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| **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-J0113 |

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| *Title:* | **AHG10: High-level syntax hook for HEVC multi-standard extensions** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This is a follow-up proposal of JCTVC-I0355.

In JCTVC-I0355, a high-level syntax hook for HEVC multi-standard scalable or 3DV extensions wherein the base layer or view is AVC compatible is proposed. It was asserted that the following design principles were followed in the proposed design:

1. The NAL unit header length in the multi-standard scalable or 3DV extensions shall be the same as in the existing HEVC design;
2. There should be sufficient NAL unit types to be used by HEVC and its potential future extensions, ideally the same as in the existing HEVC design;
3. AVC NAL units shall be distinguishable from the NAL unit header itself.

A comment was given to JCTVC-I0355 that an AVC decoder would not be able to distinguish between an AVC NAL unit and an HEVC NAL unit.

In this proposal, an improved design is proposed to solve the above issue while the above three design principles are still followed.

The proposed change to the NAL unit header is to remove nal\_ref\_flag and re-arrange the syntax elements in the HEVC NAL unit header.

# Multi-standard scalable or 3DV extension of HEVC

Multi-standard support was discussed and supported in MPEG 3DV, more specifically, it is enabled as part of 3D-HTM (the reference software of HEVC based 3DV) to support the following case: base view is coded with AVC and the enhancement view is coded with HEVC and can be predicted from the reconstructed AVC pictures.

In general, the following application scenario is being discussed and techniques for it are being developed.

Base layer/view: AVC

Enhancement layer/view: HEVC scalability or 3D extension

Target application scenarios:

* The bitstream of the base layer/view is AVC compatible and hence can be decoded by AVC decoders. The entire bitstream, including both the base layer/view and the enhancement layers/views can be decoded by decoders conforming to a scalable or 3DV extension profile of HEVC.

Inter-layer/view prediction:

* Within one access unit, an enhancement layer/view may use the reconstructed based layer/view for inter-layer/view prediction (multi-loop decoding)

# AVC NAL unit header and HEVC NAL unit header

AVC NAL unit header:

|  |  |
| --- | --- |
| **forbidden\_zero\_bit** | f(1) |
| **nal\_ref\_idc** | u(2) |
| **nal\_unit\_type** | u(5) |

HEVC NAL unit header:

|  |  |
| --- | --- |
| **forbidden\_zero\_bit** | f(1) |
| **nal\_ref\_flag** | u(1) |
| **nal\_unit\_type** | u(6) |
| **temporal\_id** | u(3) |
| **reserved\_one\_5bits** | u(5) |

# Proposed HEVC NAL unit header

The proposed design takes advantage of the following facts of the AVC design and the existing HEVC design:

* In AVC, the three possible non-zero values for the 2-bit nal\_ref\_idc in the NAL unit header do not have different semantics, hence it is possible to mandate the value of nal\_ref\_idc to be not greater than 1, and thus the second bit in the NAL unit header is mandated to be equal to 0.
* 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.
* In AVC, excluding its scalable or multiview extension, the first bit of nal\_unit\_type is always equal to 0, i.e., the value of nal\_unit\_type is always less than 16.

In this proposal, the bit corresponding to the first bit of nal\_unit\_type in AVC NAL unit header is always set to 1 in HEVC, and thus the value of this bit can be used to identify a NAL unit is an AVC NAL unit or an HEVC NAL unit.

## NAL unit syntax

|  |  |
| --- | --- |
| nal\_unit( NumBytesInNALunit ) { | Descriptor |
| **forbidden\_zero\_bit** | f(1) |
| **~~nal\_ref\_flag~~** | ~~u(1)~~ |
| **~~nal\_unit\_type~~** | ~~u(6)~~ |
| **nal\_unit\_type\_msb\_2bits** | u(2) |
| **forbidden\_one\_bit** | f(1) |
| **nal\_unit\_type\_lsb\_4bits** | u(4) |
| **temporal\_id** | u(3) |
| **reserved\_one\_5bits** | u(5) |
| NumBytesInRBSP = 0 |  |
| nalUnitHeaderBytes = 2 |  |
| for( i = nalUnitHeaderBytes; i < NumBytesInNALunit; i++ ) { |  |
| if( i + 2 < NumBytesInNALunit && next\_bits( 24 ) = = 0x000003 ) { |  |
| **rbsp\_byte[** NumBytesInRBSP++ **]** | b(8) |
| **rbsp\_byte[** NumBytesInRBSP++ **]** | b(8) |
| i += 2 |  |
| **emulation\_prevention\_three\_byte** /\* equal to 0x03 \*/ | f(8) |
| } else |  |
| **rbsp\_byte[** NumBytesInRBSP++ **]** | b(8) |
| } |  |
| } |  |

## NAL unit semantics

**~~nal\_ref\_flag~~** ~~equal to 1 specifies that the content of the NAL unit contains a sequence parameter set, a picture parameter set, an adaptation parameter set or a slice of a reference picture.~~

~~For coded video sequences conforming to one or more of the profiles specified in Annex 10 that are decoded using the decoding process specified in clauses 2-9, nal\_ref\_flag equal to 0 for a NAL unit containing a slice indicates that the slice is part of a non-reference picture.~~

~~nal\_ref\_flag shall be equal to 1 for sequence parameter set, picture parameter set or adaptation parameter set NAL units. When nal\_ref\_flag is equal to 0 for one NAL unit with nal\_unit\_type equal to 1 or 4 of a particular picture, it shall be equal to 0 for all NAL units with nal\_unit\_type equal to 1 or 4 of the picture.~~

~~nal\_ref\_flag shall be equal to 1 for NAL units with nal\_unit\_type equal to 5.~~

~~nal\_ref\_flag shall be equal to 0 for all NAL units having nal\_unit\_type equal to 6, 9, 10, 11, or 12.~~

nal\_unit\_type\_msb\_2bits specifies the 2 most significant bits of the NAL unit type, which specifies the type of the RBSP data structure contained in the NAL unit.

forbidden\_one\_bit shall be equal to 1.

nal\_unit\_type\_lsb\_4bits specifies the 4 least significant bits of the NAL unit type, which specifies the type of the RBSP data structure contained in the NAL unit.

The variable NalUnitType is derived as follows.

NalUnitType = nal\_unit\_type\_msb\_2bits << 2 + nal\_unit\_type\_lsb\_4bits

## Other changes

Due to the removal of nal\_ref\_flag, other places referring to this syntax element in HEVC WD7 should also be changed. These places are provided below.

In Clause 3 of HEVC WD7, the definitions of non-reference picture and reference picture are changed as follows:

**non-reference picture**: A *picture* that must not be included in the *reference picture set* of any other *picture*. A *non-reference picture* is not used for *inter prediction* of any other *pictures*.

**reference picture**: A *picture* that may be included in *reference picture set* of another *picture*. A *reference picture* contains samples that may be used for *inter prediction* in the *decoding process* of subsequent *pictures* in *decoding order*.

In Subclause 7.4.1.1 (Encapsulation of an SODB within an RBSP (informative)), the following text

The resulting sequence of bytes is then prefixed as follows.

– *The sequence of bytes is prefixed with the first byte of the NAL unit containing the syntax elements forbidden\_zero\_bit, nal\_ref\_flag, and nal\_unit\_type, where nal\_unit\_type indicates the type of RBSP data structure the NAL unit contains.*

is changed as follows:

The resulting sequence of bytes is then prefixed as follows.

– The sequence of bytes is prefixed with the first two bytes of the NAL unit.

In Subclause 7.4.1.2.4 (Detection of the first VCL NAL unit of a coded picture), the following bullet item is removed:

– nal\_ref\_flag differs in value with one of the nal\_ref\_flag values being equal to 0.

# Example NAL unit header for multi-standard HEVC extensions based on the proposed hook

## Comparison of AVC NAL unit header and the proposed HEVC NAL unit header

|  |  |  |  |
| --- | --- | --- | --- |
| HEVC | | AVC | |
| **forbidden\_zero\_bit** | f(1) | **forbidden\_zero\_bit** | f(1) |
| **nal\_unit\_type\_msb\_2bits** | u(2) | **nal\_ref\_idc** | u(2) |
| **forbidden\_one\_bit** | f(1) | **nal\_unit\_type** | u(5) |
| **nal\_unit\_type\_lsb\_4bits** | u(4) |  |  |
| **temporal\_id** | u(3) |  |  |
| **layer\_id\_plus1** | u(5) |  |  |

## NAL unit header syntax

|  |  |
| --- | --- |
| **forbidden\_zero\_bit** | f(1) |
| **common\_two\_bits** | u(2) |
| **hevc\_nalu\_flag** | f(1) |
| **nal\_unit\_type\_lsb\_4bits** | u(4) |
| if( hevc\_nalu\_flag ) { |  |
| **temporal\_id** | u(3) |
| **layer\_id\_plus1** | u(5) |
| } |  |

## NAL unit header semantics

forbidden\_zero\_bit shall be equal to 0.

**common\_two\_bits** represents different fields depending on the value of hevc\_nalu\_flag. If hevc\_nalu\_flag is equal to 0, common\_two\_bits represents nal\_ref\_idc as specified in AVC. Otherwise (hevc\_nalu\_flag is equal to 1), common\_two\_bits represents nal\_unit\_type\_msb\_2bits as specified in HEVC.

**hevc\_nalu\_flag** equal to 0 specifies that the NAL unit is an AVC NAL unit as specified in AVC. hevc\_nalu\_flag equal to 1 specifies that the NAL unit is not an AVC NAL unit as specified in AVC.

NOTE 1 - This flag may be used for extracting a bitstream subset that is AVC compatible, i.e. the AVC-compatible base layer or view, e.g., by discarding all NAL units having this flag equal to 1.

NOTE 2 - This implies that, in the AVC base layer or view, the value of nal\_unit\_type as specified in AVC must not be greater than 15. In other words, the MSB of nal\_unit\_type, i.e., the 3rd bit in the NAL unit header, must be equal to 0. In this case, the bitstream can still be AVC conforming, while it can be known from this bit being equal to 0 that the NAL unit is an AVC NAL unit.

nal\_unit\_type\_lsb\_4bits specifies the 4 least significant bits of the NAL unit type, which specifies the type of the RBSP data structure contained in the NAL unit. If hevc\_nalu\_flag is equal to 0, nal\_unit\_type\_lsb\_4bits effectively specifies nal\_unit\_type as specified in AVC. Otherwise (hevc\_nalu\_flag is equal to 1), nal\_unit\_type\_lsb\_4bits is the same as specified in HEVC.

**temporal\_id** has the same semantics as in HEVC.

**layer\_id\_plus1** minus 1 specifies the layer identification. When layer\_id\_plus1 is equal to 1, the layer identification is equal to 0, and the NAL unit belongs to the base layer or base view. When hevc\_nalu\_flag is equal to 0, layer\_id\_plus1 shall be equal to 1.

# Patent rights declaration(s)

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