

JCTVC-K0175:

On inter-layer prediction enabling/disabling  
for HEVC scalable extensions

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# Agenda

- Introduction
- Inter-layer Prediction and Temporal-layer Depth
- Consideration on Hybrid-codec Scalability and Inter-layer Prediction
- Conclusion

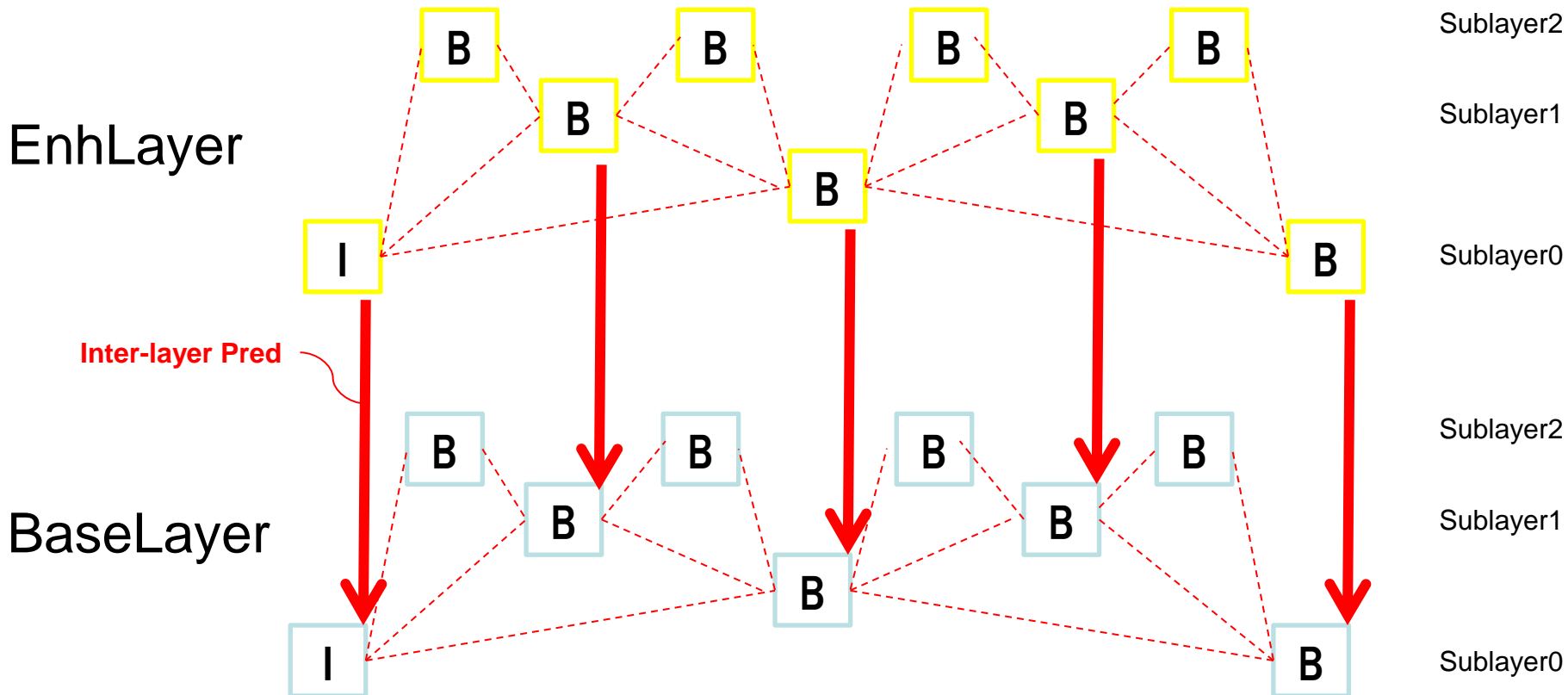
# Introduction

- This contribution discusses two topics related to inter-layer prediction in HEVC scalable extension:
  - Inter-layer Prediction and Temporal-layer Depth
  - Consideration on Hybrid-codec Scalability and Inter-layer Prediction

# Inter-layer Prediction and Temporal-layer Depth [1/]

- In HEVC scalable extension inter-layer prediction enabling/disabling will be associated with trade-off between coding efficiency and complexity.
  - It will improve coding efficiency but will cause increase in complexity.

# Inter-layer Prediction and Temporal-layer Depth [2/]



On lower sublayers, time distance b/w ref and cur pics are rather long and inter-frame prediction may not be effective. (More Intra CUs)  
In this case, inter-layer prediction will be helpful to improve coding efficiency.  
On higher sublayers, time distance b/w ref and cur pics are short and inter-layer prediction will not be helpful as inter-frame prediction works.

# Inter-layer Prediction and Temporal-layer Depth [3/]

Proposed Syntax for vps\_extension()  
based on Approach 1 in JCTVC-J1007

▪ vps_extension() { <sup>↵</sup>	Descriptor <sup>↵</sup>
▪ while( !byte_aligned() ) <sup>↵</sup>	<sup>↵</sup>
▪ vps_extension_byte_alignment_reserved_one_bit <sup>↵</sup>	u(1) <sup>↵</sup>
▪ //layer specific information <sup>↵</sup>	<sup>↵</sup>
▪ for(i = 1; i <= vps_max_layers_minus1; i++) { <sup>↵</sup>	<sup>↵</sup>
▪ //mapping of layer ID to scalability dimension IDs <sup>↵</sup>	<sup>↵</sup>
▪ num_dimensions_minus1[ i ] <sup>↵</sup>	u(4) <sup>↵</sup>
▪ for(j = 0; j <= num_dimensions_minus1; j++) { <sup>↵</sup>	<sup>↵</sup>
▪ dimension_type[ i ][ j ] <sup>↵</sup>	u(4) <sup>↵</sup>
▪ dimension_id[ i ][ j ] <sup>↵</sup>	u(8) <sup>↵</sup>
▪ } <sup>↵</sup>	<sup>↵</sup>
▪ //layer dependency <sup>↵</sup>	<sup>↵</sup>
▪ num_direct_ref_layers[ i ] <sup>↵</sup>	u(6) <sup>↵</sup>
▪ for(j = 0; j < num_direct_ref_layers[ i ]; j++) { <sup>↵</sup>	<sup>↵</sup>
▪ ref_layer_id[ i ][ j ] <sup>↵</sup>	u(6) <sup>↵</sup>
▪ max_sub_ref_layer[ i ][ j ] <sup>↵</sup>	u(6) <sup>↵</sup>
▪ } <sup>↵</sup>	<sup>↵</sup>
▪ } <sup>↵</sup>	<sup>↵</sup>
▪ } <sup>↵</sup>	<sup>↵</sup>

# Inter-layer Prediction and Temporal-layer Depth [4/]

Proposed Syntax for vps\_extension()  
 based on Approach 2 in JCTVC-J1007

<code>vps_extension() {</code>	Descriptor
<code>while( !byte_aligned() )</code>	
<code>    vps_extension_byte_alignment_reserved_one_bit</code>	<code>u(1)</code>
<code>    // scalability type and layer_id partitioning method</code>	
<code>    scalability_type</code>	<code>u(4)</code>
<code>    for( i = 0; i &lt; MaxDim( scalability_type ); i++ )</code>	
<code>        layer_id_dim_len[ i ]</code>	<code>u(3)</code>
<code>    // layer specific information</code>	
<code>    for( i = 0; i &lt;= max_num_layers_minus1; i++ ) {</code>	
<code>        vps_layer_id[ i ]</code>	<code>u(6)</code>
<code>        // layer dependency</code>	
<code>        num_direct_ref_layers[ i ]</code>	<code>u(6)</code>
<code>        for( j = 0; j &lt; num_direct_ref_layers[ i ]; j++ ) {</code>	
<code>            ref_layer_id[ i ][ j ]</code>	<code>u(6)</code>
<code>            max_sub_ref_layer[ i ][ j ]</code>	<code>u(6)</code>
<code>        }</code>	
<code>    }</code>	
<code>}</code>	

# Inter-layer Prediction and Temporal-layer Depth [5/]

- Proposed Semantics for vps\_extension()
  - max\_sub\_ref\_layer[i][j] specifies max temporal layer where inter-layer prediction be applied for scalable extensions. Its value shall be in the range of 0 to vps\_max\_sub\_layers\_minus1+1 inclusive.



# Inter-layer Prediction and Temporal-layer Depth [6/]

## Proposed Syntax for nal\_unit

<code>nal_unit(NumBytesInNALunit) {</code>	<b>Descriptor</b>
<code>  nal_unit_header()</code>	
<code>  if(nal_unit_type == SPS_NAL_UNIT)</code>	
<code>    <b>max_sub_ref_layer</b></code>	<b>u(6)</b>
<code>  NumBytesInRBSP = 0</code>	
<code>  for(i = 2; i &lt; NumBytesInNALunit; i++) {</code>	
<code>    if( i + 2 &lt; NumBytesInNALunit &amp;&amp; next_bits( 24 ) == 0x000003 ) {</code>	
<code>      rbsp_byte[ NumBytesInRBSP++ ]</code>	<b>b(8)</b>
<code>      rbsp_byte[ NumBytesInRBSP++ ]</code>	<b>b(8)</b>
<code>      i += 2</code>	
<code>      <b>emulation_prevention_three_byte</b> /* equal to 0x03 */</code>	<b>f(8)</b>
<code>    } else</code>	
<code>      rbsp_byte[ NumBytesInRBSP++ ]</code>	<b>b(8)</b>
<code>  }</code>	
<code>}</code>	

# Inter-layer Prediction and Temporal-layer Depth [7/]

- Proposed semantics for nal\_unit
  - max\_sub\_ref\_layer specifies max temporal layer where inter-layer prediction be applied for scalable extensions. Its value shall be in the range of 0 to vps\_max\_sub\_layers\_minus1+1 inclusive. If a sequence is a base-layer stream, its value should be 0.

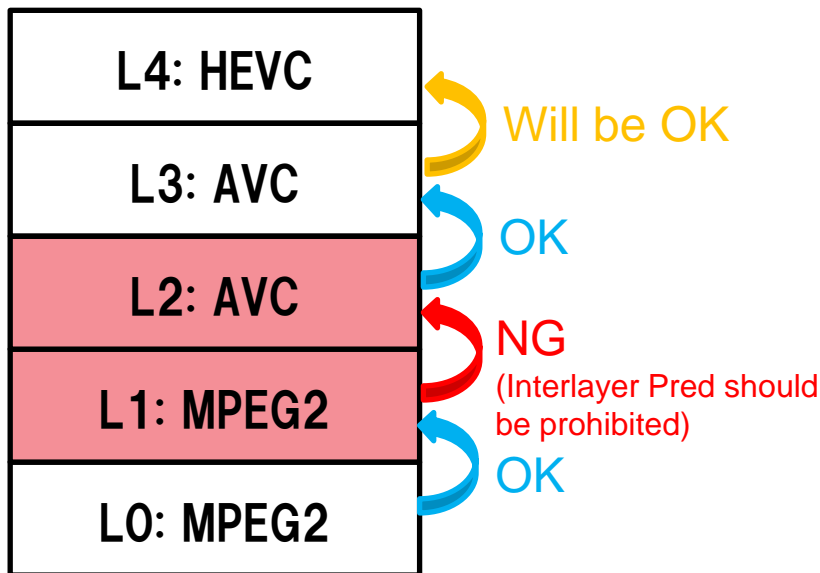
# Consideration on Codec-hybrid Scalability [1/]

- In the CfP document of HEVC scalable extensions, experiment of codec standard scalability (Base-layer: AVC, Enhancement-layer: HEVC) is included as an option.
- In addition, it is proposed by the proposal m25749 that MPEG2-HEVC scalability be supported with BLR (Base-Layer Reconstructed Pixel).
- It would be possible that proprietary codec be also included in hybrid-codec scalable bitstreams.
- It is assumed that HEVC version 2 will have flexibility that any layer can be any codec\_type.

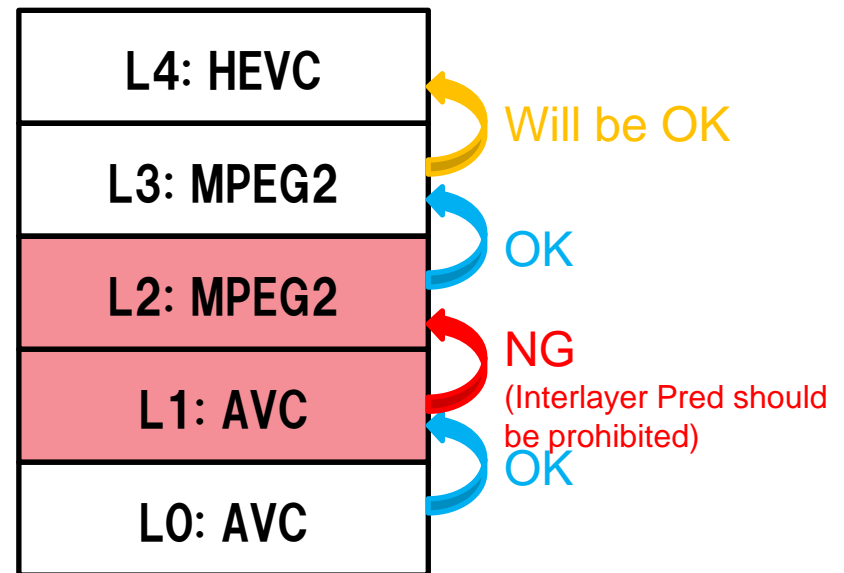
# Consideration on Codec-hybrid Scalability [2/]

With examples below,  $L(n-1)$  is a reference layer of  $L(n)$

Ex 1.



Ex 2.



# Consideration on Codec-hybrid Scalability [3/]

- It is proposed to add constraint for inter-layer prediction:
  - Either of the following conditions shall be satisfied:
    - (a) Codec\_type of upper-layer is same as the one of lower layer**
    - (b) Codec\_type of upper-layer is HEVC**
  - If a proprietary codec supports scalability, either (a) or (b) shall be satisfied
  - If a proprietary codec does not support scalability (b) shall be satisfied.

# Conclusion

- This contribution discusses two topics related to inter-layer prediction in HEVC scalable extension:
  - Inter-layer Prediction and Temporal-layer Depth
  - Consideration on Hybrid-codec Scalability and Inter-layer Prediction
- It is recommended these topics be studied in HEVC version2 standardization activities.



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