



HEVC Video with Alpha

Interoperability Profile (Preliminary)

Version 0.9

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Introduction

The ability to composite a portion of a video element over a separate background is widely utilized in video production and broadcasting. This is usually facilitated by pro-oriented mezzanine formats that support transparency (alpha channels). The same techniques are useful in consumer scenarios—such as putting video on a complex background in a presentation or a web page—but common distribution formats do not have support for transparency. To enable these consumer workflows at distribution-friendly bit rates, an alpha channel can now compatibly be added to HEVC using the technique described in this document.

Annex F of the HEVC Specification (Recommendation ITU-T H.265) defines numerous multi-layer extensions to HEVC. Among these are extensions allowing auxiliary layers within encoded video bitstreams. One use anticipated for such auxiliary layers is alpha channels. This document describes a highly focused profile for video with alpha, using the syntax and tools in the HEVC Specification, with the goal of providing a clear target for file writers and file readers that maximizes interoperability.

Video tracks with alpha encoded in this manner may be stored in QuickTime Movie files and MPEG-4 files.

Note: The QuickTime Movie File Format Specification and the ISO Base Media File Format Specification use different terminology for broadly equivalent concepts: atoms and boxes; sample descriptions and sample entries. This document uses the former specification's terminologies without loss of generality.

Apple HEVC Video with Alpha Interoperability Profile

In order for a movie file or MPEG-4 file to conform to this profile, the following constraints must be satisfied.

Adhering to the principle that writers of an interoperable data format should be conservative in what they write, while readers should be somewhat flexible in what they accept, this document

- recommends specific values for writers to use for the alpha layer's `nuh_layer_id`, SPS ID, and PPS ID; and
- recommends that readers implement their support in a way that is not fragile in the face of files using alternative ID values, where they are used consistently with the HEVC Specification.

Constraints on the Movie and Track

- A single video track shall contain the corresponding base and alpha layers.

Constraints on Sample Description / Sample Entry

- The codec type shall be 'hvc1'.

- Both layers shall conform to Main Profile.
- The HEVC Decoder Configuration Record ('hvcC') shall contain the following parameter sets:
 - One Video Parameter Set (VPS) with `nuh_layer_id` equal to 0, and with `vps_video_parameter_set_id` equal to 0, and containing a `vps_extension`.
 - The `vps_extension`, following the syntax in F.7.3.2.1.1, shall indicate that a non-zero `nuh_layer_id` (referred to here as *alpha_nuh_layer_id*) is present, and that the corresponding layer has an auxiliary ID (AuxId) of 1 (AUX_ALPHA).
 - Writers are recommended to use 1 for the *alpha_nuh_layer_id*.
 - Readers should be prepared to accept a non-zero value for the *alpha_nuh_layer_id*, and use the value when identifying the alpha layer portion of video frames.
 - Two Sequence Parameter Sets (SPS):
 - One for the base layer, with `nuh_layer_id` equal to 0, and with `sps_seq_parameter_set_id` equal to 0.
 - One for the alpha layer, with `nuh_layer_id` equal to the *alpha_nuh_layer_id*, and with `sps_seq_parameter_set_id` equal to a non-zero number referred to here as the *alpha layer SPS ID*.
 - Both Sequence Parameter Sets shall have `sps_video_parameter_set_id` equal to 0.
 - Both Sequence Parameter Sets shall indicate `chroma_format_idc` equal to 1, meaning 4:2:0 chroma format.
 - The base layer SPS shall have `vui_parameters` that indicates `video_full_range_flag` = 0 (the base layer shall use video-range pixel values).
 - The alpha layer SPS shall have `vui_parameters` that indicates `video_full_range_flag` = 1 (the alpha layer shall use full-range pixel values).
 - Both Sequence Parameter Sets shall indicate the same width.
 - Both Sequence Parameter Sets shall indicate the same height.
 - Writers are recommended to use 1 for the *alpha layer SPS ID*.
 - Readers should be prepared to accept a non-zero value for the *alpha layer SPS ID*, and recognize the value in the alpha layer PPS's `pps_seq_parameter_set_id` field.
 - Two Picture Parameter Sets (PPS):
 - One for the base layer, with `nuh_layer_id` equal to 0, with `pps_seq_parameter_set_id` equal to 0, and with `pps_pic_parameter_set_id` equal to 0.
 - One for the alpha layer, with `nuh_layer_id` equal to the *alpha_nuh_layer_id*, and with `pps_seq_parameter_set_id` equal to the *alpha layer SPS ID*, and

with `pps_pic_parameter_set_id` equal to a non-zero number referred to here as the *alpha layer PPS ID*.

- Writers are recommended to use 1 for the *alpha layer PPS ID*.
- Readers should be prepared to accept a non-zero value for the *alpha layer PPS ID*, and recognize the value in the alpha layer portion of video frames, in video slice `slice_pic_parameter_set_id` fields.
- The HEVC Decoder Configuration Record ('hvcC') shall also contain an `alpha_channel_information` SEI message NAL unit, with `nuh_layer_id` equal to 0, and with the following values:
 - `alpha_channel_cancel_flag` = 0
 - `alpha_channel_use_idc` = 1 for pre-multiplied alpha, 0 for straight alpha (also known as unassociated alpha or non-pre-multiplied alpha)
 - `alpha_channel_bit_depth_minus8` = 0
 - `alpha_transparent_value` = 0 (specified as a 9 bit number as per F.14.2.8)
 - `alpha_opaque_value` = 255 (specified as a 9 bit number as per F.14.2.8)
 - `alpha_channel_incr_flag` = 0
 - `alpha_channel_clip_flag` = 0

Constraints on Video Frames

- Every video frame in the video track shall contain a base layer NAL unit sequence followed by an alpha layer NAL unit sequence.
- Both layers of every video frame shall have the same frame type and dependency structure. (This is necessary since there is only one sample table for the track, and readers will need to use that single sample table's set of dependency information to determine which frames need to be decoded during random access or any kind of trick play.)
- All base layer NAL units shall have `nuh_layer_id` 0.
- All alpha layer NAL units shall have `nuh_layer_id` equal to the *alpha nuh_layer_id* specified in the `vps_extension`.
- All video slices in the base layer NAL units shall have `slice_pic_parameter_set_id` set to the base layer PPS ID (0).
- All video slices in the alpha layer NAL units shall have `slice_pic_parameter_set_id` set to the *alpha layer PPS ID*.
- The decoded value of all chroma samples in the alpha layer shall be 128 (following F.7.4.3.1.1). (Only the luma samples of the alpha layer are used to code the alpha channel data.)

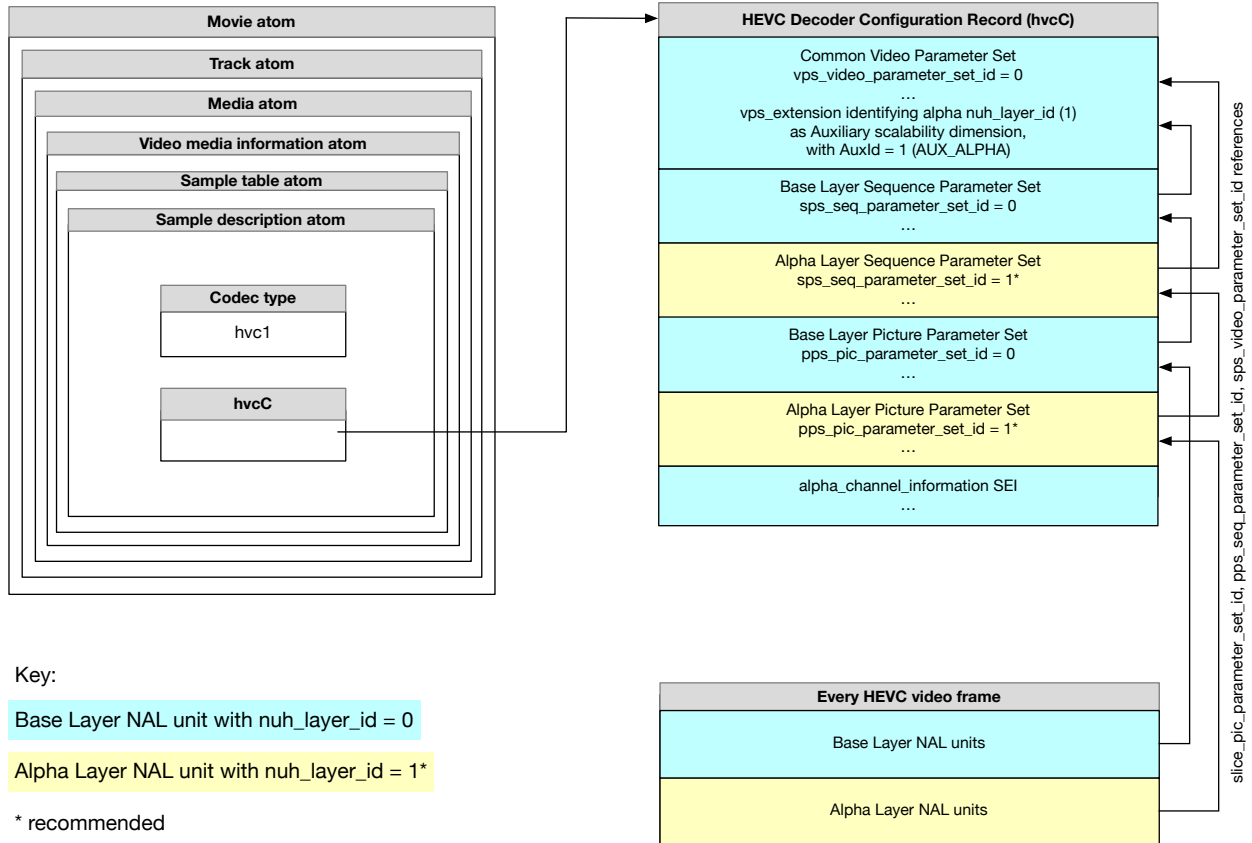


Figure 1. HEVC Decoder Configuration Record, Parameter Sets and Video Frames

File Type Brand

Movie files and MPEG-4 files containing tracks conforming to this profile should signal this by including 'muxa' in their list of minor brands in the File Type Brand atom.

Document Revision History

This table describes the changes to *HEVC Video with Alpha Interoperability Profile*

Date	Revision	Notes
2019-05-30	0.9	Preliminary release for WWDC19