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STANDARDS

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ANSI/SCTE 187-2 2019

Stereoscopic 3D PSI Signaling

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1.0 SCOPE

This document defines the transport and signaling for high-definition frame-compatible stereoscopic 3D content for distribution on cable television systems. Transport parameters and constraints defined by this specification can be applied to different content types, including broadcast programming, switched digital video (SDV), VOD content, and advertising content to be inserted into broadcast or VOD content.

This document defines only the specific parameters relevant to high-definition frame-compatible S3D content beyond what are already required and specified elsewhere for flat (2D) video content and signaling. Frame compatible S3D programming will otherwise follow all standardized encoding, transport, and signaling practices except where specifically identified in this document. This document does not define a complete distribution method nor does it define all aspects of the cable system infrastructure that content encounters during distribution and playback.

2.0 NORMATIVE REFERENCES

The following documents contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of subcommittee approval, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

2.1 SCTE References

[SCTE 43] ANSI/SCTE 43 2015, Digital Video Systems Characteristics Standard for Cable Television

[SCTE 54] ANSI/SCTE 54 2015, Digital Video Service Multiplex and Transport System Standard for Cable Television

[SCTE 128-1] ANSI/SCTE 128-1 2018, AVC Video Constraints for Cable Television Part 1: Coding

[SCTE 128-2] ANSI/SCTE 128-2 2018, AVC Video Constraints for Cable Television Part 1: Transport

[SCTE 187-1] SCTE-187-1 201x Stereoscopic 3D Formatting and Coding for Cable

2.2 Standards from other Organizations

[IEC 13818-1] ISO/IEC 13818-1:2018, International Standard, Information Technology - Generic Coding of Moving Pictures and Associated Audio Information: Systems

[IEC 13818-2] ISO/IEC 13818-2:2013 (E), International Standard, Information Technology - Generic Coding of Moving Pictures and Associated Audio Information: Video

[ITU H.264] ITU-T Recommendation H.264 (06/2019), Advanced video coding for generic audio visual services

[ITU H.265] ITU-T Recommendation H.265 (06/2019), High efficiency video coding

3.0 INFORMATIVE REFERENCES

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

3.1 SCTE References

[SCTE 215-1] ANSI/SCTE 215-1 2018, HEVC Video Constraints for Cable Television Part 1: Coding

[SCTE 215-2] ANSI/SCTE 215-2 2018, HEVC Video Constraints for Cable Television Part 2: Transport

[SCTE 187-3] SCTE 187-3 201x, Informative Guidance for Stereoscopic Video

3.2 Standards from other Organizations

3.3 Published Materials

4.0 COMPLIANCE NOTATION

shall	This word or the adjective "***required***" means that the item is an absolute requirement of this document.
shall not	This phrase means that the item is an absolute prohibition of this document.
forbidden	This word means the value specified shall never be used.
should	This word or the adjective "*recommended*" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
should not	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
may	This word or the adjective "*optional*" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.
deprecated	Use is permissible for legacy purposes only. Deprecated features may be removed from future versions of this document. Implementations should avoid use of deprecated features.

5.0 DEFINITIONS AND ACRONYMS

3DTV	Three-Dimensional Television
ASCII	American Standard Code for Information Interchange
AFD	Active Format Descriptor
AVC	Advanced Video Coding
FC-S3D	Frame-Compatible Stereoscopic Three-Dimensional
FC-S3D-ZD	FC-S3D with Zero Disparity
GOP	Group of Pictures
HD	High Definition
HEVC	High Efficiency Video Coding
MPEG	Moving Picture Experts Group

NAL	Network Abstraction Layer
PSI	Program-Specific Information
PMT	Program Map Table
S3D	Stereoscopic, three-Dimensional
SbS	Side-by-Side
SEI	Supplemental Enhancement Information
STB	Set Top Box
TaB	Top-and-Bottom
UHD	Ultra High Definition
VUI	Video Usability Information
ZPS	Zero Parallax Setting

Frame-Compatible Stereoscopic Three-Dimensional (FC-S3D): Refers to video content composed of left and right eye stereoscopic image pairs assembled into single packed video frames for delivery through legacy video distribution systems. The left and right image pairs are typically subject to a filtering, decimation, and formatting process to generate a packed frame that has the same pixel count as the original left or right frame. A reverse of this process is performed to reconstruct the full stereoscopic image pair prior to display. Examples of frame-compatible formats include top-bottom and side-by-side.

FC-S3D-Zero Disparity (FC-S3D-ZD): Refers to a subset of FC-S3D content in which the left and right images are identical. Standard 2D content can be pre-processed into FC-S3D-ZD to match the **frame_packing_arrangement_type** and video format as preceding or succeeding FC-S3D content to facilitate seamless transitions as described in Section 8.6.

6.0 INTRODUCTION

This standard is part two of a three-part standard that describes the use of stereoscopic, three-dimensional (S3D) video programming using a frame-compatible delivery mechanism for cable systems in North America. In many ways the FC-S3D signals can be processed and handled in the same way as flat (2-dimensional) video programming and hence it is described as frame-*compatible*. The purpose of this three-part standard is to define those parts that are necessarily different from conventional (2-dimensional) video programming.

7.0 DOCUMENT STRUCTURE

Part-1 of this standard [SCTE 187-1] defines the video formatting and constraints as well as specific 3D signaling that is part of the video user data bits as shown below in Figure 1. Part-2 of this standard (this document) defines the program-specific information (PSI) requirements for signaling, which are carried in the program map table (PMT), which is also illustrated below in Figure 1. Finally, Part-3 of this standard [SCTE 215-1] ANSI/SCTE 215-1 2018, HEVC Video Constraints for Cable Television Part 1: Coding

[SCTE 215-2] ANSI/SCTE 215-2 2018, HEVC Video Constraints for Cable Television Part 2: Transport

[SCTE 187-3] is an informative document that provides tutorial and reference information about the implications of certain formatting as it applies to stereoscopic-3D production and content preparation.

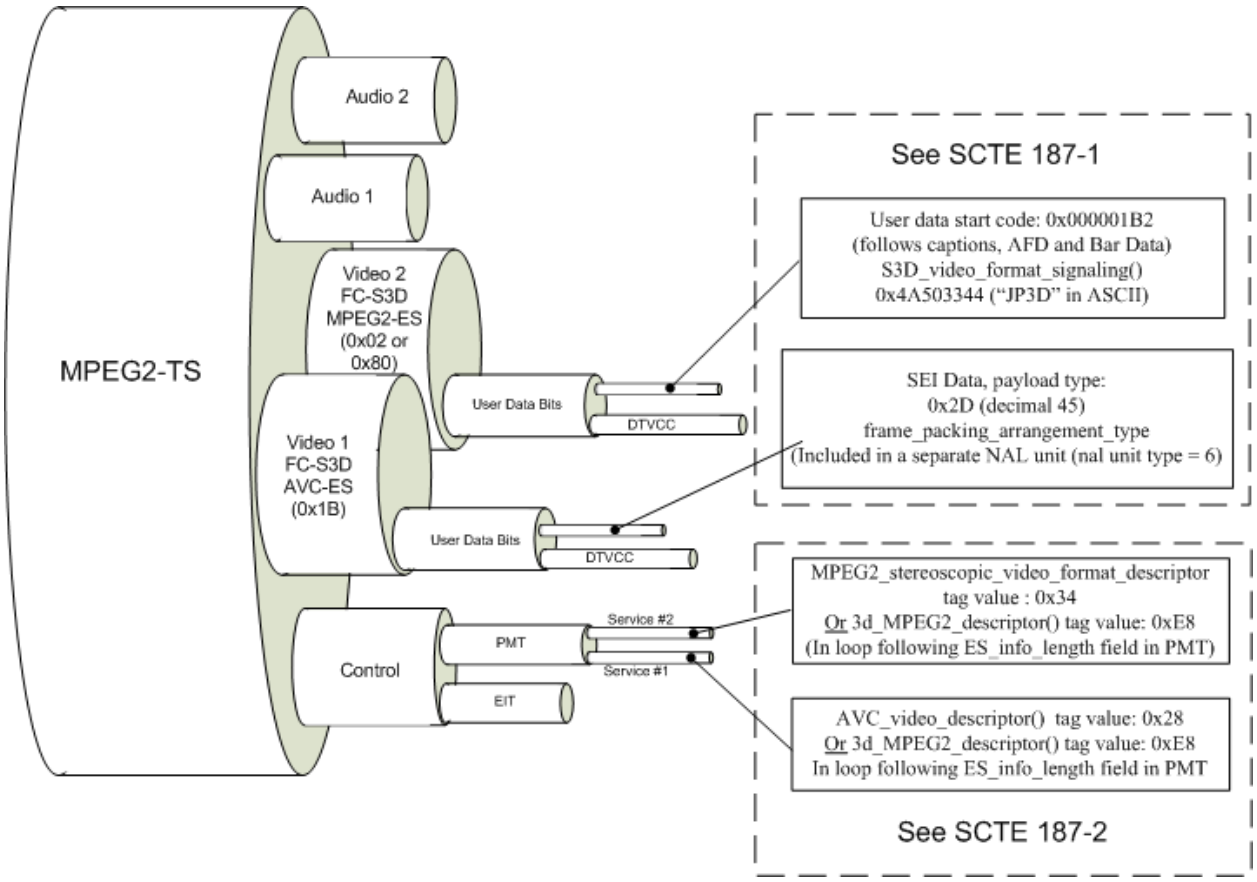

Figure 1 - Focus of Part-1 and Part-2

8.0 S3D TRANSPORT AND SIGNALING

8.1 PSI Requirements for FC-S3D MPEG-2 Video

In addition to the signaling in the video, the following descriptor ***shall*** be added to the PMT of an FC-S3D video service to signal whether the service in MPEG-2 Transport Stream carries the signaling metadata described in Section 9 [SCTE 187-1] (for MPEG-2 video based S3D). This descriptor is included in the PMT for 3DTV-coded services according to . This descriptor is only used with **stream_type** value of 0x02 or 0x80 (MPEG-2 video).

Table 1 – MPEG2_stereoscopic_video_format_descriptor() syntax

Syntax	No. of bits	Format
MPEG2_stereoscopic_video_format_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
stereo_video_arrangement_type_present	1	bslbf
If (stereo_video_arrangement_type_present)		
arrangement_type	7	bslbf
else {		
reserved }	7	bslbf
}		

8.1.1 Use and application:

The **MPEG2_stereoscopic_video_format_descriptor()** ***shall*** be associated in the PMT for MPEG-2 S3D video components (including any 2D video components formatted as FC-S3D-ZD within a 3DTV service) with **stream_type** values equal to 0x02 or 0x80.

When present, the **MPEG2_stereoscopic_video_format_descriptor()** ***shall*** be located in the loop following **ES_info_length** field in PMT.

If the **MPEG2_stereoscopic_video_format_descriptor()** is included in the PMT, then the associated MPEG-2 video elementary stream ***shall*** contain stereoscopic video format information in the **user_data()** extension as specified in **Error! Reference source not found.**.

The PMT ***shall*** contain the **MPEG2_stereoscopic_video_format_descriptor()** for all FC-S3D segments including FC-S3D-ZD segments.

8.1.2 Syntax:

descriptor_tag – The **descriptor_tag** value ***shall*** be 0x34.

descriptor_length – An 8-bit unsigned integer, in the range of 1 to 255, that indicates the number of byte to follow. The value of **descriptor_length** ***shall*** be set to 0x01 for the present version of the descriptor. If extensions to the

descriptor are defined in the future, the **descriptor_length** could change accordingly.

stereo_video_arrangement_type_present: This bit ***shall*** be set to '1'. The following 7 bits indicate the type of **S3D_video_format_type** included in the **user_data ()** of associated MPEG-2 video elementary stream (see Table 3 of [SCTE 187-1].

arrangement_type: This field shall be set to the same value as **arrangement_type** defined in Table L-1 of **Error! Reference source not found.** and included in the **user_data()** extension of associated MPEG-2 video elementary stream.

8.2 PSI Requirements for FC-S3D AVC/H.264 Video

In addition to the signaling in the video, the following descriptor ***shall*** be carried in the PMT of a S3D video service to signal whether the service in MPEG-2 Transport Stream carries the signaling metadata described in Section 10 of [SCTE 187-1] (for AVC video based FC-S3D). This descriptor is reproduced from **Error! Reference source not found.** and ***shall*** be included in the PMT for **stream_type** value = 0x1B (AVC video) when the component is 3DTV coded.

Table 2 – AVC video descriptor

Syntax	No. of bits	Mnemonic
AVC_video_descriptor() {		
descriptor_tag	**8**	**uimsbf**
descriptor_length	**8**	**uimsbf**
profile_idc	**8**	**uimsbf**
constraint_set0_flag	**1**	**bslbf**
constraint_set1_flag	**1**	**bslbf**
constraint_set2_flag	**1**	**bslbf**
constraint_set3_flag	**1**	**bslbf**
constraint_set4_flag	**1**	**bslbf**
constraint_set5_flag	**1**	**bslbf**
AVC_compatible_flags	**2**	**bslbf**
level_idc	**8**	**uimsbf**
AVC_still_present	**1**	**bslbf**
AVC_24_hour_picture_flag	**1**	**bslbf**
frame_packing_SEI_not_present_flag	**1**	**bslbf**
reserved	**5**	**bslbf**
}		

8.2.1 Use and application:

The **AVC_video_descriptor()** ***shall*** be associated in the PMT for AVC S3D video components with **stream_type** values equal to 0x1B.

When present, the **AVC_video_descriptor()** ***shall*** be located in the loop following **ES_info_length** field in PMT.

If the **AVC_video_descriptor()** is included in the PMT and the syntax element **frame_packing_SEI_not_present_flag** is set to '0', then the associated AVC video elementary stream ***shall*** contain stereoscopic video format information in the AVC SEI message as specified in ITU-T Rec. H.264 | ISO/IEC 14496-10 (2010).

For any service or stream that includes concatenated elements of full-resolution 2D and FC-S3D content, the PMT ***shall*** contain the **AVC_video_descriptor()** for both 2D and 3D segments and the syntax element **frame_packing_SEI_not_present_flag** shall be set as follows:

In the case of the preferred seamless splice points between FC-S3D and FC-S3D-ZD material as described below in Figure 2, the **frame_packing_SEI_not_present_flag** ***shall*** be set to '0' for both FC-S3D and FC-S3D-ZD segments, and both segments shall contain the frame packing arrangement SEI message.

In the case where disruptive splice points between FC-S3D and full-resolution 2D material cannot be avoided as described below in Figure 3, the **frame_packing_SEI_not_present_flag** ***shall*** be set to '0' for the S3D-FC and ***shall*** be set to '1' for the 2D segments, and such 2D segments ***shall*** NOT contain frame packing arrangement SEI message.

If the **AVC_video_descriptor()** is not present, then the video component in the service does not carry the **frame_packing_arrangement_type** SEI message described in Section 10 of [SCTE 187-1]. Thus, the video component is not 3DTV encoded.

8.2.2 Syntax:

descriptor_tag – The **descriptor_tag** value ***shall*** be 0x28.

8.3 PSI Requirements for FC-S3D HEVC/H.265 Video

In addition to the signaling in the video, the following descriptor ***shall*** be carried in the PMT of a S3D video service to signal whether the service in MPEG-2 Transport Stream carries the signaling metadata described in Section 10 of [SCTE 187-1] (for HEVC video based FC-S3D). This descriptor is reproduced from **Error! Reference source not found.** and ***shall*** be included in the PMT for **stream_type** value = 0x24 (HEVC video) when the component is 3DTV coded.

Table 3 – HEVC video descriptor

Syntax	No. of bits	Mnemonic
HEVC_video_descriptor() {		
descriptor_tag	**8**	**uimsbf**
descriptor_length	**8**	**uimsbf**
profile_space	**2**	**uimsbf**
tier_flag	**1**	**bslbf**
profile_idc	**5**	**uimsbf**
profile_compatibility_indication	**32**	**bslbf**
progressive_source_flag	**1**	**bslbf**
interlaced_source_flag	**1**	**bslbf**
non_packed_constraint_flag	**1**	**bslbf**
frame_only_constraint_flag	**1**	**bslbf**
copied_44bits	**44**	**bslbf**
level_idc	**8**	**uimsbf**
temporal_layer_subset_flag	**1**	**bslbf**
HEVC_still_present_flag	**1**	**bslbf**
HEVC_24hr_picture_present_flag	**1**	**bslbf**
sub_pic_hrd_params_not_present_flag	**1**	**bslbf**
reserved	**2**	**bslbf**
HDR_WCG_idc	**2**	**bslbf**
if (temporal_layer_subset_flag == '1') {		
temporal_id_min	**3**	**uimsbf**
reserved	**5**	**bslbf**
temporal_id_max	**3**	**uimsbf**
reserved	**5**	**bslbf**
}		
}		

8.3.1 Use and application:

The **HEVC_video_descriptor()** ***shall*** be associated in the PMT for HEVC S3D video components with **stream_type** values equal to 0x24.

When present, the **HEVC_video_descriptor()** ***shall*** be located in the loop following **ES_info_length** field in PMT.

If the **HEVC_video_descriptor()** is included in the PMT and the syntax element **non_packed_constraint_flag** is set to '0', then the associated HEVC video elementary stream ***shall*** contain stereoscopic video format information in the HEVC SEI message as specified in ITU-T Rec. H.265 | ISO/IEC 23008-2 (2018).

For any service or stream that includes concatenated elements of full-resolution 2D and FC-S3D content, the PMT ***shall*** contain the **HEVC_video_descriptor()**

for both 2D and 3D segments and the syntax element **non_packed_constraint_flag** shall be set as follows:

In the case of the preferred seamless splice points between FC-S3D and FC-S3D-ZD material as described below in Figure 2, the **non_packed_constraint_flag *shall*** be set to '0' for both FC-S3D and FC-S3D-ZD segments, and both segments shall contain the frame packing arrangement SEI message.

In the case where disruptive splice points between FC-S3D and full-resolution 2D material cannot be avoided as described below in Figure 3, the **non_packed_constraint_flag *shall*** be set to '0' for the S3D-FC and ***shall*** be set to '1' for the 2D segments, and such 2D segments ***shall not*** contain frame packing arrangement SEI message.

If the **HEVC_video_descriptor()** is not present, then the video component in the service does not carry the **frame_packing_arrangement_type** SEI message described in Section 10 of [SCTE 187-1]. Thus, the video component is not 3DTV encoded.

8.3.2 Syntax:

descriptor_tag – The **descriptor_tag** value is required to be 0x38.

8.4 Optional PSI signaling for MPEG-2 or AVC/H.264 Video (*deprecated*)

The following descriptor *may* also be included optionally in the PMT of a S3D video service to signal whether the service in MPEG-2 transport stream carries signaling metadata as described in Sections 9 (MPEG-2) or Section 10 (AVC/H.264) of [SCTE 187-1].

Table 4 – 3d_ MPEG2_descriptor() syntax

Syntax	No. of bits	Format
3d_MPEG2_descriptor() {		uimsbf
descriptor_tag	8	
descriptor_length	8	
3d_frame_packing_data_present	1	
reserved	7	
}		

8.4.1 Use and application:

The **3d_MPEG2_descriptor()** *may* be associated in the PMT for MPEG-2 video components with **stream_type** value equal to 0x02 and 0x80 and AVC/H.264 video components with **stream_type** 0x1B.

When present, the **3d_MPEG2_descriptor()** ***shall*** be located in the loop following **ES_info_length** field in PMT.

If the **3d_MPEG2_descriptor()** is included with **stream_type** 0x02 or 0x80 in the PMT and the syntax element **3d_frame_packing_data_present** is set to '1', then the associated MPEG-2 video elementary stream ***shall*** contain stereoscopic video format information in the **user_data()** extension as specified in **Error! Reference source not found.**.

If the **3d_MPEG2_descriptor()** is included with **stream_type** 0x1B in the PMT and the syntax element **3d_frame_packing_data_present** is set to '1', then the associated AVC/H.264 video elementary stream ***shall*** contain the **frame_packing_arrangement_type** SEI message.

For any service or stream that includes concatenated elements of full-resolution 2D and FC-S3D content with this descriptor, the PMT ***shall*** contain the **3d_MPEG2_descriptor()** for both 2D and 3D segments with the appropriate value of syntax element **3d_frame_packing_data_present**.

8.4.2 Syntax:

descriptor_tag – The **descriptor_tag** value ***shall*** be 0xE8.

descriptor_length – An 8-bit unsigned integer, in the range of 1 to 255, that indicates the number of byte to follow. The value of **descriptor_length** ***shall*** be set to 0x01 for the present version of the descriptor. If extensions to the descriptor are defined in the future, the **descriptor_length** could change accordingly.

3d_frame_packing_data_present – This flag ***shall*** be set to '1' when either the video component in the service carries **the S3D_video_format_signaling()** in the **user_data()** described in Section 9 of [SCTE 187-1] (for MPEG-2), or the **frame_packing_arrangement_type** SEI message described in Section 10 of [SCTE 187-1]. A value of '0' ***shall*** indicate that the video service is 2D encoded.

Note: When this descriptor is used, transitions between full-resolution 2D and FC-S3D content are indicated by a change in the value from '0' to '1' within the **3d_frame_packing_data_present** field of the descriptor.

reserved – These bits are reserved for future use and ***shall*** be set to value '1'. The values could change in future revisions.

8.5 Simultaneous Use of the 0xE8 and 0x34 Descriptors

In some cases the PMT *may* include both the **3d_MPEG2_descriptor()** (0xE8) and the **MPEG2_stereoscopic_video_format_descriptor()** (0x34) in the same stream. In such cases the **3d_ MPEG2_descriptor()** (0xE8) *should* be located in the loop

following **ES_info_length** field in PMT followed immediately by the **MPEG2_stereoscopic_video_format_descriptor()** (0x34).

8.6 Concatenation of FC-S3D with Full-Resolution 2D Content: INFORMATIVE

There are both permitted and preferred ways of concatenating 2D and 3D content. Any concatenated streams that present a transition between frame-compatible S3D and full resolution 2D images might result in a disruptive viewing experience from some decoders even when all signaling is frame-accurate and effective.

The preferred concatenation method is to pre-format the full-resolution 2D content as FC-S3D with zero disparity (FC-S3D-ZD) such that the video, transport, and signaling parameters match the adjacent FC-S3D content. 2D content formatted in this way is fully FC-S3D compliant. It is signaled, processed, and displayed as FC-S3D of the same resolution as the preceding or following stereoscopic content but with a flat 2D visual experience. The benefit is that video mode transitions are avoided at the splice points. Decoders will not need to respond to video mode transitions and so the potential for decoding disruptions is avoided.

Figure 2 below depicts examples of this preferred seamless method:

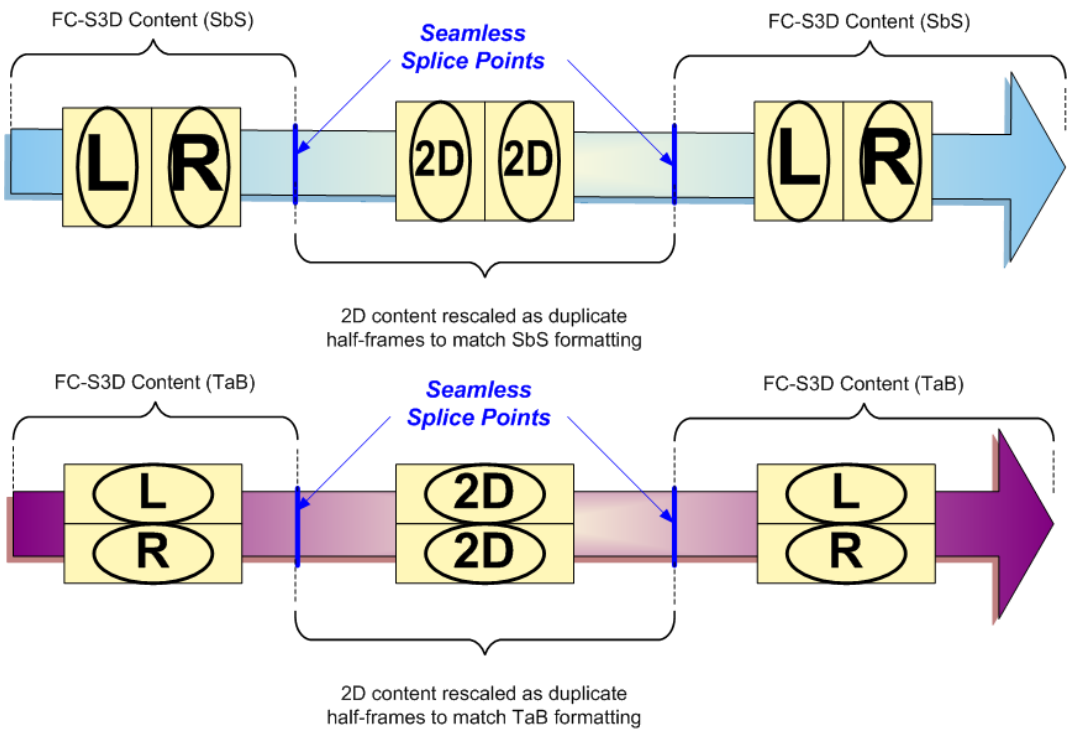

Figure 2 - Seamless Splice Points

The permitted but not preferred method is to concatenate the 2D content signaled as 2D content with FC-S3D content signaled as FC-S3D content. Video decoders will see the transitions in signaling and respond with changes in decoding and presentation

mode. For some decoders the resulting video mode changes at each transition from 2D to FC-S3D and from FC-S3D to 2D can result in user perceptible decoding disruptions.

Figure 3 below depicts examples of this permitted but not preferred and potentially disruptive method of concatenation.

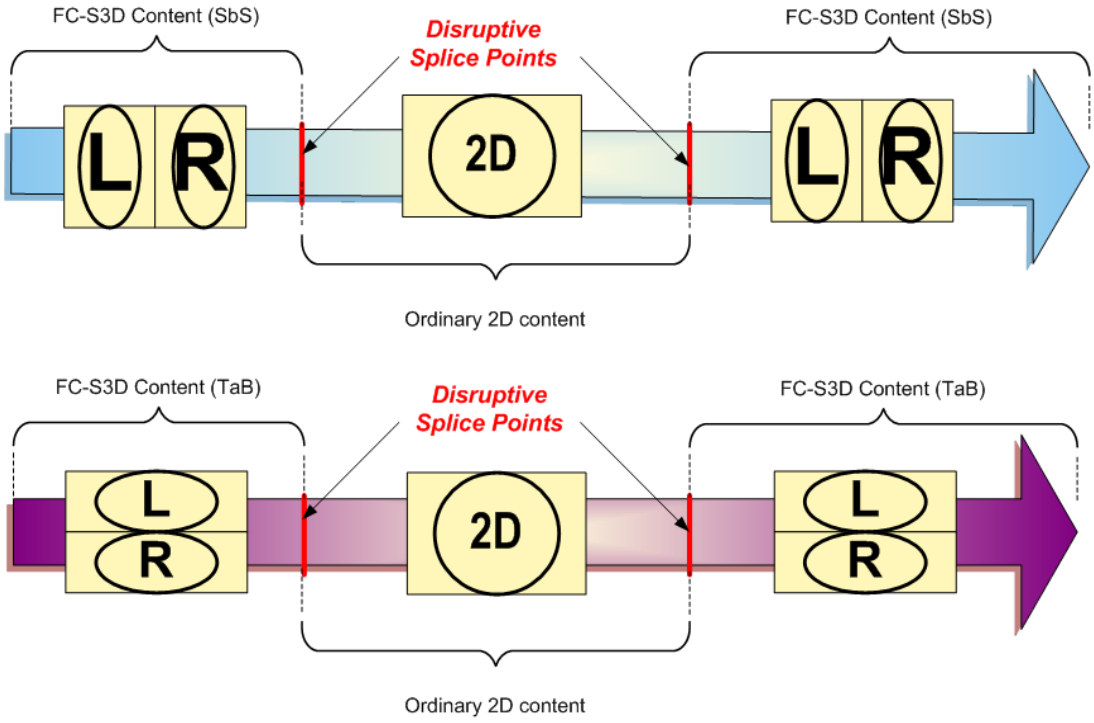

Figure 3 - Disruptive Splice Points

9.0 STREAM TYPE IDENTIFICATION

9.1 Frame-Compatible Stereoscopic 3D content encoded as MPEG-2 video ***shall*** use the **stream_type** (0x02) or (0x80) as defined by [SCTE 54].

9.2 Frame-Compatible Stereoscopic 3D content encoded as AVC/H.264 video ***shall*** use the **stream_type** (0x1B) as defined by [SCTE 128-1].

9.3 Frame-Compatible Stereoscopic 3D content encoded as HEVC/H.265 video ***shall*** use the **stream_type** (0x24) as defined by [SCTE 128-1].