SMPTE STANDARD

Professional Media Over Managed IP Networks: Uncompressed Active Video

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Approved September 18, 2017

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 use in this application, but there is 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 TR03 and TR04, and on AES67, documenting a system for transporting various essence streams over IP networks. 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.

This standard documents the transport of uncompressed active video in such systems, using an RTP format based on IETF RFC 4175.

1 Scope

This standard specifies the real-time, RTP-based transport of uncompressed active video essence over IP networks. An SDP-based signaling method is defined for image technical metadata necessary to receive and interpret the stream.

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.

Internet Engineering Task Force (IETF) RFC 3550 RTP: A Transport Protocol for Real-Time Applications [online, viewed 2017-08-10] Available at https://www.ietf.org/rfc/rfc3550.txt

Internet Engineering Task Force (IETF) RFC 4566 SDP: Session Description Protocol [online, viewed 2017-08-10] Available at https://www.ietf.org/rfc/rfc4566.txt

Internet Engineering Task Force (IETF) RFC 5285 A General Mechanism for RTP Header Extensions [online, viewed 2017-08-10] Available at https://www.ietf.org/rfc/rfc5285.txt

ISO 11664-1:2007 Colorimetry -- Part 1: CIE standard colorimetric observers

Recommendation ITU-R BT.601-7 Studio encoding parameters of digital television for standard 4:3 and wide screen 16:9 aspect ratios

Recommendation ITU-R BT.709-6 Parameter values for the HDTV standards for production and international programme exchange

Recommendation ITU-R BT.1886 Reference electro-optical transfer function for flat panel displays used in HDTV studio production

Recommendation ITU-R BT.2020-2 (10/2015) Parameter values for ultra-high definition television systems for production and international programme exchange

Recommendation ITU-R BT.2100-0 (07/2016) Image Parameter Values for High Dynamic Range Television for use in Production and International Programme Exchange

SMPTE RP 157:2012 Key and Alpha Signals

SMPTE ST 428-1:2006 D-Cinema Distribution Master — Image Characteristics

SMPTE ST 2065-1:2012 Academy Color Encoding Specification (ACES)

SMPTE ST 2065-3:2012 Academy Density Exchange Encoding (ADX) — Encoding Academy Printing Density (APD) Values

SMPTE RP 2077:2013 Full-Range Image Mapping

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

SMPTE ST 2110-21:2017 Professional Media over Managed IP Networks: Traffic Shaping and Delivery Timing for Uncompressed Active Video

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 Sample Row Number

numerical indication of the position of a row of image samples within the sample array corresponding to the visible (active) picture area

4.2 Sample Row

horizontal collection of image samples spanning the entire width of the image

4.3 Full-Bandwidth Sample Position

numerical location of a pixel within the Sample Row, in units of full-bandwidth samples, such that 0 is at the left side of the image; for sampling methods where more than one color component is represented in full bandwidth, all of the full-bandwidth components of each pixel share the same numerical location within the sample row

5 Textual Conventions

5.1 SDP Parameters and Values

The names and values of SDP Media Type parameters within the text of this document are formatted using a monospaced font (such as Courier) except when they appear in section headings.

6 Uncompressed Active Video RTP Essence Format

6.1 Payload Design and Packet format

6.1.1 General Provisions

The active sample arrays of the video essence shall be transported using RTP (IETF RFC 3550), subject to the constraints and payload definition below.

Unless otherwise noted, multi-octet fields within the RTP Header, RTP Payload Header, and RTP Payload shall be transmitted in Network Byte Order (most significant byte first). When represented in bit-field diagrams such as Figure 1 or Figure 3, the most significant bits of multi-bit fields shall occupy the lowest-numbered bit index positions (left-most positions in the figures), and shall be transmitted first.

The image technical metadata necessary to receive and interpret the RTP stream shall be communicated via SDP as defined in section 7.

Senders and Receivers compliant to this standard shall comply with the provisions of SMPTE ST 2110-21.

Note: All of the IETF RFC documents which are listed in section 3 (Normative References) are Standards-Track Documents within the IETF; they are however at varying phases of standardization within the IETF process, not all of them have reached the final phase of "Internet Standard". The IETF standardization phases are described in IETF RFC 6410.

6.1.2 RTP Header

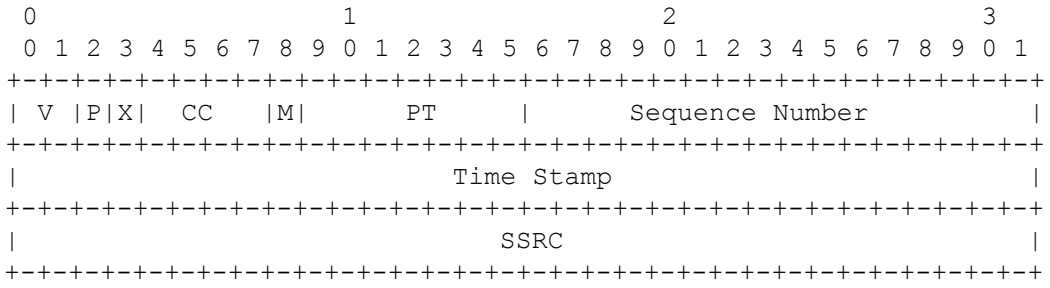

Figure 1 -- RTP Header

The RTP Packet Header is illustrated in Figure 1.

The fields of the RTP packet header and their order shall be as defined in IETF RFC 3550. The following additional constraints shall apply:

Payload Type (PT): 7 bits	The Payload Type field shall refer to the dynamically allocated payload type as specified in SMPTE ST 2110-10 section 6.2 “Real-Time Transport Protocol (RTP)”.
Timestamp: 32 bits	The Timestamp field shall contain the RTP Timestamp as specified in SMPTE ST 2110-10.
SSRC: 32 bits	The SSRC field shall be as specified in IETF RFC 3550.
Marker bit (M): 1 bit	For progressive scan video, the marker bit shall be set to 1 to denote when this RTP packet is the last packet carrying video essence data for a video frame. For interlaced video, the marker bit shall be set to 1 to denote when this RTP packet is the last packet carrying video essence data for a video field. The marker bit shall be set to 0 for all other packets.
Sequence Number: 16 bits	The RTP header sequence number field shall contain the 16 low order bits of the extended 32-bit RTP packet sequence counter.
Extension bit (X): 1 bit	When this bit is set, an RTP header extension is present immediately following the SSRC field.