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| *Title:* | **On wavefront parallel processing** | | |
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# Abstract

This document proposes to simply the wavefront parallel design in the following three aspects: 1) bitstream causality is kept to avoid bitstream pointer jumping back and forth within a coded slice; 2) the entropy coding synchronization point is fixed to be the second LCU in the above LCU row; 3) CABAC flushing and byte alignment at the end of LCU row is mandated.

# Proposal

HEVC WD5 includes the support of wavefronts parallel processing (WPP), which provides multiple sub-streams that can be parsed (with some LCU delay) and decoded in parallel (semi independently) without restricting in-picture prediction and usage of context elements across the sub-streams for the waves (rows of LCUs). At the start of each wave the CABAC states are initialized based on the CABAC states of the upper row of LCUs after decoding N >= 1 LCUs. The entry points of WPP sub-streams can be signaled as bit offsets in the slice header of the slice that contains the waves.

A problem associated with the current WPP design is as follows. When the number of WPP sub-streams is greater than one, the bitstream order (i.e. the decoding order if the coded picture is processed by one decoder core, not decoded in parallel) of coded bits for LCUs is changed. Basically, a coded LCU later in bitstream/decoding order may be by disallowing needed for cross-LCU prediction by another coded LCU earlier in decoding order. In other words, this breaks the bitstream causality (wherein no earlier data depends on data coming later in bitstream/decoding order) that has been always followed in video coding standards. While it is still possible to make the decoding process work, the decoding process gets more complex as the bitstream pointer need to jump back and forth with a NAL unit.

We propose to solve the bitstream causality problem the reordering of the coded waves with the same prediction relationship (effectively the same as num\_substreams\_minus1 being mandated to be equal to 0), and the syntax element num\_substreams\_minus1 is removed from the PPS syntax.

We also propose that, when WPP is in use, the entropy coding synchronization point is fixed to be the second LCU in the above LCU row (effectively the same as entropy\_coding\_synchro being equal to 1). Thus, when the use of WPP is signaled by another syntax element than entropy\_coding\_synchro (e.g. when WPP is considered as one mode of tiles, as proposed in JCTVC-H0513), entropy\_coding\_synchro is not needed and can be removed. The reason behind this proposal is that it does not make essential difference from coding efficiency point of view by using different synchronization points in the above LCU row. When a specific flexibility does not bring benefits, but only drawbacks, it should not be allowed. The drawback to allow for flexible entropy coding synchronization point in WPP is that additional conformance tests would be needed in decoder implementations.

We further propose to remove cabac\_istate\_reset\_flag and mandate CABAC flushing (effectively the same as mandating the value of cabac\_istate\_reset\_flag equal to 1) when and only when WPP is in use (the current PPS syntax includes cabac\_istate\_reset\_flag even when WPP is not in use, but in the decoding process, the value of the flag only takes effect when WPP is in use), and byte alignment is also mandated at the end of each wave. As shown in JCTVC-F275, CABAC flushing only causes 0.2% bitrate increase when WPP is in use. Byte alignment costs in average only 3.5 bits for each wave. With these marginal overhead (again only when WPP is in use), the different coded waves can be easily split from a coded slice and sent to different decoding cores for parallel decoding. Entry byte offset for each wave (except for the first one) is signaled using the same syntax for tiles and entropy slice as proposed in JCTVC-H0513.

Required syntax, semantics and decoding process changes are included in the attachment of JCTVC-H0513.

# Patent rights declaration(s)

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