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| *Title:* | **NAL unit header and sub-bitstream extraction** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

In HEVC WD2, the temporal\_id field only appears in the VCL NAL unit headers. There was a proposal in JCTVC-D080 to include temporal\_id also in the NAL unit header of SEI NAL units for support of temporal subsets specific SEI messages. This document proposes the inclusion of temporal\_id in the NAL unit header for all NAL unit types, and further proposes a sub-bitstream extraction process that is only based on information in NAL unit headers.

# SVC sub-bitstream extraction process

For convenience, the SVC sub-bitstream extraction process is copied in Section 1.1. An analysis of the SVC sub-bitstream extraction process is present in Section 1.2.

## SVC sub-bitstream extraction process

The SVC sub-bitstream extraction process is copied below for convenience.

G.8.8.1 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 pIdTarget equal to any value in the range of 0 to 63, inclusive, tIdTarget equal to any value in the range of 0 to 7, inclusive, dIdTarget equal to any value in the range of 0 to 7, inclusive, and qIdTarget equal to any value in the range of 0 to 15, inclusive, shall be conforming to this Recommendation | International Standard.

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

Inputs to this process are:

– a variable pIdTarget (when present),

– a variable tIdTarget (when present),

– a variable dIdTarget (when present),

– a variable qIdTarget (when present).

Output of this process is a sub-bitstream.

When pIdTarget is not present as input to this subclause, pIdTarget is inferred to be equal to 63.

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

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

When qIdTarget is not present as input to this subclause, qIdTarget is inferred to be equal to 15.

The sub-bitstream is derived by applying the following operations in sequential order:

1. Mark all VCL NAL units and filler data NAL units for which any of the following conditions is true as "to be removed from the bitstream":

– priority\_id is greater than pIdTarget,

– temporal\_id is greater than tIdTarget,

– dependency\_id is greater than dIdTarget,

– dependency\_id is equal to dIdTarget and quality\_id is greater than qIdTarget.

1. Remove all access units for which all VCL NAL units are marked as "to be removed from the bitstream".
2. Remove all VCL NAL units and filler data NAL units that are marked as "to be removed from the bitstream".
3. When dIdTarget is equal to 0 and qIdTarget is equal to 0, remove the following NAL units:

– all NAL units with nal\_unit\_type equal to 14 or 15,

– all NAL units with nal\_unit\_type equal to 6 in which the first SEI message has payloadType in the range of 24 to 35, inclusive.

1. Remove all NAL units with nal\_unit\_type equal to 6 that only contain SEI messages that are part of a scalable nesting SEI message with any of the following properties:

– sei\_temporal\_id is greater than tIdTarget,

– the minimum value of ( sei\_dependency\_id[ i ] << 4 ) + sei\_quality\_id[ i ] for all i in the range of 0 to num\_layer\_representations\_minus1, inclusive, is greater than ( dIdTarget << 4 ) + qIdTarget.

1. Remove all NAL units with nal\_unit\_type equal to 6 that contain SEI messages with payloadType equal to 24, 28, or 29.

## An analysis of the SVC sub-bitstream extraction process

The SVC sub-bitstream extraction process has the following shortcomings:

* As shown in steps 5 and 6, removal of SEI messages from the original bitstream needs to look into fields in NAL unit payloads, including payloadType, sei\_temporal\_id, sei\_dependency\_id[ i ], and/or sei\_quality\_id[ i ]. If the sub-bitstream extractor only needs to look into NAL unit header fields, which are always fixed-length coded, the implementation complexity of the bitstream extractor would be lower and extracting a bitstream subset would be of either lower computational complexity or faster.
* NAL units such as sequence parameter sets, picture parameter sets, and subset sequence parameter sets are not associated with priority\_id, temporal\_id, dependency\_id or quality\_id. These NAL may remain in the extracted sub-bitstream but are actually not needed, thus waste bandwidth when transmitted and waste storage space when stored. Moreover, for HRD compliance, these non-required data need to be taken into account in setting the buffering parameters.

# An example sub-bitstream extraction process for HEVC

Following the same principle of the SVC sub-bitstream extraction process, the sub-bitstream extraction process for HEVC can be specified as follows.

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 applying the following operations in sequential order:

1. Mark all VCL NAL units and filler data NAL units for which the following condition is true as "to be removed from the bitstream":

– temporal\_id is greater than tIdTarget.

1. Remove all access units for which all VCL NAL units are marked as "to be removed from the bitstream".

Similar as for the SVC sub-bitstream extraction process, this sub-bitstream extraction process is associated with the following shortcoming:

* NAL units not associated with temporal\_id, such as sequence parameter sets, picture parameter sets, and SEI messages may remain in the extracted sub-bitstream but actually not needed, thus waste bandwidth when transmitted and waste storage space when stored. Moreover, for HRD compliance, these non-required data need to be taken into account in setting the buffering parameters.

# Proposal

This document proposes to include temporal\_id in NAL unit headers of all types of NAL units, such that not only temporal subsets specific SEI messages are supported, but also a simple sub-bitstream extraction process is enabled. This document further proposes a sub-bitstream extraction process that is only based on information included in NAL unit headers.

The proposed changed NAL unit header syntax and semantics are described in Section 3.1, and the proposed sub-bitstream extraction process is described in Section 3.2.

## Proposed NAL unit header syntax and semantics

The NAL unit header syntax is changed as follows:

|  |  |
| --- | --- |
| nal\_unit( NumBytesInNALunit ) { | Descriptor |
| **forbidden\_zero\_bit** | f(1) |
| **nal\_ref\_idc** | u(2) |
| **nal\_unit\_type** | u(5) |
| **temporal\_id** | u(3) |
| **output\_flag** | u(1) |
| **reserved\_zero\_4bits** | u(4) |
| 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) |
| } |  |
| } |  |

Basically, the fields temporal\_id, output\_flag and reserved\_zero\_4bits are now included in the NAL unit header for all NAL unit types, instead of being included only in the NAL unit header of VCL NAL units in WD2.

The semantics of output\_flag is missing in WD2. In HEVC context, the flag basically specifies whether the decoded picture from decoding an access unit is to be output or not. For non-VCL NAL units, the flag shall be identical to the value of the flag in the VCL NAL units of the same access unit.

The semantics of temporal\_id and output\_flag is as follows.

**temporal\_id** specifies a temporal identifier for the NAL unit. The assignment of values to temporal\_id is constrained by the sub-bitstream extraction process.

The value of temporal\_id shall be identical for all VCL NAL units in an access unit.

When an access unit contains any NAL unit with nal\_unit\_type equal to 5, temporal\_id in all VCL NAL units of the access unit shall be equal to 0.

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:

* A non-VCL NAL unit with temporal\_id equal to *tId* is not included in the sub-bitstream extracted per the sub-bitstream extraction process with tIdTarget less than *tId* as input.
* The value of temporal\_id shall be identical to or greater than the temporal\_id of the access unit containing the non-VCL NAL unit (i.e. shall not be less than the temporal\_id of the access 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.

## 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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