|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  10th Meeting: Stockholm, SE, 11 – 20 July 2012 | Document: JCTVC-J0112 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **AHG9: Various comments on HEVC draft 7** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Ye-Kui Wang Ying Chen  5775 Morehouse Drive San Diego, CA 92121 USA | Tel: Email: | 1-858-651-8345 [yekuiw@qualcomm.com](mailto:yekuiw@qualcomm.com)  1-858-845-6589 [cheny@qualcomm.com](mailto:cheny@qualcomm.com) |
| *Source:* | Qualcomm Incorporated | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Abstract

This document proposes the following:

1. Removal of nal\_ref\_flag, and push the saved bit to reserved\_one\_5bits to make it to reserved\_one\_6bits; this proposal is suggested to be ignored if the proposal in JCTVC-J0113 is adopted
2. Change of temporal\_id to temporal\_id\_plus1
3. Change of the value 0 of nal\_unit\_type from "Unspecified" to "Reserved"
4. A fix to the semantics of the extension syntax elements in VPS, SPS, PPS, APS and slice data
5. Extending of the extension mechanism to all types of NAL units
6. To support SEI NAL units that may succeed the first VCL NAL unit in the same access unit

# On NAL unit header

## On nal\_ref\_flag and reserved\_one\_5bits

In HEVC, the one-bit flag nal\_ref\_flag in the NAL unit header is not necessary after the use of the reference picture set based decoded picture buffer management, because now the decoding process does not need to know whether a picture is a reference picture or not. The only possible use of nal\_ref\_flag may be for media-aware network elements (MANEs) to discard non-reference pictures (pictures that will never be used by any other picture for inter prediction reference). However, since in HEVC temporal\_id is included in the NAL unit header, and it may be used by MANEs to perform better stream adaptation than simply discarding non-reference pictures, the presence of nal\_ref\_flag gets completely useless and can be removed.

It is thus proposed to 1) release the nal\_ref\_flag bit. 2) add the bit to reserved\_one\_5bits, such that it is of 6 bits, and the name of the syntax element is changed to reserved\_one\_6bits.

Document JCTVC-J0113 proposes a high-level syntax (HLS) hook for support of HEVC multi-standard extensions. That proposal also proposes to remove nal\_ref\_flag and utilize the saved bit for another purpose. If that proposal is adopted, then the second aspect of the proposal (extending reserved\_one\_5bits to reserved\_one\_6bits) should be ignored.

The proposed text changes for removal of nal\_ref\_flag are included in JCTVC-J0113.

## On temporal\_id and reserved\_one\_5bits

The DPB size in level definitions only support hierarchical coding structures with GOP size up to 16 (see document JCTVC-J0111 for analyses of DPB size requirements for different GOP sizes), i.e., typically up to 5 temporal layers are supported.

It is thus proposed to change temporal\_id to temporal\_id\_plus1, and the value of temporal\_id\_plus1 shall be greater than 0, and the value 7 is reserved for potential future NAL unit header extensions.

Consequently, reserved\_one\_5bits is proposed to be changed to reserved\_zero\_5bits, thus shall be equal to 0 in the base specification (currently the value of the five bits shall be equal to 1 in the base specification). Thus one more layer or view becomes possible in future HEVC extensions.

If the bit of nal\_ref\_flag is released and added to reserved\_one\_5bits (hence the field becomes reserved\_one\_6bits), as proposed above, reserved\_one\_6bits is proposed to be changed to reserved\_zero\_6bits, and shall be equal to 0 in the base specification.

## On nal\_unit\_type

The value of nal\_unit\_type equal to 0 is currently specified as "Unspecified", i.e., the value shall never be used. We believe the reason for this is to ensure that start code emulation avoidance can be performed for any RBSP data independently of the NAL unit header. However, since now we have reserved\_one\_5bits that can never be equal to 0, i.e., at least one of the five bits must be equal to 1, start code emulation avoidance can be performed for any RBSP data independently of the NAL unit header even when the value of nal\_unit\_type is equal to 0. The same applies if the above proposal on temporal\_id is adopted.

It is thus proposed to change the value 0 of nal\_unit\_type from "Unspecified" to "Reserved".

# On NAL unit extension mechanism

## Semantics problem of the extension syntax elements

In a bitstream per a future extension, a NAL unit that applies to the base layer (i.e., required for decoding of the base layer) may actually include extension data that applies to enhancement layers and must be ignored by a decoder per the base specification. However, the current semantics for the extension syntax elements in VPS, SPS, PPS, APS, slice header and slice layer RBSP disallow these NAL units with the presence of extension data to be seen by decoders per the base specification.

We thus propose the following changes to the semantics to solve the above problem:

**vps\_extension\_flag** equal to 0 specifies that no vps\_extension\_data\_flag syntax elements are present in the video parameter set RBSP syntax structure. ~~vps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for vps\_extension\_flag is reserved for future use by ITU-T | ISO/IEC.~~ Decoders shall ignore all data that follow the value 1 for vps\_extension\_flag in a video parameter set NAL unit.

**vps\_extension\_data\_flag** may have any value. It shall not affect the conformance to profiles specified in this Recommendation | International Standard.

**sps\_extension\_flag** equal to 0 specifies that no sps\_extension\_data\_flag syntax elements are present in the sequence parameter set RBSP syntax structure. ~~sps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for sps\_extension\_flag is reserved for future use by ITU-T | ISO/IEC.~~ Decoders shall ignore all data that follow the value 1 for sps\_extension\_flag in a sequence parameter set NAL unit.

**sps\_extension\_data\_flag** may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.

**slice\_header\_extension\_present\_flag** equal to 0 specifies that no slice header extension syntax elements are present in the slice header for coded pictures referring to the picture parameter set. ~~slice\_header\_extension\_present\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for slice\_header\_extension\_present\_flag is reserved for future use by ITU-T | ISO/IEC.~~

**slice\_extension\_present\_flag** equal to 0 specifies that no slice extension syntax elements are present in the slice layer RBSP for coded pictures referring to the picture parameter set. ~~slice\_extension\_present\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for slice\_extension\_present\_flag is reserved for future use by ITU-T | ISO/IEC.~~

**pps\_extension\_flag** equal to 0 specifies that no pps\_extension\_data\_flag syntax elements are present in the picture parameter set RBSP syntax structure. ~~pps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for pps\_extension\_flag is reserved for future use by ITU‑T | ISO/IEC.~~ Decoders shall ignore all data that follow the value 1 for pps\_extension\_flag in a picture parameter set NAL unit.

**pps\_extension\_data\_flag** may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.

**aps\_extension\_flag** equal to 0 specifies that no aps\_extension\_data\_flag syntax elements are present in the picture parameter set RBSP syntax structure. ~~aps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for aps\_extension\_flag is reserved for future use by ITU‑T | ISO/IEC.~~ Decoders shall ignore all data that follow the value 1 for aps\_extension\_flag in a picture parameter set NAL unit.

**aps\_extension\_data\_flag** may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.

**slice\_extension\_flag** equal to 0 specifies that no slice\_extension\_data\_flag syntax elements are present in the slice layer RBSP syntax structure. ~~slice\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for slice\_extension\_flag is reserved for future use by ITU‑T | ISO/IEC.~~ Decoders shall ignore all data that follow the value 1 for slice\_extension\_flag in a coded slice NAL unit.

**slice\_extension\_data\_flag** may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.

**slice\_header\_extension\_length** specifies the length of the slice header extension data in bytes, not including the bits used for signalling slice\_header\_extension\_length itself. The value of slice\_header\_extension\_length shall be in the range of 0 to 256, inclusive.

**slice\_header\_extension\_data\_byte** may have any value. Decoders shall ignore the value of slice\_header\_extension\_data\_byte. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.

## Extending the extension mechanism to all NAL units

In the latest HEVC draft, the same extension mechanism is included for all types of VCL NAL units and all parameter sets NAL units. Those types of NAL units that do have an extension mechanism are AU delimiter, filler data, SEI, and the reserved NAL unit types.

From both technical and editorial points of view, we think it makes sense to simply include the extension mechanism for all types of NAL units. From the technical point of view, extension becomes possible for all types of NAL unit, whenever needed, and NAL unit parsing would also be more consistent for all NAL units. From the editorial point of view, the two extension syntax elements do not need to be repeated in each RBSP syntax, but can be simply included in the rbsp\_trailing\_bits( ) syntax structure, and the semantics would not need to be repeated either.

We thus propose to always include the extension mechanism to all NAL units.

The proposed syntax and semantics changes are as follows.

|  |  |
| --- | --- |
| video\_parameter\_set\_rbsp( ) { | Descriptor |
| **...** |  |
| **~~vps\_extension\_flag~~** | ~~u(1)~~ |
| ~~if( vps\_extension\_flag )~~ |  |
| ~~while( more\_rbsp\_data( ) )~~ |  |
| **~~vps\_extension\_data\_flag~~** | ~~u(1)~~ |
| ~~}~~ |  |
| rbsp\_trailing\_bits( ) |  |
| } |  |

|  |  |
| --- | --- |
| seq\_parameter\_set\_rbsp( ) { | Descriptor |
| **...** |  |
| **~~sps\_extension\_flag~~** | ~~u(1)~~ |
| ~~if( sps\_extension\_flag )~~ |  |
| ~~while( more\_rbsp\_data( ) )~~ |  |
| **~~sps\_extension\_data\_flag~~** | ~~u(1)~~ |
| rbsp\_trailing\_bits( ) |  |
| } |  |

|  |  |
| --- | --- |
| pic\_parameter\_set\_rbsp( ) { | Descriptor |
| **...** |  |
| **slice\_header\_extension\_present\_flag** | u(1) |
| **~~slice\_extension\_present\_flag~~** | ~~u(1)~~ |
| **~~pps\_extension\_flag~~** | ~~u(1)~~ |
| ~~if( pps\_extension\_flag )~~ |  |
| ~~while( more\_rbsp\_data( ) )~~ |  |
| **~~pps\_extension\_data\_flag~~** | ~~u(1)~~ |
| rbsp\_trailing\_bits( ) |  |
| } |  |

|  |  |
| --- | --- |
| aps\_rbsp( ) { | Descriptor |
| **...** |  |
| **~~aps\_extension\_flag~~** | ~~u(1)~~ |
| ~~if( aps\_extension\_flag )~~ |  |
| ~~while( more\_rbsp\_data( ) )~~ |  |
| **~~aps\_extension\_data\_flag~~** | ~~u(1)~~ |
| rbsp\_trailing\_bits( ) |  |
| } |  |

|  |  |
| --- | --- |
| slice\_layer\_rbsp( ) { | Descriptor |
| slice\_header( ) |  |
| slice\_data( ) |  |
| ~~if( slice\_extension\_present\_flag ) {~~ |  |
| **~~slice\_extention\_flag~~** | ~~u(1)~~ |
| ~~if( slice\_extension\_flag )~~ |  |
| ~~while( more\_rbsp\_data( ) )~~ |  |
| **~~slice\_extension\_data\_flag~~** | ~~u(1)~~ |
| ~~}~~ |  |
| rbsp\_slice\_trailing\_bits( ) |  |
| } |  |

|  |  |
| --- | --- |
| rbsp\_trailing\_bits( ) { | Descriptor |
| **rbsp\_extension\_flag** | u(1) |
| if( rbsp\_extension\_flag ) |  |
| while( more\_rbsp\_data( ) ) |  |
| **rbsp\_extension\_data\_flag** | u(1) |
| **rbsp\_stop\_one\_bit** /\* equal to 1 \*/ | f(1) |
| while( !byte\_aligned( ) ) |  |
| **rbsp\_alignment\_zero\_bit** /\* equal to 0 \*/ | f(1) |
| } |  |

**~~vps\_extension\_flag~~** ~~equal to 0 specifies that no vps\_extension\_data\_flag syntax elements are present in the video parameter set RBSP syntax structure. vps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for vps\_extension\_flag is reserved for future use by ITU-T | ISO/IEC. Decoders shall ignore all data that follow the value 1 for vps\_extension\_flag in a video parameter set NAL unit.~~

**~~vps\_extension\_data\_flag~~** ~~may have any value. It shall not affect the conformance to profiles specified in this Recommendation | International Standard.~~

**~~sps\_extension\_flag~~** ~~equal to 0 specifies that no sps\_extension\_data\_flag syntax elements are present in the sequence parameter set RBSP syntax structure. sps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for sps\_extension\_flag is reserved for future use by ITU-T | ISO/IEC. Decoders shall ignore all data that follow the value 1 for sps\_extension\_flag in a sequence parameter set NAL unit.~~

**~~sps\_extension\_data\_flag~~** ~~may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.~~

**slice\_header\_extension\_present\_flag** equal to 0 specifies that no slice header extension syntax elements are present in the slice header for coded pictures referring to the picture parameter set. slice\_header\_extension\_present\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for slice\_header\_extension\_present\_flag is reserved for future use by ITU-T | ISO/IEC.

**~~slice\_extension\_present\_flag~~** ~~equal to 0 specifies that no slice extension syntax elements are present in the slice layer RBSP for coded pictures referring to the picture parameter set. slice\_extension\_present\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for slice\_extension\_present\_flag is reserved for future use by ITU-T | ISO/IEC.~~

**~~pps\_extension\_flag~~** ~~equal to 0 specifies that no pps\_extension\_data\_flag syntax elements are present in the picture parameter set RBSP syntax structure. pps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for pps\_extension\_flag is reserved for future use by ITU‑T | ISO/IEC. Decoders shall ignore all data that follow the value 1 for pps\_extension\_flag in a picture parameter set NAL unit.~~

**~~pps\_extension\_data\_flag~~** ~~may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.~~

**~~aps\_extension\_flag~~** ~~equal to 0 specifies that no aps\_extension\_data\_flag syntax elements are present in the picture parameter set RBSP syntax structure. aps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for aps\_extension\_flag is reserved for future use by ITU‑T | ISO/IEC. Decoders shall ignore all data that follow the value 1 for aps\_extension\_flag in a picture parameter set NAL unit.~~

**~~aps\_extension\_data\_flag~~** ~~may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.~~

**~~slice\_extension\_flag~~** ~~equal to 0 specifies that no slice\_extension\_data\_flag syntax elements are present in the slice layer RBSP syntax structure. slice\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for slice\_extension\_flag is reserved for future use by ITU‑T | ISO/IEC. Decoders shall ignore all data that follow the value 1 for slice\_extension\_flag in a coded slice NAL unit.~~

**~~slice\_extension\_data\_flag~~** ~~may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.~~

**rbsp\_extension\_flag** equal to 0 specifies that no rbsp\_extension\_data\_flag syntax elements are present in the RBSP syntax structure. Decoders shall ignore all data that follow the value 1 for rbsp\_extension\_flag in a NAL unit.

**rbsp\_extension\_data\_flag** may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.

# On SEI messages

## Sub-AU-level SEI NAL unit

Currently, any SEI NAL unit of an access unit (AU) must precede all VCL NAL units in the AU. However, it would be beneficial to enable an SEI message to immediately precede the VCL NAL units the SEI message applies, in the bitstream or in transport, which is not possible if the SEI message applies to only a subset of the VCL NAL units that does not include the first VCL NAL unit in the AU. Such cases can often happen particularly in scalable and 3D contexts. For example, in both AVC based SVC and MVC, SEI messages may apply only to particular layer representations or view components. In SVC RTP payload format as specified in RFC 6190 (<http://tools.ietf.org/html/rfc6190>), SEI NAL units can be transported in different sessions in the multi-session transport (MST) mode. Due to the above restriction on SEI NAL units, a special and rather complicated reordering process has to be specified in the payload format.

We thus propose either

1. to use a new NAL unit for sub-AU level SEI NAL units, which may follow the first VCL NAL unit in the same AU, but must precede the last VCL NAL unit in the same AU, or
2. to relax the constraint for the current SEI NAL units to be allowed to follow the first VCL NAL unit in the same AU (but still must precede the last VCL NAL unit in the same AU, as in the latest HEVC draft).

We prefer solution 2 unless there are some technical benefits of having SEI NAL units not allowed to follow the first VCL NAL unit in the same AU, which we are not aware of.

# Patent rights declaration(s)

**Qualcomm Incorporated 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).**