right luma sample of the current picture in units of two luma samples. When not present, the value of scaled\_ref\_layer\_right\_offset[ i ]is inferred to be equal to 0.

**scaled\_ref\_layer\_bottom\_offset**[ i ]specifies the vertical offset between the bottom-right luma sample of the resampled i-th direct reference layer picture ,with layer\_id equal to RefLayerId[ nuh\_layer\_id  ][ i ], used for inter-layer prediction and the bottom-right luma sample of the current picture in units of two luma samples. When not present, the value of scaled\_ref\_layer\_bottom\_offset[ i ]is inferred to be equal to 0.

## Semantics restriction on inter layer sample prediction

We propose a semanctics restriction of inter layer sample prediction.

**Re-sampled reference layer picture rsPIc**

**-**

**Current picture curPic**

**ROI**

**Reference layer picture rlPic**

**(**

**xP,yP**

**)**

**Case2**

**(xP,yP)**

**wPb**

**hPb**

**Case1**

**(xP,yP)**

**Case3**

**(xP,yP)**

**Case4**

**(**

**xP,yP**

**)**

**: padding area**

A reference block for

Inter layer sample prediction

Figure 1: Restriction of inter layer sample prediction outside or across the bounds specified by scaled reference layer offsets parameter

Following semantics are added after scaled reference layer offsets section:

At the decoding process of a block of current picture, it is not allowed to use inter layer sample prediction (ILP), if a prediction block in the resampled reference picture for ILP satisfies one of the following conditions: ( i.e. inter layer sample prediction outside or across the bounds specified by scaled reference layer offsets parameters shall not be used. )

Case 1: The most-left samples of the prediction block for ILP is outside the most-left samples of the bounds.

xP < max ( 0, ScaledRefLayerLeftOffset )

Case 2: The most-right samples of the prediction block for ILP is outside the most-right samples of the bounds.

xP + wPb -1 > min ( PicWidthinSamplesL - 1, PicWidthInSamplesL - ScaledRefLayerRightOffset -1 )

Case 3: The most-top samples of the prediction block for ILP is outside the most-top samples of the bounds.

yP < max ( 0, ScaledRefLayerTopOffset )

Case 4: The most-bottom samples of the prediction block for ILP is outside the most bottom samples of the bounds.

yP + hPb - 1 > min( PicHeightInSamplesL -1, PicHeightInSamplesL - ScaledRefLayerBottomOffset - 1)

where, ( xP, yP ) indicates the top-left sample location of the prediction block relative to the top-left sample location of the resampled reference picture, ( wPb, hPb ) is the size ( width, height ) of the prediction block.

# Conclusion

This contribution proposes a modified signalling and restriction regarding scaled reference layer offsets. On the modified signalling, a present flag indicating whether to signal scaled reference layer offsets parameters is added, and a present flag for scaled reference layer offsets is added for each direct reference layer. On the restriction, a semantic restriction is proposed to restrict inter layer sample prediction outside or across the bounds specified by scaled reference layer offsets.

It is asserted that the signalling modification is beneficial to improve the coding efficiency and to simplify decoder implementation by removing additional boundary operation for scaled reference layer offsets. It is recommended to adopt the proposed method to the next SHVC draft.

# Reference

1. J. Chen, et.al, “SHVC Working Draft 2”, JCTVC-M1008, Incheon, KR, 18–26 Apr. 2013.

# Patent rights declaration(s)

**SHARP Corporation may have current or pending patent rights 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).**