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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  6th Meeting: Torino, IT, 14-22 July, 2011 | Document: JCTVC-F463 |

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| *Title:* | **On NAL unit header** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This document presents the following proposals: 1) dropping of the forbidden\_zero\_bit from the NAL unit header; 2) changing of nal\_ref\_idc (2 bits) in the NAL unit header to nal\_ref\_flag (1 bit); 3) unification of the NAL unit header to be a fixed-length 2-byte header; and 4) a sub-bitstream extraction process utilizing the unified NAL unit header.

# Proposals

## On forbidden\_zero\_bit

The first bit in the NAL unit header, forbidden\_zero\_bit, must be set to 0. Hence the bit does not carry any information. To the author’s knowledge, the possible reason for introduction of this bit in AVC was because of some restriction in IETF RFC 1889 (RTP: A Transport Protocol for Real-Time Applications, available at <http://www.ietf.org/rfc/rfc1889.txt>), which has been obsoleted by IETF RFC 3551 (available at <http://www.ietf.org/rfc/rfc3550.txt>). It was further commented that the new RTP specification in RFC 3550 does not have that restriction anymore. The restriction should be something like “the first bit in an RTP packet payload (under certain condition) must not be equal to 1.” Unfortunately, the author was not able to find that restriction in RFC 1889. In any case, it seems that now and in the future there is no need to mandate the first bit of each and every NAL unit to be equal to 0.

*Therefore, it is proposed to drop forbidden\_zero\_bit such that it can be made use of when needed.*

## On nal\_ref\_idc

The NAL unit header contains a two-bit field nal\_ref\_idc. As in AVC, the HEVC WD makes no semantics difference among the three non-zero values of nal\_ref\_idc. The only known use of the different non-zero values for nal\_ref\_idc is in AVC RTP payload format, initially specified in IETF RFC 3984 (available at <http://tools.ietf.org/rfc/rfc3984.txt>), which was recently obsoleted by IETF RFC 6184 (available at <http://tools.ietf.org/rfc/rfc6184.txt>), wherein greater values of nal\_ref\_idc indicate higher transport priorities. Even this use was dropped in the SVC RTP payload format, specified in IETF RFC 6190 (available at <http://tools.ietf.org/rfc/rfc6190.txt>), due to that there are other NAL unit header fields like dependency\_id, quality\_id and temporal\_id that are more relevant to transport priorities. Though it was commented that there were implementations using different non-zero values of nal\_ref\_idc, no real-world use of the different non-zero values in prioritized transport was identified.

In HEVC, temporal\_id is present, and it naturally indicates different transport priorities. In this context, even a future transport/system specification (e.g., HEVC RTP payload format) tries to specify diffenent semantics for the different non-zero values, it is difficult to specify due to the presence of temporal\_id, similar as in the SVC RTP format case.

*Therefore, it is proposed to use one bit instead of two bits for this syntax element, and change the name from “nal\_ref\_idc” to “nal\_ref\_flag” or simply “ref\_flag”.*

## On NAL unit header unification and sub-bitstream extraction

Document JCTVC-E345 proposed to unity the NAL unit header for VCL and non-VCL NAL units by including the optional second byte of the NAL unit header, currently present only for VCL NAL units, also for non-VCL NAL units, such that all NAL units have the same 2-byte NAL unit header.

Pros and cons of unifying NAL unit header are summarized below.

Pros:

* Fixed -length 2-byte NAL unit header, instead of variable-length NAL unit header
* Simpler sub-bitstream extraction process (see JCTVC-E345)
* Temporal subsets specific SEI messages can be supported (see JCTVC-D080)

Cons:

* One more byte overhead for non-VCL NAL units

Based on the above, and usually the amount of non-VCL NAL units is relatively low compared to VCL NAL units, it is obvious that it is beneficial to unity the NAL unit header.

*It is therefore proposed to unify the NAL unit header for VCL and non-VCL NAL units. A sub-bitstream extraction process utilizing the unified NAL unit header is also proposed.*

# Text changes

The changes, in relative to HEVC WD3d8, provided below are proposed.

# 7.3.1 NAL unit syntax

|  |  |
| --- | --- |
| nal\_unit( NumBytesInNALunit ) { | Descriptor |
| **nal\_unit\_type** | u(5) |
| **nal\_ref\_flag** | u(1) |
| **temporal\_id** | u(3) |
| **output\_flag** | u(1) |
| **reserved\_one\_6bits** | u(6) |
| 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) |
| } |  |
| } |  |

# 7.4.1 NAL unit semantics

NOTE 1 – The VCL is specified to efficiently represent the content of the video data. The NAL is specified to format that data and provide header information in a manner appropriate for conveyance on a variety of communication channels or storage media. All data are contained in NAL units, each of which contains an integer number of bytes. A NAL unit specifies a generic format for use in both packet-oriented and bitstream systems. The format of NAL units for both packet-oriented transport and byte stream is identical except that each NAL unit can be preceded by a start code prefix and extra padding bytes in the byte stream format.

NumBytesInNALunit specifies the size of the NAL unit in bytes. This value is required for decoding of the NAL unit. Some form of demarcation of NAL unit boundaries is necessary to enable inference of NumBytesInNALunit. One such demarcation method is specified in Annex  for the byte stream format. Other methods of demarcation may be specified outside of this Recommendation | International Standard.

**nal\_unit\_type** specifies the type of RBSP data structure contained in the NAL unit as specified in .

NAL units that use nal\_unit\_type equal to 0 or in the range of 24..31, inclusive, shall not affect the decoding process specified in this Recommendation | International Standard.

NOTE 2 – NAL unit types 0 and 24..31 may be used as determined by the application. No decoding process for these values of nal\_unit\_type is specified in this Recommendation | International Standard. Since different applications might use NAL unit types 0 and 24..31 for different purposes, particular care must be exercised in the design of encoders that generate NAL units with nal\_unit\_type equal to 0 or in the range of 24 to 31, inclusive, and in the design of decoders that interpret the content of NAL units with nal\_unit\_type equal to 0 or in the range of 24 to 31, inclusive.

Decoders shall ignore (remove from the bitstream and discard) the contents of all NAL units that use reserved values of nal\_unit\_type.

NOTE 3 – This requirement allows future definition of compatible extensions to this Recommendation | International Standard.

Table 7‑1 – NAL unit type codes, syntax element categories, and NAL unit type classes

|  |  |  |
| --- | --- | --- |
| **nal\_unit\_type** | **Content of NAL unit and RBSP syntax structure** | **NAL unit type class** |
| 0 | Unspecified | non-VCL |
| 1 | Coded slice of a non-IDR and non-CDR picture slice\_layer\_rbsp( ) | VCL |
| 2-3 | Reserved | n/a |
| 4 | Coded slice of a CDR picture  slice\_layer\_rbsp( ) | VCL |
| 5 | Coded slice of an IDR picture slice\_layer\_rbsp( ) | VCL |
| 6 | Supplemental enhancement information (SEI) sei\_rbsp( ) | non-VCL |
| 7 | Sequence parameter set seq\_parameter\_set\_rbsp( ) | non-VCL |
| 8 | Picture parameter set pic\_parameter\_set\_rbsp( ) | non-VCL |
| 9 | Access unit delimiter access\_unit\_delimiter\_rbsp( ) | non-VCL |
| 10-11 | Reserved | n/a |
| 12 | Filler data filler\_data\_rbsp( ) | non-VCL |
| 13-23 | Reserved | n/a |
| 24..31 | Unspecified | non-VCL |

The variable IdrPicFlag is specified as

IdrPicFlag = ( ( nal\_unit\_type = = 5 ) ? 1 : 0 ) (7‑1)

When the value of nal\_unit\_type is equal to 5 for a NAL unit containing a slice of a particular picture, the picture shall not contain NAL units with nal\_unit\_type equal to 1 or 4. Such a picture is referred to as an IDR picture.

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

**temporal\_id** specifies a temporal identifier for the NAL unit. The value of temporal\_id shall be the same for all VCL NAL units of an access unit. When an access unit contains any NAL unit with nal\_unit\_type equal to 5, temporal\_id shall be equal to 0 for all VCL NAL units of the access unit.

The temporal\_id of an access unit is derived as equal to the temporal\_id value of the VCL NAL units in the access unit.

For a non-VCL NAL unit, the following applies:

* The value of temporal\_id shall not be less than the temporal\_id of the access unit containing the non-VCL NAL unit.
  + For a sequence parameter set NAL unit, temporal\_id shall be equal to 0.
  + For an access unit delimiter NAL unit, temporal\_id shall be identical to the temporal\_id of the access unit.

**output\_flag** affects the decoded picture output and removal processes as specified in Annex . The value of the flag shall be the same for all NAL units of one access unit.

[Ed. KS: There is no output definition on Annex C yet]

**reserved\_one\_6bits** shall be equal to 1. Other values of reserved\_one\_6bits may be specified in the future by ITU‑T | ISO/IEC. Decoders shall ignore the value of reserved\_one\_6bits.

**…**

# 8.7 Proposed sub-bitstream extraction process

It is requirement of bitstream conformance that any sub-bitstream that is the output of the process specified in this subclause with tIdTarget equal to any value in the range of 0 to 7, inclusive, shall be conforming to this Recommendation | International Standard.

NOTE – A conforming bitstream contains one or more coded slice NAL units with temporal\_id equal to 0.

Input to this process is:

* – a variable tIdTarget (when present),

Output of this process is a sub-bitstream.

When tIdTarget is not present as input to this subclause, tIdTarget is inferred to be equal to 7.

The sub-bitstream is derived by removing all NAL units for which temporal\_id is greater than tIdTarget.

# Patent rights declaration(s)

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