



JCTVC-N0282

MV-HEVC/SHVC HLS: On Handling Alternative Filtered Inter-Layer References

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Overall Summary

- Alternative filtered inter-layer reference pictures (IL-ref-pic)
 - SCE3 coding tools with alternative inter-layer filters
 - More than one filtered IL-ref-pic from same layer (PU-switching)
 - Proper support of such functionality: syntax, RPS, default ref List temp
- Support of alternative filtered IL-ref-pic
 - Syntax, semantics
 - Decoding process: RPS, default ref List temp

Design Considerations

- Follow closely the design principle of handling IL-ref-pic in the current spec (JCTVC-M1008).
- VPS: High-level control specified, indicating which (if any) layers of the IL-ref-pic may utilize alternative filtering.
- Slide header: Slice-level refinement of the management of filtered IL-ref-pic for the construction of inter-layer RPS.
- Given modified RPS which copes the additional filtered IL-ref-pic, initialization of the default reference List 0 temp and List 1 temp are modified.

VPS extension syntax and semantics (1)

- High-level control

vps_extension() {	Descriptor
...	
max_one_active_ref_layer_flag	u(1)
filtered_inter_layer_ref_present_flag	u(1)
direct_dep_type_len_minus2	ue(v)
for(i = 1; i <= vps_max_layers_minus1; i++)	
for(j = 0; j < i; j++)	
if(direct_dependency_flag[i][j]) {	
direct_dependency_type[i][j]	u(v)
if(filtered_inter_layer_ref_present_flag)	
direct_dependency_filtered_flag[i][j]	u(1)
}	
single_layer_for_non_irap_flag	u(1)
}	

filtered_inter_layer_ref_present_flag equal to 1 specifies that there is at least one direct reference layer in which alternative filtered inter-layer reference picture is used for inter-layer prediction. This is a present flag to indicate the existence of the corresponding syntax and decoding process for filtered inter-layer reference pictures. **filtered_inter_layer_ref_present_flag** equal to 0 indicates that there is no filtered direct reference layer.

direct_dependency_filtered_flag[i][j] equal to 0 specifies that there is no alternative filtered version of the layer with index j to be used as a direct reference layer for the layer with index i.

direct_dependency_filtered_flag[i][j] equal to 1 specifies that an alternative filtered version of the layer with index j may be a direct reference layer for the layer with index i. When **direct_dependency_filtered_flag[i][j]** is not present for i and j in the range of 0 to vps_max_layers_minus1, it is inferred to be equal to 0.

VPS extension syntax and semantics (2)

F.7.4.3.1.1 Video parameter set extension semantics

The variables NumSamplePredRefLayers[i], NumMotionPredRefLayers[i], SamplePredEnabledFlag[i][j], MotionPredEnabledFlag[i][j], NumDirectRefLayers[i], DirectRefLayerIdx[i][j], RefLayerId[i][j], RefLayerIdFiltFlag[i][j], MotionPredRefLayerId[i][j], and SamplePredRefLayerId[i][j] are derived as follows:

```

for( i = 0; i < 64; i++ ) {
    NumSamplePredRefLayers[ i ] = 0
    NumMotionPredRefLayers[ i ] = 0
    NumDirectRefLayers[ i ] = 0
    for( j = 0; j < 64; j++ ) {
        SamplePredEnabledFlag[ i ][ j ] = 0
        MotionPredEnabledFlag[ i ][ j ] = 0
        RefLayerId[ i ][ j ] = 0
        RefLayerIdFiltFlag[ i ][ j ] = 0
        SamplePredRefLayerId[ i ][ j ] = 0
        MotionPredRefLayerId[ i ][ j ] = 0
    }
}

for( i = 1; i <= vps_max_layers_minus1; i++ ) {
    iNuhLid = layer_id_in_nuh[ i ]
    for( j = 0; j < i; j++ ) {
        if( direct_dependency_flag[ i ][ j ] ) {
            DirectRefLayerIdx[ iNuhLid ][ layer_id_in_nuh[ j ] ] = NumDirectRefLayers[ iNuhLid ]
            RefLayerId[ iNuhLid ][ NumDirectRefLayers[ iNuhLid ]++ ] = layer_id_in_nuh[ j ]
            RefLayerIdFiltFlag[ iNuhLid ][ NumDirectRefLayers[ iNuhLid ] ] = direct_dependency_filtered_flag[i][j]
            SamplePredEnabledFlag[ iNuhLid ][ j ] = ( ( direct_dependency_type[ i ][ j ] + 1 ) & 1 )
            NumSamplePredRefLayers[ iNuhLid ] += SamplePredEnabledFlag[ iNuhLid ][ j ]
            MotionPredEnabledFlag[ iNuhLid ][ j ] = ( ( ( direct_dependency_type[ i ][ j ] + 1 ) & 2 ) >> 1 )
            NumMotionPredRefLayers[ iNuhLid ] += MotionPredEnabledFlag[ iNuhLid ][ j ]
        }
    }
}

```

General slice segment header semantics

G.7.4.7.1 General slice segment header semantics

The variables `RefPicLayerId[i]` and flags `RefPicLayerIdFiltFlag[i]` of for each value of `i` in the range of 0 to `NumActiveRefLayerPics - 1`, inclusive, `NumActiveMotionPredRefLayers`, and `ActiveMotionPredRefLayerId[j]` for each value of `j` in the range of 0 to `NumActiveMotionPredRefLayers - 1`, inclusive, are derived as follows:

```
for( i = 0, j = 0; i < NumActiveRefLayerPics; i++)
    RefPicLayerId[ i ] = RefLayerId[ nuh_layer_id ][ inter_layer_pred_layer_idc[ i ] ]
    RefPicLayerIdFiltFlag[ i ] = RefLayerIdFiltFlag[ nuh_layer_id ][ inter_layer_pred_layer_idc[ i ] ]
    if( MotionPredEnabledFlag[ nuh_layer_id ][ inter_layer_pred_layer_idc[ i ] ] )
        ActiveMotionPredRefLayerId[ j++ ] =
        RefLayerId[ nuh_layer_id ][ inter_layer_pred_layer_idc[ i ] ]
    }
NumActiveMotionPredRefLayers = j
```

All slices of a picture shall have the same value of `inter_layer_pred_layer_idc[i]` for each value of `i` in the range of 0 to `NumActiveRefLayerPics - 1`, inclusive.

- For each inter-layer reference picture specified by `RefPicLayerId[i]`, a corresponding flag `RefPicLayerIdFiltFlag[i]` is derived from `RefLayerIdFiltFlag` to indicate whether an alternative filtered version of the inter-layer reference picture specified by `RefPicLayerId[i]` is used.

RPS and Ref Pic Lists – Method 1

- New RPS, RefPicSetInterLayerFiltered to accommodate alternative filtered IL-ref-pic

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

```

....
Initialize k = 0.
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 G.8.1.4 with picX and
        DirectRefLayerIdx[ currLayerId ][ RefPicLayerId[ i ] ] given as inputs
        RefPicSetInterLayer[ i ] = rsPic
        RefPicSetInterLayer[ i ] is marked as "used for long-term reference"
        if (RefPicLayerIdFiltFlag[i]) {
            RefPicSetInterLayerFiltered [ k ] = rsPic_filtered (derived by invoking the "filtering process")
            RefPicSetInterLayerFiltered [ k ] is marked as "used for long-term reference"
            k++
        }
    } else
        RefPicSetInterLayer[ i ] = "no reference picture"
}
NumActiveRefLayerPicsFilt = k

```

One possible way of Ref Pic List initialization:

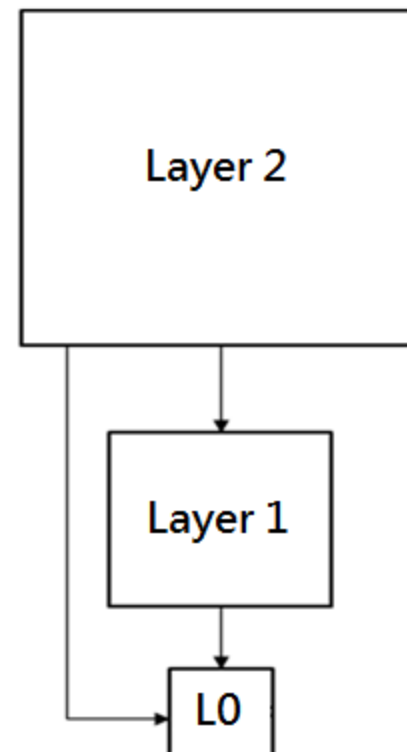
- RefPicListTemp0: RPS Temporal (before/after/long) + **RefPicSetInterLayerFilt** + RefPicSetInterLayer
- RefPicListTemp1: RPS Temporal (after/before/long) + RefPicSetInterLayer + **RefPicSetInterLayerFilt**

RPS and Ref Pic Lists – Method 1

- New RPS, RefPicSetInterLayerFiltered to accommodate alternative filtered IL-ref-pic

One possible way of Red Pic List initialization:

- RefPicListTemp0: RPS Temporal (before/after/long) + **RefPicSetInterLayerFilt** + RefPicSetInterLayer
 - RefPicListTemp1: RPS Temporal (after/before/long) + RefPicSetInterLayer + **RefPicSetInterLayerFilt**
 - If multiple filtered IL-ref-pics
 - L0temp: Filtered Layer 1, Filtered Layer 0, Layer 1, Layer 0
 - L1temp: Layer 1, Layer 0, Filtered Layer 1, Filtered Layer 0
- RPLM syntax needed if we want ordering layer-by-layer:
- Filtered Layer 1, Layer 1, Filtered Layer 0, Layer 0



RPS and Ref Pic Lists – Method 2

- RefPicSetInterLayer to accommodate both alternative filtered conventional IL-ref-pic

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

....

Initialize k = 0.

```

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 G.8.1.4 with picX and
        DirectRefLayerIdx[ currLayerId ][ RefPicLayerId[ i ] ] given as inputs
        RefPicSetInterLayer[ k ] = rsPic
        RefPicSetInterLayer[ k ] is marked as "used for long-term reference"
        k++
        if (RefPicLayerIdFiltFlag[i]) {
            RefPicSetInterLayer [ k ] = rsPic_filtered
            RefPicSetInterLayer [ k ] is marked as "used for long-term reference"
            k++
        }
    } else
        RefPicSetInterLayer[ k ] = "no reference picture"
}
NumActiveRefLayerPicsAddFilt = k

```

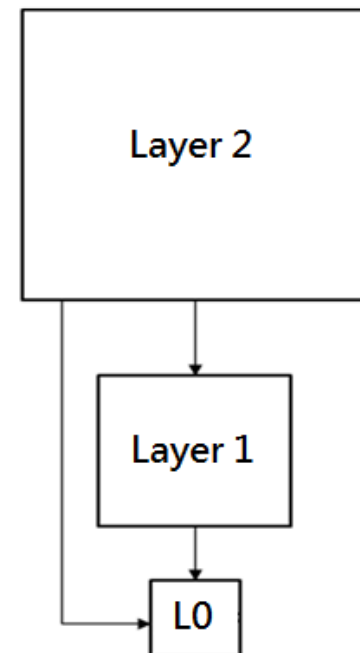
- As above, in RPS-IL, alternative filtered IL-ref-pic is put after the corresponding conventional one (can also be put before the corresponding non-filtered one)

RPS and Ref Pic Lists – Method 2

- RefPicSetInterLayer to accommodate both alternative filtered conventional IL-ref-pic

One possible way of Ref Pic List initialization:

- RefPicListTemp0: RPS Temporal (before/after/long) + RefPicSetInterLayer
- RefPicListTemp1: RPS Temporal (after/before/long) + RefPicSetInterLayer
- If multiple filtered IL-ref-pics
 - Same RPS-IL for both default RefPicListTemp0 and 1
 - RefPicSetInterLayer: Layer 1, Filtered Layer 1, Layer 0, Filtered Layer 0





Thank You

