                          RTP Payload for
        Society of Motion Picture and Television Engineers (SMPTE)
                       ST 291-1 Ancillary Data

Abstract

   This memo describes a Real-time Transport Protocol (RTP) payload
   format for the Society of Motion Picture and Television Engineers
   (SMPTE) ancillary space (ANC) data, as defined by SMPTE ST 291-1.
   SMPTE ANC data is generally used along with professional video
   formats to carry a range of ancillary data types, including time
   code, Closed Captioning, and the Active Format Description (AFD).

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 7841.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   https://www.rfc-editor.org/info/rfc8331.

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1. Introduction

   This memo describes a Real-time Transport Protocol (RTP) payload
   format for the Society of Motion Picture and Television Engineers
   (SMPTE) ancillary space (ANC) data, as defined by SMPTE ST 291-1
   [ST291]. ANC data is transmitted in the ancillary space of serial
   digital video interfaces, the space outside of the active video
   region of images intended for users to view. Ancillary space roughly
   corresponds to vertical and horizontal blanking periods of cathode
   ray tube type displays. ANC data can carry a range of data types,
   including time code, Closed Captioning, and the Active Format
   Description (AFD).

   ANC data is generally associated with the carriage of metadata within
   the bit stream of a Serial Digital Interface (SDI), such as the
   standard definition (SD) Serial Digital Interface, the 1.5 Gb/s
   Serial Digital Interface for high definition (HD) television
   applications, or the 3 Gb/s Signal/Data Serial Interface (SMPTE ST
   259 [ST259], SMPTE ST 292-1 [ST292], and SMPTE ST 424 [ST424]).

   ANC data packet payload definitions for a specific application are
   specified by a SMPTE Standard, Recommended Practice, Registered
   Disclosure Document, or by a document generated by another
   organization, a company, or an individual (an entity). When a
   payload format is registered with SMPTE, it is identified by a
   registered data identification word.

This memo describes an RTP payload that supports carriage of ANC data packets that originate from any location within any SMPTE-defined SDI signal. This payload also supports the carriage of ANC data packets that did not originate from an SDI signal. Sufficient information is provided to enable the ANC data packets at the output of the decoder to be restored to their original locations in the serial digital video signal raster (if that is desired). An optional media type parameter allows for the signaling of carriage of one or more types of ANC data as specified by data identification (DID) and secondary data identification (SDID) words. Another optional media type parameter allows for the identification of the Video Payload ID (VPID) code of the source interface of ANC data packets.

Note that the Ancillary Data Flag (ADF) word is not specifically carried in this RTP payload. The ADF might be specified in a document defining an interconnecting digital video interface; otherwise, a default ADF is specified by SMPTE ST 291-1 [ST291].

This ANC data payload can be used by itself or used along with a range of RTP video formats. In particular, it has been designed so that it could be used along with "RTP Payload Format for Uncompressed Video" [RFC4175] or "RTP Payload Format for JPEG 2000 Video Streams" [RFC5371].

The data model in this document for the ANC data RTP payload is based on the data model of SMPTE ST 2038 [ST2038], which standardizes the carriage of ANC data packets in an MPEG-2 Transport Stream.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

2. RTP Payload Format for SMPTE ST 291 Ancillary Data

   An example of the format of an RTP packet containing SMPTE ST 291 ANC
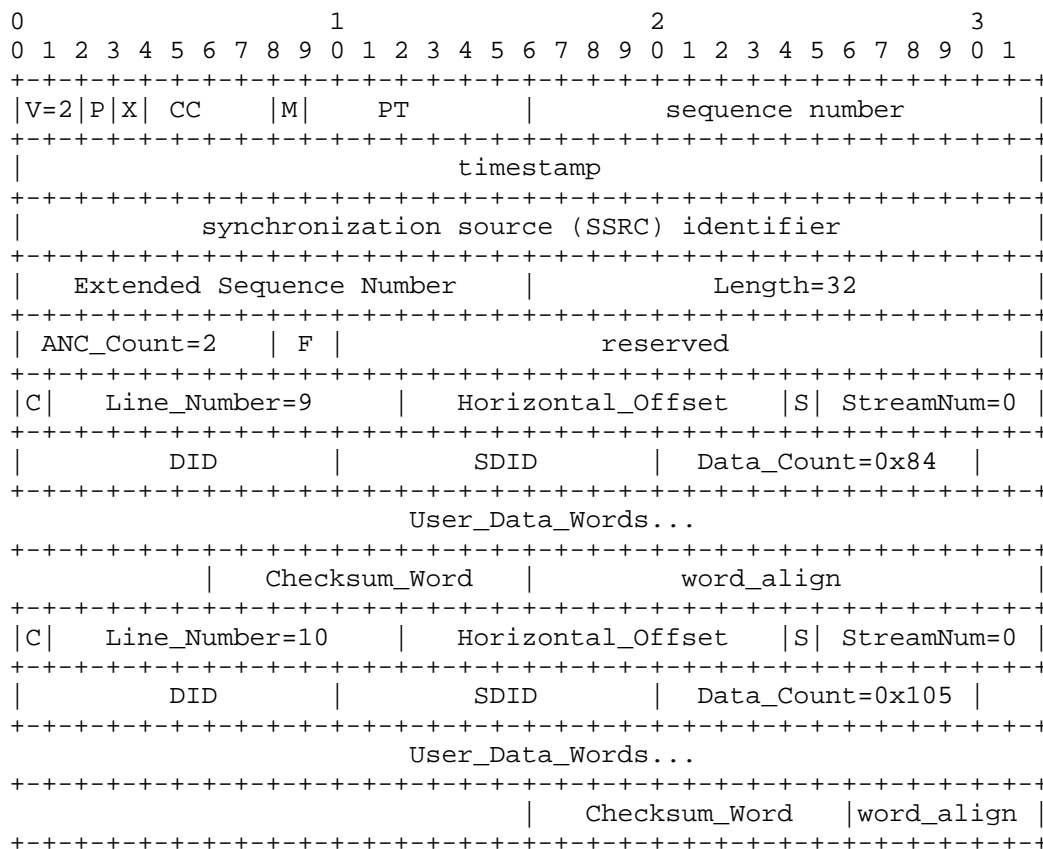   data is shown below:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |V=2|P|X|  CC   |M|     PT      |       sequence number         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                           timestamp                           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           synchronization source (SSRC) identifier            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    Extended Sequence Number     |          Length=32          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | ANC_Count=2   | F |                  reserved                 |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |C|   Line_Number=9      |    Horizontal_Offset   |S| StreamNum=0 |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        DID       |        SDID        |  Data_Count=0x84   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                        User_Data_Words...
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
              |  Checksum_Word   |           word_align            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |C|   Line_Number=10     |    Horizontal_Offset   |S| StreamNum=0 |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        DID       |        SDID        | Data_Count=0x105   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                        User_Data_Words...
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                                  |   Checksum_Word   |word_align |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

            Figure 1: SMPTE Ancillary Data RTP Packet Format

   In this example, two ANC data packets are present. The first has
   four 10-bit User_Data_Words, and the second has five 10-bit
   User_Data_Words (note that few ANC data packets are this small; thus,
   this example does not reflect actual defined ANC data packets and
   does not specifically call out the DIDs and SDIDs). The ANC data
   packets are located on lines 9 and 10 of the SDI raster.

   The term "network byte order" in the payload format SHALL refer to
   the Data Transmission Order as defined in Appendix B of RFC 791
   [RFC0791].

   RTP packet header fields SHALL be interpreted as per RFC 3550
   [RFC3550], with the following specifics:

   Timestamp: 32 bits
      The timestamp field is interpreted in a similar fashion to
      RFC 4175 [RFC4175]:

      For progressive scan video, the timestamp denotes the sampling
      instant of the frame to which the ANC data in the RTP packet
      belongs. RTP packets MUST NOT include ANC data from multiple
      frames, and all RTP packets with ANC data belonging to the same
      frame MUST have the same timestamp.

      For interlaced video, the timestamp denotes the sampling instant
      of the field to which the ANC data in the RTP packet belongs. RTP
      packets MUST NOT include ANC data packets from multiple fields,
      and all RTP packets belonging to the same field MUST have the same
      timestamp.

      If the sampling instant does not correspond to an integer value of
      the clock, the value SHALL be truncated to the next lowest integer
      with no ambiguity. Section 3.1 describes timestamp clock rates.

   Marker bit (M): 1 bit
      The marker bit set to "1" indicates the last ANC data RTP packet
      for a frame (for progressive scan video) or the last ANC data RTP
      packet for a field (for interlaced video).

2.1. Payload Header Definitions

   The ANC data RTP payload header fields are defined as:

   Extended Sequence Number: 16 bits
           The high-order bits of the extended 32-bit sequence number,
           in network byte order. This is the same as the Extended
           Sequence Number field in RFC 4175 [RFC4175].

   Length: 16 bits
           Number of octets of the ANC data RTP payload, beginning with
           the "C" bit of the first ANC packet data header, as an
           unsigned integer in network byte order. Note that all
           word_align fields contribute to the calculation of the Length
           field.

ANC_Count: 8 bits
        This field is the count of the total number of ANC data
        packets carried in the RTP payload, as an unsigned integer.
        A single ANC data RTP packet payload cannot carry more than
        255 ANC data packets.

        If more than 255 ANC data packets need to be carried in a
        field or frame, additional RTP packets carrying ANC data MAY
        be sent with the same RTP timestamp but with different
        sequence numbers. ANC_Count of 0 indicates that there are no
        ANC data packets in the payload (for example, an RTP packet
        that carries no actual ANC data packets even though its
        marker bit indicates the last ANC data RTP packet in a field/
        frame). If the ANC_Count is 0, the Length will also be 0.

F: 2 bits
        These two bits relate to signaling the field specified by the
        RTP timestamp in an interlaced SDI raster. A value of 0b00
        indicates that either the video format is progressive or that
        no field is specified. A value of 0b10 indicates that the
        timestamp refers to the first field of an interlaced video
        signal. A value of 0b11 indicates that the timestamp refers
        to the second field of an interlaced video signal. The value
        0b01 is not valid. Receivers SHOULD ignore an ANC data
        packet with an F field value of 0b01 and SHOULD process any
        other ANC data packets with valid F field values that are
        present in the RTP payload.

        Note that some multi-stream SDI interfaces might use multiple
        interlaced signal streams to transmit progressive images, in
        which case the "F" bits would refer to the field of the
        interlaced stream used for transport of the ANC data packet.

reserved: 22 bits
        The 22 reserved bits of value "0" follow the F field to
        ensure that the first ANC data packet header field in the
        payload begins 32-bit word-aligned with the start of the RTP
        header to ease implementation.

For each ANC data packet in the payload, the following ANC data
packet header fields MUST be present:

C: 1 bit
        This flag, when set to "1", indicates that the ANC data
        corresponds to the color-difference data channel (C). When
        set to "0", this flag indicates either that the ANC data
        corresponds to the luma (Y) data channel, that the ANC data
        source is from an SD signal, or that the ANC data source has

          no specific luma or color-difference data channels. For ANC
          data from a multi-stream interface source, the C flag SHALL
          refer to the channel of the stream used to transport the ANC
          data packet. For situations where there is no SDI source, if
          the ANC data type definition specifically requires the use of
          the C or Y data channel, the C flag SHALL reflect that
          requirement.

   Line_Number: 11 bits
          This field contains the digital interface line number that
          corresponds to the location of the ANC data packet as an
          unsigned integer in network byte order.

          The following special Line_Number values indicate that the
          location of the ANC data packet is in certain generic
          vertical regions of the SDI raster:

+-------------+--+
| Line_Number | ANC data packet generic vertical location |
+-------------+--+
0x7FF	Without specific line location within the field or
	frame
0x7FE	On any line in the range from the second line after
	the line specified for switching, as defined in SMPTE
	RP 168 [RP168], to the last line before active video,
	inclusive
0x7FD	On a line number larger than can be represented in 11
	bits of this field (if needed for future formats)
+-------------+--+

          Note that the lines that are available to convey ANC data are
          as defined in the applicable sample structure specification
          (e.g., SMPTE ST 274 [ST274], SMPTE ST 296 [ST296], ITU-R
          BT.656 [BT656]) and are possibly further restricted per SMPTE
          RP 168 [RP168].

          In multi-stream interfaces, this field refers to the line
          number that an ANC data packet is carried on within a
          particular data stream in the interface.

   Horizontal_Offset: 12 bits
          This field defines the location of the ANC data packet in an
          SDI raster relative to the start of active video (SAV; a
          digital synchronizing signal present in SDI interfaces) as an
          unsigned integer in network byte order. A value of 0 means
          that the ADF of the ANC data packet begins immediately

following SAV. The horizontal offset from SAV is measured in
terms of 10-bit words of the indicated data stream and data
channel.

The following special Horizontal_Offset values indicate that
the location of the ANC data packet is in certain generic
horizontal regions of the SDI raster:

+-------------+---+
| Horizontal_ | ANC data packet generic horizontal location |
| Offset | |
+-------------+---+
0xFFF	Without specific horizontal location
0xFFE	Within horizontal ancillary data space (HANC) as
	defined in SMPTE ST 291-1 [ST291]
0xFFD	Within the ancillary data space located between SAV
	(Start of Active Video) and EAV (End of Active Video)
	markers of the serial digital interface
0xFFC	Horizontal offset is larger than can be represented in
	the 12 bits of this field (if needed for future
	formats or for certain low frame rate 720p formats)
+-------------+---+

In multi-stream interfaces, this field refers to the
horizontal location where an ANC data packet is placed on a
line carried within a particular data stream in the
interface.

Note that HANC data space will generally have higher luma
sample numbers than any samples in the active digital line.
Also note that SMPTE ST 296 [ST296] (1280 x 720 progressive
active images) image sampling systems 7 and 8 (1280 x 720
progressive @ 24 fps and 1280 x 720 progressive @ 23.98 fps
respectively) have a luma sample number maximum of 4124. It
is unlikely that an actual implementation would have an ANC
data packet begin at a Horizontal_Offset beyond 4091 (0xFFB)
in these formats; should that occur, the Horizontal_Offset
value 0xFFC can be used to signal a horizontal offset larger
than can be represented in the field. Further note that the
12-bit field of Horizontal_Offset is kept that size in this
memo to maintain easy conversion to/from SMPTE ST 2038
[ST2038], which also has a 12-bit Horizontal_Offset field.

S (Data Stream Flag): 1 bit
        This field indicates whether the data stream number of a
        multi-stream data mapping used to transport the ANC data
        packet is specified. If the S bit is '0', then the StreamNum
        field provides no guidance regarding the source data stream
        number of the ANC data packet. If the S bit is '1', then the
        StreamNum field carries information regarding the source data
        stream number of the ANC data packet.

StreamNum: 7 bits
        If the S bit (Data Stream Flag) is '1', then the StreamNum
        field MUST carry identification of the source data stream
        number of the ANC data packet. If the data stream is
        numbered, then the StreamNum field SHALL carry the number of
        the source data stream minus one. If the source multi-stream
        interface does not have numbered data streams, the following
        numbers SHALL be used in this field: '0' for link A data
        stream and '1' for link B data stream. For stereoscopic
        multi-stream interface formats that do not have numbered
        streams, the following numbers SHALL be used in this field:
        '0' for left eye stream and '1' for right eye stream.

        Note that in multi-link SDI connections, the physical link
        that a particular stream utilizes is typically specified by
        the interface standard. Also note that numbering of data
        streams is across the interface as a whole. For example, in
        the SMPTE ST 425-3 dual-link 3 Gb/s interface, the data
        streams are numbered 1-4 with data streams 1 and 2 on link 1
        and data streams 3 and 4 on link 2.

An ANC data packet with the header fields Line_Number of 0x7FF and
Horizontal_Offset of 0xFFF SHALL be considered to be carried without
any specific location within the field or frame.

For each ANC data packet in the payload, immediately after the ANC
data packet header fields, the following data fields MUST be present
with the fields DID, SDID, Data_Count, User_Data_Words, and
Checksum_Word representing the 10-bit words carried in the ANC data
packet, as per SMPTE ST 291-1 [ST291]:

DID: 10 bits
        Data identification word

SDID: 10 bits
        Secondary data identification word. Used only for a "Type 2"
        ANC data packet. Note that in a "Type 1" ANC data packet,
        this word will actually carry the data block number (DBN).

Data_Count: 10 bits
        The lower 8 bits of Data_Count, corresponding to bits b7
        (MSB; most significant bit) through b0 (LSB; least
        significant bit) of the 10-bit Data_Count word, contain the
        actual count of 10-bit words in User_Data_Words. Bit b8 is
        the even parity for bits b7 through b0, and bit b9 is the
        inverse (logical NOT) of bit b8.

User_Data_Words: integer number of 10-bit words
        User_Data_Words (UDW) are used to convey information of a
        type as identified by the DID word or the DID and SDID words.
        The number of 10-bit words in the UDW is defined by the
        Data_Count field. The 10-bit words are carried in order
        starting with the most significant bit and ending with the
        least significant bit.

Checksum_Word: 10 bits
        The Checksum_Word can be used to determine the validity of
        the ANC data packet from the DID word through the UDW. It
        consists of 10 bits, where bits b8 (MSB) through b0 (LSB)
        define the checksum value and bit b9 is the inverse (logical
        NOT) of bit b8. The checksum value is equal to the nine
        least significant bits of the sum of the nine least
        significant bits of the DID word, the SDID word, the
        Data_Count word, and all User_Data_Words in the ANC data
        packet. The checksum is initialized to zero before
        calculation, and any "end carry" resulting from the checksum
        calculation is ignored.

At the end of each ANC data packet in the payload:

word_align: bits as needed to complete 32-bit word
        Word_align contains enough "0" bits as needed to complete the
        last 32-bit word of an ANC data packet in the RTP payload.
        If an ANC data packet in the RTP payload ends and is aligned
        with a word boundary, there is no need to add any word
        alignment bits. Word align SHALL be used even for the last
        ANC data packet in an RTP packet. Word align SHALL NOT be
        used if there are zero ANC data packets being carried in the
        RTP packet.

When reconstructing an SDI signal based on this payload, it is
important to place ANC data packets into the locations indicated by
the ANC data packet header fields C, Line_Number and
Horizontal_Offset, and also to follow the requirements of Section 7
of SMPTE ST 291-1 [ST291], "Ancillary Data Space Formatting
(Component or Composite Interface)", which includes rules on the
placement of initial ANC data into allowed spaces as well as the

contiguity of ANC data packet sequences within those spaces in order
to assure that the resulting ANC data packets in the SDI signal are
valid. The optional media type parameter VPID_Code can inform
receivers of the type of originating SDI interface. For multi-stream
originating interfaces, the StreamNum field can provide information
regarding which stream an ANC data packet can be placed in to match
the ANC data location in the originating SDI interface.

Senders of this payload SHOULD transmit available ANC data packets as
soon as practical to reduce end-to-end latency, especially if the
receivers will be embedding the received ANC data packet into an SDI
signal emission. One millisecond is a reasonable upper bound for the
amount of time between when an ANC data packet becomes available to a
sender and the emission of an RTP payload containing that ANC data
packet.

ANC data packets with headers that indicate specific location within
a field or frame SHOULD be sent in raster scan order, both in terms
of packing position within an RTP packet and in terms of transmission
time of RTP packets.

3. Payload Format Parameters

This RTP payload format is identified using the "video/smpte291"
media type, which is registered in accordance with RFC 4855
[RFC4855]; the template defined in RFC 6838 [RFC6838] is used.

Note that the media type definition is in the "video" tree due to the
expected use of SMPTE ST 291 Ancillary Data along with video formats.

3.1. Media Type Definition

Type name: video

Subtype name: smpte291

Required parameters:

   Rate:
      RTP timestamp clock rate.

      When an ANC data RTP stream is to be associated with an RTP
      video stream, the RTP timestamp rates SHOULD be the same to
      ensure that ANC data packets can be associated with the
      appropriate frame or field. Otherwise, a 90 kHz rate SHOULD be
      used.

Note that techniques described in RFC 7273 [RFC7273] can
provide a common reference clock for multiple RTP streams
intended for synchronized presentation.

Optional parameters:

   DID_SDID:
      Data identification and secondary data identification words.

      The presence of the DID_SDID parameters signals that all ANC
      data packets of this stream are of a particular type or types,
      i.e., labeled with particular DIDs and SDIDs. DID and SDID
      values of SMPTE-registered ANC data packet types can be found
      in the SMPTE Registry for Data Identification Word Assignments
      [SMPTE-RA].

      "Type 1" ANC data packets (which do not have SDIDs defined)
      SHALL be labeled with SDID=0x00.

      DID and SDID values can be registered with SMPTE as per SMPTE
      ST 291-1 [ST291].

      The absence of the DID_SDID parameter signals that
      determination of the DID and SDID of ANC data packets in the
      payload can only be achieved through direct inspection of the
      ANC data packet fields.

      The ABNF description of the DID_SDID parameter is described in
      Section 4.

   VPID_Code:
      This integer parameter specifies the Video Payload ID (VPID)
      code of the source interface of ANC data packets using the
      value from byte 1 of the VPID as defined in SMPTE ST 352
      [ST352]. The integer SHALL be made with bit 7 of VPID byte 1
      being the most significant bit and bit 0 of VPID byte 1 being
      the least significant bit. For example, 132 refers to SMPTE ST
      292-1, 720-line video payloads on a 1.5 Gb/s (nominal) serial
      digital interface.

Encoding considerations: This media type is framed and binary; see
   Section 4.8 of RFC 6838 [RFC6838].

Security considerations: See Section 7.

   Interoperability considerations: Data items in smpte291 can be very
      diverse. Receivers might only be capable of interpreting a subset
      of the possible data items. Some implementations might care about
      the location of the ANC data packets in the SDI raster, but other
      implementations might not care.

   Published specification: RFC 8331

   Applications that use this media type: Devices that stream real-time
      professional video, especially those that interoperate with legacy
      serial digital interfaces (SDI).

   Additional Information:

      Deprecated alias names for this type: N/A

      Magic number(s): N/A

      File extension(s): N/A

      Macintosh file type code(s): N/A

   Person & email address to contact for further information:

      T. Edwards <thomas.edwards@fox.com>
      IETF Payload Working Group <payload@ietf.org>

   Intended usage: COMMON

   Restrictions on usage: This media type depends on RTP framing and
      hence is only defined for transfer via RTP RFC 3550 [RFC3550].
      Transport within other framing protocols is not defined at this
      time.

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   Change controller: The IETF PAYLOAD Working Group, or other party as
      designated by the IESG.

4. SDP Considerations

   The mapping of the above-defined payload format media type and its
   parameters SHALL be done according to Section 3 of RFC 4855
   [RFC4855].

   o The type name ("video") goes in SDP "m=" as the media name.

   o The subtype name ("smpte291") goes in SDP "a=rtpmap" as the
      encoding name, followed by a slash ("/") and the rate parameter.

   o The optional parameters VPID_Code and DID_SDID, when present, are
      included in the "a=fmtp" attribute line of SDP as a semicolon-
      separated list of parameter=value pairs.

   DID and SDID values SHALL be specified in hexadecimal with a "0x"
   prefix (such as "0x61"). The ABNF as per RFC 5234 [RFC5234] of the
   DID_SDID optional parameter SHALL be:

        TwoHex = "0x" 1*2(HEXDIG)
        DidSdid = "DID_SDID={" TwoHex "," TwoHex "}"

   For example, EIA 608 Closed Caption data would be signaled with the
   parameter DID_SDID={0x61,0x02}. If a DID_SDID parameter is not
   specified, then the ANC data stream might potentially contain ANC
   data packets of any type.

   Multiple DID_SDID parameters can be specified (separated by
   semicolons) to signal the presence of multiple types of ANC data in
   the stream. DID_SDID={0x61,0x02};DID_SDID={0x41,0x05}, for example,
   signals the presence of EIA 608 Closed Captions as well as AFD/Bar
   Data. Multiple DID_SDID parameters do not imply any particular
   ordering of the different types of ANC data packets in the stream.

   If the optional parameter VPID_Code is present, it SHALL be present
   only once in the semicolon-separated list, taking a single integer
   value.

   A sample SDP mapping for ANC data is as follows:

      m=video 30000 RTP/AVP 112
      a=rtpmap:112 smpte291/90000
      a=fmtp:112 DID_SDID={0x61,0x02};DID_SDID={0x41,0x05};VPID_Code=132

   In this example, a dynamic payload type 112 is used for ANC data.
   The 90 kHz RTP timestamp rate is specified in the "a=rtpmap" line
   after the subtype. In the "a=fmtp:" line, DID 0x61 and SDID 0x02 are
   specified (registered to EIA 608 Closed Caption Data by SMPTE), and
   also DID 0x41 and SDID 0x05 (registered to AFD/Bar Data). The
   VPID_Code is 132 (referring to SMPTE ST 292-1, 720-line video
   payloads on a 1.5 Gb/s serial digital interface).

4.1. Grouping ANC Data Streams with Other Media Streams

   To indicate the association of an ANC data stream with a particular
   video stream, implementers MAY group the "m" lines together using
   Flow Identification ("FID") semantics as defined in RFC 5888
   [RFC5888].

   A sample SDP mapping for grouping ANC data with video as described in
   RFC 4175 [RFC4175] is as follows:

```
v=0
o=Al 123456 11 IN IP4 host.example.com
s=Professional Networked Media Test
i=A test of synchronized video and ANC data
t=0 0
a=group:FID V1 M1
m=video 50000 RTP/AVP 96
c=IN IP4 233.252.0.1/255
a=rtpmap:96 raw/90000
a=fmtp:96 sampling=YCbCr-4:2:2; width=1280; height=720; depth=10
a=mid:V1
m=video 50010 RTP/AVP 97
c=IN IP4 233.252.0.2/255
a=rtpmap:97 smpte291/90000
a=fmtp:97 DID_SDID={0x61,0x02};DID_SDID={0x41,0x05}
a=mid:M1
```

5. Offer/Answer Model and Declarative Considerations

5.1. Offer/Answer Model

   Receivers might wish to receive ANC data streams with specific
   DID_SDID parameters. Thus, when offering ANC data streams using the
   Session Description Protocol (SDP) in an Offer/Answer model
   [RFC3264], the offerer MAY provide a list of ANC data streams
   available with specific DID_SDID parameters in the fmtp line. The
   answerer MAY (1) respond with all or a subset of the streams offered
   along with fmtp lines with all or a subset of the DID_SDID parameters
   offered, (2) set the corresponding port number to 0 to decline the
   smpte291 stream if not in the same media section as a corresponding
   video stream, or (3) remove the corresponding payload type if the
   smpte291 stream is in the same media section as a corresponding video
   stream. There are no restrictions on updating DID_SDID parameters in
   a subsequent offer.

5.2. Declarative SDP Considerations

   For declarative use of SDP, nothing specific is defined for this
   payload format. The configuration given by the SDP MUST be used when
   sending and/or receiving media in the session.

6. IANA Considerations

   The media type "video/smpte291" is defined in Section 3.1. IANA has
   registered "video/smpte291" in the "Media Types" registry.

7. Security Considerations

   RTP packets using the payload format defined in this specification
   are subject to the security considerations discussed in the RTP
   specification [RFC3550] and in any applicable RTP profile such as
   RTP/AVP [RFC3551], RTP/AVPF [RFC4585], RTP/SAVP [RFC3711], or RTP/
   SAVPF [RFC5124]. However, as "Securing the RTP Protocol Framework:
   Why RTP Does Not Mandate a Single Media Security Solution" [RFC7202]
   discusses, it is not the responsibility of an RTP payload format to
   discuss or mandate what solutions are to be used to meet the basic
   security goals like confidentiality, integrity, and source
   authenticity for RTP in general. This responsibility lays on anyone
   using RTP in an application. They can find guidance on available
   security mechanisms and important considerations in "Options for
   Securing RTP Sessions" [RFC7201]. Applications SHOULD use one or
   more appropriately strong security mechanisms. The rest of this
   section discusses the security impacting properties of the payload
   format itself.

   To avoid potential buffer overflow attacks, receivers SHOULD validate
   that the ANC data packets in the RTP payload are of the appropriate
   length (using the Data_Count field) for the ANC data type specified
   by DID and SDID. Also, the Checksum_Word SHOULD be checked against
   the ANC data packet to ensure that its data has not been damaged in
   transit; note that the Checksum_Word is unlikely to provide a payload
   integrity check in case of a directed attack.

   Some receivers will simply move the ANC data packet bits from the RTP
   payload into SDI. It might still be a good idea for these "re-
   embedders" to perform the above-mentioned validity tests to avoid
   downstream SDI systems from becoming confused by bad ANC data
   packets, which could be used for a denial-of-service attack.

   "Re-embedders" into SDI SHOULD also double check that the Line_Number
   and Horizontal_Offset lead to the ANC data packet being inserted into
   a legal area to carry ANC data in the SDI video bit stream of the
   output video format.

8. References

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