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| *Title:* | **AHG 9 / AHG 10: On NAL unit header** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution discusses two items. First, it is assessed that the functionality of nal\_ref\_flag might be redundant as described in JCTVC-I0251 and JCTVC-I0355 so that the removal of the flag should be considered. To cover the flag functionality to differentiate reference and non-reference picture, it is suggested to add a constraint to the semantic of temporal\_id such that temporal\_id of NAL units that contain slices that are not use for reference must not be equal to 0.

Second, it is assessed that if future extensions of HEVC also use the current fixed 2 bytes NAL unit header size, there is only 5 bits, which is the reserved\_one\_5bits, available to be used to describe layer identification. This might be too small considering the extension might cover not only scalability extension but also multiview extension. Furthermore, it might not be necessary to treat temporal identification from identification of other scalability / view types in the extensions of HEVC. Therefore, it is propose to combine reserved\_one\_5bits and temporal\_id and change its name to layer\_id.

# Introduction and Problem Statement

In the meeting in San Jose, 5 reserved bits are added to the NAL unit header as a hook for future extensions of HEVC. The purpose was to have a fixed size (2 bytes) NAL unit header while still supporting the future extensions. In this contribution, we propose some revisions to the existing syntax elements of NAL unit header to support more efficient extraction of bitstreams. First nal\_ref\_flag is suggested to be removed, saving one bit for other purpose. Second, the 5 bits of reserved\_one\_5bits are combined with 3 bits of temporal\_id, forming a 8-bit element called layer\_id. .

# Proposed modifications

## Remove nal\_ref\_flag and modify semantic of temporal\_id

Currently, nal\_ref\_flag is used to indicate the non-reference pictures and reference pictures. This information gives some rough priority between these two types of pictures. This syntax element may have the following issues:

1. The use of this flag for extraction is rather limited as pointed in [1]. If all non-reference pictures (mostly those in the highest temporal layer) are discarded, all remaining pictures have nal\_ref\_flag equal to 1. Yet, it is obvious that some pictures (again mostly at the highest temporal layer) of the adapted/extracted bitstream in fact become non-reference pictures though their nal\_ref\_flag’s are equal to 1.
2. The flag functionality may not be necessary anymore as it is overlaped with other syntaxes [2]. After the adoption of reference picture set based decoded picture buffer management the decoding process does not need to know whether a picture is a reference picture or not. Also, the functionality of the flag for bitstream extraction may be replaced by temporal\_id as this syntax element provides more information that can be used by media-aware network elements to discard pictures.

Thus, since nal\_ref\_flag is not really useful when temporal\_id is in use, we propose to remove the flag.

Simply removing nal\_ref\_flag may not be enough since currently temporal\_id can be set equal to 0 for all VCL NAL units. If temporal\_id is 0 for all VCL NAL units, then it is difficult to differentiate reference and non-reference picture at NAL unit header level. Thus, to anticipate such situation, we also propose to add the following constraint to the semantic of temporal\_id.

“Temporal\_id of NAL units that contain slices that are not use for reference must not be equal to 0”

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

Current NAL unit header specification might not be the best configuration to support easy future extensions (i.e., scalability, multiview, three dimension coding extensions, etc). The foreseen problems with the current NAL unit header specification are as follow:

1. ***Limited space for layer identification description***

If the current designed of fixed 2 bytes NAL unit header is used in the extensions of HEVC, then the only possible place for defining layer identification (i.e., scalability layers, view identification, etc) is only the reserved\_one\_5bits syntax element, which is only support up to 32 layers since it has only 5 bits.

Having only 32 possible layers might not be enough since ther are many types of scalabilities and view layers are necessary to be supported (e.g., spatial scalability, quality scalability, bit-rate scalability, etc).

1. ***Confusion over temporal scalability***

Current NAL unit header specification already has temporal\_id while other possible additional scalability extension can only uses the reserved\_one\_5bits. This separation between temporal scalability and other type of scalabilities can create confusion. For some, temporal scalability is just a type of scalability and should be treated similar to other type of scalability.

1. ***Redundancy for bit assignment***

Current NAL unit header specification fixes the order such that temporal\_id is sent before the reserved\_one\_5bits. With this designed, it is mandatory to assign 3 bits for describing temporal scalability. However, temporal scalability is not always used. It is possible that bitstreams of scalable extension of HEVC might turn off temporal scalability and use other type of scalability. That means that the 3 bits assigned for temporal scalability may be redundant and should be better used for describing other scalabilities

Considering the above three possible problem, it might be desired that current temporal\_id syntax element shall be treated as part of layer identification for HEVC extension. By doing this, layer identification for HEVC extension can use not only reserved\_one\_5bits but also the combination of reserved\_one\_5bits and temporal\_id. Therefore, we propose:

* Both reserved\_one\_5bits and temporal\_id are combined to form a new element called layer\_id.
* For base layer (i.e., HEVC), layer\_id shall also be considered the same as current temporal\_id.

The modification to accommodate the above proposals is as follow:

|  |  |
| --- | --- |
| nal\_unit( NumBytesInNALunit ) { | Descriptor |
| **forbidden\_zero\_bit** | f(1) |
| **~~nal\_ref\_flag~~** | ~~u(1)~~ |
| **reserved\_one\_bit** | u(1) |
| **nal\_unit\_type** | u(6) |
| **~~temporal\_id~~** | ~~u(3)~~ |
| **~~reserved\_one\_5bits~~** | ~~u(5)~~ |
| **layer\_id** | u(8) |
| 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) |
| } |  |
| } |  |

**layer\_id** specifies a layer identifier for the NAL unit. The value of layer\_id shall be the same for all VCL NAL units of an access unit.

NOTE: For VCL NAL unit of HEVC:

* When an access unit is a RAP access unit, layer\_id for all VCL NAL units of the access unit shall be equal to 0.
* When nal\_unit\_type is equal to 3, layer\_id shall not be equal to 0.

# References

[1] T. C. Thang, J. W. Kang, H. Lee, J. S. Choi, "On NAL unit header," JCTVC-I0251, 9th meeting: Geneva, CH, 27 April – 7 May, 2012.

[2] Y.-K. Wang, Y. Chen, "High-level syntax hook for HEVC multi-standard extensions," JCTVC-I0355, 9th meeting: Geneva, CH, 27 April – 7 May, 2012.

# Patent rights declaration(s)

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