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| *Title:* | **Proposal to Video Parameter Set and its Extension** | | |
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| *Purpose:* | Proposal | | |
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# Abstract

In the last meeting, a reserved\_zero\_6bits element in the NAL unit header is reserved to indicate scalable layers of a bitstream of the extension spec. Also, two initial approaches for describing scalable layers in VPS extension are provided in JCTVC-J1007. In this contribution, some changes and new syntax for VPS and its extension are proposed. A summary of proposed items is as follows.

1. Signaling in VPS an option that reserved\_zero\_6bits of NAL unit header can be used as priority\_id
2. Introduction of default dependency and specific dependency, where only the specific dependency between scalable layers are described in detail in VPS extension.
3. Harmonization of the two existing designs by using dimension\_type element in both solutions.
4. Two new scalability dimension types: priority dimension and region-of-interest (or special region) dimension.

(Note: this revision simplifies the syntax for describing default dependency)

# Introduction

In the last meeting, a reserved\_zero\_6bits element is reserved in the NAL unit header to indicate scalable layers of a bitstream of the extension spec [1]. Also, two initial approaches for representing scalable layers are provided in JCTVC-J1007 [2]. In this contribution, some improvements and modifications to the Video parameter set of the High Efficiency Video Coding (HEVC) text specification draft version 8 [1] and the base-line approaches of JCTVC-J1007 [2] are proposed to improve the operation of bitstream extraction. The list of proposed items includes:

* Usage of reserved\_zero\_6bits in NAL unit header as priority\_id
* Introduction of default dependency and specific dependency
* Harmonization of scalable dimension descriptions
* New scalability dimensions: priority dimension and region-of-interest (or special region) dimension.

In the following Section, the detailed description of each proposed item is provided.

# Proposal

## Use of priority\_id in NAL unit header

Currently, the reserved\_zero\_6bits element of the NAL unit header is planned to be used to indicate scalable layers of a bitstream. We propose that these bits (or part of them) could be used as priority\_id in SVC specification [3]. With this usage, a bitstream can be manipulated in a very cost-effective manner.

The following priority\_flag is added to VPS to signal this purpose.

|  |  |
| --- | --- |
| video\_parameter\_set\_rbsp( ) { | Descriptor |
| **video\_parameter\_set\_id** | u(4) |
| **vps\_temporal\_id\_nesting\_flag** | u(1) |
| **reserved\_zero\_2bits** | u(2) |
| **reserved\_zero\_6bits** | u(6) |
| **vps\_max\_sub\_layers\_minus1** | u(3) |
| **priority\_flag** | u(1) |
| profile\_level( 1, vps\_max\_sub\_layers\_minus1 ) |  |
| **reserved\_zero\_12bits** | u(12) |
| for( i = 0; i <= vps\_max\_sub\_layers\_minus1; i++ ) { |  |
| **vps\_max\_dec\_pic\_buffering[** i **]** | ue(v) |
| **vps\_max\_num\_reorder\_pics[** i **]** | ue(v) |
| **vps\_max\_latency\_increase[** i **]** | ue(v) |
| } |  |
| **num\_hrd\_parameters** | ue(v) |
| for( i = 0; i < num\_hrd\_parameters; i++ ) { |  |
| if( i > 0 ) |  |
| op\_point( i ) |  |
| hrd\_parameters( i = = 0, vps\_max\_sub\_layers\_minus1 ) |  |
| } |  |
| **bit\_equal\_to\_one** | u(1) |
| vps\_extension( ) |  |
| **vps\_extension\_flag** | u(1) |
| if( vps\_extension\_flag ) |  |
| while( more\_rbsp\_data( ) ) |  |
| **vps\_extension\_data\_flag** | u(1) |
| rbsp\_trailing\_bits( ) |  |
| } |  |

* **priority\_flag** equal to 1 indicates that the reserved\_zero\_6bits element of the NAL unit header can be used as priority\_id element of SVC specification.

However, if some bits of the reserved\_zero\_6bits are used for other purpose, the priority\_id element may use less than 6 bits of the reserved\_zero\_6bits.

## Layer referencing

Currently, the solution for layer referencing in JCTVC-J1007 simply lists all references from a layer to its directly dependent layers. However, in certain dimension(s), it is obvious that a layer (e.g. temporal layer 3) will directly depend on the next lower layer (e.g. temporal layer 2). For that, we propose to describe first the dimensions that have default direct dependency. Then, only the special dependencies will be specifically described in the description loop of scalable layers.

Some examples of default dependence and specific dependence are shown in Fig. 1. It can be seen that, in the first example, no specific dependency needs to be described. Meanwhile, in the second example, only two specific dependencies should be described. Without the concept of default dependency, all dependencies need to be described, resulting in a large VPS message.

Dimension 2 (spatial)

Dimension 1 (temporal)

Default dependency

Dimension 1 (quality)

specific dependency

Dimension 2 (spatial)

Fig. 1: Examples of default dependence and specific dependence

The proposed syntax changes to approaches of JCTVC-J1007 are provided in Section 2.3.

## Harmonization of two description approaches

The two approaches in JCTVC-J1007 employ different ways to describe the scalability dimensions of a NAL unit. To harmonize these, we propose to use the dimension\_type element in both approaches. In this way, there is no need to use scalability\_type and the scalability table. The improved syntax of VPS extension is provided in the following. This syntax also includes the changes of Section 2.2.

- Syntax for approach 1:

|  |  |
| --- | --- |
| vps\_extension( ) { | Descriptor |
| while( !byte\_aligned( ) ) |  |
| **vps\_extension\_byte\_alignment\_reserved\_one\_bit** | u(1) |
| **num\_dimensions\_minus1** |  |
| for( i = 0; i <= num\_dimensions\_minus1; i++ ) { |  |
| **dimension\_type**[ i ] | u(4) |
| **default\_dependency\_flag [i]** | u(1) |
| } |  |
| for( i = 1; i <= vps\_max\_layers\_minus1; i++ ) { |  |
| // mapping of layer ID to scalability dimension IDs |  |
|  |  |
| for( j = 0; j <= num\_dimensions\_minus1; j++ ) { |  |
|  |  |
| **dimension\_id**[ i ][ j ] | u(8) |
| } |  |
| // layer dependency |  |
| **specific\_dependency\_flag [i]** | u(1) |
| if( **specific\_dependency\_flag [i]** = =1) { |  |
| **num\_direct\_ref\_layers**[ i ] | u(6) |
| for( j = 0; j < num\_direct\_ref\_layers[ i ]; j++ ) |  |
| **ref\_layer\_id**[ i ][ j ] | u(6) |
| **}** |  |
| } |  |
| } |  |

Semantics of new elements:

* **specific\_dependency\_flag** [i] equal to 1 indicates that there are direct dependences/references which are specifically described for this layer.
* **default\_dependency\_flag** [i] equal to 1 specifies that scalability dimension i has default dependency. In this dimension, a higher layer (e.g. with dimension\_id[i] = n) will directly depend on the next lower layer (e.g. with dimension\_id[i] = n – 1).

Note: Layer C directly depending on layer B means that, to decode layer C, the decoder must use the data (non-decoded and/or decoded) of layer B. However, if layer B directly uses data of layer A, C is NOT considered to be directly dependent on A.

- Syntax for approach 2:

|  |  |
| --- | --- |
| vps\_extension( ) { | Descriptor |
| while( !byte\_aligned( ) ) |  |
| **vps\_extension\_byte\_alignment\_reserved\_one\_bit** | u(1) |
| // scalability type and layer\_id partitioning method |  |
| **~~scalability\_type~~** | ~~u(4)~~ |
| ~~for( i = 0; i < MaxDim( scalability\_type ); i++ )~~ |  |
| **num\_dimensions\_minus1** |  |
| for( i = 0; i <= num\_dimensions\_minus1; i++ ) { |  |
| **dimension\_type**[ i ] | u(4) |
| **layer\_id\_dim\_len**[ i ] | u(3) |
| **default\_dependency\_flag [i]** | u(1) |
| **}** |  |
| for( i = 0; i <= max\_num\_layers\_minus1; i++ ) { |  |
| **vps\_layer\_id[** i **]** | u(6) |
| // layer dependency |  |
| **specific\_dependency\_flag [i]** | u(1) |
| if( **specific\_dependency\_flag [i]** = =1) { |  |
| **num\_direct\_ref\_layers**[ i ] | u(6) |
| for( j = 0; j < num\_direct\_ref\_layers[ i ]; j++ ) |  |
| **ref\_layer\_id**[ i ][ j ] | u(6) |
| } |  |
| } |  |
| } |  |

* **num\_dimensions\_minus1** plus 1 specifies the number of scalability dimension present in the NAL unit header

Semantics of the other new elements is the same as above.

## Scalability dimensions

In JCTVC-J1007, some basic types of scalability dimension have been listed. In this part, we propose to add two more dimension types which are 1) priority and 2) region of interest.

|  |  |
| --- | --- |
| dimension\_type[ i ][ j ] | dimension\_id[ i ][ j ] |
| 0 | view order idx |
| 1 | depth flag |
| 2 | dependency ID |
| 3 | quality ID |
| 4 | priority ID |
| 5 | region ID |
| 6..15 | reserved |

The value of dimension\_type[ i ][ j ] shall be in the range of 0 to 5, inclusive, in bitstreams conforming to this Recommendation | International Standard. Other values for dimension\_type[ i ][ j ] are reserved for future use by ITU-T | ISO/IEC. Decoders shall ignore values of dimension\_type[ i ][ j ] that are not in the range of 0 to 5, inclusive.

When dimension\_type is equal to 4, the corresponding dimension\_id indicates the id of a priority layer of the bitstream as in SVC specification.

When dimension\_type is equal to 5, the corresponding dimension\_id indicates the id of a special region of the bitstream. A special region can be one or more spatio-temporal segment of the bitstream.

# Conclusions

In this contribution, some improvements and modifications to the Video parameter set of the High Efficiency Video Coding (HEVC) text specification draft version 8 and the base-line approaches of JCTVC-J1007 are presented. These proposed items helps simplify the actual message of VPS as well as improve the operation of bitstream extraction. We propose to adopt these items into the next version of HEVC specification draft.

# References

1. JCTVC-J1003 “High Efficiency Video Coding (HEVC) text specification draft 8”
2. JCTVC-J1007 “Solutions considered for NAL unit header and video parameter set for HEVC extensions”
3. Annex G of ISO/IEC 14496-10 “Advanced Video Coding for Generic Audiovisual Services,” 2012.

# Patent rights declaration(s)

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