

ENGINEERING REPORT

# Digital Cinema – Overview for the SMPTE 428, 429, 430, 431, 432, and 433 Document Suites

SMPTE ER 1008:2022

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# SMPTE ENGINEERING REPORT

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## 1 Introduction

The Digital Cinema Format is a file-based framework that allows high-quality versions of motion pictures, called Compositions, to be efficiently represented and played back on digital playback servers and projectors. The delivery of these Compositions is packaged into what is known worldwide as a Digital Cinema Package or its more common acronym; DCP.

The DCP, its assets, corresponding video/audio/text-based data essence and operational processing, and security and operation of DCP playback servers and projectors are governed by a family suite of SMPTE standards which regulate the constrained application specific implementation of the framework.

## 2 Document Roadmap

Digital Cinema is comprised of seven categories: Security, Digital Cinema Distribution Master, Packaging, Operations, Quality, Digital Source Processing and XML Data Types. The SMPTE documents for each category are specified in the SMPTE 427, 428, 429, 430, 431, 432 and 433 suites of documents respectively. This ‘family suite’ is organized according to Table 1 below.

**Table 1 - Organization of the SMPTE Digital Cinema Suite of Documents**

Suite	Category
427	Security
428	Digital Cinema Distribution Master
429	Packaging
430	Operations
431	Quality
432	Digital Source Processing
433	XML Data Types

### 2.1 427 Documents

Table 2 below lists the latest versions of the documents of the 427 suite available at the time of publication of this document.

**Table 2 - Documents of the SMPTE ST 427 Suite (Latest Versions)**

Type	Label	Title	Library DOI
ST	427:2009	Link Encryption for 1.5 Gb/s Serial Digital Interface	<a href="https://www.smpthe.org/standards/10.5594/SMPTE.ST427.2009">10.5594/SMPTE.ST427.2009</a>

### 2.2 428 Documents

Table 3 below lists the latest versions of the documents of the 428 suite available at the time of publication of this document.

**Table 3 - Documents of the SMPTE ST 428 Suite** (Latest Versions)

Type	Label	Title	Library DOI
ST	428-1:2019	Image Characteristics	<a href="https://doi.org/10.5594/SMPTE.ST428-1.2019">10.5594/SMPTE.ST428-1.2019</a>
ST	428-2:2006	Audio Characteristics	<a href="https://doi.org/10.5594/SMPTE.ST428-2.2006">10.5594/SMPTE.ST428-2.2006</a>
ST	428-3:2006	Audio Channel Mapping and Channel Labelling [withdrawn]	<a href="https://doi.org/10.5594/SMPTE.ST428-3.2006">10.5594/SMPTE.ST428-3.2006</a>
RP	428-4:2010	Audio File Formats and Delivery Constraints	<a href="https://doi.org/10.5594/SMPTE.RP428-4.2010">10.5594/SMPTE.RP428-4.2010</a>
RP	428-5:2010	Mapping of Images into Constrained Tag Image File	<a href="https://doi.org/10.5594/SMPTE.RP428-5.2010">10.5594/SMPTE.RP428-5.2010</a>
RP	428-6:2009	Digital Leader	<a href="https://doi.org/10.5594/SMPTE.RP428-6.2009">10.5594/SMPTE.RP428-6.2009</a>
ST	428-7:2014	Subtitle	<a href="https://doi.org/10.5594/SMPTE.ST428-7.2014">10.5594/SMPTE.ST428-7.2014</a>
ST	428-9:2008	Serial Digital Interface Signal Formatting	<a href="https://doi.org/10.5594/SMPTE.ST428-9.2008">10.5594/SMPTE.ST428-9.2008</a>
ST	428-10:2008	Closed Caption and Closed Subtitle	<a href="https://doi.org/10.5594/SMPTE.ST428-10.2008">10.5594/SMPTE.ST428-10.2008</a>
ST	428-11:2013	Additional Frame rates for D-Cinema	<a href="https://doi.org/10.5594/SMPTE.ST428-11.2013">10.5594/SMPTE.ST428-11.2013</a>
ST	428-12:2013	Common Audio Channels and Sound field Groups	<a href="https://doi.org/10.5594/SMPTE.ST428-12.2013">10.5594/SMPTE.ST428-12.2013</a>
ST	428-19:2010	Additional Frame Rates Level AFR2 and Level AFR4 —Serial Digital Interface Signal Formatting	<a href="https://doi.org/10.5594/SMPTE.ST428-19.2010">10.5594/SMPTE.ST428-19.2010</a>
ST	428-21:2011	Archive Frame Rates for D-Cinema	<a href="https://doi.org/10.5594/SMPTE.ST428-21.2011">10.5594/SMPTE.ST428-21.2011</a>

### 2.3 429 Documents

Table 4 below lists the latest versions of the documents of the 429 suite available at the time of publication of this document.

**Table 4 - Documents of the SMPTE ST 429 Suite** (Latest Versions)

Type	Label	Title	Library DOI
ST	429-2:2020	DCP Operational Constraints	<a href="https://doi.org/10.5594/SMPTE.ST429-2.2020">10.5594/SMPTE.ST429-2.2020</a>
ST	429-3:2007	Sound and Picture Track File	<a href="https://doi.org/10.5594/SMPTE.ST429-3.2007">10.5594/SMPTE.ST429-3.2007</a>
ST	429-4:2020	MXF JPEG2000 Application	<a href="https://doi.org/10.5594/SMPTE.ST429-4.2020">10.5594/SMPTE.ST429-4.2020</a>
ST	429-5:2017	Timed Text Track File	<a href="https://doi.org/10.5594/SMPTE.ST429-5.2017">10.5594/SMPTE.ST429-5.2017</a>

ST	429-6:2006 <sup>1</sup>	MXF Track File Essence Encryption	<a href="https://doi.org/10.5594/SMPTE.ST429-6.2006">10.5594/SMPTE.ST429-6.2006</a>
ST	429-7:2006	Composition Playlist	<a href="https://doi.org/10.5594/SMPTE.ST429-7.2006">10.5594/SMPTE.ST429-7.2006</a>
ST	429-8:2007	Packing List	<a href="https://doi.org/10.5594/SMPTE.ST429-8.2007">10.5594/SMPTE.ST429-8.2007</a>
ST	429-9:2014	Asset Mapping and File Segmentation	<a href="https://doi.org/10.5594/SMPTE.ST429-9.2014">10.5594/SMPTE.ST429-9.2014</a>
ST	429-10:2008	Stereoscopic Picture Track File	<a href="https://doi.org/10.5594/SMPTE.ST429-10.2008">10.5594/SMPTE.ST429-10.2008</a>
ST	429-12:2008	Caption and Closed Subtitles	<a href="https://doi.org/10.5594/SMPTE.ST429-12.2008">10.5594/SMPTE.ST429-12.2008</a>
ST	429-13:2009	DCP Operational Constraints for Additional Frame Rates	<a href="https://doi.org/10.5594/SMPTE.ST429-13.2009">10.5594/SMPTE.ST429-13.2009</a>
ST	429-14:2014	Aux Data Track File	<a href="https://doi.org/10.5594/SMPTE.ST429-14.2014">10.5594/SMPTE.ST429-14.2014</a>
ST	429-16:2014	Additional Composition Metadata and Guidelines	<a href="https://doi.org/10.5594/SMPTE.ST429-16.2014">10.5594/SMPTE.ST429-16.2014</a>
ST	429-17:2017	XML Constraints	<a href="https://doi.org/10.5594/SMPTE.ST429-17.2017">10.5594/SMPTE.ST429-17.2017</a>
ST	429-18:2019	Immersive Audio Track File	<a href="https://doi.org/10.5594/SMPTE.ST429-18.2019">10.5594/SMPTE.ST429-18.2019</a>
ST	429-19:2019	DCP Operational Constraints for Immersive Audio	<a href="https://doi.org/10.5594/SMPTE.ST429-19.2019">10.5594/SMPTE.ST429-19.2019</a>

## 2.4 430 Documents

Table 5 below lists the latest versions of the documents of the 430 suite available at the time of publication of this document.

**Table 5 - Documents of the SMPTE ST 430 Suite (Latest Versions)**

Type	Label	Title	Library DOI
ST	430-1:2017	Key Delivery Message	<a href="https://doi.org/10.5594/SMPTE.ST430-1.2017">10.5594/SMPTE.ST430-1.2017</a>
ST	430-1:2017 Am1:2019	Key Delivery Message - Amendment 1	<a href="https://doi.org/10.5594/SMPTE.ST430-1.2017Am1.2019">10.5594/SMPTE.ST430-1.2017Am1.2019</a>
ST	430-2:2017	Digital Certificate	<a href="https://doi.org/10.5594/SMPTE.ST430-2.2017">10.5594/SMPTE.ST430-2.2017</a>
ST	430-3:2012	Generic Extra-Theater Message Format	<a href="https://doi.org/10.5594/SMPTE.ST430-3.2012">10.5594/SMPTE.ST430-3.2012</a>
ST	430-4:2008	Log Record Specification	<a href="https://doi.org/10.5594/SMPTE.ST430-4.2008">10.5594/SMPTE.ST430-4.2008</a>
ST	430-4:2008 Am1:2011	Log Record Specification - Amendment 1	<a href="https://doi.org/10.5594/SMPTE.ST430-4.2008Am1.2011">10.5594/SMPTE.ST430-4.2008Am1.2011</a>

<sup>1</sup> The reference to SMPTE ST 429-6:2006 is intentional. SMPTE ST 429-6:2006 Am1:2018 is not appropriate for use with Digital Cinema implementations.

ST	430-5:2011	Security Log Event Class and Constraints	<a href="https://doi.org/10.5594/SMPTE.ST430-5.2011">10.5594/SMPTE.ST430-5.2011</a>
ST	430-6:2010	Auditorium Security Messages for Intra-Theater Communications	<a href="https://doi.org/10.5594/SMPTE.ST430-6.2010">10.5594/SMPTE.ST430-6.2010</a>
ST	430-7:2008	Facility List Message [withdrawn]	<a href="https://doi.org/10.5594/SMPTE.ST430-7.2008">10.5594/SMPTE.ST430-7.2008</a>
ST	430-7:2008 Am1:2001	Facility List Message – Amendment 1 [withdrawn]	<a href="https://doi.org/10.5594/SMPTE.ST430-7.2008Am1.2011">10.5594/SMPTE.ST430-7.2008Am1.2011</a>
ST	430-9:2008	Key Delivery Bundle	<a href="https://doi.org/10.5594/SMPTE.ST430-9.2008">10.5594/SMPTE.ST430-9.2008</a>
ST	430-9:2008 Am1:2011	Key Delivery Bundle – Amendment 1	<a href="https://doi.org/10.5594/SMPTE.ST430-9.2008Am1.2011">10.5594/SMPTE.ST430-9.2008Am1.2011</a>
ST	430-10:2010	Auxiliary Content Synchronisation Protocol	<a href="https://doi.org/10.5594/SMPTE.ST430-10.2010">10.5594/SMPTE.ST430-10.2010</a>
ST	430-11:2011	Auxiliary Resource Presentation List	<a href="https://doi.org/10.5594/SMPTE.ST430-11.2010">10.5594/SMPTE.ST430-11.2010</a>
ST	430-12:2014	FSK Synchronization Protocol	<a href="https://doi.org/10.5594/SMPTE.ST430-12.2014">10.5594/SMPTE.ST430-12.2014</a>
ST	430-12:2014 Am1:2019	FSK Synchronization Protocol – Amendment 1	<a href="https://doi.org/10.5594/SMPTE.ST430-12.2014Am1.2019">10.5594/SMPTE.ST430-12.2014Am1.2019</a>
ST	430-14:2022	Digital Sync and Aux Data Transfer Protocol	<a href="https://doi.org/10.5594/SMPTE.ST430-14.2022">10.5594/SMPTE.ST430-14.2022</a>
ST	430-15:2017	Facility List Message Exchange Protocol	<a href="https://doi.org/10.5594/SMPTE.ST430-15.2017">10.5594/SMPTE.ST430-15.2017</a>
ST	430-16:2017	Extended Facility List Message	<a href="https://doi.org/10.5594/SMPTE.ST430-16.2017">10.5594/SMPTE.ST430-16.2017</a>
ST	430-17:2022	SMS-OMB Communications Protocol Specification	<a href="https://doi.org/10.5594/SMPTE.ST430-17.2022">10.5594/SMPTE.ST430-17.2022</a>

## 2.5 431 Documents

Table 6 below lists the latest versions of the documents of the 430 suite available at the time of publication of this document.

**Table 6 - Documents of the SMPTE ST 431 Suite (Latest Versions)**

Type	Label	Title	Library DOI
ST	431-1:2006	Screen Luminance Level, Chromaticity and Uniformity	<a href="https://doi.org/10.5594/SMPTE.ST431-1.2006">10.5594/SMPTE.ST431-1.2006</a>
RP	431-2:2011	Reference Projector and Environment	<a href="https://doi.org/10.5594/SMPTE.RP431-2.2011">10.5594/SMPTE.RP431-2.2011</a>

## 2.6 432 Documents

Table 7 below lists the latest versions of the documents of the 430 suite available at the time of publication of this document.

**Table 7 - Documents of the SMPTE ST 432 Suite (Latest Versions)**

Type	Label	Title	Library DOI
EG	432-1:2010	Color Processing for D-Cinema	<a href="https://doi.org/10.5594/SMPTE.EG432-1.2010">10.5594/SMPTE.EG432-1.2010</a>
EG	432-2:2006	D-Cinema Low Frequency Effects (LFE) Channel Audio Characteristics	<a href="https://doi.org/10.5594/SMPTE.EG432-2.2006">10.5594/SMPTE.EG432-2.2006</a>

## 2.7 433 Documents

Table 8 below lists the latest versions of the documents of the 433 suite available at the time of publication of this document.

**Table 8 - Documents of the SMPTE ST 433 Suite (Latest Versions)**

Type	Label	Title	Library DOI
ST	433:2008	XML Data Types	<a href="https://doi.org/10.5594/SMPTE.ST433.2008">10.5594/SMPTE.ST433.2008</a>
ST	433:2008 Am1:2011	XML Data Types – Amendment 1	<a href="https://doi.org/10.5594/SMPTE.ST433.2008Am1.2011">10.5594/SMPTE.ST433.2008Am1.2011</a>

## 3 XML Namespaces and Schema Documents

The following section lists the XML namespaces defined by the latest version of the SMPTE 428, 429, 430, 431, 432 and 433 suites of documents. Any XML Schema Document associated with each namespace, if any, can be retrieved at the namespace URL.

*Note: In case of a conflict between schema and the prose in the defining document, the prose takes precedence.*

Table 9 below lists the XML namespaces defined by the latest version of the SMPTE technology committee 27C suite of documents for Digital Cinema.

**Table 9 - XML Namespaces defined in the SMPTE 27C Suite of Standards for Digital Cinema (Latest Versions)**

Namespace	Defining Document
<a href="http://www.smpte-ra.org/schemas/428-7/2010/DCST">http://www.smpte-ra.org/schemas/428-7/2010/DCST</a>	ST 428-7:2014
<a href="http://www.smpte-ra.org/schemas/428-7/2014/DCST">http://www.smpte-ra.org/schemas/428-7/2014/DCST</a>	ST 428-7:2014
<a href="http://www.smpte-ra.org/schemas/429-7/2006/CPL">http://www.smpte-ra.org/schemas/429-7/2006/CPL</a>	ST 429-7:2006
<a href="http://www.smpte-ra.org/schemas/429-8/2007/PKL">http://www.smpte-ra.org/schemas/429-8/2007/PKL</a>	ST 429-8:2007

<a href="http://www.smpte-ra.org/schemas/429-9/2007/AM">http://www.smpte-ra.org/schemas/429-9/2007/AM</a>	ST 429-9:2014
<a href="http://www.smpte-ra.org/schemas/429-10/2008/Main-Stereo-Picture-CPL">http://www.smpte-ra.org/schemas/429-10/2008/Main-Stereo-Picture-CPL</a>	ST 429-10:2008
<a href="http://www.smpte-ra.org/schemas/429-12/2008/TT">http://www.smpte-ra.org/schemas/429-12/2008/TT</a>	ST 429-12:2008
<a href="http://www.smpte-ra.org/schemas/429-14/2014/Aux-Data">http://www.smpte-ra.org/schemas/429-14/2014/Aux-Data</a>	ST 429-14:2014
<a href="http://www.smpte-ra.org/schemas/429-16/2014/CPL-Metadata">http://www.smpte-ra.org/schemas/429-16/2014/CPL-Metadata</a>	ST 429-16:2014
<a href="http://www.smpte-ra.org/schemas/430-1/2006/KDM">http://www.smpte-ra.org/schemas/430-1/2006/KDM</a>	ST 430-1:2017
<a href="http://www.smpte-ra.org/schemas/430-3/2006/ETM">http://www.smpte-ra.org/schemas/430-3/2006/ETM</a>	ST 430-3:2012
<a href="http://smpte-ra.org/schemas/430-4/2008">http://smpte-ra.org/schemas/430-4/2008</a>	ST 430-4:2008 Am1:2011
<a href="http://www.smpte-ra.org/430-5/2008/SecurityLog">http://www.smpte-ra.org/430-5/2008/SecurityLog</a>	ST 430-5:2011
<a href="https://smpte-ra.org/schemas/430-7/2008/FLM">https://smpte-ra.org/schemas/430-7/2008/FLM</a>	
<a href="http://smpte-ra.org/schemas/430-9/2008">http://smpte-ra.org/schemas/430-9/2008</a>	ST 430-9:2008
<a href="http://www.smpte-ra.org/schemas/430-11/2010/RPL">http://www.smpte-ra.org/schemas/430-11/2010/RPL</a>	ST 430-11:2010
<a href="http://www.smpte-ra.org/ns/430-15/2017/SiteList">http://www.smpte-ra.org/ns/430-15/2017/SiteList</a>	ST 430-15:2017
<a href="http://www.smpte-ra.org/ns/430-16/2017/FLM">http://www.smpte-ra.org/ns/430-16/2017/FLM</a>	ST 430-16:2017
<a href="http://www.smpte-ra.org/schemas/433/2008/dcmlTypes">http://www.smpte-ra.org/schemas/433/2008/dcmlTypes</a>	ST 433:2008 Am1:2011



## Annex A.1 RDD Documents

Table A.1 below lists the latest versions of Registered Disclosure Documents of particular importance to Digital Cinema available at the time of publication of this document.

**Table A.1 – Registered Disclosure Documents (Latest Versions)**

Type	Label	Title	Library DOI
RDD	20:2010	Cinelink 2 Specification	<a href="https://doi.org/10.5594/SMPTE.RDD20.2010">10.5594/SMPTE.RDD20.2010</a>
RDD	28:2014	Dolby Atmos® Print Master File Specification	<a href="https://doi.org/10.5594/SMPTE.RDD28.2014">10.5594/SMPTE.RDD28.2014</a>
RDD	29:2019	Dolby Atmos® Bitstream Specification	<a href="https://doi.org/10.5594/SMPTE.RDD29.2019">10.5594/SMPTE.RDD29.2019</a>
RDD	52:2020	SMPTE DCP Bv2.1 Application Profile	<a href="https://doi.org/10.5594/SMPTE.RDD52.2020">10.5594/SMPTE.RDD52.2020</a>
RDD	57:2021	IAB Application Profile 1	<a href="https://doi.org/10.5594/SMPTE.RDD57.2021">10.5594/SMPTE.RDD57.2021</a>

## Annex A.2 IMF Documents

The Interoperable Master Format (IMF), as defined by the ST 2067 Suite and governed by the TC 35PM, is reliant on certain 27C documents created specifically for IMF applications. These documents are listed in Table A.3 and should not be referenced for Digital Cinema implementations. Where there is a conflict between the prose in either the 27C Document and the referencing 35PM Document, the 35PM document will take precedence.

**Table A.3 – IMF Reliant Documents**

Type	Label	Title	Library DOI
ST	429-6:2006 Am1:2018	MXF Track File Essence Encryption – Amendment 1	<a href="https://doi.org/10.5594/SMPTE.ST429-6.2006Am1.2018">10.5594/SMPTE.ST429-6.2006Am1.2018</a>