

# SMPTE STANDARD

## Interoperable Master Format – Isochronous Stream of XML Documents (ISXD) Plug-in



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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 TC 35PM.

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 clause 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.

## **Introduction**

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

This document defines a method for wrapping an Isochronous Stream of XML Documents (ISXD) in an Interoperable Master Format (IMF) Essence Component file. An ISXD Track File is appropriate for reference by an IMF Composition Playlist or Packing List, and in any other context where reference to an abstract IMF Essence Component is appropriate.

An isochronous stream of XML documents is a contiguous, ordered collection of discrete data items, where each item is a Constrained XML Document, and where all the documents in the collection conform to a defined data model. The items are also related temporally, with the first item occurring earliest, and with the temporal distance between each item being inversely proportional to Edit Rate. The ISXD items are frame-wrapped as a single MXF Source Clip having only Data Elements.

An ISXD Track File can also contain one or more static XML documents, which can be used, e.g., to provide global context for the ISXD data.

This document also defines a Virtual Track structure compatible with the IMF Composition Playlist. This structure provides a method of reference to an ISXD Track File from within an IMF Composition Playlist instance.

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.

## 1 Scope

This SMPTE Standard specifies a method for wrapping isochronous streams of XML documents in a manner consistent with the Interoperable Master Format (IMF) Essence Component. Only a Frame Wrapping method is defined. Clip Wrapping and Custom Wrapping are not considered.

This document defines:

- an ISXD Track File to carry ISXD data as specified in an application;
- an ISXD Virtual Track for use in an IMF Composition Playlist.

## 2 Normative References

The following engineering documents contain provisions that, through reference in this text, constitute provisions of this standard. Dated references require that the specific edition cited shall be used as the reference. Undated citations refer to the edition of the referenced document (including any amendments) current at the date of publication of this document. All engineering documents are subject to revision, and users of this engineering document are encouraged to investigate the possibility of applying the most recent edition of any undated reference.

SMPTE ST 377-1:2019, Material Exchange Format (MXF) – File Format Specification

SMPTE ST 379-2:2010, For Television – Material Exchange Format (MXF) – MXF Constrained Generic Container

SMPTE ST 429-17:2017, XML Constraints

SMPTE RP 2057, Text-Based Metadata Carriage in MXF

SMPTE ST 2067-2, Interoperable Master Format – Core Constraints

SMPTE ST 2067-3, Interoperable Master Format – Composition Playlist

SMPTE ST 2067-5, Interoperable Master Format – Essence Component

World Wide Web Consortium (W3C) (2004 February 4), Extensible Markup Language (XML) 1.0 (Third Edition)

World Wide Web Consortium (W3C) (28 October 2004), XML Schema Part 1: Structures (Second Edition)

World Wide Web Consortium (W3C) (28 October 2004), XML Schema Part 2: Datatypes (Second Edition)

## 3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply:

### 3.1

#### Constrained XML Document

well-formed and valid XML document as defined by W3C Extensible Markup Language (XML) 1.0 and as constrained by SMPTE ST 429-17

### 3.2

#### Isochronous Stream of XML Documents

##### ISXD

ordered collection of discrete data items, one per edit unit, where each item is a Constrained XML Document, and where all of the documents in the collection conform to a common data model, defined by the application

### 3.3

#### Static XML Document

Constrained XML Document pertaining globally to the entire Track File

## 4 XML Schema Definitions

This clause shall apply whenever a data structure is specified using XML schema definitions as specified in W3C XML Schema Part 1: Structures and W3C XML Schema Part 2: Datatypes.

In order to avoid duplication between text and schema, the cardinality and default values of elements are specified in the schema definitions only.

In the event of a conflict between schema definitions and the prose, the prose shall take precedence.

## 5 ISXD Track File

### 5.1 General

An ISXD Track File is a Track File, as specified in SMPTE ST 2067-2, and is further constrained by the provisions of this clause.

### 5.2 Wrapping

An ISXD Track File shall conform to Clause 7 of this document.

### 5.3 Essence

Each frame-wrapped data item in an ISXD Track File shall contain a Constrained XML Document.

All Constrained XML Documents in the Isochronous Stream of XML Documents of an ISXD Track File shall have identical root element name and namespace name. This namespace shall be indicated using the `NamespaceURI` item of the `ISXDDataEssenceDescriptor` defined in Clause 9.2.

## 5.4 Static XML Document Instances

An ISXD Track File may contain zero or more Static XML Document instances. When present, the following constraints apply:

- Each Static XML Document shall be contained within a Generic Stream Partition for Text-based Metadata, as specified by SMPTE RP 2057.
- When more than one Static XML Document is present, each Descriptive Metadata Segment which contains a Text Based Descriptive Metadata Framework object corresponding to a Static XML Document, shall be referenced by the same Sequence object, and will thus belong to the same Static Track (DM), as defined by SMPTE ST 377-1. The Static Track, which contains the respective Text Based Descriptive Metadata Framework object(s), shall be strongly referenced by the top-level file package as defined by SMPTE ST 2067-5.
- Generic Stream Partitions containing Static XML Documents shall be ordered immediately before the start of the footer partition (i.e., all Body partitions containing ISXD content packages or index table segments shall occur before any Static XML Documents).

## 6 ISXD Virtual Track

A Composition, as defined in SMPTE ST 2067-3, that references an ISXD Track File, shall contain one or more ISXD Virtual Tracks.

Each ISXD Virtual Track shall consist of one or more instances of `ISXDSequence` elements as specified in Table 1 below.

**Table 1 — ISXDSequence element schema definition.**

```
<xs:schema
  targetNamespace="http://www.smpte-ra.org/ns/2067-202/2022"
  xmlns:cpl="http://www.smpte-ra.org/schemas/2067-3/2016"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified">
  <xs:import namespace="http://www.smpte-ra.org/schemas/2067-3/2016"/>
  <xs:element name="ISXDSequence" type="cpl:SequenceType"/>
</xs:schema>
```

Each `ISXDSequence` element shall contain Resource elements, as defined in SMPTE ST 2067-3, of type `TrackFileResourceType`. Each Resource element shall reference a single ISXD Track File. The Edit Rate of an ISXD Virtual Track shall be equal to the Edit Rate of the Main Image Virtual Track as defined in SMPTE ST 2067-2.

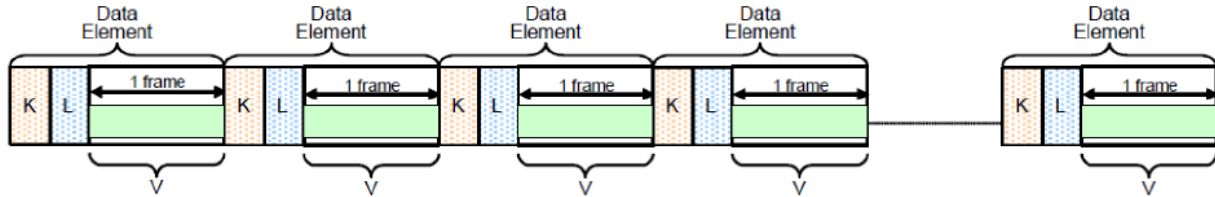
All ISXD Track Files referenced by an ISXD Virtual Track shall have an identical value for the `NamespaceURI` item. This namespace shall be indicated using the `NamespaceURI` property of the `ISXDDataEssenceDescriptor` defined in Clause 9.2.

## 7 ISXD Mapping to MXF Generic Container

### 7.1 Frame Wrapping

The "Frame Wrapping" method for data essence is illustrated in Figure 1 below. Frame wrapping as specified in SMPTE ST 379-2 shall be used for the ISXD Track File.

Figure 1 shows a series of data elements, each wrapped in a single Content Package Data Element with no other Generic Container Elements in the Container. Each Content Package has the duration of one edit unit.



**Figure 1 — Simple Representation of Frame Wrapping (Informative).**

The Frame Wrapping method enables frame-by-frame access by MXF applications which process at the KLV level. Sufficient Information is provided to allow individual frames to be identified at the KLV level without an MXF decoder having to parse or decode the Essence Data. Each data frame shall be KLV wrapped using a Generic Container Data Element Key.

### 7.2 Clip Wrapping

Clip wrapping shall not be used in an ISXD Track File.

### 7.3 Custom Wrapping

Custom wrapping shall not be used in an ISXD Track File.

### 7.4 Element and Item Constraints

Only Data Elements shall be carried in an ISXD Track File. Each Data Item shall contain only a single Data Element.

## 8 KLV Coding of ISXD Data Elements

### 8.1 Data Element Key

The value for the ISXD Data Element Essence Key Universal Label (UL) shall be as defined in Table 2 below.

**Table 2 — Essence Key.**

Item Name	Symbol	Kind	UL
Frame Wrapped ISXD Data	FrameWrappedISXDData	LEAF	urn:smppte:ul:060e2b34.01020105.0e090502.01kk01nn

NOTE 1 kk = Element Count, nn = Element Number

NOTE 2 The wildcard bytes (14 and 16) in the UL for `FrameWrappedISXDData`, “kk” and “nn”, are replaced with the hexadecimal value 0x7f in an essence keys register.

NOTE 3 This UL is from a Class 14 node that does not comply with the UL construction defined in SMPTE ST 379-2.

### 8.2 Length

The length field and its application shall comply with SMPTE ST 377-1.

### 8.3 Value

The frame-wrapped value field shall be a Constrained XML Document. The Constrained XML Document shall be encoded with a default namespace name, which shall be equal to the value of the `NamespaceURI` item defined in Clause 9.2. The temporal duration of the value shall be 1 / Edit Rate.

## 9 Essence Container Label and Essence Descriptor

### 9.1 Label for ISXD Essence Container Identification

The value for the Essence Container UL shall be as defined in Table 3 below.

**Table 3 — Essence Container UL.**

Item Name	Symbol	Kind	UL
Frame Wrapped ISXD Container	FrameWrappedISXDContainer	LEAF	urn:smppte:ul:060e2b34.04010105.0e090607.01010103

The Essence Container UL is used within a batch of ULs in Partition Packs and the Preface set and on its own in the Essence Descriptor.

NOTE This UL is from a Class 14 node so does not comply with the UL construction defined in SMPTE ST 379-2.

## 9.2 ISXD Data Essence Descriptor

The File Descriptor sets are those structural metadata sets in the Header Metadata that describe the essence and metadata elements defined in this document. The `ISXDDataEssenceDescriptor`, as defined in Table 5 below, shall be a subclass of the Generic Data Essence Descriptor defined in SMPTE ST 377-1. The ULs of the `ISXDDataEssenceDescriptor` Key and of the `ISXDDataEssenceDescriptor` items shall be as specified in Table 4. File Descriptor sets shall be present in the Header Metadata for each Essence Element. Implementations that carry specific data types may extend the `ISXDDataEssenceDescriptor` using a SubDescriptor. Implementations complying with this specification shall ignore unrecognized SubDescriptors.

**Table 4 — ISXDDataEssenceDescriptor ULs.**

Item Name	Symbol	Kind	UL
ISXD Data Essence Descriptor	<code>ISXDDataEssenceDescriptor</code>	LEAF	urn:smpte:ul:060e2b34.027f0105.0e090502.00000000
Namespace URI	<code>NamespaceURI</code>	LEAF	urn:smpte:ul:060e2b34.01010105.0e090400.00000000

NOTE The value of byte 6 of the `ISXDDataEssenceDescriptor` UL to use in an MXF file is determined according to SMPTE ST 377-1 (typically 0x53).

**Table 5 — Elements of ISXD Data Essence Descriptor Set.**

Symbol	Type	Len	Req?	Meaning	Default
<code>ISXDDataEssenceDescriptor</code>	Set UL	16	Req	ISXD Data Essence Descriptor	
<i>Length</i>	BER length	var	Req	Set Length	
<i>All items from the Generic Data Essence Descriptor in SMPTE ST 377-1 to be included. DataEssenceCoding item usage is modified as specified below.</i>					
<code>NamespaceURI</code>	UTF8String	var	Req	Default namespace of the essence XML documents	

## 9.3 Label for ISXD Data Essence Coding

The `DataEssenceCoding` item shall be present in the `ISXDDataEssenceDescriptor`. The value of the `DataEssenceCoding` item shall be as defined in Table 6 below.

**Table 6 — Data Essence Coding UL.**

Item Name	Symbol	Kind	UL
UTF-8 Text Data Essence Coding	<code>UTF8TextDataEssenceCoding</code>	LEAF	urn:smpte:ul:060e2b34.04010105.0e090606.00000000

All other items shall use the default value as specified in SMPTE ST 377-1.

## **Annex A (Informative) Additional Elements**

This annex lists non-prose elements of this document.

This specification is accompanied by the following element, which is an XML schema document as specified in XML Schema Part 1: Structures.

st2067-202a-2023.xsd

This element collects the XML schema definitions defined in this document. It is informative and, in case of conflict, this document takes precedence.