

JCTVC-M0151:  
AHG9: Inter-layer Prediction Signaling

Kazushi.Sato@jp.sony.com  
peter.chuang@mediatek.com

# Agenda

- Introduction / Problem Statement
- Inter-layer Texture Prediction
- Inter-layer Syntax Prediction
  - Proposal -1
  - Proposal -2
- Conclusion

# Introduction / Problem Statement [1/]

- In SHVC draft text (JCTVC-L1008), dependency between layers is specified in `vps_extension()`.
  - It is a sequence-level specification.
  - However enabling/disabling of inter-layer prediction specification at picture-level or slice-level will help providing trade-off between coding efficiency and complexity, or error resiliency.
    - **For example, a certain implementation will be based on multi-loop scalability while other will be based on single-loop scalability, depending on memory bandwidth capabilities.**
- Moreover, separation of signalling of on/off with inter-layer texture and syntax prediction will also be helpful for efficiency-complexity trade-off.
  - inter-layer texture prediction requires more storage size than syntax prediction.

# Introduction / Problem Statement [2/]

- Related Contributions in the Past JCTVC Meetings
  - Proposals for signaling inter-layer prediction associated with temporal hierarchy: JCTVC-K0175, JCTVC-K0264, JCTVC-L0258, JCTVC-L0278 and JCTVC-L0449
    - **Single-loop scalability can be regarded as the special case of these proposals: JCTVC-L0111 and JCTVC-L0154**
    - **Additionally JCTVC-L0258 proposed to signal enabling/disabling of inter-layer prediction at the slice header.**
  - Separation of signaling inter-layer texture and syntax prediction: JCTVC-L0071, JCTVC-L0278
    - **Motion vector coding is the only syntax element for inter-layer syntax prediction: JCTVC-L1008**
    - **Inter-layer syntax predictions of other syntax elements have been proposed as follow:**
      - Intra-mode coding: JCTVC-L1101
      - Residue signal: JCTVC-L1103
      - Slice header syntax: JCTVC-L0231
      - Single-loop scalability (JCTVC-L0154) also contains inter-layer syntax prediction

# Inter-layer Texture Prediction

- This contribution proposes that inter-layer texture prediction be specified as follows, like RPS in HEVC version 1:
  - Default setting be specified at GOP-level, associated with temporal hierarchy, and
  - it can be override at the slice header

	Descriptor
<code>vps_extension ( ) {</code>	
<code>...</code>	
<code>for ( i = 1; i&lt;= vps_max_layers_minus1; i++ ) {</code>	
<code>  // layer dependency</code>	
<code>  for ( j = 0; j &lt;i; j++ )</code>	
<code>    direct_dependency_flag [ i ] [ j ]</code>	<code>u (1)</code>
<code>  }</code>	
<code>for ( i = 0; i&lt;= vps_max_layers_minus1; i++ ) {</code>	
<code>  vps_max_sublayer_for_inter_layer_texture_prediction [ i ]</code>	<code>u (3)</code>
<code>  }</code>	
<code>}</code>	

**vps\_max\_sublayer\_for\_inter\_layer\_texture\_prediction** specifies max\_sublayer where inter-layer texture prediction is enabled. If the temporalId of the current picture is smaller than or equal to vps\_max\_sublayer\_for\_inter\_layer\_texture\_prediction, inter-layer texture prediction is enabled. Otherwise inter-layer texture prediction is disabled. When not specified its value is inferred to be equal to vps\_max\_sub\_layers\_minus1.

slice_segment_header ( ) {	Descriptor
...	
if ( layer_id >0 && tepmpralld < vps_max_sublayer_for_inter_layer_texture_prediction [layer_id] - 1 )	
slice_inter_layer_texture_prediction_flag	u(1)
...	
}	

**slice\_inter\_layer\_texture\_prediction\_flag** is equal to 1 indicates that inter-layer texture prediction is enabled for the current slice.  
 slice\_inter\_texture\_prediction\_flag is equal to 0 indicates that inter-layer is disabled for the current slice. When not specified its value is inferred to be equal to 1 if temporalId < vps\_max\_sublayer\_for\_inter\_layer\_texture\_prediction[layer\_id] and 0 otherwise.

## Inter-layer Syntax Prediction –Proposal 1

- Motion vector information is the only syntax element for inter-layer prediction in current SHM.
- In this case it is proposed to add syntax elements “sps\_colblmv\_mvp\_enabled\_flag” and “slice\_colbl\_mvp\_enabled\_flag”.
- It is proposed by JCTVC-L0073 and L0221 that tmvp is disabled at the enhancement layer, if co-located base-layer motion information is available.
  - This can be realised by setting temporal\_mvp\_enabled\_flag as 0 and colbl\_mvp\_enabled\_flag as 1.

seq_parameter_set_rbsp ( ) {	Descriptor
...	
sps_temporal_mvp_enabled_flag	u(1)
if ( layer_id > 0 )	
sps_colbl_mvp_enabled_flag	u(1)
...	
}	

**sps\_colbl\_mvp\_enabled\_flag** equals to 1 specifies that slice\_colbl\_mvp\_enabled\_flag is present in the slice headers of non-IDR pictures in the CVS.

sps\_colbl\_mvp\_enabled\_flag equals to 0 specifies that slice\_colbl\_mvp\_flag is not present in slice headers and that collocated base layer motion vector predictors are not used in the CVS.

slice_segment_header ( ) {	Descriptor
...	
if ( sps_temporal_mvp_enabled_flag )	
slice_temporal_mvp_enabled_flag	u (1)
if ( layer_id > 0 && sps_colblmv_mvp_enabled_flag )	
slice_colbl_mvp_enabled_flag	u (1)
...	
}	

**slice\_colbl\_mvp\_enabled\_flag** specifies whether collocated base layer motion vector prediction can be used for inter prediction. If slice\_colbl\_mvp\_enabled\_flag is equal to 0, the syntax elements of the current picture shall be constrained such that no collocated base layer motion vector predictor is used in decoding of the current picture. Otherwise (slice\_colbl\_mvp\_enabled\_flag is equal to 1), collocated base layer motion vector predictor may be used in decoding of the current picture. When not present the value of slice\_colbl\_mvp\_enabled\_flag is inferred to be equal to 0.

## Inter-layer Syntax Prediction –Proposal 2

- However inter-layer predictions of other syntax elements have been proposed as follows:
  - Intra-mode coding: JCTVC-L1101
  - Residue signal: JCTVC-L1103
  - Slice header syntax: JCTVC-L0231
- A proposal on single-loop scalability, JCTVC-L0154, also contains inter-layer syntax prediction as intra-mode coding, motion vector coding and base-layer residuals.
- If these inter-layer syntax predictions are adopted, it will be useful to signal enabling/disabling of inter-layer syntax prediction as follows, proposed by JCTVC-L0071.
- Or it is possible that inter-layer syntax prediction be specified associated with temporal hierarchy and be override at the slice header, similarity with the syntax proposed for inter-layer texture prediction in this contribution.

pic_parameter_set_rbsp ( ) {	Descriptor
...	
pps_extension_flag	u(1)
if ( pps_extension_flag ) {	
if ( layer_id > 0 )	
pps_inter_layer_syntax_prediction_flag	u(1)
while ( more_rbsp_data ( ) )	
pps_extension_data_flag	u(1)
}	

**pps\_inter\_layer\_syntax\_prediction\_flag** is equal to 1 indicates that inter-layer syntax prediction is enabled for the current picture. pps\_inter\_layer\_syntax\_prediction\_flag is equal to 0 indicates that inter-layer syntax prediction is disabled for the current picture. When not present its value is inferred to be equal to 0.

slice_segment_header ( ) {	Descriptor
...	
if (layer_id > 0 && pps_inter_layer_syntax_pred_flag)	
slice_header_inter_layer_syntax_prediction_flag	u(1)
...	
}	

**slice\_header\_inter\_layer\_syntax\_prediction\_flag** is equal to 1 indicates that inter-layer syntax prediction is enabled for the current slice. slice\_header\_inter\_layer\_syntax\_prediction\_flag is equal to 0 indicates that inter-layer syntax prediction is disabled for the current slice. When not present its value is inferred to be equal to pps\_inter\_layer\_syntax\_prediction\_flag.

# Conclusion

- In this contribution syntax for signalling inter-layer texture and syntax prediction is proposed as:
  - Indication of inter-layer texture prediction and syntax prediction be signalled separately;
  - Inter-layer texture (and syntax) prediction be signalled in terms of temporal hierarchy at VPS and can be override at the slice header;
- It is recommended that the proposed changes in syntax elements be considered for adoption with other related proposals.
- MediaTek and Sony will volunteer integrating the proposed syntax into SHM.