

SMPTE STANDARD

D-Cinema Operations —
Digital Sync Signal and
Aux Data Transfer Protocol



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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.

SMPTE ST 430-14 was prepared by Technology Committee 21DC.

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.

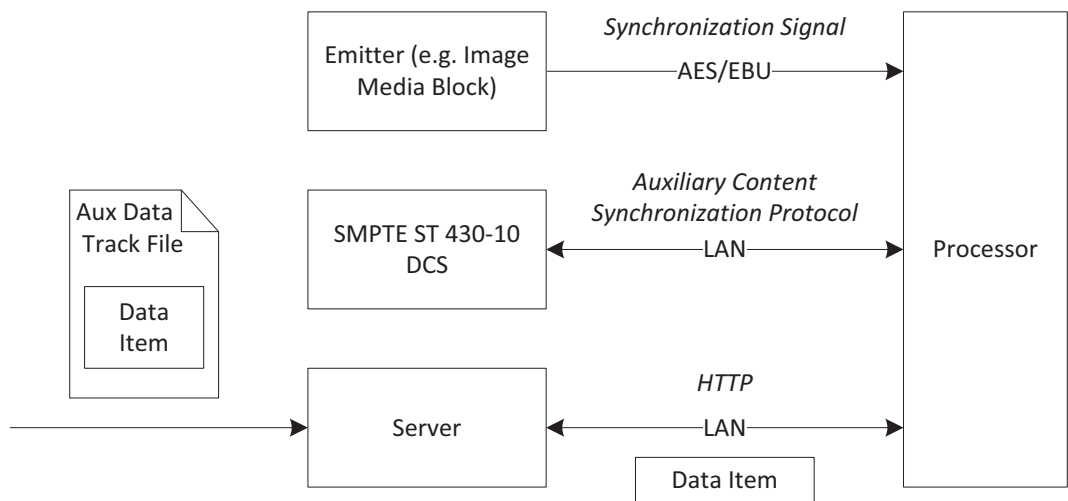


Figure 1 – Overview of the Aux Data Synchronization Signal and Transfer Protocol Architecture

As illustrated in Figure 1, this document specifies a Transfer Protocol that allows Data Items, as specified SMPTE ST 429-14, to be transmitted to a Processor over the Local Area Network (LAN); and a generic Synchronization Signal that carries sufficient information to allow these Data Items to be reproduced by the Processor synchronously with Show playback.

The source of the Data Items transmitted using the Transfer Protocol is called the Server, and the source of the Synchronization Signal is called the Emitter. The Processor discovers the Server by connecting to a Digital Cinema Server (DCS) entity using the Auxiliary Content Synchronization (ACS) protocol — both DCS and ACS are specified in SMPTE ST 430-10.

This specification allows the Server, Emitter and the DCS to be implemented on the same or different devices. A Processor can take many forms, including that of an Immersive Sound Processor or a Motion System Controller.

The Synchronization Signal (see Section 5) is an audio sample-accurate binary signal generated by an Emitter, typically the Image Media Block, at time of playback and compatible with AES/EBU interfaces. It includes the current playback position within a timeline (see Figure 4) that consists of a sequence of contiguous Edit Units corresponding to the currently playing sequence of Compositions; i.e., the Show.

The Transfer Protocol (see Section 6) uses the Hypertext Transfer Protocol (HTTP). It allows the Processor to request from a Server the Data Items of a specified kind (as determined by the Data Essence Coding item of the Data Essence Descriptor) and corresponding to a position with the Timeline (determined from the Synchronization Signal).

Figure 2 illustrates the interaction between Emitter, Server, DCS and Processor in a typical application. When a Show is selected and a valid Synchronization signal is detected (with the Status flag set to Pause or Stopped), the Processor connects to the DCS and, using the Set RPL Location message, determines the Server network address (see Section 6.4). The Processor then buffers Data Items by making a number of requests (see Figure 3) to the Server. While it is buffering, the Processor responds with ACS Busy to Get Status Requests issued by the DCS, indicating that it is not ready for playback.

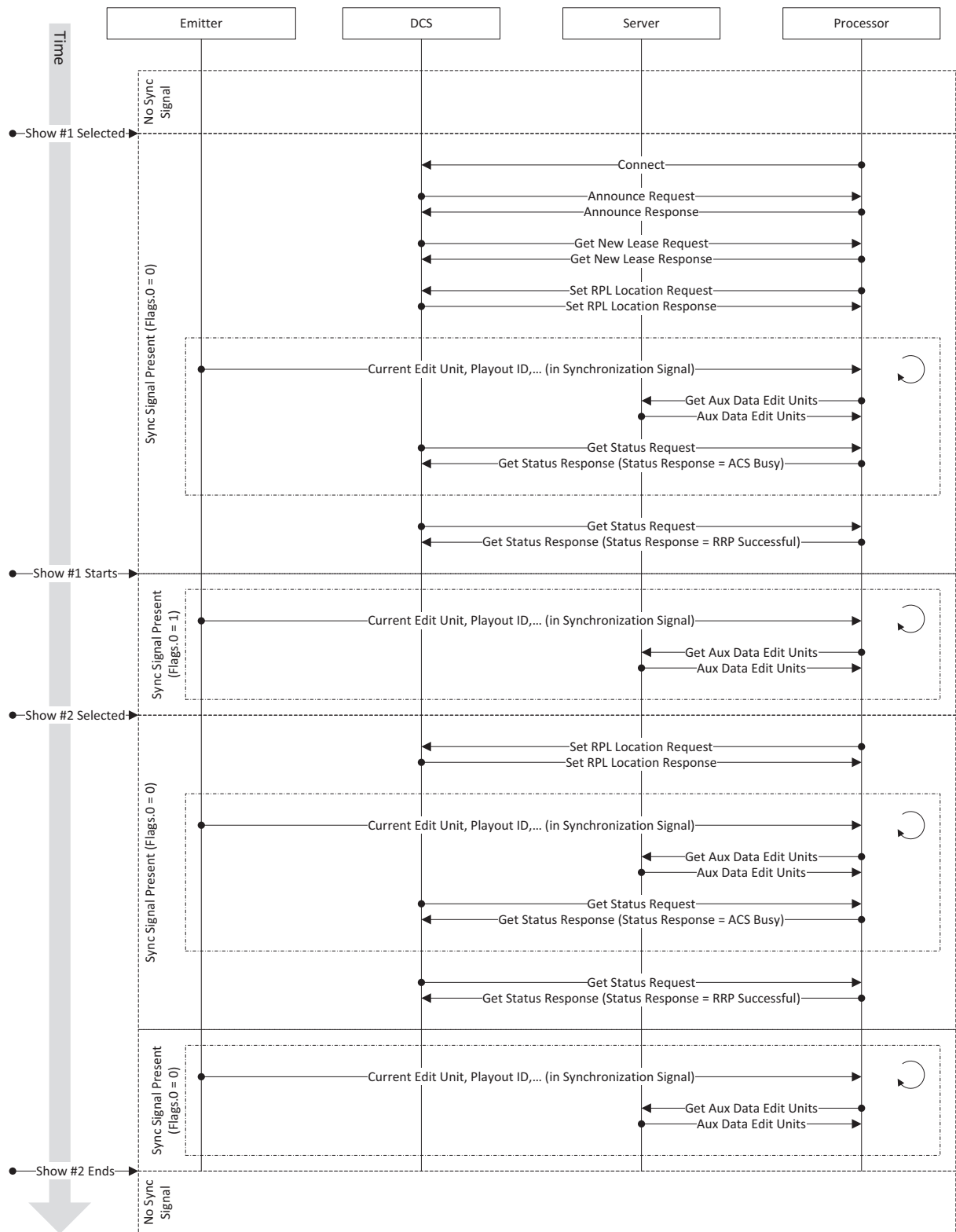


Figure 2 – Transfer Protocol Sequence Diagram

The start of Show playback is signaled by the Status flag of the Synchronization Signal (see Section 5.3.4) transitioning to Playing. While the Status flag remains equal to Playing, the Processor reproduces the Data Items it has obtained from the Server based on the `Timeline Edit Unit Index` carried by the Synchronization Signal.

When playback of the first Show stops and a second Show is selected, the Status flag of the Synchronization Signal transitions to Stopped, and the Processor stops playback and starts buffering. The Processor starts playback along the second Show timeline when the Status flag transitions to Playing again.

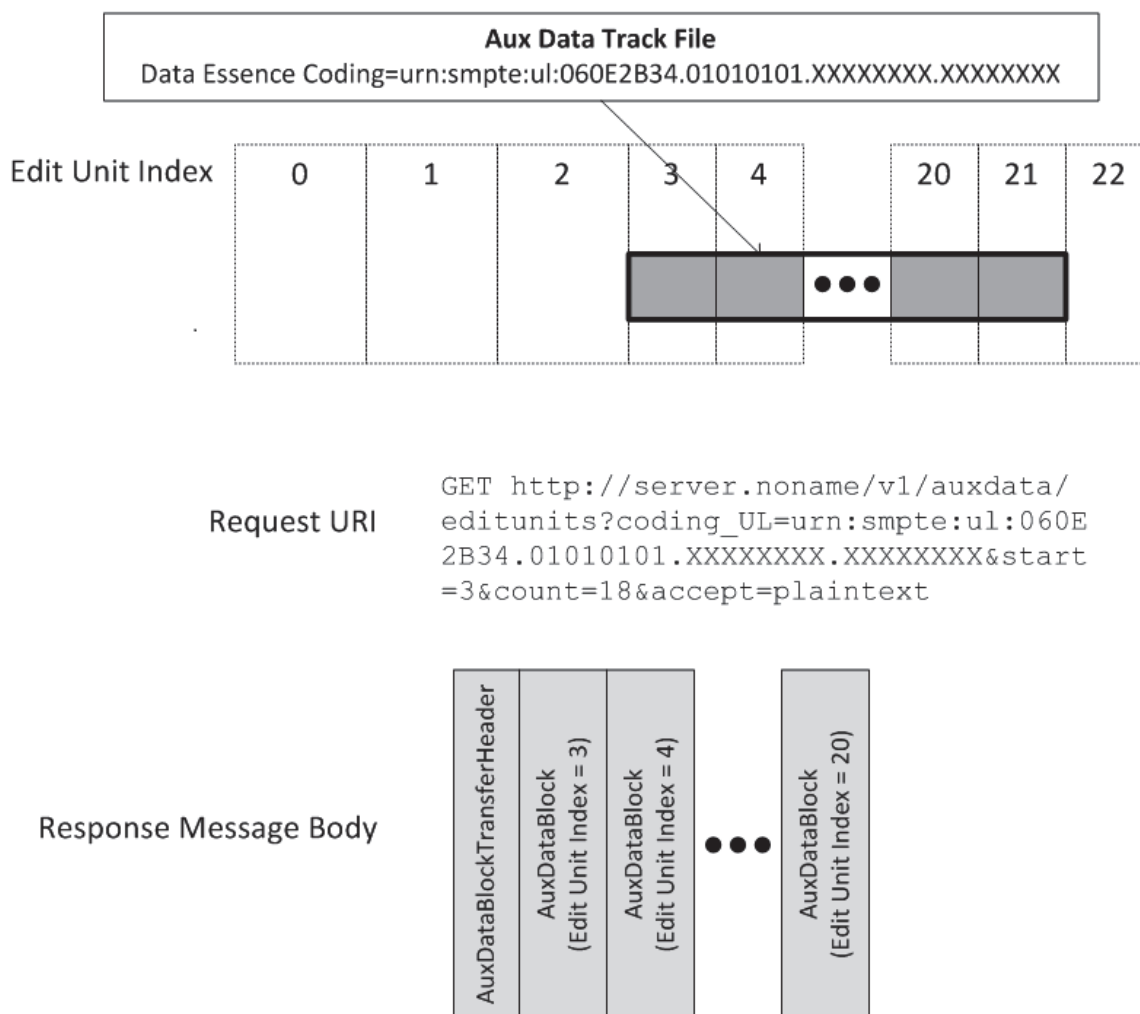


Figure 3 – Sample Transfer Protocol Request-Response

The minimal expected behavior of a Processor is specified in Section 5.7.

The Synchronization Signal and Transfer Protocol are designed to work together. The Synchronization Signal can nevertheless be used without the Transfer Protocol; e.g., a Processor can use the Synchronization Signal to determine playback location within the current Show but use means other than the Transfer Protocol to obtain playback essence. The Transfer Protocol however requires the presence of the Synchronization Signal.

1 Scope

This document specifies (i) a Transfer Protocol that allows Data Items from an Aux Data Track File to be transmitted to a Processor for reproduction, and (ii) a Synchronization Signal that allows a Processor to reproduce Data Items synchronously with the D-Cinema presentation. The Transfer Protocol uses the Hypertext Transfer Protocol (HTTP), while the Synchronization Signal is a binary signal that is accurate to the nearest audio sample of the presentation, intended to be generated by the Image Media Block at time of playback, and for use with AES3 interfaces.

While the Transfer Protocol requires the presence of the Synchronization Signal, the Synchronization Signal can be used in absence of the Transfer Protocol.

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 standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE ST 298:2009, Universal Labels for Unique Identification of Digital Data

SMPTE ST 336:2007, Data Encoding Protocol Using Key-Length-Value

¹⁾ SMPTE ST 377:2004, Television — Material Exchange Format (MXF) — File Format Specification

¹⁾ SMPTE ST 379:2004, Material Exchange Format (MXF) — MXF Generic Container

SMPTE ST 429-2:2013, D-Cinema Packaging — DCP Operational Constraints

SMPTE ST 429-6:2006, D-Cinema Packaging — MXF Track File Essence Encryption

SMPTE ST 429-14:2014, D-Cinema Packaging — Aux Data Track File

SMPTE ST 430-10:2010, D-Cinema Operations — Auxiliary Content Synchronization Protocol

AES3-2009, AES Standard for Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

IETF RFC 2616, Hypertext Transfer Protocol — HTTP/1.1

IETF RFC 2818, HTTP over TLS

IETF RFC 3986, Uniform Resource Identifier (URI): Generic Syntax

IETF RFC 6597, RTP Payload Format for Society of Motion Picture and Television Engineers (SMPTE) ST 336 Encoded Data

IETF RFC 2234, Augmented BNF for Syntax Specifications: ABNF

IETF RFC 4122, A Universally Unique Identifier (UUID) URN Namespace

IETF RFC 2046, Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types

¹⁾ Note: The reference to SMPTE ST 377:2004 (<http://dx.doi.org/10.5594/S9781614827689>) and SMPTE ST 379:2004 (<http://dx.doi.org/10.5594/S9781614828068>) are intentional. SMPTE ST 377-1:2011 and SMPTE ST 379-1:2009 or future versions are not appropriate for use with this document.

4 Terms and Definition

4.1 Timeline

As illustrated in Figure 4, the Timeline is a sequence of N contiguous Timeline Edit Units, resulting from the successive and uninterrupted playback of one or more Compositions in their entirety. Timeline Edit Units can have different duration to accommodate change of edit rates across Composition boundaries.

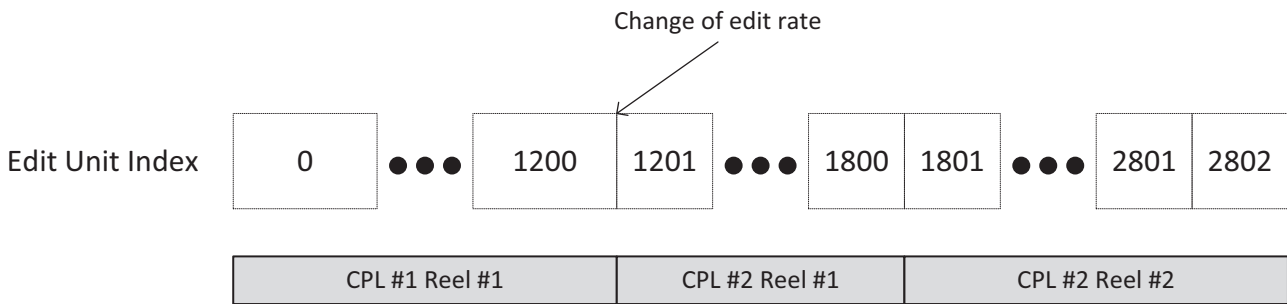


Figure 4 – Timeline

The Timeline Edit Units are indexed from 0 for the first Timeline Edit Unit to N-1 for the last Timeline Edit Unit.

4.2 Primary Picture

The primary picture is the picture projected on the main screen of the auditorium, commonly the output of the Primary Picture Track File.

4.3 Primary Picture Track File

The Primary Picture Track File is the Track File referenced by the Composition Playlist `MainPicture` or `MainStereoscopicPicture` element associated with the Timeline Edit Unit.

4.4 Primary Sound Track File

The Primary Sound Track File is the Track File referenced by the Composition Playlist `MainSound` element associated with the Timeline Edit Unit.

4.5 Server

Source of the Data Items transmitted using the Transfer Protocol.

4.6 Emitter

Source of the Synchronization Signal.

4.7 DCS

Digital Cinema Server as defined in SMPTE ST 430-10.

4.8 ACS

Auxiliary Content Synchronization as defined in SMPTE ST 430-10

5 Synchronization Signal

5.1 General

Bits are numbered starting at 0 for the least significant bit.

Note: Bit structures are documented using the conventions used in AES3, with the least-significant bit positioned to the left.

Hexadecimal constants are prefixed with "0x" and written most-significant bit and byte first.

EXAMPLE: The unsigned integer constant 0xAAF0 corresponds to the decimal integer 43,760.

5.2 Structure

As illustrated in Figure 5, the Synchronization Signal shall consist of a sequence of 24-bit Samples, grouped into Packets separated by zero or more Fill Samples.

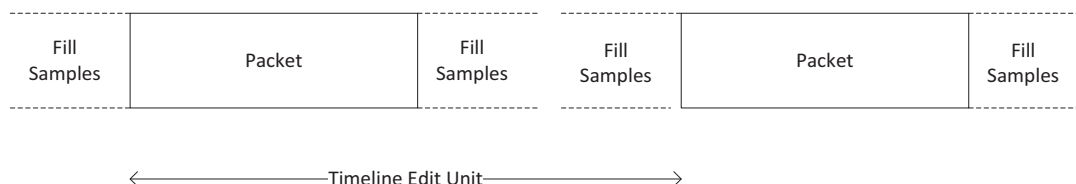


Figure 5 – Synchronization Signal

Each Fill Sample shall be equal to 0x000000.

Each Packet shall consist of the payload of Section 5.3 mapped to a sequence of Sample-Pairs, each consisting of a Lead Sample followed by a Tail Sample.

As illustrated in Table 1, the lower 16 bits of the n^{th} Lead Sample of a Packet shall be equal to the n^{th} Word of the Payload specified in Section 5.3.

Table 1 – Lead Sample Structure

Lead Sample																MSB							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
LSB Payload Word MSB																S	0	0	0	0	0	0	0

Bit 16 (labeled *s* in Table 1) of the Lead Sample shall be:

- 1 for the first Lead Sample of a Packet; and
- 0 otherwise.

The most significant 7 bits of each Lead Sample shall be 0.

The Tail Sample shall consist of the two's complement of the lead Sample, as illustrated in Table 2.