In section 5.3.2, replace:

- **Sub-sequence and layering SEI messages.** Sub-sequence or layering SEI messages shall not occur in the AVC elementary stream. Specifically, the sub-sequence information, sub-sequence layer characteristics, and sub-sequence characteristics SEI messages shall not occur in the stored AVC video elementary stream.

with:

- **Sub-sequence and layering SEI messages.** Sub-sequence or layering SEI messages should not occur in the AVC elementary stream. Specifically, the sub-sequence information, sub-sequence layer characteristics, and sub-sequence characteristics SEI messages should not occur in the stored AVC video elementary stream.
In section 5.3.3.1.2 replace:
aligned(8) class AVCDecoderConfigurationRecord {
  unsigned int(8) configurationVersion = 1;
  unsigned int(8) AVCProfileIndication;
  [...]  
  if( profile_idc == 100 || profile_idc == 110 ||
      profile_idc == 122 || profile_idc == 144 )
}

with:
aligned(8) class AVCDecoderConfigurationRecord {
  unsigned int(8) configurationVersion = 1;
  unsigned int(8) AVCProfileIndication;
  [...]  
  if( AVCProfileIndication == 100 || AVCProfileIndication == 110 ||
      AVCProfileIndication == 122 || AVCProfileIndication == 144 )
}

In section 5.4.7 replace
reserved field is defined for AVC as follows:
with
The codec_specific_parameters field of the Subsample Information box is defined for AVC as follows:

In section 6.5.9 replace
reserved field is defined for SVC as follows:
with
The codec_specific_parameters field of the Subsample Information box is defined for SVC as follows:

Modify section 8 as follows:

8 HEVC elementary streams and sample definitions

8.1 Introduction

The High Efficiency Video Coding (HEVC) standard, jointly developed by the ITU-T and
ISO/IEC JTC 1/SC 29/WG 11 (MPEG), offers not only increased coding efficiency and enhanced robustness,
but also many features for the systems that use it. To enable the best visibility of, and access to, those
features, and to enhance the opportunities for the interchange and interoperability of media, this part of
ISO/IEC 14496-15 defines a storage format for video streams compressed using HEVC.

This clause of ISO/IEC 14496-15 specifies the storage format for HEVC (ISO/IEC 23008-2) video streams.

The storage of HEVC content uses the existing capabilities of the ISO base media file format but also defines
extensions to support the following features of the HEVC codec.

- Parameter sets:
  The video, sequence and picture parameter set mechanism decouples the transmission of infrequently
  changing information from the transmission of coded block data. Each slice containing the coded block
data references the picture parameter set containing its decoding parameters. In turn, the picture
  parameter set references a sequence parameter set that contains sequence level decoding parameter
  information, and the sequence parameter set references a video parameter set that contains global
decoding parameter information (across layers or view in potential scalable and 3DV extensions).

This specification includes the following tools for supporting of HEVC contents:

- Temporal scalability sample grouping:
  a structuring and grouping mechanism to indicate the association of access units with different hierarchy
  levels of temporal scalability.

- Temporal sub-layer access sample grouping:
  a structuring and grouping mechanism to indicate the identification of access units as temporal sub-layer
  access (TSA) samples.
— Step-wise temporal sub-layer access sample grouping:
  a structuring and grouping mechanism to indicate the identification of access units as step-wise temporal
  sub-layer access (STSA) samples.

8.2 Elementary Stream Structure

A video stream is represented by one video track in a file.
Two types of elementary streams are defined for storing HEVC content:
  • Video Elementary Stream that does not contain any parameter sets; all parameter sets are stored in
    a sample entry or sample entries;
  • Video and Parameter set elementary stream that may contain parameter sets, and may also have
    parameter sets stored in their sample entry or sample entries.

8.3 Sample and configuration definition

8.3.1 Introduction

HEVC sample: An HEVC sample is an access unit as defined in ISO/IEC 23008-2.

8.3.2 Canonical order and restrictions

The canonical stream format is an HEVC elementary stream that satisfies the following conditions in addition
 to the general conditions in 4.3.2
  • Access unit delimiter NAL units: The constraints obeyed by access unit delimiter NAL units are
    defined in ISO/IEC 23008-2.
  • Parameter sets: A parameter set to be used in a picture must be sent prior to the sample containing
    that picture or in the sample for that picture. For a video stream that a particular sample entry applies
    to, the video parameter set, sequence parameter sets, and picture parameter sets, shall be stored only
    in the sample entry when the sample entry name is "hvc1", and may be stored in the sample entry and
    the samples when the sample entry name is "hev1".
    NOTE Storing parameter sets in the sample entries of a video stream provides a simple and static way to
    supply parameter sets. Storing parameters in samples on the other hand is more complex but allows for more
    dynamism in the case of parameter set updates (a particular parameter set’s content is changed but using the
    same ID) and in the case of adding additional parameter sets. A decoder initializes with the parameter sets in the
    sample entry, and then updates using the parameter sets as they occur in the stream, starting from any sample
    marked as a sync sample. Such updating may replace parameter sets with a new definition using the same
    identifier. Each time the sample entry changes, the decoder re-initializes with the parameter sets included in the
    sample entry.
  • SEI messages: SEI messages of declarative nature may be stored in the sample entry; there is no
    prescription about removing such SEI messages from the samples.
  • Filler data. Video data is naturally represented as variable bit rate in the file format and should be filled
    for transmission if needed. Filler Data NAL units and Filler Data SEI messages shall not be present in
    the file format stored stream when the sample entry does not also permit parameter sets.

    NOTE The removal or addition of Filler Data NAL units, start codes, SEI messages or Filler Data SEI messages
    may change the bitstream characteristics with respect to conformance with the HRD when operating the HRD in
    CBR mode as specified in ISO/IEC 23008-2, Annex C.
8.3.3 Decoder configuration information

8.3.3.1 HEVC decoder configuration record

8.3.3.1.1 Definition

This subclause specifies the decoder configuration information for ISO/IEC 23008-2 video content. This record contains the size of the length field used in each sample to indicate the length of its contained NAL units as well as the parameter sets, if stored in the sample entry. This record is externally framed (its size must be supplied by the structure which contains it).

This record contains a version field. This version of the specification defines version 1 of this record. Incompatible changes to the record will be indicated by a change of version number. Readers must not attempt to decode this record or the streams to which it applies if the version number is unrecognised.

Compatible extensions to this record will extend it and will not change the configuration version code. Readers should be prepared to ignore unrecognised data beyond the definition of the data they understand. The values for `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flags`, `general_constraint_indicator_flags`, `general_level_idc`, `min_spatial_segmentation_idc`, `chroma_format_idc`, `bit_depth_luma_minus8` and `bit_depth_chroma_minus8` must be valid for all parameter sets that are activated when the stream described by this record is decoded (referred to as "all the parameter sets" in the following sentences in this paragraph). Specifically, the following restrictions apply:

- The value of `general_profile_space` in all the parameter sets must be identical.
- The tier indication `general_tier_flag` must indicate a tier equal to or greater than the highest tier indicated in all the parameter sets.
- The profile indication `general_profile_idc` must indicate a profile to which the stream associated with this configuration record conforms.

**NOTE** If the sequence parameter sets are marked with different profiles, then the stream may need examination to determine which profile, if any, the entire stream conforms to. If the entire stream is not examined, or the examination reveals that there is no profile to which the entire stream conforms, then the entire stream must be split into two or more sub-streams with separate configuration records in which these rules can be met.

- Each bit in `general_profile_compatibility_flags` may only be set if all the parameter sets set that bit.
- Each bit in `general_constraint_indicator_flags` may only be set if all the parameter sets set that bit.
- The level indication `general_level_idc` must indicate a level of capability equal to or greater than the highest level indicated for the highest tier in all the parameter sets.

- The `min_spatial_segmentation_idc` indication must indicate a level of spatial segmentation equal to or less than the lowest level of spatial segmentation indicated in all the parameter sets.
- The value of `chroma_format_idc` in all the parameter sets must be identical.
- The value of `bit_depth_luma_minus8` in all the parameter sets must be identical.
- The value of `bit_depth_chroma_minus8` in all the parameter sets must be identical.

Explicit indication can be provided in the HEVC Decoder Configuration Record about the chroma format and bit depth as well as other important format information used by the HEVC video elementary stream. Each type of such information must be identical in all parameter sets, if present, in a single HEVC configuration record. If two sequences differ in any type of such information, two different HEVC sample entries must be used. If the
two sequences differ in color space indications in their VUI information, then two different HEVC sample entries are also required.

There is a set of arrays to carry initialization NAL units. The NAL unit types are restricted to indicate SPS, PPS, VPS, and SEI NAL units only. NAL unit types that are reserved in ISO/IEC 23008-2 and in this specification may acquire a definition in future, and readers should ignore arrays with reserved or unpermitted values of NAL unit type.

NOTE – this 'tolerant' behaviour is designed so that errors are not raised, allowing the possibility of backwards-compatible extensions to these arrays in future specifications.

It is recommended that the arrays be in the order VPS, SPS, PPS, SEI.

When general_non_packed_constraint_flag (bit 3 of the 6-byte general_constraint_indicator_flags) is equal to 0 and some of the samples referring to this sample entry represent frame-packed content and any of the default display windows specified by the active SPSs for the samples referring to this sample entry covers more than one constituent frame of the frame-packed content, the techniques described in 8.15 of ISO/IEC 14496-12 ('Post-decoder requirements on media') using the scheme type "stvi" shall be used. In this case, the stereo_scheme in the Stereo Video Box should be set to 1, to indicate that the frame packing scheme used in HEVC is the same as in AVC.

8.3.3.1.2 Syntax

```plaintext
class HEVCDecoderConfigurationRecord {
    configurationVersion = 1;
    unsigned (2) general_profile_space;
    unsigned (1) general_tier_flag;
    unsigned (5) general_profile_idc;
    general_profile_compatibility_flags;
    unsigned (48) general_constraint_indicator_flags;
    unsigned (8) general_level_idc;
    bit (4) reserved = '1111'b;
    unsigned (12) min_spatial_segmentation_idc;
    bit (6) reserved = '111111'b;
    unsigned (2) parallelismType;
    bit (6) reserved = '111111'b;
    unsigned (2) chroma_format_idc;
    bit (5) reserved = '11111'b;
    unsigned (3) bit_depth_luma_minus8;
    bit (5) reserved = '11111'b;
    unsigned (3) bit_depth_chroma_minus8;
    bit (16) avgFrameRate;
    bit (2) constantFrameRate;
    bit (3) numTemporalLayers;
    bit (1) temporalIdNested;
    unsigned (2) lengthSizeMinusOne;
    unsigned (8) numOfArrays;
    for (j=0; j < numOfArrays; j++) {
        bit (1) array_completeness;
        reserved = 0;
        NAL_unit_type;
        for (i=0; i < numNalus; i++) {
            nalUnitLength;
            nalUnit;
        }
    }
}
```

8.3.3.1.3 Semantics

- `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flags`, `general_constraint_indicator_flags`, `general_level_idc`, `min_spatial_segmentation_idc`, `chroma_format_idc`, `bit_depth_luma_minus8`, and `bit_depth_chroma_minus8` contain the matching values for the fields `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`, `general_profile_space`, `general_tier_flag`, `general_profile_idc`, `general_profile_compatibility_flag[i]` for i from 0 to 31, inclusive, the 6 bytes starting with the byte containing the `general_progressive_source_flag`, `general_level_idc`, `min_spatial_segmentation_idc`,
chroma_format_idc, bit_depth_luma_minus8 and bit_depth_chroma_minus8 as defined in ISO/IEC 23008-2, for the stream to which this configuration record applies.

parallelismType indicates the type of parallelism that is used to meet the restrictions imposed by min_spatial_segmentation_idc when the value of min_spatial_segmentation_idc is greater than 0. Value 1 indicates that the stream to which this configuration record applies supports slice based parallel decoding. Value 2 indicates that the stream to which this configuration record applies supports tile based parallel decoding. Value 3 indicates that the stream to which this configuration record applies supports entropy coding synchronization based parallel decoding. Value 0 indicates that the stream supports mixed types of parallel decoding or that the parallelism type is unknown. The values above can be inferred by the fields tiles_enabled_flag and entropy_coding_sync_enabled_flag as defined in ISO/IEC 23008-2. Specifically: if the fields tiles_enabled_flag and entropy_coding_sync_enabled_flag are both equal to 0 in all PPSs that are activated when the stream to which this configuration record applies is decoded, then parallelismType can be set to 1. If tiles_enabled_flag in all PPSs that are activated when the stream to which this configuration record applies is decoded, is equal to 1 then parallelismType can be set to 2. If entropy_coding_sync_enabled_flag in all PPSs that are activated when the stream to which this configuration record applies is decoded, is equal to 1 then parallelismType can be set to 3. If none of the above is true (or if it is unknown which of them is true) then parallelismType should be set to 0.

avgFrameRate gives the average frame rate in units of frames/(256 seconds), for the stream to which this configuration record applies. Value 0 indicates an unspecified average frame rate.

constantFrameRate equal to 1 indicates that the stream to which this configuration record applies is of constant frame rate. Value 2 indicates that the representation of each temporal layer in the stream is of constant frame rate. Value 0 indicates that the stream may or may not be of constant frame rate.

numTemporalLayers greater than 1 indicates that the stream to which this configuration record applies is temporally scalable and the contained number of temporal layers (also referred to as temporal sub-layer or sub-layer in ISO/IEC 23008-2) is equal to numTemporalLayers. Value 1 indicates that the stream is not temporally scalable. Value 0 indicates that it is unknown whether the stream is temporally scalable.

temporalIdNested equal to 1 indicates that all SPSs that are activated when the stream to which this configuration record applies is decoded have sps_temporal_id_nesting_flag as defined in ISO/IEC 23008-2 equal to 1 and temporal sub-layer up-switching to any higher temporal layer can be performed at any sample. Value 0 indicates that the conditions above are not or may not be met.

lengthSizeMinusOne plus 1 indicates the length in bytes of the NALUnitLength field in an HEVC video sample in the stream to which this configuration record applies. For example, a size of one byte is indicated with a value of 0. The value of this field shall be one of 0, 1, or 3 corresponding to a length encoded with 1, 2, or 4 bytes, respectively.

numArrays indicates the number of arrays of NAL units of the indicated type(s).

array_completeness when equal to 1 indicates that all NAL units of the given type are in the following array and none are in the stream; when equal to 0 indicates that additional NAL units of the indicated type may be in the stream; the default and permitted values are constrained by the sample entry name.

NAL_unit_type indicates the type of the NAL units in the following array (which must be all of that type); it takes a value as defined in ISO/IEC 23008-2; it is restricted to take one of the values indicating a VPS, SPS, PPS, or SEI NAL unit;

numNalus indicates the number of NAL units of the indicated type included in the configuration record for the stream to which this configuration record applies. The SEI array must only contain SEI messages of a ‘declarative’ nature, that is, those that provide information about the stream as a whole. An example of such an SEI could be a user-data SEI.

nalUnitLength indicates the length in bytes of the NAL unit.

nalUnit contains an SPS, PPS, VPS or declarative SEI NAL unit, as specified in ISO/IEC 23008-2.

In 8.4.1.1.1 replace the following text
An HEVC visual sample entry shall contain an HEVC Configuration Box, as defined below. This includes an HEVCDecoderConfigurationRecord, as defined in 5.3.3.1.

With
An HEVC visual sample entry shall contain an HEVC Configuration Box, as defined below. This includes an HEVCDecoderConfigurationRecord, as defined in 8.3.3.1.

In section 8.4.1.1.2, replace:
In 8.4.1.1.3 replace the following text
HEVCDecoderConfigurationRecord is defined in 5.3.3.
With
HEVCDecoderConfigurationRecord is defined in 8.3.3.

In section 8.4.8, replace:
For the use of the sub-sample information box (8.7.7 of ISO/IEC 14496-12) in an HEVC stream, a sub-sample is defined on the basis of the value of the flags field of the sub-sample information box as specified below. The presence of this box is optional; however, if present in a track containing HEVC data, it shall have the semantics defined here.

With:
For the use of the sub-sample information box (8.7.7 of ISO/IEC 14496-12) in an HEVC stream, a sub-sample is defined on the basis of the value of the flags field of the sub-sample information box as specified below. The presence of this box is optional; however, if present in a track containing HEVC data, the 'codec_specific_parameters' field in the box shall have the semantics defined here.