

# **SCTE** | **STANDARDS**

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**Digital Video Subcommittee**

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**SCTE STANDARD**

**SCTE 172 2024**

**Constraints on NAL Structured Video Coding for  
Digital Program Insertion**

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## Document Tags

<input checked="" type="checkbox"/> Specification	<input type="checkbox"/> Checklist	<input checked="" type="checkbox"/> Facility
<input type="checkbox"/> Test or Measurement	<input type="checkbox"/> Metric	<input type="checkbox"/> Access Network
<input type="checkbox"/> Architecture or Framework	<input checked="" type="checkbox"/> Cloud	<input type="checkbox"/> Customer Premises
<input checked="" type="checkbox"/> Procedure, Process or Method		

## Document Release History

Release	Date
SCTE 172 2011	3/28/2011
SCTE 172 2017	7/10/2017
SCTE 172 2024	2/2/2024

Note: Standards that are released multiple times in the same year use: a, b, c, etc. to indicate normative balloted updates and/or r1, r2, r3, etc. to indicate editorial changes to a released document after the year.

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## 1. Introduction

### 1.1. Executive Summary

This document defines additional video coding and transport constraints for Digital Program Insertion applications using SCTE 35 messaging.

### 1.2. Scope

This document defines additional video coding and transport constraints on [SCTE 128-1] and [SCTE 128-2] (which constrains ITU-T H.264/ ISO/IEC [14496-10] (“AVC”) video compression [14496-10] or on [SCTE 215-1], and [SCTE 215-2] (which constrains ITU-T H.265/ISO/IEC [23008-2] (“HEVC”) video compression [23008-2]) or on [SCTE 281-1] and [SCTE 281-2] (which constrains ITU-T H.266/ ISO/IEC [23090-3] (“VVC”) video compression [23090-3]) for Digital Program Insertion applications using SCTE 35 messaging [SCTE 35]. AVC, HEVC, VVC video uses a network abstraction layer structure to carry video and in this document “NAL structured video” will collectively refer to AVC, HEVC, and VVC Video.

Note: This standard applies only when both the insertion content and the network both use AVC video coding, or both use HEVC video coding, or both use VVC video coding.

### 1.3. Benefits

By applying these video coding constraints, video streams with Digital Program Insertion applications using SCTE 35 messaging can create a playable video streaming experience.

### 1.4. Intended Audience

This specification is intended for use by product/system designers for encoders or other downstream devices that can condition video streams for Digital Program Insertion operations.

### 1.5. Areas for Further Investigation or to be Added in Future Versions

This specification will need to add future versions as next generation video codecs are introduced into the video streaming environment.

## 2. Normative References

The following documents contain provisions which, through reference in this text, constitute provisions of this document. The editions indicated were valid at the time of subcommittee approval. All documents are subject to revision and, while parties to any agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version.

### 2.1. SCTE References

[SCTE 35] ANSI/SCTE 35-202x, Digital Program Insertion Cueing Message

[SCTE 128-1] ANSI/SCTE 128-1 2020, AVC Video Constraints for Cable Television Part 1-Coding

- [SCTE 128-2] ANSI/SCTE 128-2 2018, AVC Video Constraints for Cable Television Part 2-Transport
- [SCTE 215-1] ANSI/SCTE 215-1 2024, HEVC Video Constraints for Cable Television Part 1-Coding
- [SCTE 215-2] ANSI/SCTE 215-2 2018, HEVC Video Constraints for Cable Television Part2-Transport
- [SCTE 281-1] SCTE 281-1 2023, VVC Video Constraints for Cable Television Part 1- Coding
- [SCTE 281-2] SCTE 281-2 2023, VVC Video Constraints for Cable Television Part 2- Transport

## **2.2. Standards from Other Organizations**

- [13818-1] ISO/IEC 13818-1:2022 (E), International Standard, Information technology – Generic coding of moving pictures and associated audio information: Systems
- [14496-10] ISO/IEC 14496-10:2022 (ITU-T H.264), International Standard (2009), Advanced video coding for generic audiovisual services
- [23008-2] ISO/IEC 23008-2:2021 (ITU-T Rec. H.265), International Standard (2015) – MPEG H Information technology – High efficiency coding and media delivery in heterogeneous environments Part 2: High efficiency video coding
- [23090-3] ITU-T Rec. H.266 | ISO/IEC 23090-3:2022 – MPEG-I Part 3: Versatile Video Coding
- [23002-7] ITU-T Rec. H.274 | ISO/IEC 23002-7:2022 – Versatile supplemental enhancement information messages for coded video bitstreams

## **2.3. Other Published Materials**

No normative references are applicable.

## **3. Informative References**

The following documents might provide valuable information to the reader but are not required when complying with this document.

### **3.1. SCTE References**

- [SCTE 104] ANSI/SCTE 104, Automation System to Compression System Communications Applications Program Interface (API).
- [SCTE 214-1] ANSI/SCTE 214-1, MPEG DASH for IP-Based Cable Services Part 1: MPD Constraints and Extensions.

### 3.2. Standards from Other Organizations

[DASH-IF IOP5] Guidelines for Implementation: DASH-IF Interoperability Points, Version 5.0, <https://dashif.org/guidelines/iop-v5/>

[ST\_2016\_1] SMPTE ST 2016-1, Format for Active Format Description and Bar Data, Society of Motion Picture and Television Engineers (SMPTE).

### 3.3. Other Published Materials

No informative references are applicable.

## 4. Compliance Notation

<i>shall</i>	This word or the adjective “ <i>required</i> ” means that the item is an absolute requirement of this document.
<i>shall not</i>	This phrase means that the item is an absolute prohibition of this document.
<i>forbidden</i>	This word means the value specified <i>shall</i> never be used.
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## 5. Abbreviations and Definitions

Note: Throughout this document, the terms used have specific meanings. Because some of the terms that are defined in ISO/IEC [13818-1], ISO/IEC [14496-10] ISO/IEC [23008-2], and ISO/IEC [23090-3] have very specific technical meanings, the reader is referred to the original sources for their definition. For terms used in this document, brief definitions are given below.

### 5.1. Abbreviations

AFD	Active Format Description [ST_2016_1]
AU	Access Unit
AVC	Advanced video coding (refers specifically to video compression standardized in ISO/IEC [14496-10]).
BLA	Broken link access (as defined in ISO/IEC [23008-2]).
CPB	Coded picture buffer (as defined in ISO/IEC [14496-10] and as defined in ISO/IEC [23008-2]).
CRA	Clean random access (as defined in ISO/IEC [23008-2]).

DASH	Dynamic Adaptive Streaming over HTTP
DPB	Decoded picture buffer (as defined in ISO/IEC [14496-10] and as defined in ISO/IEC [23008-2]).
DTS	Decoding time stamp (defined in ISO/IEC [13818-1]).
EOS	End of Stream
GOP	Group of Pictures
HEVC	High efficiency video coding (refers specifically to video compression standardized in ISO/IEC [23008-2]).
IDR	Instantaneous decoding refresh (A picture type defined in ISO/IEC [14496-10] and as defined in ISO/IEC [23008-2]).
IRAP	Intra Random Access Point (as defined in [23008-2])
MPEG	Moving Pictures Experts Group
NAL	Network abstraction layer (as defined in ISO/IEC [14496-10] or as defined in ISO/IEC [23008-2]).
PES	Packetized elementary stream (defined in ISO/IEC [13818-1]).
PID	Packet Identifier (define in ISO/IEC [13818-1])
PTS	Presentation time stamp (defined in ISO/IEC [13818-1]).
RADL	Random access decodable leading (as defined in ISO/IEC [23008-2]).
RASL	Random access skipped leading (as defined in ISO/IEC [23008-2]).
SAP	Stream access point (as defined in ANSI/SCTE [SCTE 214-1]).
SEI	Supplemental Enhancement Information
SGOP	SCTE Group of Pictures (as defined in [SCTE 128-1] or as defined in [SCTE 215-1] for HEVC [23008-2] or as defined in [SCTE 281-1] for VVC).
SHRAP	SCTE- HEVC Random Access Point (as defined in [SCTE 215-1]).
SPS	Sequence Parameter Set
SRAP	SCTE Random Access Point (as defined in [SCTE 128-1] ).
SVRAP	SCTE VVC Random Access Point (as defined in [SCTE 281-1] ).
TS	Transport Stream (as defined in ISO/IEC [13818-1]).
VoD	Video on Demand
VSEI	Versatile Supplemental Enhancement Information (as defined in ISO/IEC [23002-7])
VVC	Versatile Video Coding (as defined in [23090-3])

## 6. Digital Program Insertion System Overview (Informative)

Digital Program Insertion assumes a linear program delivery with periodic insertion opportunities signaled by [SCTE 35] splice\_info\_section() messages carried in TS packets of a particular PID or PIDs within the program's TS. Insertion opportunities signal first a splice from network PTS value (usually to an advertisement) and optionally followed sometime later by the signaling of a splice back into a different (usually later) network PTS value. An alternative signaling method signals only the first PTS but supplies a duration and signals "auto return to network." Signaling may also, in the case of content which may be delivered in a non-time-linear method (e.g. VoD), specify that the return to network PTS value be the same as the initial PTS value.

Insertion durations are seconds in length normally, although they are sometimes hours in length. For typical commercials durations run 30, 60, or 120 seconds.

Different delivery mechanisms may use different technologies to perform the insertions. For example, insertions in linear program delivery are typically done by a splicer/content server pair. In a VOD



environment a VOD server may assemble a playlist of entertainment content and the inserted ads. For DASH delivery ad content segments may be inserted into or replaced in the manifest. The coding constraints defined in the specification are applicable to all delivery mechanisms. The transport constraints are applicable to delivery mechanisms that are based on MPEG transport [13818-1].

### 6.1. Collective Terminology for NAL Based Video Streams (Informative)

Text in this specification related to NAL based video streams use the following structures and syntax to support use of common collective terminology across codecs for describing spliced based expectations and constraints in this specification. The “context” when referring to NAL based terminology is determined by expectations of which coding format (e.g. AVC, HEVC, or VVC) is being used. There is no intention of mixing of different coding format NAL structures so collective terminology is not to be interpreted as such. If there are splicing conditions that are specific to particular codec formats then this will be explicitly documented in the specification without the use of collective NAL terminology.

When NAL ISO/IEC Video Coding Standard is used this either refers to ISO/IEC 14496-10 (ITU-T H.264), International Standard, Advanced video coding for generic audiovisual services [14496-10] or ISO/IEC 23008-2 (ITU-T Rec. H.265), International Standard (2015) – MPEG H Information technology – High efficiency coding and media delivery in heterogeneous environments Part 2: High efficiency video coding [23008-2] or ITU-T Rec. H.274 | ISO/IEC 23002-7:2020 – Versatile supplemental enhancement information messages for coded video bitstreams [23002-7] .

The following list is the set of NAL collective terminologies used in this specification. The specific codec context needs to be selected to understand details relevant to that specific format.

- NAL Video Coding Standard
  - 14496-10 context:* AVC ISO/IEC 14496-10 Coding Specification [14496-10].
  - 23008-2 context:* HEVC ISO/IEC 23008-2 Coding Specification [23008-2].
  - 23090-3 context:* VVC ISO/IEC 23090-3 Coding Specification [23090-3].
- NAL SCTE In-Point
  - 14496-10 context:* refers to an IDR picture that meets the requirements of an SRAP as defined in Section 6.4.1 of [SCTE 128-1] .
  - 23008-2 context:* refers to an IDR, BLA, or CRA picture or a TRAIL\_R field picture that meets the requirements of an SHRAP as defined in Section 7.1.2.1 of [SCTE 215-1]. BLA or CRA pictures can have associated RADL pictures but no associated RASL pictures.
  - 23090-3 context:* refers to an IDR, or CRA picture that meets the requirements of an SVRAP as defined in Section 8.1.2.1 of [SCTE 281-1] . CRA pictures can have associated RADL pictures but no associated RASL pictures.

Note: To condition a NAL SCTE In-Point that is also aligned as a start of an adaptive streaming segment, NAL SCTE In-Points also needs to meet the requirements of SAP type 1 or 2 [SCTE 214-1].
- NAL SRAP
  - 14496-10 context:* refers to an I or IDR picture contained in an access unit that meets the requirements of an SRAP as defined in as defined in [SCTE 128-1] .

*23008-2 context:* refers to an IDR, BLA, or CRA pictures or TRAIL\_R field picture contained in an access unit that meets the requirements of an SHRAP as defined in Section 7.1.2.1 of [SCTE 215-1]. BLA or CRA pictures can have associated RADL pictures but no associated RASL pictures.

*23090-3 context:* refers to an IDR, CRA pictures contained in an access unit that meets the requirements of an SVRAP as defined in Section 8.1.2.1 of [SCTE 281-1] . CRA pictures can have associated RADL pictures but no associated RASL pictures.

Note: To condition a NAL SCTE In-Point that is also aligned as a start of an adaptive streaming segment, NAL SCTE In-Points also needs to meet the requirements of SAP type 1 or 2 [SCTE 214-1].

- NAL IDR Picture
  - 14496-10 context:* refers to an IDR picture [14496-10].
  - 23008-2 context:* refers to an IRAP picture that is an IDR, BLA, or CRA picture or a TRAIL\_R field picture [23008-2].
  - 23090-3 context:* refers to an IRAP picture that is an IDR, or CRA picture [23090-3].
- NAL SGOP
  - 14496-10 context:* refers to an AVC SCTE GOP (SGOP) [14496-10].
  - 23008-2 context:* refers to an HEVC SCTE GOP (SGOP) [23008-2].
  - 23090-3 context:* refers to an VVC SCTE GOP (SGOP) [23090-3].
- NAL structured video
  - 14496-10 context:* refers to an AVC coded video stream [14496-10].
  - 23008-2 context:* refers to an HEVC coded video stream [23008-2].
  - 23090-3 context:* refers to an VVC coded video stream [23090-3].
- NAL EOS
  - 14496-10 context:* refers to an AVC end\_of\_stream\_rbsp( ) NAL unit [14496-10].
  - 23008-2 context:* refers to an HEVC end\_of\_bitstream\_rbsp( ) NAL unit [23008-2].
  - 23090-3 context:* refers to an VVC end\_of\_bitstream\_rbsp( ) NAL unit [23090-3].
- NAL no\_output\_of\_prior\_pics\_flag
  - 14496-10 context:* refers to the no\_output\_of\_prior\_pics\_flags syntax [14496-10].
  - 23008-2 context:* refers to the no\_output\_of\_prior\_pics\_flag syntax with conditioned constraints as specified in [23008-2].
  - 23090-3 context:* refers to the sh\_no\_output\_of\_prior\_pics\_flag syntax with conditioned constraints as specified in 23090-3. The decoder infers a NoOutputOfPriorPicsFlag through the value set be sh\_no\_ouput\_of\_prior\_pics\_flag or as constrained by the VVC specification [23090-3] or as indicated in this specification.
- NAL receiver
  - 14496-10 context:* refers to an AVC receiver [14496-10].
  - 23008-2 context:* refers to an HEVC receiver [23008-2].
  - 23090-3 context:* refers to an VVC receiver [23090-3].
- NAL AU
  - 14496-10 context:* refers to an AVC access unit [14496-10].
  - 23008-2 context:* refers to an HEVC access unit [23008-2].

*23090-3 context:* refers to an VVC access unit [23090-3].

- Presentation Unit
  - In 13818-1, a presentation unit is a decoded picture or an audio access unit [13818-1].
- NAL SCTE Coding Level Constraints
  - 14496-10 context:* refers to the SCTE 128-1 specification [SCTE 128-1].
  - 23008-2 context:* refers to the SCTE 215-1 specification [SCTE 215-1].
  - 23090-3 context:* refers to the SCTE 281-1 specification [SCTE 281-1].
- NAL SCTE Transport Level Constraints
  - 14496-10 context:* refers to the SCTE 128-2 specification [SCTE 128-2].
  - 23008-2 context:* refers to the SCTE 215-2 specification [SCTE 215-2].
  - 23090-3 context:* refers to the SCTE 281-2 specification [SCTE 281-2].
- NAL Capable Splicing Devices
  - 14496-10 context:* refers to AVC capable splicing devices [14496-10].
  - 23008-2 context:* refers to HEVC capable splicing devices [23008-2].
  - 23090-3 context:* refers to VVC capable splicing devices [23090-3].

## 6.2. Content Creation System Expectations (Informative)

It is expected that the creator of NAL structured video content with insertion opportunities compliant with this document will use [SCTE 104] triggers to generate the [SCTE 35] splice messages in the Transport Stream. In situations where NAL structured video content is created by “digital turnaround” systems, then the insertion of the resulting splice messages will be in reaction to splice messages in an incoming service, which should be compliant with [SCTE 35].

[SCTE 35] requires placement of splice messages at least 4 seconds before the signaled splice event (splice messages placed earlier than 4 seconds might help splicers). This should provide encoders with more than adequate notice for the placement of the syntax elements required by this document.

Use of “immediate mode” splicing operations with NAL structured video coding is strongly discouraged, as its use will likely result in the transition having video and/or audio anomalies.

It is expected that NAL structured video content with insertion opportunities for non-time-linear applications (ex. Time shifted, VOD) is compliant with this document.

It is expected that NAL structured video content that will be inserted for time-linear or non-time-linear content is compliant with this document.

## 6.3. NAL End Of Stream Signaling (Normative)

Prior versions of this standard required that streams contain a NAL EOS immediately prior to a splice, followed by the spliced-in bitstream to signal older AVC receivers that a splice has occurred. This revision makes such NAL EOS signaling optional and *deprecated*, but if present it **shall** conform to the requirements in this specification.

#### 6.4. Expectations for NAL Based Video Receiver Behavior (Informative)

This specification describes stream conditioning that makes it possible for a NAL receiver to decode and present a NAL structured video bitstream containing spliced content without disruption. This section describes expectations around receiver behavior when decoding these bitstreams.

The access unit following the splice will meet the requirements for a NAL In-Point and may be accompanied by a signaled time base discontinuity. NAL receivers are expected to handle these discontinuities.

To effect clean playback across a splice the NAL receiver is expected to continue processing the bitstream. If the first access unit following the splice has the NAL `no_output_of_prior_pics_flag` set to “0”, the receiver *should not* infer it to be “1”.

Note: If the first picture output from the DPB for the following bitstream does not immediately follow the last output picture from the DPB for the stream preceding, the NAL receiver repeats the last output picture from the DPB until the first picture from the following bitstream is outputted from the DPB.

NAL receivers are expected to seamlessly handle picture resolution changes to avoid disruptions due to resetting of picture memory in the decoded picture buffer (DPB). There are techniques that can be used to mitigate resolution changes. For aspect ratio changes (e.g. 4:3/16:9), AFD and bar data (see SMPTE ST 2016-1 [ST\_2016\_1]) can be used to avoid a picture resolution change (this impacts presentation, not decoding). Upscaling (e.g. 720p/1080i, 1080p/4K) can be used for pictures having the same aspect ratios. A downward resolution change may not disrupt the DPB output. Profile and Level changes are to be constrained according to NAL SCTE Coding Level Constraints specifications and should cause no additional disruptions beyond a resolution change or decoder limitations on handling higher levels.

#### 6.5. Consequences of the Difference between MPEG-2 and NAL Based Video (Informative)

[SCTE 35] splice messages use presentation time stamps (PTS) to signal splice points. NAL structured video frames are usually transmitted in a different order than their display order. While this is also true of MPEG-2 video coding, NAL structured video has much larger buffers, holding several pictures at a time. Each picture is decoded and moved into the DPB at the time indicated by its decoding time stamp (DTS). For further constraints see section 8.1.

### 7. Constraints On Video Coding For Digital Program Insertion

Inserted content (e.g. Advertisement), non-time-linear content and the time-linear (e.g. Network) content *shall* be coded in accordance with SCTE Coding Standards, subject to the additional constraints of this standard.

Note: Constraints are provided for both network (see Section 7.2) and inserted content (see Section 7.4).

#### 7.1. Definition of Out Point and In Point

For both Out Point and In Point, the NAL AU selected *shall* be the first NAL AU with a PTS time greater than or equal to the `pts_time` as adjusted by the `pts_adjustment` from the SCTE 35 message as defined in [SCTE 35].

### 7.1.1. Out Point

As defined in [SCTE 35] an Out Point is a point between two presentation units and the corresponding point between two NAL AUs in the coded stream in decode order. An Out Point is a suitable place to exit a NAL structured video stream allowing the decoder to output contiguous and displayable frames up to the out point.

Splicing devices are responsible for locating the corresponding splice point in decode order of a respective Out Point (see Section 7.2.1). Methods to assist splicing devices in locating the splice point in decode order may be provided by other means.

### 7.1.2. In Point

As defined in [SCTE 35], an In Point is a point between two NAL AUs and the corresponding point between two NAL AUs in the coded stream in decode order. An In Point is a suitable place to enter a NAL structured video stream. The first coded picture following an In Point (in decode order, not presentation order), *shall* be a NAL SCTE In-Point .

### 7.1.3. Out Point and In Point Co-location

When an Out Point and an In Point are co-located (at the same point in the stream), the values of the respective pts\_time as modified by pts\_adjustment from the SCTE 35 message *shall* point to the same NAL AU (as defined by Section 6.1 Splice Points of [SCTE 35]).

Note: The two values of pts\_time as modified by pts\_adjustment in such a case may not be bit-for-bit identical.

## 7.2. Coding Constraints for Network Content

### 7.2.1. Constraints at network Out Points

In the network stream, at the moment when the last access unit prior to an Out Point is decoded, all of the pictures in the DPB which are not yet output (displayed/presented) *shall* be, starting immediately, contiguously displayable (no gaps in their PTS values).

If NAL EOS Signaling is in use the following paragraph *shall* apply. The access unit in decode order prior to the Out Point *shall* end with either a NAL EOS unit or a filler data NAL unit (**filler\_data\_rbsp()** syntax element with a single filler (0xFF) byte). The presence of the filler data NAL unit is to permit a splicing device to convert the filler data NAL unit and the filler byte into a NAL EOS in the splicer's output when the splice is performed. That NAL EOS unit or the filler data NAL unit (as the case may be) *shall* be entirely contained within the payload of a single TS packet. Also, note the additional constraint in section 6.1 which requires each PES packet to contain exactly one NAL AU.

The next video access unit in decode order *may* be a NAL SCTE In-Point. It *shall* contain a NAL IDRPicture access unit if the access unit preceding this in decode order represented a point in the stream of contiguously displayable pictures.

Note: If the NAL structured video format is interlaced, it is recommended that the last displayed picture before the network Out Point end with a bottom field and the first displayed picture following the network Out Point begin with a top field. For HEVC codec, Trail\_R fields would need to be converted to IDR or BLA picture and leading picture are then skipped by converting to RASL pictures. VVC should use the VSEI Frame Field SEI message to indicate top and bottom fields [23002-7] .

### 7.2.2. Constraints at network In Points

If NAL EOS Signaling is in use the following paragraph *shall* apply. The intended network In Point *shall be* preceded, in decode order, by a NAL EOS unit (NAL EOS syntax element) or filler data NAL unit (**filler\_data\_rbsp()** syntax element).

The next video access unit in decode order, following the In Point, *shall* be a NAL SCTE In-Point . That access unit *shall* contain a NAL IDRPicture and be placed in the bitstream equal to in time or immediately following the intended network In Point. The network In Point may be either explicitly signaled or implicitly signaled via a duration carried in the [SCTE 35] **splice\_info\_section()** that specified the network Out Point.

The intended network In Point *may be* preceded, in decode order, by a NAL EOS unit (NAL EOS syntax element) or filler data NAL unit (**filler\_data\_rbsp()** syntax element).

Note: An In Point does not require a preceding NAL EOS or filler data NAL unit, but omission of these NAL unit types could affect the behavior of some older existing splicing devices.

If explicitly signaled, the [SCTE 35] **splice\_info\_section()** signaling the end of the insertion *shall* be provided to specify the location of the network In Point. If implicitly signaled, the insertion duration *shall* be present in the [SCTE 35] **splice\_info\_section()** that specified the network Out Point. Alternatively, the insertion duration may be determined by an external system (ex. Advertising Decision System).

If the video format is interlaced, the last displayed picture before the network In Point should end with a bottom field and the first displayed picture following the network In Point should begin with a top field.

Note: To ensure that a splicer running in real-time can return to the network in the case of a slight mismatch in insertion length versus the intended length, it is recommended (while considering bandwidth limitations) that the first two NAL SRAPs following a network In Point should also be coded as NAL SCTE In-Points. The successive NAL SCTE In-Points will represent acceptable places to enter the stream but will not likely be signaled by an [SCTE 35] **splice\_info\_section()**.

### 7.3. Constraints on splice point Access Units

Each access unit which immediately follows an indicated In Point *shall* comply with the requirements for a NAL SCTE In-Point. The access unit *shall* have NAL **no\_output\_of\_prior\_pics\_flag** set to '0' in all slice headers or slice segment headers within the access unit.

Note: Output of splicers must conform to both the relevant NAL Video Coding Standards and NAL SCTE Coding Level Constraints specifications. Setting the NAL **no\_output\_of\_prior\_pics\_flag** to '0' (in a splicer's output) ensures that splices which do not result in conformance errors are "seamless."

The output of a splicing device should be a compliant stream.

#### 7.3.1. Constraints on fields in seq\_parameter\_set\_rbsp()

For AVC video, **profile\_idc** is set as indicated in Section 7.2.1.1 Sequence Parameter Set (SPS) Constraints of ANSI/SCTE 128-1 [SCTE 128-1] . **pic\_order\_cnt\_type** is set to zero. **vui\_parameters\_present\_flag** is set to '1' and the **vui\_parameters()** follows. The value of **seq\_parameter\_set\_id** is not to be changed from the prior value.

For HEVC video, **general\_profile\_idc** is set as indicated in Section 7.1.1 Profile, Levels, and Tiers constraints of ANSI/SCTE 215-1 [SCTE 215-1]. **pic\_order\_cnt\_type** is set to zero.

**vui\_parameters\_present\_flag** is set to '1' and the **vui\_parameters()** follows. The value of **seq\_parameter\_set\_id** is not to be changed from the prior value.

For VVC video, **general\_profile\_idc** is set as indicated in Section 8.1.1 Profiles, Levels, and Tiers constraints of SCTE 281-1 [SCTE 128-1]. **sps\_field\_seq\_flag** is set to '1' and the VSEI **vui\_parameters()** follow with Frame Field information SEI message following section 8.1.7.1 Frame-field SEI Message of SCTE 281-1 [SCTE 281-1]. The value of **seq\_parameter\_set\_id** is not to be changed from the prior value.

## 7.4. Coding Constraints on Insertion Material

### 7.4.1. Constraints on Insertion Material In Points

Coded Insertion Material (to be inserted into a Network following its Out Point) **shall** begin with a NAL SCTE in-point (in decode order). This **shall** be an Insertion Material In Point. There may exist additional points of entry (In Points) within the Insertion Material.

Note: For NAL video based codec formats, both NAL Video Coding Standard and NAL SCTE Coding Level Constraints Specification place additional constraints upon the construction of the NAL SCTE in-point access unit. The reader should consult respective documents for specifics.

[SCTE 35] messages are not necessary, and not prohibited, in the Insertion Material content.

If the video format is interlaced, the first displayed picture of the Insertion Material should begin with a top field.

### 7.4.2. Constraints on Insertion Material Out Points

Each item of Insertion Material (e.g. an advertisement) to be inserted into a Network stream **shall** be terminated by an Out Point as described in this section of this document. There may exist additional Out Points within the body of the Insertion Material.

A signaled break may result in multiple insertions. Each item of Insertion Material **shall** be a complete "coded video sequence" as defined by NAL Video Coding Standard.

If NAL EOS Signaling is in use, each item of Insertion Material **shall** be terminated by a NAL EOS.

If the video format is interlaced, the last displayed picture of the Insertion Material and the last display picture of each Out Point should end with a bottom field.

At an Insertion Material Out Point, at the moment when the last access unit is decoded, all of the pictures in the DPB which are not yet displayed **shall** be, starting immediately, contiguously displayable (no gaps in their PTS values).

## 7.5. Use of splice event cancel

If an [SCTE 35] **splice\_info\_section()** occurs in the Transport Stream with **splice\_event\_cancel\_indicator** set to '1', the structure of the video stream is not constrained and a seamless splice should not be expected.

## 8. Constraints On Transport

### 8.1. Constraints beyond NAL SCTE Transport Level Constraints

The Transport Constraints of NAL SCTE Transport Level Constraints specification *shall* be followed. Further, each PES packet *shall* contain exactly one NAL access unit as defined in PES Constraint Section as specified in section 6.1 of NAL SCTE Transport Level Constraints.

The access unit following the intended splice point specified in the [SCTE 35] **splice\_info\_section()** (and which may be either a splice from network or a splice into the network) *shall* begin a PES packet, which in turn *shall* begin a TS packet. This PES packet *shall* contain a PTS and a DTS, should it differ from the PTS.

The previous access unit (in TS order) *may* be terminated by a NAL EOS or by a **filler\_data\_rbsp()**.

An NAL IDRPicture access unit which follows the intended splice point specified in the [SCTE 35] **splice\_info\_section()** should not be directly preceded by another NAL IDRpicture access unit.

### 8.2. Constraints on SCTE 35 messages associated with AVC coding

The intended splice point specified in the [SCTE 35] **splice\_info\_section()** may be for either a splice from network (“network Out Point”) or a splice into the network (“network In Point”). If a splice from network, **auto\_return** may be set to ‘1’ in the **break\_duration()** of the message.

The PTS sample (**pts\_time** in the **splice\_time()** structure) specified in the [SCTE 35] message *shall* comply with the requirements of **splice\_time()** section of [SCTE 35].

## 9. Function of Splicing Devices (Informative)

NAL capable splicing devices should keep the following in mind during operation:

The output of the splicing operation needs to be conformant to the NAL Video Coding Standard.

Note: Splicers can examine the structures in both the network and the insertion material to ensure conformance. Should the two match, then the NAL **no\_output\_of\_prior\_pics\_flag** should be set to '0' by the splicer and the splice is “seamless”.

Field parity must always be maintained across the splice at all out and in-points.