JCTVC-L0178: Legacy base layer codec support in SHVC

Jill Boyce, Danny Hong, Wonkap Jang

Vidyo

Introduction

- **SVC uses single-loop codec design, precludes use of legacy base layer codec with an enhancement layer codec**

- **Current SHVC design uses multi-loop codec design**
  - In theory, legacy base layer codec could be used
  - Relevant for both AVC base layer and HEVC base layer

- **Problem identified when output cropping of base layer is used**
  - Mismatch may occur if decoded picture rather than cropped output picture is used for inter-layer picture

- **Propose to use cropped output reference layer picture for inter-layer prediction, with padding**
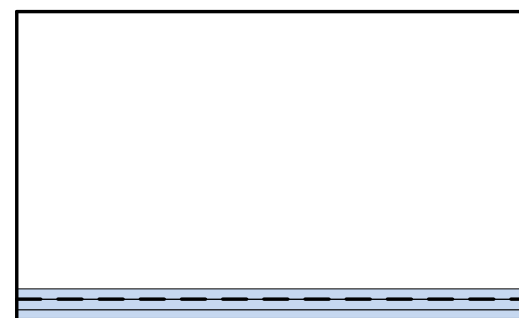
Problem Description Example

- Enhancement layer resolution 960x540

- Base layer resolution 480x270, coded as 480x272

- Legacy base layer decoder outputs 480x270 cropped output picture

- **Sample values in corresponding base layer CU in bottom row not available in cropped output picture**

  - Samples needed for multi-tap upsampling filter also not available
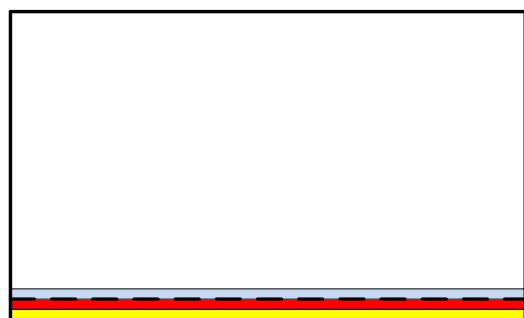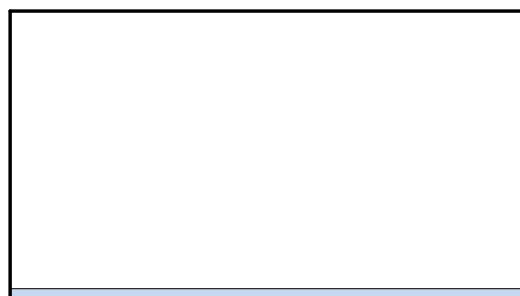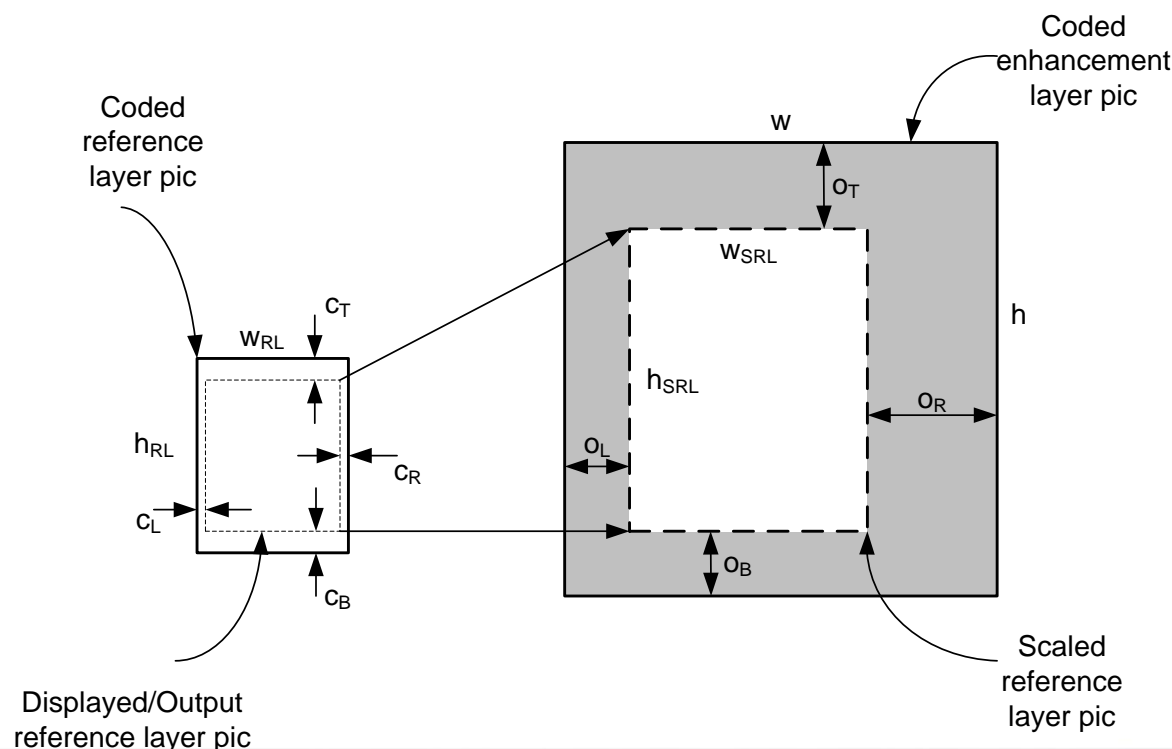

(a) (b) (c)

(a) Decoded base layer picture
(b) Cropped output base layer picture
(c) Cropped and padded base layer picture used for scaled reference

SVC Background

- **SVC syntax in SPS for offsets between corners between scaled reference layer and enhancement layer, for Region-of-Interest scalability**
  - Offset values may be either positive or negative
  - Scaled reference layer may be larger or smaller than the enhancement layer

Coded reference layer pic

Coded enhancement layer pic

w

c_T

w_{RL}

o_T

w_{SRL}

h

h_{RL}

h_{SRL}

o_R

c_R

o_L

c_L

c_B

o_B

Displayed/Output reference layer pic

Scaled reference layer pic

SVC Background

- **SVC has conditional inter-layer prediction syntax elements, based upon availability of corresponding MB in reference layer, using InCropWindow( ) function**
  - base_mode_flag, residual_prediction_flag, etc.

macroblock_layer_in_scalable_extension( ) {	C	Descriptor
if(InCropWindow(CurrMbAddr) && adaptive_base_mode_flag)		
base_mode_flag	2	u(1) | ae(v)
…		

if(adaptive_residual_prediction_flag && slice_type != EI &&
    (base_mode_flag ||
     (MbPartPredMode(mb_type, 0) != Intra_16x16 &&
     MbPartPredMode(mb_type, 0) != Intra_8x8 &&
     MbPartPredMode(mb_type, 0) != Intra_4x4 &&
     InCropWindow(CurrMbAddr))))		

residual_prediction_flag	2	u(1) | ae(v)
…		

Proposal

- **Motivation**
  - SHVC should allow for a legacy base layer codec without mismatch
  - SHVC should allow similar flexibility as SVC for ROI and offsets

- **Details**
  - Add syntax elements for scaled ref offsets in SPS, similar to SVC
  - Use output cropped reference layer picture for inter-layer prediction
  - Perform padding on output cropped reference layer picture
    - Use same method as used for motion vectors pointing outside reference picture
  - Do not introduce conditional syntax using function similar to SVC's InCropWindow( )
    - Consider <u>all</u> CUs to have available corresponding CU in reference layer, using padding when necessary
    - intra_bl_flag is only relevant inter-layer prediction syntax element in current design

Discussion

- **Advantages**
  - Simpler syntax and specification
  - Removes parsing dependency in decoder from calculations using offsets in SPS
  - Possible coding efficiency improvement by allowing inter-layer prediction for CUs with partially available corresponding samples in the reference layer
    - Gains may be offset by cost of signaling inter-layer syntax elements for CUs with no corresponding samples in the reference layer

- **Impact on SMuC and common test conditions**
  - Identified problem only relevant when output cropping of base layer used, e.g. resolution not divisible by 8, or lack of correspondence between layers, e.g. ROI
  - In common test conditions:
    - Only 1920x1080 enhancement resolution, 960x540 base resolution impacted
    - 960x540 coded as 960x544
  - Cropping and padding functionality already added to SMuC for AVC base layer, where legacy SVC software codec used

Conclusion

- **Recommend to use proposal when initial SHVC test model document is drafted**

- **Decoding process to be described in the test model, should include the following steps when describing the decoding of a current layer:**

  1. Decode the reference layer picture
  2. For each CU (or PU) in the current layer picture, when inter-layer prediction is indicated
     a) Find the corresponding CU in the cropped and padded scaled reference layer picture
     b) Use that corresponding CU for inter-layer prediction