Scientific Working Group on Digital Evidence

SWGDE Fundamentals of H.264 Coded Video for Examiners

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1. Purpose

The purpose of this document is to explain the storage and transmission of H.264 coded video for forensic practitioners. An understanding of the H.264 standard, as well as two common implementations will help to provide the practitioner with the ability to understand and organize packet and frame information, as well as validate tools that utilize the format information at the byte level. This information can also aid in decoding video data from H.264 coded video streams as well as unstructured or buffered data sets where a stream has not been defined, or a file has become damaged.

2. Scope

This document will discuss how coded video is stored as binary streams within standard implementations of H.264. The specifics discussed are H.264's AVCC and Annex B implementations for storing components of frame data and format information. A bit and byte level discussion for manually decoding these components will be discussed.

3. Limitations

This is not intended to replace or transcribe the H.264 ITU-T/ISO standard (1). Information specifically relevant to the storage of H.264 coded video will be included in this document. This document is not intended to be an instruction document on how to manually parse video data, but is to be used to better understand how this process could be accomplished. This document does not discuss H.264 when accompanied by an audio stream, as there could be several audio codecs integrated within a video file. This document does not address how video information is read or how to interpret data in binary and hexadecimal viewers.

This document does not discuss picture decoding or compression. (For more information about compression at a high level can be found in *SWGDE Fundamental of Digital File Formats*.)

4. Terminology[1]

- ***Access unit:*** A set of the Network Abstraction Layer (NAL) units always containing a primary coded picture. In addition to the primary coded picture, an access unit may also contain one or more redundant coded pictures or other NAL units not containing slices or slice data partitions of a coded picture. The decoding of an access unit always results in a decoded picture.
- ***Byte stream:*** An encapsulation of a NAL unit stream containing start code prefixes and NAL units as specified in Annex B.

[1] These terms are sourced from *ISO/IEC 14496-12 Section 3 - Definitions*. Additional terms can be found within the standard.

- ***Coded picture:*** A coded representation of a picture. A coded picture may be either a coded field or a coded frame. Coded picture is a collective term referring to a primary coded picture or a redundant coded picture, but not both together.
- ***Coded video sequence:*** A sequence of access units that consists, in decoding order, of an instantaneous decoding refresh (IDR) access unit followed by zero or more non-IDR access units including all subsequent access units up to but not including any subsequent IDR access unit.
- ***IDR access unit:*** An access unit in which the primary coded picture is an IDR picture.
- ***IDR picture:*** A coded picture containing only slices with I or SI slice types that causes a "reset" in the decoding process. After the decoding of an IDR picture, all following coded pictures in decoding order can be decoded without inter prediction from any picture decoded prior to the IDR picture.
- ***Network abstraction layer (NAL) unit:*** Syntax structure containing an indication of the type of data to follow and bytes containing that data in the form of a raw byte sequence payload (RBSP) interspersed as necessary with emulation prevention bytes.
- ***Primary coded picture:*** The coded representation of a picture to be used by the decoding process for a bitstream conforming to H.264. The primary coded picture contains all macroblocks of the picture.
- ***Redundant coded picture:*** A coded representation of a picture or a part of a picture. The content of a redundant coded picture shall not be used by the decoding process for a bitstream conforming to H.264. The content of a redundant coded picture may be used by the decoding process for a bitstream that contains errors or losses.
- ***Start code prefix:*** A unique sequence of three bytes equal to 0x000001 embedded in the byte stream as a prefix to each NAL unit. The location of a start code prefix can be used by a decoder to identify the beginning of a new NAL unit and the end of a previous NAL unit. Emulation of start code prefixes is prevented within NAL units by the inclusion of emulation prevention bytes.
- ***VCL (Video coded layer) NAL unit:*** A collective term used to refer to coded slice and coded data partition NAL units.

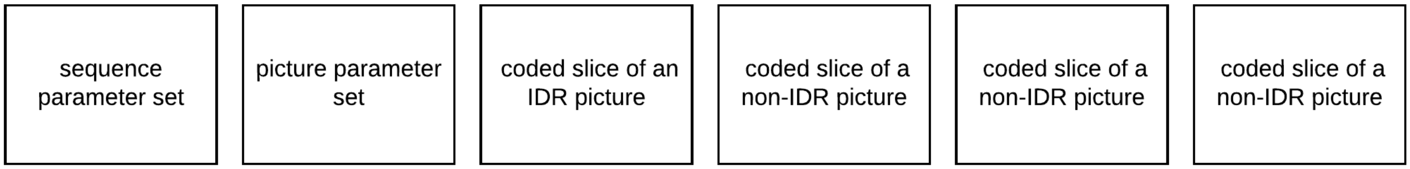
5. Introduction

H.264 is a video codec developed in 2004 in response to the growing amount of high-resolution video. H.264 encoding allows for compressing video images for storage efficiency and network or internet transport. Each video is split into coded video components, which is the collection of video frames (and ancillary metadata) within a byte stream. These streams are divided into sequences which are then broken down further into pictures (i.e., frames), and from pictures into slices, and from slices into macroblocks. This reduction into smaller units effectively allows components to be used as building blocks that can be duplicated or adjusted when H.264 decoding occurs.

6. Common H.264 Stream Components

H.264 defines a full set of components that can be used within a coded video stream. Some component types carry video data, others carry non-video data. The H.264 specification defines eighteen (18) component types. This document will cover a subset of the common components found in consumer and commercial video applications that use H.264 video coding. Video coding layer components addressed include a coded slice of a non-IDR picture (i.e., P-frame or B-frame) and a coded slice of an IDR picture (i.e., I-frame). Non-video coding layer components covered include supplemental enhancement information (SEI), sequence parameter sets (SPS), picture parameter sets (PPS), and access unit delimiters.

H.264 video streams require a combination of video and non-video coding layer components. For example, a minimally valid H.264 stream would include the following components:


sequence parameter set
picture parameter set
coded slice of an IDR picture
coded slice of a non-IDR picture
coded slice of a non-IDR picture
coded slice of a non-IDR picture

The pattern would continue throughout the video stream. In H.264, an access unit is the equivalent of a frame, or a single picture; supplemental enhancement metadata can also be included within the stream. One or more NAL units can be put together to make up an access unit.[2]

To support predictive video compression, a coded video sequence is a concept used to group related picture data together. The coded video sequence is a group of access units that consists in the decoding order of an IDR access unit (such as an I-frame) followed by zero or more non-IDR access units including all subsequent access units until the next IDR access unit (this is sometimes referred to as a group of pictures, or GOP). Ultimately, an H.264 video stream is made up of one or more coded video sequences and the necessary supporting non-video data.

7. Network Abstraction Layer

In order to encode the components above into a binary format, a basic building block called the network abstraction layer (NAL) unit is defined in the H.264 standard. This generic NAL unit structure is the fundamental building block of an H.264 video stream and carries all types of H.264 data. Each NAL unit declares, in its header, the type of data it carries. A NAL unit can contain data from the video coded layer (e.g., I-, P-, or B- frames) or from non-video coded layer

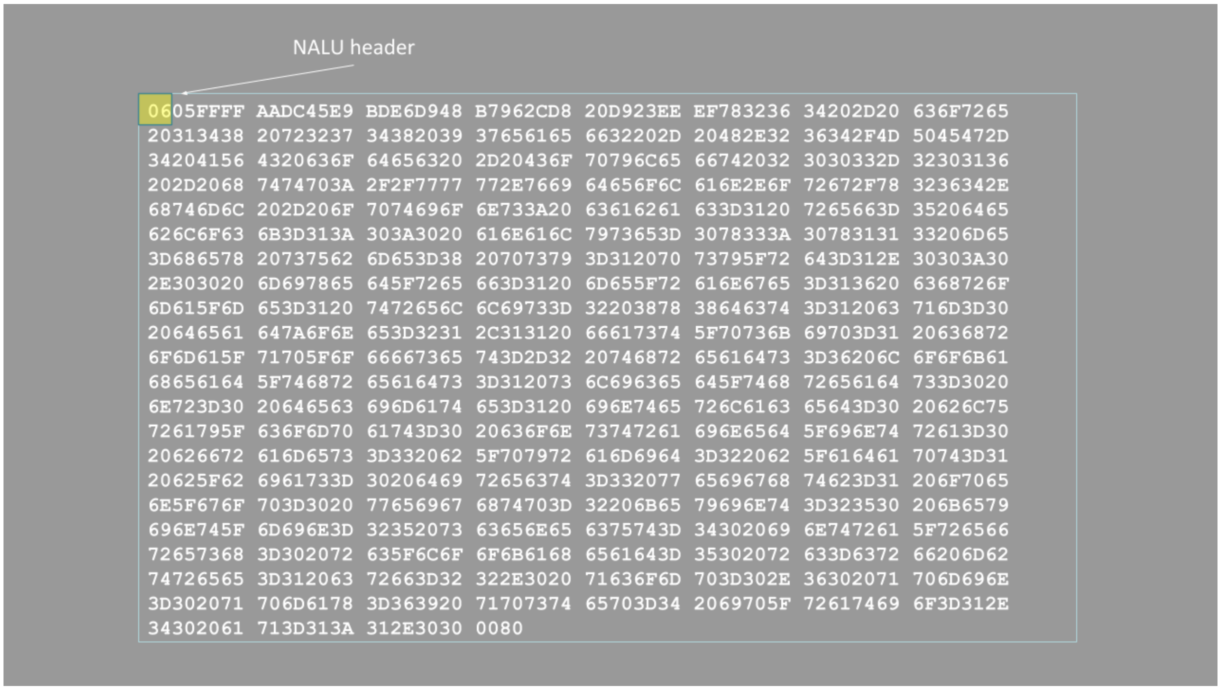
[2] There are circumstances when an I-frame or P-/B-frame is represented as multiple slices that constitute a single frame, then an access unit delimiter can be inserted to distinguish between coded slices that make up a single frame and those that make up slices within a frame. Because of this, a single NAL unit that contains coded picture does not always equate to a single frame; it may, instead, contain a slice of a single frame. However, the decoding of an access unit always results in a decoded picture, or a single frame

(e.g., ancillary metadata or parameter sets). Video coded layer NAL units can also be categorized according to whether they contain instantaneous decoder refresh (IDR) image data (i.e., I-frame) or non-instantaneous decoder refresh image data (i.e., P- or B-frames). Similarly, video coded layer NAL units can be categorized as reference frames (i.e., I- or P-frames) or non-reference frames (i.e., B-frames). I- and P-frames are capable of being referenced by other NAL units, whereas, a B-frame is not. The following table categorizes the H.264 component types covered in this document. Note that each type is given a numeric identifier in the H.264 specification. These identifiers are critical for understanding the type of data contained in a given NAL unit.

NAL unit type	**H.264 Stream Component**	**Common Name for Component**	**VCL/non-VCL**	**IDR/non-IDR**	**Reference/non-Reference**
5	coded slice of an IDR picture	I-frame	VCL	IDR	Reference
1	coded slice of a non-IDR picture	P-frame	VCL	Non-IDR	Reference
1	coded slice of a non-IDR picture	B-frame	VCL	Non-IDR	non-Reference
6	supplemental enhancement information	SEI	non-VCL	N/A	N/A
7	sequence parameter set	SPS	non-VCL	N/A	N/A
8	picture parameter set	PPS	non-VCL	N/A	N/A
9	access unit delimiter	AUD	non-VCL	N/A	N/A

A NAL unit is generally defined and identified as a single byte (i.e., NAL unit header that is then interpreted in binary terms) followed by a variable sequence of bytes that differ depending on the type of NAL unit and its contents. Always, the first byte is a header indicating the type of payload and the relative importance. The remaining bytes are the payload.

The following image displays an example of a single supplemental (or SEI) NAL unit encoded as binary data (viewed as hexadecimal values):



```
0605FFFF AADC45E9 BDE6D948 B7962CD8 20D923EE EF783236 34202D20 636F7265
20313438 20723237 34382039 37656165 6632202D 20482E32 36342F4D 5045472D
34204156 4320636F 64656320 2D20436F 70796C65 66742032 3030332D 32303136
202D2068 7474703A 2F2F7777 772E7669 64656F6C 616E2E6F 72672F78 3236342E
68746D6C 202D206F 7074696F 6E733A20 63616261 633D3120 7265663D 35206465
626C6F63 6B3D313A 303A3020 616E616C 7973653D 3078333A 30783131 33206D65
3D686578 20737562 6D653D38 20707379 3D312070 73795F72 643D312E 30303A30
2E303020 6D697865 645F7265 663D3120 6D655F72 616E6765 3D313620 6368726F
6D615F6D 653D3120 7472656C 6C69733D 32203878 38646374 3D312063 716D3D30
20646561 647A6F6E 653D3231 2C313120 66617374 5F70736B 69703D31 20636872
6F6D615F 71705F6F 66667365 743D2D32 20746872 65616473 3D36206C 6F6F6B61
68656164 5F746872 65616473 3D312073 6C696365 645F7468 72656164 733D3020
6E723D30 20646563 696D6174 653D3120 696E7465 726C6163 65643D30 20626C75
7261795F 636F6D70 61743D30 20636F6E 73747261 696E6564 5F696E74 72613D30
20626672 616D6573 3D332062 5F707972 616D6964 3D322062 5F616461 70743D31
20625F62 6961733D 30206469 72656374 3D332077 65696768 74623D31 206F7065
6E5F676F 703D3020 77656967 6874703D 32206B65 79696E74 3D323530 206B6579
696E745F 6D696E3D 32352073 63656E65 6375743D 34302069 6E747261 5F726566
72657368 3D302072 635F6C6F 6F6B6168 6561643D 35302072 633D6372 66206D62
74726565 3D312063 72663D32 322E3020 71636F6D 703D302E 36302071 706D696E
3D302071 706D6178 3D363920 71707374 65703D34 2069705F 72617469 6F3D312E
34302061 713D313A 312E3030 0080
```

The 8-bit (1-byte) header of a NAL unit is deciphered as follows:

```
NAL Unit header
[8 bits]
      forbidden_zero     1 bit       must be 0
      nal_ref_idc        2 bits      will be 0, or > 0 (if referenced)
      nal_unit_type      5 bits      0- 31 (commonly 1, 5, 6, 7, 8, 9)

NALU payload
[variable size]
```

The example NAL unit header above is deciphered in the following manner:

hex	**binary**		**bit 1**	**bit 2-3**	**bit 4-8**
06	00000110	->	0	00	00110
			forbidden zero	nal_ref_idc	nal_unit_type

Although not comprehensive, the table below includes examples of commonly found NAL unit header bytes and how they are deciphered in order to identify the type of H.264 component contained within the NAL unit.

NAL unit header (hex)	binary	bit 1	bit 2-3	bit 4-8	
		forbidden zero	*nal_ref_idc*	*nal_unit_type*	*note*
06	00000110	0	00	00110	SEI
65	01100101	0	11	00101	I Frame
45	01000101	0	10	00101	I Frame
41	01000001	0	10	00001	P Frame
01	00000001	0	00	00001	B Frame
67	01100111	0	11	00111	SPS
68	01101000	0	11	01000	PPS

The definition of a NAL unit does not include two important pieces of information that are critical for constructing an H.264 stream: when does a NAL unit express how many bytes it contains (i.e., how large is it), and how does one know when a NAL unit ends. Depending upon the implementation of H.264, there are different approaches to expressing the beginning and ends of NAL units in a byte stream. Two of these implementations are discussed below.

8. Annex B Implementation

Annex B is a common implementation[3] of a video byte stream within H.264. This implementation is typically implemented in systems where there is a continuous video stream, or where the start and end times of a video are initially undefined. Another reason that a system

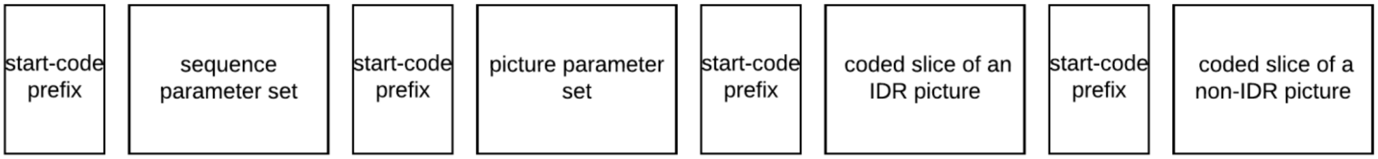
[3] See *ISO/IEC 14496-12 Annex B - Byte Stream Format* for more information about full Annex B standard

would implement Annex B is that it allows for less processing than an AVCC implementation of H.264 (see section below) as it does not require packing the H.264 coded video stream into a multimedia format (e.g., MP4). In the Annex B implementation, video coded NAL units and non-video coded NAL units are strung together linearly within the stream. For example, this implementation is often found in Digital CCTV systems as well the native derivative files these systems generate.

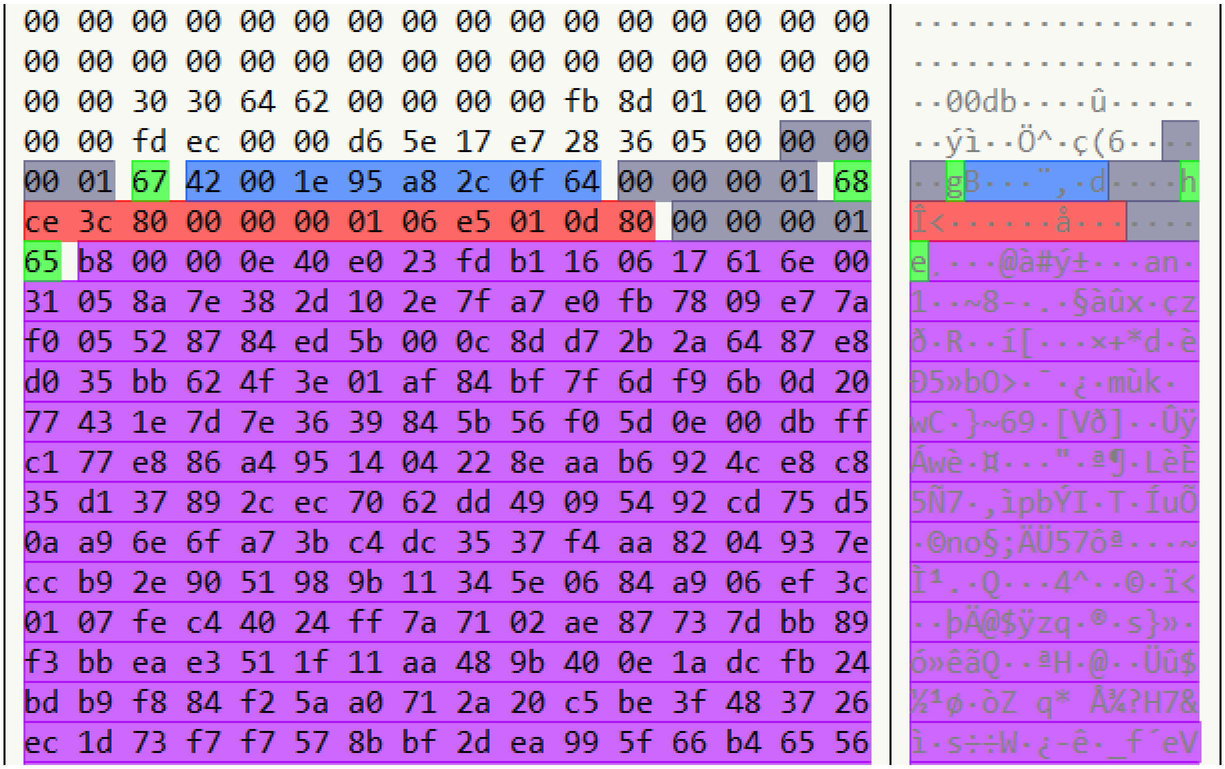
The Annex B implementation introduces the concept of a "start-code prefix" as a new binary element included within a H.264 coded video stream. A start-code prefix is used to designate the start of a NAL unit in an Annex B H.264 byte stream, allowing a reader of the byte stream to identify the start of a NAL unit, and therefore to identify the single-byte NAL unit header that communicates the type of the NAL unit. The Annex B H.264 byte stream follows the structure of start-code prefix, NAL unit header, and NAL unit payload. The start-code prefix is either 3 or 4 bytes that are added before the header to signify the start of the next NAL unit. This will be represented in hexadecimal by either `0x000001` or `0x00000001`.

After the start-code prefix, the NAL unit header is the next byte in the stream. The value within this byte defines the NAL unit type as described above. The bytes succeeding the NAL unit header are then described as the payload. The payload is the data that makes up either the VCL or non-VCL. For a video stream in Annex B, prior to the first VCL, IDR NAL unit, there must be two specific non-VCL NAL units. These will be the sequence parameter set (SPS) and the picture parameter set (PPS). The payload of each of these NAL units informs the decoder on how to interpret the VCLs that will follow.

After the SPS and PPS have been presented in the stream, the next VCL IDR NAL unit can be delivered to the decoder to allow picture data to be decoded and displayed. Once a VCL IDR NAL unit is completed, the next NAL unit start code will be present. See below for an illustration of how the start-code prefixes appear in the byte stream in the Annex B implementation.



In the Annex B implementation, the next IDR VLC will need to have another SPS and PP NAL unit preceding it.



```
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ················
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ················
00 00 30 30 64 62 00 00 00 00 fb 8d 01 00 01 00   ··00db····û·····
00 00 fd ec 00 00 d6 5e 17 e7 28 36 05 00 00 00   ··ýì··Ö^·ç(6····
00 01 67 42 00 1e 95 a8 2c 0f 64 00 00 00 01 68   ··gB···¨,·d····h
ce 3c 80 00 00 00 01 06 e5 01 0d 80 00 00 00 01   Î<······å·······
65 b8 00 00 0e 40 e0 23 fd b1 16 06 17 61 6e 00   e¸···@à#ý±···an·
31 05 8a 7e 38 2d 10 2e 7f a7 e0 fb 78 09 e7 7a   1··~8-·.·§àûx·çz
f0 05 52 87 84 ed 5b 00 0c 8d d7 2b 2a 64 87 e8   ð·R··í[···×+*d·è
d0 35 bb 62 4f 3e 01 af 84 bf 7f 6d f9 6b 0d 20   Ð5»bO>·¯·¿·mùk· 
77 43 1e 7d 7e 36 39 84 5b 56 f0 5d 0e 00 db ff   wC·}~69·[Vð]··Ûÿ
c1 77 e8 86 a4 95 14 04 22 8e aa b6 92 4c e8 c8   Áwè·¤···"·ª¶·LèÈ
35 d1 37 89 2c ec 70 62 dd 49 09 54 92 cd 75 d5   5Ñ7·,ìpbÝI·T·ÍuÕ
0a a9 6e 6f a7 3b c4 dc 35 37 f4 aa 82 04 93 7e   ·©no§;ÄÜ57ôª···~
cc b9 2e 90 51 98 9b 11 34 5e 06 84 a9 06 ef 3c   Ì¹.·Q···4^··©·ï<
01 07 fe c4 40 24 ff 7a 71 02 ae 87 73 7d bb 89   ··þÄ@$ÿzq·®·s}»·
f3 bb ea e3 51 1f 11 aa 48 9b 40 0e 1a dc fb 24   ó»êãQ··ªH·@··Üû$
bd b9 f8 84 f2 5a a0 71 2a 20 c5 be 3f 48 37 26   ½¹ø·òZ q* Å¾?H7&
ec 1d 73 f7 f7 57 8b bf 2d ea 99 5f 66 b4 65 56   ì·s÷÷W·¿-ê·_f´eV
```

Example of the beginning of a video stream in Annex B. Grey is a start-code prefix, Green is a NAL unit header, Blue is an SPS NAL unit payload, Red is a PPS NAL unit payload, and Purple is an I-frame VLC NAL unit payload.

9. AVCC Implementation

For implementations that require the carriage of H.264 NAL units within an ISO base media file format wrapper, ISO/IEC 14496-15[4] defines the approach for packing H.264 coded video streams within the “MDAT” box of the wrapper[5]. This implementation differs from the Annex B approach in three distinct ways: 1) start-code prefixes are not employed; 2) SPS and PPS non-VCL NAL units are extracted from the H.264 byte stream and stored in a separate location in the file format wrapper (i.e., within the “avcC” box of the ISO base media file); and 3) a 1, 2, or 4 byte value (big-endian, unsigned integer) is introduced and prepended to all non-SPS and non-

[4] See *ISO/IEC 14496-15 Information technology — Coding of audio-visual objects — Part 15: Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format*.

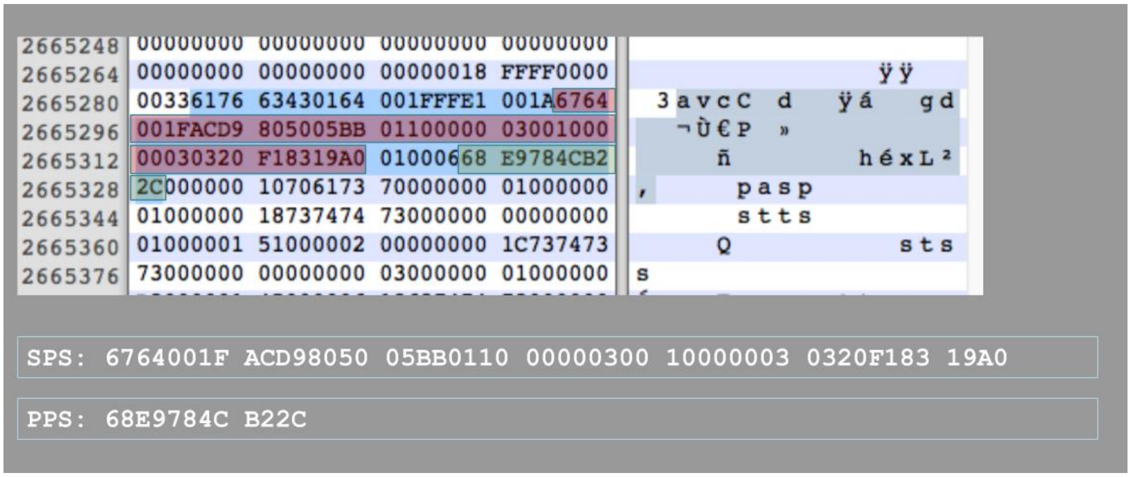
[5] See *ISO/IEC 14496-12 Information technology — Coding of audiovisual objects — Part 12: ISO base media file format* for more information about the structure of ISO base media file format wrappers.

PPS NAL units that are stored in the “MDAT” box to signal the length of each NAL unit, as a replacement for the start-code prefix.

The “avcC” box is used within the ISO base media file to contain information about the H.264 data stored within the “MDAT” box as noted above. This “avcC” box will also contain information about how large the value will be that is preprended in the “MDAT” box to each NAL unit, (i.e., 1, 2, or 4 bytes in length). It also contains the SPS NAL unit(s) and the PPS NAL unit(s) that were extracted from the H.264 coded video stream before packing it into the “MDAT” box. The table below documents the expected contents of the “avcC” box when H.264 coded video is present in an ISO base media file.

Structure Name	Length	Type	Endian	Hex Example	Interpreted Value
Box Size	4 bytes	u32int	Big	h.00000033	51
Box Name	4 bytes	ASCII	Big	h.61766343	avcC
Version Number	1 byte	u8int	n/a	h.01	Always 1
avcC:avc Profile	1 byte	u8int	n/a	h.64	profile = 100
avcC:avc compatibility	1 byte	u8int	n/a	h.00	compatibility = 0
avcC:avc level	1 byte	u8int	n/a	h.1F	level = 31
avcC:reserved	6 bits	bit6	Big	b.111111	all on, all the time
avcC:NALULength	2 bits	bit2	Big	b.11	3 = 3+1 = 4 (NAL unit size value = 4 bytes long)
avcC:reserved	3 bits	bit3	Big	b.111	all on, all the time
avcC:numberSPSs	5 bits	bit5	Big	b.00001	1
avcC:SPSsize	2 bytes	u16int	Big	h.001A	Next 26 bytes are the SPS NAL unit
avcC:SPS	variable	byte	n/a	h.6764001FACD9805005BB011000000300100000030320F18319A0	SPS NAL unit
avcC:numberPPSs	1 byte	8int	n/a	h.01	1
avcC:PPSsize	2 bytes	u16int	Big	h.0006	Next 6 bytes are the PPS NALU
avcC:PPS	variable	byte	n/a	h.68E9784CB22C	PPS NAL unit

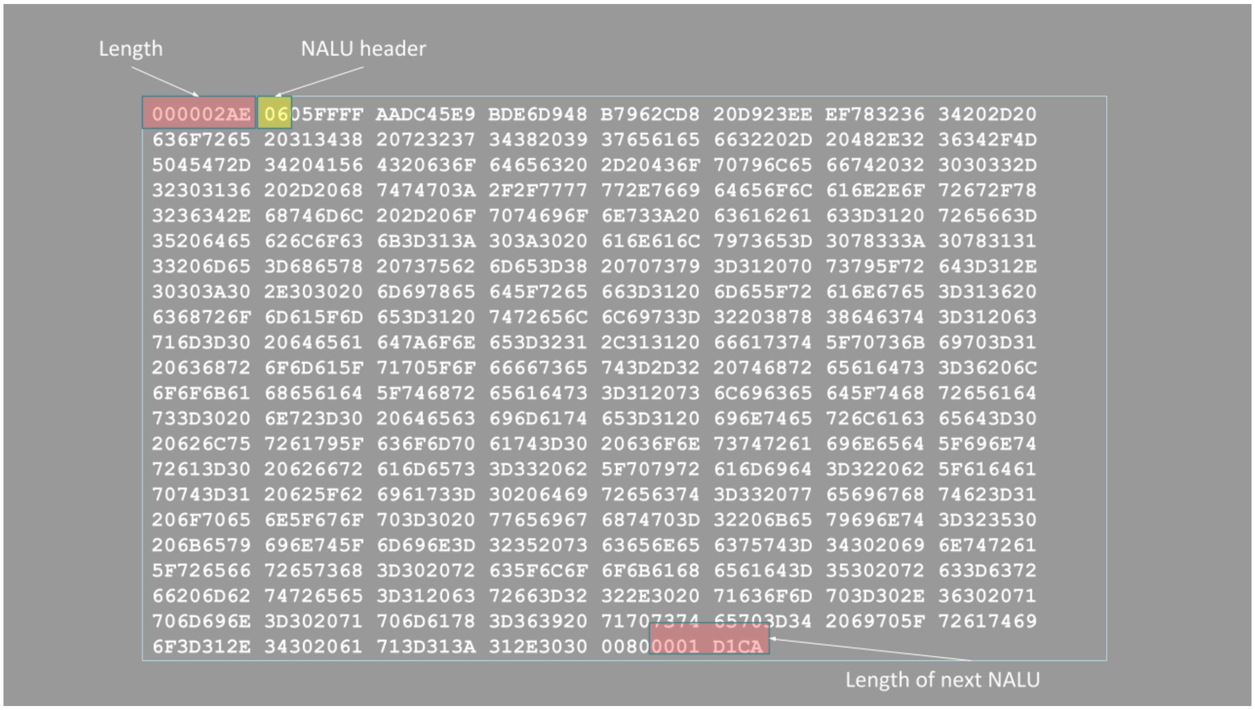
In an AVCC implementation of H.264, the examiner should look for SPS and PPS NAL unit data within the “avcC” box in the file as discussed above. An example hex analysis would look like the illustration below, which demonstrates the actual “avcC” box of a sample file, where the SPS NAL unit is highlighted in red and the PPS NAL unit is highlighted in green.



```
2665248 00000000 00000000 00000000 00000000
2665264 00000000 00000000 00000018 FFFF0000              ÿÿ
2665280 00336176 63430164 001FFFE1 001A6764   3avcC d  ÿá  gd
2665296 001FACD9 805005BB 01100000 03001000    ¬Ù€P  »
2665312 00030320 F18319A0 01000668 E9784CB2      ñ       héxL²
2665328 2C000000 10706173 70000000 01000000   ,    pasp
2665344 01000000 18737474 73000000 00000000        stts
2665360 01000001 51000002 00000000 1C737473      Q          sts
2665376 73000000 00000000 03000000 01000000   s
```

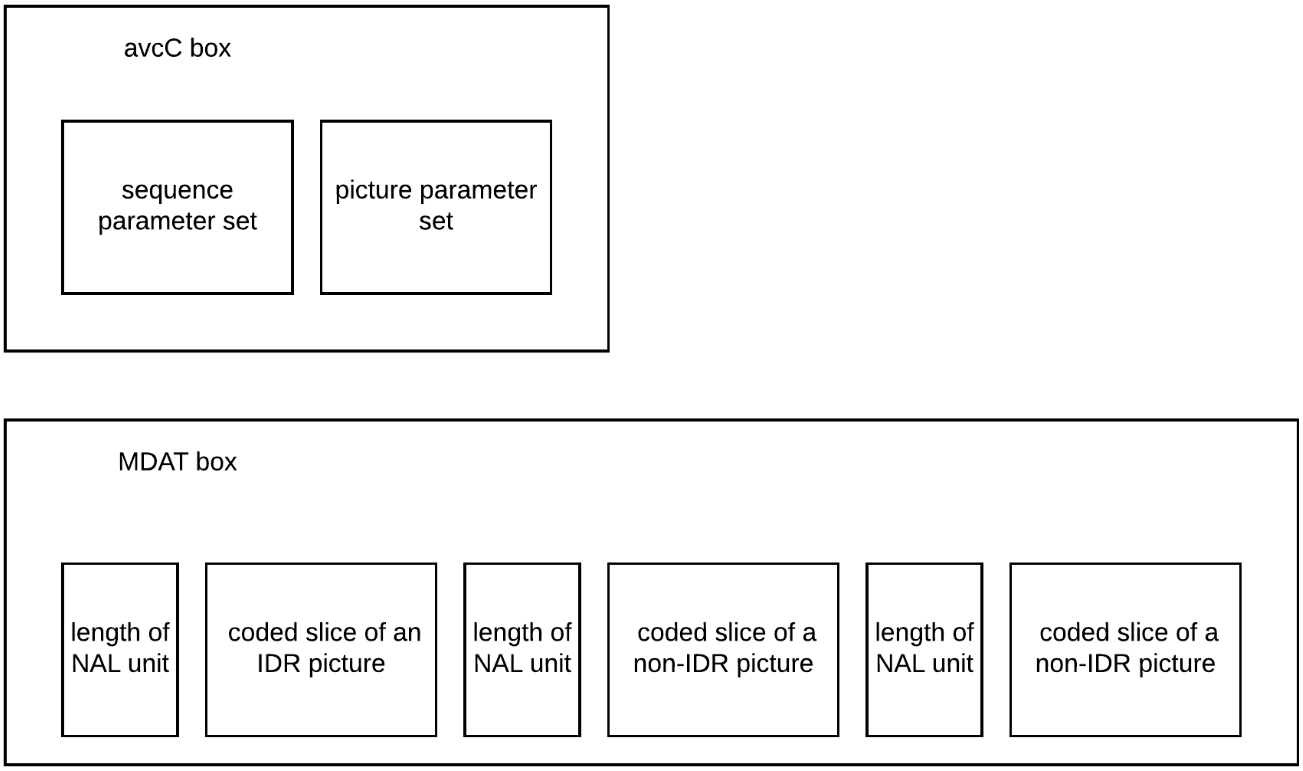
```
SPS: 6764001F ACD98050 05BB0110 00000300 10000003 0320F183 19A0

PPS: 68E9784C B22C
```

Within the “MDAT” box, the remaining NAL units from the H.264 coded video stream are found. Keeping in mind that the start-code prefix from Annex B is replaced with a 1, 2, or 4-byte value that communicates the size in bytes of each NAL unit in the stream, the implementation will look like the following illustration.



```
000002AE 0605FFFF AADC45E9 BDE6D948 B7962CD8 20D923EE EF783236 34202D20
636F7265 20313438 20723237 34382039 37656165 6632202D 20482E32 36342F4D
5045472D 34204156 4320636F 64656320 2D20436F 70796C65 66742032 3030332D
32303136 202D2068 7474703A 2F2F7777 772E7669 64656F6C 616E2E6F 72672F78
3236342E 68746D6C 202D206F 7074696F 6E733A20 63616261 633D3120 7265663D
35206465 626C6F63 6B3D313A 303A3020 616E616C 7973653D 3078333A 30783131
33206D65 3D686578 20737562 6D653D38 20707379 3D312070 73795F72 643D312E
30303A30 2E303020 6D697865 645F7265 663D3120 6D655F72 616E6765 3D313620
6368726F 6D615F6D 653D3120 7472656C 6C69733D 32203878 38646374 3D312063
716D3D30 20646561 647A6F6E 653D3231 2C313120 66617374 5F70736B 69703D31
20636872 6F6D615F 71705F6F 66667365 743D2D32 20746872 65616473 3D36206C
6F6F6B61 68656164 5F746872 65616473 3D312073 6C696365 645F7468 72656164
733D3020 6E723D30 20646563 696D6174 653D3120 696E7465 726C6163 65643D30
20626C75 7261795F 636F6D70 61743D30 20636F6E 73747261 696E6564 5F696E74
72613D30 20626672 616D6573 3D332062 5F707972 616D6964 3D322062 5F616461
70743D31 20625F62 6961733D 30206469 72656374 3D332077 65696768 74623D31
206F7065 6E5F676F 703D3020 77656967 6874703D 32206B65 79696E74 3D323530
206B6579 696E745F 6D696E3D 32352073 63656E65 6375743D 34302069 6E747261
5F726566 72657368 3D302072 635F6C6F 6F6B6168 6561643D 35302072 633D6372
66206D62 74726565 3D312063 72663D32 322E3020 71636F6D 703D302E 36302071
706D696E 3D302071 706D6178 3D363920 71707374 65703D34 2069705F 72617469
6F3D312E 34302061 713D313A 312E3030 00800001 D1CA
```

In sum, the full AVCC implementation of H.264 includes the following components spread out in two distinct locations within the ISO base media file format wrapper.



When media samples in addition to H.264 are included in an ISO base media file, these samples are interleaved in the “MDAT” box with the H.264 coded video stream, which will add complexity to the process of locating and extracting H.264 samples. To understand this scenario, review the ISO base media file format specification to understand how sample tables are used to document the location of each sample set within the “MDAT” box[6].

10. Application in Forensics

For examiners, there are several uses of this understanding in practical application. Once an examiner understands and can interpret the video stream at the byte level, they should be able to locate and extract video information from unstructured datasets or proprietary video containers. For a fuller understanding of this process, see *SWGDE Best Practices for the Recovery of Data from Security Digital Video Recorders Containing H.264 Data*. Additionally, by being able to differentiate between the two implementations standard in H.264, it allows for the rebuilding of

[6] See *ISO/IEC 14496-12 Information technology — Coding of audiovisual objects — Part 12: ISO base media file format* for more information about the structure of ISO base media file format wrappers.

damaged files should the information be obfuscated or corrupted - the recording was not properly started or closed, or the manufacturer improperly segmented NAL units. This process may be addressed more in depth at a future point, however the process of manually parsing AVCC is time consuming and may be better conducted using automated tools.

Once a video stream is repaired or carved, either purpose-built software or open-source tools such as FFmpeg can be employed to place the H.264 video stream in a container that allows for more traditional playback and analysis. For more on utilizing FFmpeg, see the *SWGDE Technical Notes on FFmpeg*.

History

Revision	Issue Date	Section	History
1.0 DRAFT	2019-09-19	All	Initial draft created and voted by SWGDE for release as a Draft for Public Comment.
1.0 DRAFT	2019-09-29	--	Formatting and technical edit performed for release as a Draft for Public Comment.
1.0	2020-09-17		Voted for release as final publication