

# **SMPTE STANDARD**

## **Professional Media Over Managed IP Networks: SMPTE ST 291-1 Ancillary Data**



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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 its Standards Operations Manual. This SMPTE Engineering Document was prepared by Technology Committee 32NF.

## Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. 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.

## Introduction

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

The capability and capacity of IP networking equipment has improved steadily, enabling the use of IP switching and routing technology to transport and switch video, audio, and metadata essence within television facilities. Existing standards such as SMPTE ST 2022-6 have gained some amount of use in this application, but there was a desire in the industry to switch different essence elements separately.

This family of SMPTE engineering documents builds on the work of Video Services Forum (VSF) Technical Recommendations TR-03 and TR-04, and on AES67, documenting a system for transporting various essence streams over IP networks, capturing the timing relationships between those streams. The system is designed to be extensible to a variety of essence types .

SMPTE ST 2110-10 covers the system as a whole, the timing model, and common requirements across all essence types. Other documents cover specific media essence formats.

SMPTE ST 2110-40 documents the transport of SMPTE ST 291-1 Ancillary Data packets using RTP over an IP network.

## 1 Scope

This Standard specifies the real-time, RTP payload based transport of SMPTE ST 291-1 Ancillary (ANC) Data packets related to digital video data streams, over IP networks, referenced to a common reference clock.

## 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; then 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 engineering document. At the time of publication, the editions indicated were valid. All standards are

subject to revision, and parties to agreements based on this engineering document 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 RP 291-2:2013 - Ancillary Data Space Use — 4:2:2 SDTV and HDTV Component Systems and 4:2:2 2048 × 1080 Production Image Formats

SMPTE ST 2110-10:2017 Professional Media over Managed IP Networks: System Timing and Definitions

Internet Engineering Task Force (IETF) RFC 8331 RTP Payload for SMPTE ST 291-1 Ancillary Data [online, viewed 2018-03-06] Available at <https://tools.ietf.org/rfc/rfc8331.txt>

## **4 Terms and Definitions**

For the purposes of this document, the terms and definitions of SMPTE ST 2110-10 and the following apply.

### **4.1 ANC Data Packet**

Ancillary data (ANC) packet as specified in SMPTE ST 291-1

### **4.2 VPID\_Code**

Code indicating the digital interface standard as specified in IETF RFC 8331

### **4.3 HANC**

Horizontal ANC data space as specified in SMPTE RP 291-2

### **4.4 VANC**

Vertical ANC data space as specified in SMPTE RP 291-2

## **5 ANC Data Packet RTP Payload Format**

### **5.1 Overview (Informative)**

The television production and distribution ecosystem has developed a large and growing set of data items beyond simple video and audio essence. Rather than developing a custom physical transport for each of these data items, a practice has evolved in which the data items are mapped into ANC Data packets, and transported over the Serial Digital Interface (SDI) in either the HANC data space or the VANC data space. SMPTE ST 291-1 specifies the fundamental structures and properties which pertain to all ANC Data Packets. These Ancillary Data Packets often include time-related non-video essence elements (such as

closed captions and subtitles) and also metadata about the video signals such as Active Format Description (AFD).

SMPTE maintains a registry of ANC packet types, which can be found on the SMPTE Registry for Data Identification Word Assignments for Registered DIDs at:

<https://smpte-ra.org/smpete-ancillary-data-smpte-st-291/>

This standard leverages existing practices and definitions by mapping the contents of the ANC Data Packets into RTP, based on IETF RFC 8331.

This mechanism is not intended for the carriage of audio, since there are already well-established mechanisms for doing that; similarly this mechanism is not intended to carry EDH packets.

ANC data packets are contextually related to the video essence which appears in the same SDI signal. While not within the scope of this standard, the systemic implementation of facilities utilizing this transport method could require grouping or coupling of essence streams with ANC data streams to ensure that the contextual relationships are preserved.

## **5.2 RTP Payload Format**

### **5.2.1 General Requirements**

The contents of the ANC Data packets shall be directly mapped into RTP packets as specified in IETF RFC 8331 subject to the additional constraints and guidelines of this standard.

The UDP size of each RTP packet shall not exceed the Standard UDP Size Limit as specified in SMPTE ST 2110-10.

Note: The DID, SDID or DBN, DC, UDW, and CS portions of the ANC packet (as specified in SMPTE ST 291-1) are included in the RTP payload. The Ancillary Data Flag (ADF) specified in SMPTE ST 291-1 is not included in the RTP payload. A single RTP packet can contain zero or more ANC data packets, subject to limits and conditions specified in IETF RFC 8331.

### **5.2.2 Indication of SDI Location Information**

Senders of ANC Data packets may use the Line\_Number, Horizontal\_Offset, StreamNum, and C fields specified in IETF RFC 8331 to indicate the proposed SDI location information for the ANC Data Packet within a single- or multi-link SDI signal. The Sender may indicate an exact proposed location using these fields, or may specify constraints on the horizontal location or vertical location or both using the special Horizontal\_Offset and Line\_Number values defined for this purpose.

Senders of Ancillary Data Packets which propose exact SDI interface line number or stream number information (not the 0x7FE or 0x7FF Line\_Number codes) shall signal the digital interface standard of the corresponding SDI format using the VPID\_Code parameter as specified in IETF RFC 8331. Such signaling is optional for other Senders.

Note: The special Line\_Number value 0x7FE indicates a proposed location within the range from the second line after the line specified for switching, as defined in SMPTE RP 168, to the last line before active video, inclusive, while the Line\_Number value of 0x7FF indicates that no specific proposal is made.

### **5.2.3 Receivers which construct SDI outputs**

Receivers creating SDI output which contains Ancillary Data Packets shall meet the requirements of SMPTE ST 291-1 when constructing the HANC and VANC spaces. If the VPID\_Code associated with the ANC Data packets RTP stream is consistent with the SDI format being created, these receivers should use the proposed SDI Line\_Number, Horizontal\_Offset, StreamNum, and C-bit information when available, to the extent that it meets the requirements of SMPTE ST 291-1.

When the proposed SDI location information is not specified exactly, or is not applicable to the output SDI format, devices constructing SDI should locate the ANC packets within the VANC space starting 2 lines after the SMPTE RP 168 switching point for the output SDI format, while maintaining compliance with SMPTE ST 291-1, and should comply with any constraints on the horizontal location or vertical location signaled using the special codes defined in IETF RFC 8331.

Note: The Line\_Number and StreamNum values in IETF RFC 8331 refer to digital interface line numbers and stream numbers in an SDI signal format, whereas the SRD Row numbers in SMPTE ST 2110-20 refer to video sample row numbers within the active sample array starting with zero. Any proposed SDI location information being conveyed within the RTP payload header relates to the location within the digital interface signal.

## **5.3 Media Clock and RTP Clock**

The Media Clock and RTP Clock rates shall be 90 kHz. The Media Clock shall be aligned to the SMPTE Epoch and the RTP Clock shall have a zero offset from the Media Clock as specified in SMPTE ST 2110-10.

## **5.4 RTP Timestamps**

SMPTE ST 291-1 clearly defines ANC Data Packets in the context of SDI video signals; as such there exists a timing relationship between SMPTE ST 291-1 ANC data packets and frames of video essence.

As specified in IETF RFC 8331, the RTP timestamps of ANC Data mapped as specified in this standard are interpreted in a similar fashion to the RTP timestamps of frames of video essence.

Senders shall generate RTP timestamps for the ANC Data packets using the procedures specified for video signals in SMPTE ST 2110-10, such that the RTP Timestamp of the ANC Data is contemporaneous with the related field or frame of the video signal.

## **5.5 Keep Alive**

Senders shall send at least one RTP packet corresponding to each video field or frame or segment. In the event that no ANC packets are transmitted in relation to a frame (or interlaced field or PsF segment) of video, an RTP packet with an ANC\_Count value of zero and a Marker bit set shall be transmitted.

## **6 Session Description Protocol (SDP)**

The SDP object shall be constructed as described in IETF RFC 8331, subject also to the provisions of SMPTE ST 2110-10.

Section 4.1 of IETF RFC 8331 permits the use of Flow Identification (FID) semantics to group streams within the SDP; such use is inconsistent with the “one SDP object per RTP Stream” provision of SMPTE ST 2110-10 and therefore not permitted under this standard.

## **Bibliography (Informative)**

Video Services Forum (VSF) TR-03 Transport of Uncompressed Elementary Stream Media over IP  
[online] Nov 2015 [Viewed 2018-03-06] Available at  
[http://www.videoservicesforum.org/download/technical\\_recommendations/VSF\\_TR-03\\_2015-11-12.pdf](http://www.videoservicesforum.org/download/technical_recommendations/VSF_TR-03_2015-11-12.pdf)

Video Services Forum (VSF) TR-04 Utilization of ST-2022-6 Media Flows within a VSF TR-03  
Environment [online] Nov 2015 [viewed 2018-03-06] Available at  
[http://www.videoservicesforum.org/download/technical\\_recommendations/VSF\\_TR-04\\_2015-11-12.pdf](http://www.videoservicesforum.org/download/technical_recommendations/VSF_TR-04_2015-11-12.pdf)

SMPTE ST 352:2013 Payload Identification Codes For Serial Digital Interfaces

SMPTE ST 2110-20:2017 Professional Media over Managed IP Networks: Uncompressed Active Video