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| *Title:* | **On reference picture list construction** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This document proposes to change the reference picture list construction process such that any reference picture with greater temproal\_id value would never appear in the reference picture list of a slice during its reference picture list construction process. This document further discusses the need of gaps\_in\_frame\_num\_value\_allowed\_flag in sequence parameter set and the related processes for generating and handling “non-existing” pictures needed when there is a gap between frame\_num values.

Introduction

The reference picture list construction process in HEVC WD can be summarized as the following three steps:

1. Reference picture list initialization, wherein the initial reference picture list(s), RefPicList0 and, for B slices, RefPicList1, are formed.
2. Reference picture list truncation, as specified by the following text copied from subclause 8.2.2.2 of the WD:
   * When the number of entries in the initial RefPicList0 or RefPicList1 produced as specified in subclauses 8.2.2.2.1 through 8.2.2.2.2 is greater than num\_ref\_idx\_l0\_active\_minus1 + 1 or num\_ref\_idx\_l1\_active\_minus1 + 1, respectively, the extra entries past position num\_ref\_idx\_l0\_active\_minus1 or num\_ref\_idx\_l1\_active\_minus1 are discarded from the initial reference picture list.
   * When the number of entries in the initial RefPicList0 or RefPicList1 produced as specified in subclauses 8.2.2.2.1 through 8.2.2.2.2 is less than num\_ref\_idx\_l0\_active\_minus1 + 1 or num\_ref\_idx\_l1\_active\_minus1 + 1, respectively, the remaining entries in the initial reference picture list are set equal to "no reference picture".
3. Reference picture list modification, wherein RefPicList0 and, for B slices, RefPicList1, from the above steps are modified according to reference picture modification commands signaled in the slice header, when present.

HEVC NAL unit header includes a temporal\_id field for VCL NAL units. By definition, a slice may use a reference picture with the same or less temporal\_id for inter prediction reference, but must not use a reference picture with greater temporal\_id for inter prediction reference. Therefore, there is no good reason for a reference picture list of a slice to contain reference pictures with greater temporal\_id values. For example, for a slice with temporal\_id equal to 1, if it happens that the first reference picture in the RefPicList0 has temporal\_id greater than 1, then either the reference index value would be equal to or greater than 1, which requires more bits to code at prediction unit level, or the slice header must contain reference picture list modification commands.

A clean design would be to slightly modify the reference picture list construction process such that reference pictures with greater temporal\_id value would never appear in a reference picture list at any phase of the reference picture list construction process.

Proposal

The following restriction to the reference picture list construction process is proposed:

* Let temporal\_id of the current slice be tId, reference pictures with temporal\_id greater than tId shall never be included in RefPicList0 or RefPicList1 (during and after the reference picture list construction process). This implies the following.
  + In reference picture list initialization, no reference picture with temporal\_id greater than tId is included in the initial RefPicList0 or RefPicList1.
  + In reference picture list modification, the following applies.
    - When modification\_of\_pic\_nums\_idc is equal to 0 or equal to 1, picNumLX shall be equal to the PicNum of a reference picture that is marked as "used for short-term reference" and that has temporal\_id equal to or less than tId.
    - When modification\_of\_pic\_nums\_idc is equal to 2, long\_term\_pic\_num picNumLX shall be equal to the long term picture number of a reference picture that is marked as "used for long-term reference" and that has temporal\_id equal to or less than tId.

Discussion

The sequence parameter set (SPS) includes gaps\_in\_frame\_num\_value\_allowed\_flag, which specifies whether a gap between values of frame\_num is allowed. In connection to this flag, the decoding process in case of an inferred gap between values of frame\_num is specified, and processes for handling of “non-existing” pictures are specified (currently not in the WD, but agreed to take from the AVC specification).

A frame\_num gap may only appear in a conforming bitstream when that bitstream is equivalent to an extracted subset of a temporal scalable bitstream and during the sub-bitstream extraction process some excluded high-layer pictures are reference pictures.

By including temporal\_id in the NAL unit header for VCL NAL units, HEVC explicitly supports temporal scalability (at least more explicitly than AVC). Thus, it would not make much sense to disallow gaps between values of frame\_num. In other words, it would not make much sense to allow gaps\_in\_frame\_num\_value\_allowed\_flag to be equal to 0. If the value of the flag can only be equal to 1, then it does not make sense to have the flag signaled at all.

Therefore, we think that gaps\_in\_frame\_num\_value\_allowed\_flag should be removed from SPS. Likely, the processes for generating and handling of “non-existing” pictures can also be excluded from the entire specification. We would like to have a discussion on this issue at this meeting, and a study after the meeting if needed.

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