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| *Title:* | **MV-HEVC/SHVC HLS: Additional layer set** | | |
| *Status:* | Input Document to JCT-VC and JCT-3V | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution presents an additional layer set definition. In the current spec, layer sets are defined by a syntax layer\_id\_included\_flag in VPS. There more number of layers, more bits is needed. Considering subset dependency structure in SHVC and arranged many views in MV-HEVC, the layer sets tend to have similar structure. Thus, the layer set can be defined by a represent layer named key layer. This contribution proposes an additional layer set indication by key layer concept.

# Introduction

In the current spec, layer sets are specified as shown Table 1 and the number of bits for a layer set increases when the number of layer increases. The bits amount of layer set is M x N (where M is the number of layer and N is the number of layer set).

Table 1 Layer set specification in VPS

|  |  |
| --- | --- |
| video\_parameter\_set\_rbsp( ) { | Descriptor |
|  |  |
| **vps\_num\_layer\_sets\_minus1** | ue(v) |
| for( i = 1; i <= vps\_num\_layer\_sets\_minus1; i++ ) |  |
| for( j = 0; j <= vps\_max\_layer\_id; j++ ) |  |
| **layer\_id\_included\_flag**[ i ][ j ] | u(1) |

In MV-HEVC, to achieve selected view decoding and playing, layer set which represents one view needs to be defined. In this case, when the number of view is 64 (8x8 camera), the number of layer sets is also 64 (As shown Fig 1).

And if we want to get a free view point by generating a synthesis view, whose view position is between coded two view positions, it is needed to decode two views neighbouring the required view position, to synthesis the view. For this application, a pair of views should be defined as layer set. In the above case (8x8 camera), the number of layer set for pairs is 56 (As shown Fig 2).

In the above assumption, the number of bytes accounts for 952 bytes in total. Considering these layer sets are very structural, where each layer set contains one representing layer (key layer ) and may contain one other layer (accompanying layer), the layer set is thought to be defined with key layer and bits amount can be reduced.



Figure 1 Layer sets representing one view (64 layer sets)



Figure 2 Layer sets representing pair views (56 layer sets)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Number of bits per layer set | Number of layer sets | Bytes |
| Layer sets for one view | 64 | 63 | 504 |
| Layer sets for pair views | 64 | 56 | 448 |

# Proposal

**Additional layer set**

Define additional layer set which includes a signalled layer (key layer) and its direct and indirect layer. The signalled layer is signalled by add\_layer\_set\_defined\_flag[ j ] and only 1 bit per layer set is needed.

To generate layer sets for pair view, accompanying layer is defined for each key layer. (If key layer is specified by j, accompanying layer is specified by j – 1).

For this purpose, a variable named accompanying\_layer\_flag is utilized. It accompanying\_layer\_flag is equal to 1, accompanying layer specified by j minus 1 and its dependent layers are also included in the layer set as well as key layer and its dependent layers.

Text change by the proposal is highlighted with green

|  |  |
| --- | --- |
| vps\_extension( ) { | Descriptor |
| for (i = 0; i < 2; i++) { |  |
| accompanying\_layer\_flag = i |  |
| **additional\_layer\_set\_present\_flag[ i ]** | u(1) |
| if (additional\_layer\_set\_present\_flag [ i ] ) { |  |
| for( j = 1; j <= vps\_max\_layer\_id; j++ ) |  |
| **add\_layer\_set\_defined\_flag [ i ][ j ]** | u(1) |
| } |  |
| } |  |
| } |  |
| NumOutputLayerSets = vps\_number\_layer\_sets\_minus1 + 1 + NumAdditionalLayerSets |  |
| **more\_output\_layer\_sets\_than\_default\_flag** | u(1) |
| if( more\_output\_layer\_sets\_than\_default\_flag ) { |  |
| **num\_add\_output\_layer\_sets\_minus1** | u(10) |
| NumOutputLayerSets += num\_add\_output\_layer\_sets\_minus1 + 1 |  |
| } |  |
| if( NumOutputLayerSets > 1 ) |  |
| **default\_one\_target\_output\_layer\_idc** | u(2) |
| for( i = 1; i < NumOutputLayerSets; i++ ) { |  |
| if( i > vps\_number\_layer\_sets\_minus1+ NumAdditionalLayerSets) { |  |
| **output\_layer\_set\_idx\_minus1**[ i ] | u(v) |
| lsIdx = output\_layer\_set\_idx\_minus1[ i ] + 1 |  |
| for( j = 0 ; j < NumLayersInIdList[ lsIdx ] − 1; j++) |  |
| **output\_layer\_flag**[ i ][ j ] | u(1) |
| } |  |
| **profile\_level\_tier\_idx**[ i ] | u(v) |
| } |  |

**vps\_number\_layer\_sets\_minus1** plus 1 specifies the number of layer sets that are specified by the VPS. The value of vps\_number\_layer\_sets\_minus1 shall be in the range of 0 to 1023, inclusive, and shall be equal to vps\_num\_layer\_sets\_minus1.

It is a requirement of bitstream conformance that NumOutputLayerSets is in the range of 1 to 1024

**additional\_layer\_set\_present\_flag**[ i ] specifies that whether additional layer sets are specified.

**add\_layer\_set\_defined\_flag**[ i ][ j ] specifies that whether an additional layer set is specified by a layer with index equal to j in the layer identifier list layerSetLayerIdList[ i + vps\_num\_layer\_sets\_minus1+1].

The layer set list layerSetLayerIdList is modified and the variable numLayersInList and the number of additional layer set NumAdditionalLayerSet is derived as follows.

　 a variable layerSetId is set equal to vps\_number\_layer\_sets\_minus1 + 1 For i for 0 and 1; if additional\_layer\_set\_present\_flag[ i ] is equal to 1, the following applies

For j for 1..vps\_max\_layer\_id; the following applies

If add\_layer\_set\_defined\_flag[ i ][ j ] is equal to 1, the layer A specified by j and direct and indirect dependent layer A are included in the layerSetLayerIdList[layerSetId] and layerSetId is increased by 1 and if i is equal to 1, the layer B specified by j - 1 and direct and indirect dependent layer B are included in the layerSetLayerIdList[layerSetId] as follows:

layerIdA = j

layerIdB = i > 0 ? j -1 : -1

numLayersInList[layerSetId] = 0

　 for (k = 0; k <= vps\_max\_layer\_id; k++) {

　　 if (k == layerIdA) {

　　 　 layerSetLayerIdList[layerSetId][numLayersInList[layerSetId]] = layerIdA

　　 　 numLayersInList[layerSetId] += 1

　　 else if (k == layerIdB) {

　　　 layerSetLayerIdList[layerSetId][numLayersInList[layerSetId]] = layerIdB

　　　 numLayersInList[layerSetId] += 1

　　 } else if (recursiveRefLayerFlag[layerIdA][k] || (layerIdB >= 0 &&

recursiveRefLayerFlag[layerIdB][k]) ) {

　　　 layerSetLayerIdList[layerSetId][numLayersInList[layerSetId]] = k

　　　 numLayersInList[layerSetId] += 1

　　 }

}

layerSetId += 1

NumAdditionalLayerSet is set equal to layerSetId – (vps\_number\_layer\_sets\_minus1 + 1)

# Conclusion

The contribution proposes an additional layer set definition. Because the proposed additional layer set is beneficial in many layer cases, it is recommended to adopt these proposals in SHVC and MV-HEVC.

# 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).**