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| *Title:* | **Proposal to the Extension of Video Parameter Set** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

In the last meeting, some solutions considered for NAL unit header and video parameter set for HEVC extensions in VPS extension are provided in JCTVC-K1007. In this contribution, some changes and new syntax for VPS extension are proposed. A summary of proposed items is as follows.

1. Introduction of default dependency and specific dependency, where only the specific dependency between scalable layers are described in detail in VPS extension.
2. Describing the maximum number of temporal sub-layers in each layer of a scalable bitstream. The reason is that each layer may have a different number of temporal sub-layer, which should be known by a middle box.
3. Describing the priority of each layer of a bitstream. This information can be used as hints to adapt a bitstream, by removing the low priority layers first.

# Introduction

In the last meeting, some solutions considered for NAL unit header and video parameter set for HEVC extensions in VPS extension are provided in JCTVC-K1007. The current syntax provides the basic information of scalability dimensions and the dependency between scalable layers. In this contribution, some changes and new syntax for VPS extension are proposed. A summary of proposed items is as follows.

1. Introduction of default dependency and specific dependency, where only the specific dependency between scalable layers are described in detail in VPS extension.
2. Describing the maximum number of temporal sub-layers in each layer of a scalable bitstream. The reason is that each layer may have a different number of temporal sub-layer, which should be known by a middle box.
3. Describing the priority of each layer of a bitstream. This information can be used as hints to adapt a bitstream, by removing the low priority layers first.

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

# Proposal

## Layer referencing

Currently, the solution for layer referencing in [2] simply lists all links (or references) from a layer to its directly dependent layers. However, in certain dimension(s), it is obvious that a layer (e.g. quality layer 3) will directly depend on the next lower layer (e.g. quality 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.

The syntax of vps\_extension() is revised as in Section 2.4 (yellow part).

The semantics of the new/revised elements are as follows:

* **default\_dependency\_flag**[ i ] equal to 1 indicates that scalability dimension *i* have default dependency. That means, in dimension *i*, by default a layer with dimension\_id[i] = n will directly depend on another layer with dimension\_id[i] = n – 1. Only non-default dependencies will be signaled by the specific\_dependency\_flag.
* **specific\_dependency\_flag**[ i ] equal to 1 indicates that there are direct dependences/references which are specifically described for this layer.

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.

## Improvement of sub-layer and profile\_tier\_level signaling

Currently, signaling of profile\_tier\_level of every layer in extension part of VPS is provided with the same value of vps\_max\_layers\_minus1. However, each layer may have different number of temporal sub-layer. So, for a middle box, it is better to describe the specific number of temporal sub-layers in each layer. The signaling of profile\_tier\_level is then improved as shown in the syntax of Section 2.4 (gray part).

The semantics of the new/revised elements are as follows:

* **same\_max\_sub\_layers\_flag**[ i ] equal to 1 indicates that the maximum number of temporal sub-layers of layer i is equal to **vps\_max\_sub\_layers\_minus1** plus 1.
* **max\_sub\_layers\_minus1**[ i ] plus 1 specifies the maximum number of temporal sub-layers of layer i.

## Priority Information

In this part, we propose to describe the priority of each scalable layer of a bitstream. This information can be used as hints to adapt a bitstream, by removing the low priority layers first. As there could be different policies of priority setting, each policy will be identified by a URI. The priority information can be provided by several options: for example 1) in VPS (as shown in Section 2.4, cyan part), 2) in an existing SEI message, or 3) in a new SEI message. As an example, the layer\_priority\_info SEI message also is presented in Section 2.4.

The semantics of the new elements in the above syntax is as follows.

* **priority\_description\_flag** equal to 1 indicates that the priority information of scalable layer is provided.
* **num\_priority\_policies\_minus1** plus 1 specifies the number of priority setting policies
* **priority\_id**[ i ] [ j ] specifies the priority value of sub-layer j of layer i. The lower the value of this element is, the higher the priority is.
* **priority\_id\_setting\_uri**[ PriorityIdSettingUriIdx ] is the PriorityIdSettingUriIdx-th byte of a null-terminated string encoded in UTF-8 characters, specifying the universal resource identifier (URI) of the description of the method used to calculate the priority\_id values for the target layers.

If layer\_priority\_info SEI message is present, this message shall be contained in the first access unit in decoding order of the period to which the message applies.

## Proposed Syntax

|  |  |
| --- | --- |
| vps\_extension( ) { | Descriptor |
| while( !byte\_aligned( ) ) |  |
| **vps\_extension\_byte\_alignment\_reserved\_one\_bit** | u(1) |
| **avc\_base\_codec\_flag** | u(1) |
| **scalability\_mask** | u(16) |
| for( i = 0; i <NumScalabilityTypes; i++ ) { |  |
| **dimension\_id\_len\_minus1**[ i ] | u(3) |
| **default\_dependency\_flag** [ i ] | u(1) |
| } |  |
| **vps\_nuh\_layer\_id\_present\_flag** | u(1) |
| // layer specific information |  |
| for( i = 1; i <= vps\_max\_layers\_minus1; i++ ) { |  |
| // mapping of layer ID to scalability dimension IDs |  |
| if( vps\_nuh\_layer\_id\_present\_flag ) |  |
| **layer\_id\_in\_nuh**[ i ] | u(6) |
| for( j = 0; j <= num\_dimensions\_minus1; j++ ) |  |
| **dimension\_id**[ i ][ j ] | u(v) |
| } |  |
| for( i = 1; i <= vps\_max\_layers\_minus1 ; i++ ) { |  |
| **same\_max\_sub\_layers\_flag**[ i ] | u(1) |
| if( same\_max\_sub\_layers\_flag [ i ]) |  |
| profile\_tier\_level( 1, vps\_max\_sub\_layers\_minus1 ) |  |
| else { |  |
| **max\_sub\_layers\_minus1[ i ]** | u(3) |
| profile\_tier\_level( 1, max\_sub\_layers\_minus1[ i ] ) |  |
| } |  |
| } |  |
| for( i = 1; i <= vps\_max\_layers\_minus1; i++ ) { |  |
| // 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) |
| **}** |  |
| } |  |
| **priority\_description\_flag** |  |
| if( priority\_description\_flag ) { |  |
| **num**\_**priority\_policies\_minus1** | u(8) |
| for(i = 0; i < num\_priority\_policies\_minus1; i++) |  |
| priority\_policy\_description( ) |  |
| } |  |
| } |  |

An option for priority info: layer\_priority\_info SEI message

|  |  |
| --- | --- |
| layer\_priority\_info( payloadSize ) { | **Descriptor** |
| **duration\_flag** | u(1) |
| if( duration\_flag ) |  |
| **period\_duration** | u(32) |
| **num**\_**priority\_policies\_minus1** | u(8) |
| for(i = 0; i < num\_priority\_policies\_minus1; i++) |  |
| priority\_policy\_description( ) |  |
| } |  |

|  |  |
| --- | --- |
| priority\_policy\_description( ) { | Descriptor |
| // mapping of scalable layer to priority IDs |  |
| for( i = 0; i <= vps\_max\_layers\_minus1; i++ ) |  |
| for( j = 0; j <= vps\_max\_sub\_layers\_minus1; j++ ) |  |
| **priority\_id**[ i ] [ j ] | u(9) |
| //Priority Id Setting Uri |  |
| PriorityIdSettingUriIdx = 0 |  |
| do |  |
| **priority\_id\_setting\_uri**[ PriorityIdSettingUriIdx ] |  |
| while( priority\_id\_setting\_uri[ PriorityIdSettingUriIdx++ ] != 0 ) |  |
| } |  |

# Conclusions

In this contribution, some improvements and modifications to the Video parameter set of the High Efficiency Video Coding (HEVC) text specification draft version 9 and the base-line approaches of JCTVC-K1007 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-K1003 “High Efficiency Video Coding (HEVC) text specification draft 9”
2. JCTVC-K1007 “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)

**ETRI 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).**

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