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# Abstract

This document discusses the HEVC NAL unit header syntax and proposes the following:

* To save one bit from nal\_ref\_idc
* To include temporal\_id in SEI NAL units
* To include indication of anchor picture (i.e. open-GOP picture) in NAL unit header
* To discuss indication of intra picture in NAL unit header

On nal\_ref\_idc

The NAL unit header contains a two-bit field nal\_ref\_idc. The semantics is missing in the HEVC WD, but basically it is the same as in AVC. Simply put, nal\_ref\_idc greater than 0 (i.e. equal to 1, 2, or 3) indicates a reference picture, while nal\_ref\_idc equal to 0 indicates a non-reference picture. The WD (as well as the AVC specification) does not specify the difference among the non-zero values 1, 2, and 3 of nal\_ref\_idc. The only use of different non-zero values for nal\_ref\_idc that we know is in AVC RTP payload format specified by the IETF, wherein greater values of nal\_ref\_idc indicate higher transport priorities. Even this use was dropped in the SVC RTP payload format, as there are other fields like dependency\_id, quality\_id and temporal\_id that are more relevant to transport priorities.

In the context of video coding specifications (HEVC, AVC, SVC, and MVC), we think using two bits for nal\_ref\_idc is a waste, as the difference among the non-zero values is not specified. Rather, using one bit would be sufficient.

*Therefore, we propose to use one bit instead of two bits for this syntax element, and change the name from “nal\_ref\_idc” to “nal\_ref\_flag”. For the one bit saved from change, we propose to either make it part of the syntax element nal\_unit\_type, i.e. using six bits instead of five bits for nal\_unit\_type, or make it as reserved.*

On temporal\_id

In the current HEVC WD, the temporal\_id field only appears in the VCL NAL unit headers. On the other hand, there may be SEI messages (e.g. buffering period SEI messages as specified in AVC) that are coded only for certain temporal subsets of an HEVC bitstream. Furthermore, an access unit in HEVC may include multiple SEI messages of the same type for use when different temporal subsets are decoded. Therefore, it is necessary to have a mechanism to specify the temporal subset for which an SEI message is signaled.

One solution is to borrow the scalable nesting SEI message defined in SVC. However, that SEI message was designed for bitstream subsets identified by three variables, namely, dependency\_id, quality\_id and temporal\_id. Therefore, if taken from SVC and applied to HEVC, its syntax needs be modified to exclude dependency\_id and quality\_id, as the two are not applicable in HEVC. There is another problem with this solution, i.e.,temporal subset information is included inside the scalable nesting SEI message. Therefore it requires parsing into the scalable nesting SEI message to obtain the information.

Unlike the backward compatibility requirement imposed upon SVC when SVC was designed, HEVC is free of such restriction. That provides us the possibility to come up with a cleaner design without being tied up by legacy issues. Therefore, we propose to include the temporal\_id field in SEI NAL unit headers. This way, not only the same type of SEI messages can now be applied to different temporal subsets in an HEVC bitstream, but also the extraction process of relevant SEI messages becomes simple (by just looking into SEI NAL unit headers).

*We therefore propose to include temporal\_id in the NAL unit header for SEI NAL units.*

On indication of anchor picture in NAL unit header

There are three types of coded pictures that may be used as random access points (RAPs):

* IDR pictures: When decoding starts from an IDR picture, the IDR picture and all following pictures decoding order can be correctly decoded. IDR pictures are also referred to as closed-GOP pictures.
* Anchor pictures: When decoding starts from an anchor picture, the anchor picture and all following pictures in output order can be correctly decoded. However, there may exist some pictures that are posterior to it in decoding order but prior to it in output order cannot be correctly decoded. Anchor pictures are also referred to as open-GOP pictures.
* Gradual decoding refresh (GDR) pictures: When decoding starts from a GDR picture, the GDR picture and a few following pictures in decoding order cannot be correctly decoded, but all pictures afterwards in decoding order can be correctly decoded.

IDR pictures are signaled through nal\_unit\_type (when equal to 5) in the NAL unit header. Anchor pictures and GDR pictures may be signaled using the recovery point SEI message. In MVC, anchor pictures can also be indicated by a flag in the NAL unit header MVC extension.

Many video bitstreams do not contain many IDR pictures, but rely on anchor pictures to provide random access points. One example is the highly efficient hierarchical B coding structure. Another example is the IBBP coding structure.

In many application systems, e.g. video streaming, it is ideal to easily know the locations of random access points, particularly the locations of the “clean” RAPs comprised of IDR pictures and anchor pictures. As mentioned earlier, IDR pictures can already be identified by nal\_unit\_type in the NAL unit header. However, the other widely used “clean” RAP type, anchor pictures, cannot be easily identified.

*We therefore propose to include the indication in the NAL unit header about whether a picture is an anchor picture for HEVC. One way is to simply use one bit as a flag to indicate whether the picture the NAL unit belongs to is an anchor picture. An alternative is to specify a new NAL unit type.*

On indication of intra picture in NAL unit header

Intra pictures, which contain only intra coded slices, can be used for fast forward and fast rewind of a video bitstream. According to the WD, a coded picture is an intra picture if any of the following conditions is true:

* nal\_unit\_type is equal to 5 for a slice in the coded picture.
* slice\_type is equal to 2 for all slices in the coded picture.
* the access unit contains an access unit delimiter and the primary\_pic\_type is equal to 0.

That means, parsing into all slices’ the slice headers may be needed to find out whether a coded picture is an intra picture. Indication of intra pictures in NAL unit header would ease fast forward and fast rewind operations based on intra pictures.

*Therefore, we propose to discuss including the indication of whether a picture is an intra picture in the NAL unit header for HEVC. Similar as the indication of anchor pictures, one way is to simply use one bit as a flag to indicate whether the picture the NAL unit belongs to is an intra, and an alternative is to specify a new NAL unit type.*

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