

SMPTE STANDARD

Stereoscopic 3D Frame Compatible Packing and Signaling for HDTV



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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Operations Manual.

SMPTE ST 2068 was prepared by Technology Committee 10E.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Specifically, one or more multiplexing methods signaled by this Standard may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

Stereoscopic 3D imaging systems deliver two images (left eye image and right eye image), that are arranged to be seen simultaneously or near simultaneously by the left and right eyes. Viewers then perceive increased depth in the picture, which becomes more like the natural binocular viewing experience.

One method of carrying stereoscopic signals in existing 2D HDTV systems is to multiplex two temporally or spatially sub-sampled images of a stereoscopic image pair into a single stream. This method of carriage is called the Frame Compatible packing method. This document provides a mechanism to signal the packing method used to create a Frame Compatible serial data stream. This signaling is based upon and is compatible with the H.264/MPEG-4 AVC Frame Packing Arrangement SEI message.

Annex B Frame Compatible Packing Methods (informative) provides illustrations of the frame packing methods covered by this standard.

Figure 1 illustrates the process of creating a frame compatible image stream from a Stereoscopic 3D image pair. The general order of operations that occur when two images of a stereoscopic image pair are packed into one frame compatible image are as follows:

(1) The input Stereoscopic serial data stream consisting of a stereoscopic image pair (Left Eye image and Right Eye image), as defined for example in SMPTE ST 292-2, Dual 1.5 Gb/s Serial Digital Interface for Stereoscopic Image Transport or SMPTE ST 425-4, Dual 3Gb/s Serial Digital Interface for Stereoscopic Image Transport, are first decoded into a Full resolution Left eye image (FrLe) and a Full resolution Right eye image (FrRe). The FrLe and FrRe images are then filtered prior to the application of temporal or spatial sub-sampling.

The sub-sampling process produces two half resolution sub-images — Half spatial resolution Left eye / Right eye (HrLe / HrRe), or Half Temporal resolution Left eye / Right eye (HTrLe / HTrRe). These sub images may be half the horizontal, vertical or temporal resolution of the originating full resolution stereoscopic image pair.

(2) The two HrLe and HrRe or HTrLe and HTrRe sub-images are then packed into an intermediate form in preparation for multiplexing into a single Frame Packed Image. The packing step may also format the sub-images by reversing the image orientation or pixel order. The two Frame Packed sub-images are then multiplexed together to form the frame packed image.

(3) The frame packed image (FPI) is then output as a frame compatible serial data stream in accordance with SMPTE ST 292-1, 1.5 Gb/s Serial Digital Interface or SMPTE ST 425-1, 3 Gb/s Serial Digital Interface.

(4) Information describing the sub-sampling, packing method and multiplexing (Packing Method Signaling), is appended to the frame compatible serial data stream to facilitate interchange of Frame Compatible signals.

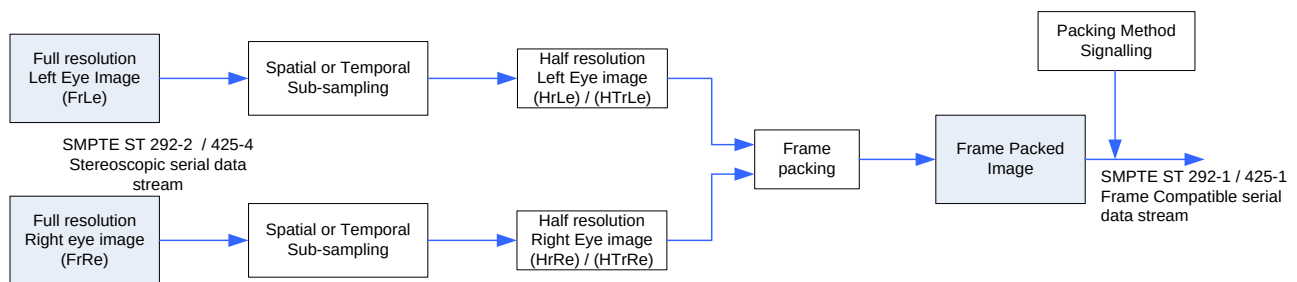


Figure 1 (Informative) – Overview of the frame packing operations

1 Scope

This standard defines a 3D Frame Compatible (3DFC) ancillary data packet that enumerates various frame packing methods in a manner compatible with Recommendation ITU-T H.264 (H.264) and ISO/IEC 14496-10 MPEG-4 AVC (MPEG-4 AVC), Frame Packing Arrangement SEI message.

This ancillary data packet provides information for the frame compatible transport of 10-bit stereoscopic image pairs (Left eye and Right eye images) — as defined in dual 1.5 Gb/s and 3 Gb/s serial digital interfaces for stereoscopic image transport — that are temporally or spatially sub-sampled and combined to form a frame compatible serial data stream in accordance with 1.5 Gb/s and 3 Gb/s serial digital interfaces.

The ancillary data packet is carried in the vertical ancillary (VANC) data space of the frame compatible serial data stream having the same pixel array structure as the originating stereoscopic image pair, and is used to signal the frame packing method utilized in order to facilitate interchange of Stereoscopic Frame Compatible signals.

The information contained in this ancillary data packet could then be used to set the H.264/MPEG-4 AVC Frame Packing Arrangement SEI message prior to delivery to a subsequent transmission delivery device.

The precise translation between the 3DFC ancillary data packet and the Frame Packing Arrangement SEI message is not within the scope of this standard. Nor does this standard address other additional H.264/MPEG-4 AVC SEI messages that may be required for transmission delivery of a 3D Frame Compatible signal.

Definition of the filtering mechanism is not within the scope of this standard since implementers can employ a variety of standard or proprietary filtering methods to improve image quality.

It is not necessary for implementations to include support for all frame packing arrangements defined in Table 4 to conform to this standard. Implementers should indicate supported frame packing arrangements in commercial publications.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE RP 168:2009, Definition of Vertical Interval Switching Point for Synchronous Video Switching

SMPTE ST 291-1:2011, Ancillary Data Packet and Space Formatting

SMPTE ST 292-1:2012, 1.5 Gb/s Signal/Data Serial Interface

SMPTE ST 425-1:2011, Source Image Format and Ancillary Data Mapping for the 3 Gb/s Serial Interface

4 Definition of Terms

4.1

Frame Compatible

For the purposes of this standard, a frame compatible serial data stream means that the left-eye and right-eye images of a stereoscopic image pair are arranged in a spatial or temporal multiplex which results in a single image stream that can be treated like a conventional 2D serial data stream. The frame compatible serial data stream may be progressive, interlaced or progressive segmented frame in accordance with the format of the originating stereoscopic image pair.

5 3DFC Ancillary Data Packet — Specification and Carriage

5.1 Format of the Ancillary Data Packet

The 3DFC Ancillary Data Packet shall be a Type 2 ANC packet as defined in SMPTE ST 291-1. It consists of the ancillary data flag (ADF), the data ID (DID), the secondary data ID (SDID), the data count (DC), the user data words (UDW), and the checksum (CS).

The UDW consists of the data payload that describes the Frame Packing method employed for the frame compatible transport of the stereoscopic image pair.

The DID word shall be set to the value 41h. The SDID word shall be set to the value of 0Ah.

DC is a count of the number of words in the UDW and shall be set to a fixed value of 03h.

5.2 Location and Timing of the Ancillary Data Packet

The 3DFC Ancillary Data Packet shall be located in the active line portion of the vertical ancillary space of the frame compatible serial data stream, in accordance with the image formats referenced by SMPTE ST 292-1, or SMPTE ST 425-1. Data may be located in any lines in the VANC area from the second line after the line specified for switching, as defined in SMPTE RP 168, to the last line before active video, inclusive.