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ISO 26428-9

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Digital cinema (D-cinema) distribution master —

Part 9: Image pixel structure level 3 — Serial digital interface signal formatting

Souche de la distribution du cinéma numérique (cinéma D) —

Partie 9: Structure de pixel d'image de niveau 3 — Formatage périodique de signal d'interface numérique

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 26428-9 was prepared by the Society of Motion Picture and Television Engineers (as SMPTE 428-9-2008) and was adopted, under a special “fast-track procedure”, by Technical Committee ISO/TC 36, *Cinematography*, in parallel with its approval by the ISO member bodies.

ISO 26428 consists of the following parts, under the general title *Digital cinema (D-cinema) distribution master*:

— *Part 1: Image characteristics* [equivalent to SMPTE 428-1]

— *Part 2: Audio characteristics* [equivalent to SMPTE 428-2]

— *Part 3: Audio channel mapping and channel labeling* [equivalent to SMPTE 428-3]

— *Part 9: Image pixel structure level 3 — Serial digital interface signal formatting* [equivalent to SMPTE 428-9]

The following part is under preparation:

— *Part 7 Subtitle* [equivalent to SMPTE 428-7]

Introduction

This part of ISO 26428 comprises SMPTE 428-9-2008 and Annex ZZ (which provides equivalences between ISO standards and SMPTE standards referenced in the text).

SMPTE 428-9-2008

SMPTE STANDARD

D-Cinema Distribution Master — Image Pixel Structure Level 3 — Serial Digital Interface Signal Formatting

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Approved
February 14, 2008

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 Part XIII of its Administrative Practices.

SMPTE Standard 428-9 was prepared by Technology Committee DC28.

1 Scope

This standard defines the formatting and constraints of the DCDM SMPTE 428-1 Level 3 image Pixel Structure for transmission over the 1.485Gb/s dual link serial digital interface SMPTE 372M or 3Gb/s interface SMPTE 424M. The Serial Digital Interface (SDI) container parameters for DCDM level 3 are given in Table 1.

Table 1 – SDI container pixel array

DCDM level	System nomenclature	*X' Y' Z'* samples per active line (S/AL)	Lines per container (AL/F)	Frame rate (Hz)	Interface sampling frequency fs (MHz)	*X' Y' Z'* sample periods per total line (S/TL)	Interface total lines per frame
3	2048 × 1080/24/P	2048	1080	24	74.25	2750	1125

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.

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 291M-2006, Television — Ancillary Data Packet and Space Formatting

SMPTE 428-1-2006, D-Cinema Distribution Master (DCDM) — Image Characteristics

4 SDI Image Data Format Constraints

4.1 The serial digital container is a fixed container size with a 2048x1080 pixel array . See Figure 1.

4.2 Within the serial digital container not all pixels will form the image as defined by SMPTE 428-1, these pixels shall be called padding pixels and have a value of 010h. The center of the DCDM Image pixel array shall correspond to the center of the SDI container.

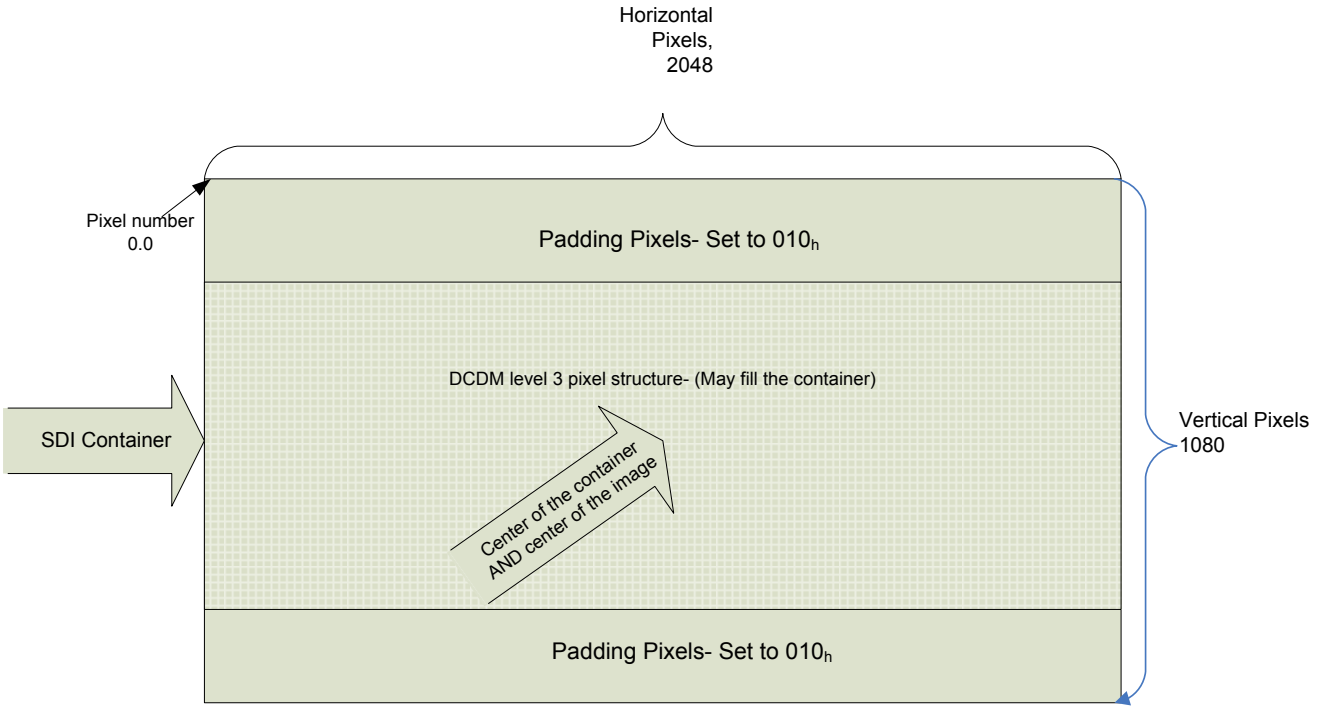


Figure 1 – Serial digital container

4.3 The DCDM level 3 pixel image structure shall employ *X', Y', Z'* coding as defined in DCDM image pixel structure format, SMPTE 428-1,

4.4 *X' Y' Z'* code values shall be contained within the range of FEF_h – $O10_h$. Values that may exist in the source signal, beyond these defined limits shall be clipped.

4.5 Code values FFO_h - FFF_h and 000_h – $00F_h$ are prohibited in the payload.

5 Virtual Interface Data Format

There shall be 3 data channels, *X', Y', Z'* each with identical data structures

5.1 The data format at the virtual interface of each channel shall consist of sychronizing signals (EAV and SAV) , the serial digital interface container, and ancillary data space. See Figures 1 and 2.

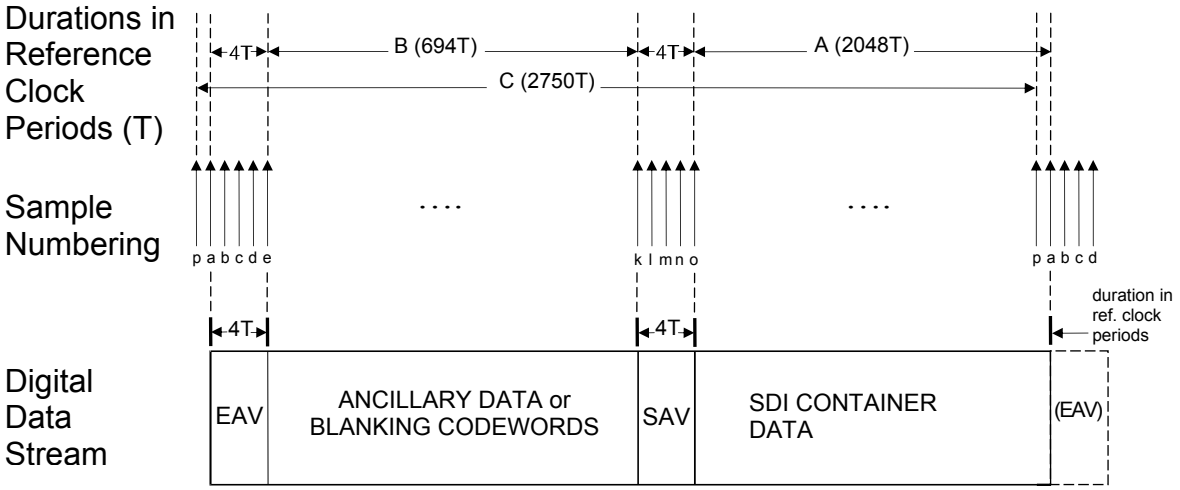


Figure 2 – Data Format – Interface horizontal line

Notes:

1 Horizontal axis not to scale.

2 A line of SDI container extends from the first word of EAV through the last word of container data.

3 The number of samples of the SDI container data (sample number 'o' through 'p' in Figure 2) is 2048. That is, the letter 'o' denotes sample number 0 and the letter 'p' denotes sample number 2047 in the SDI container container.

Table 2 – Values for SDI container array structure

SDI container	Sample numbering											Durations in reference clock periods (T)		
	a	b	c	d	e	k	l	m	n	o	p	A	B	C
	2048	2049	2050	2051	2052	2746	2747	2748	2749	0	2047	2048	694	2750

5.2 SAV (start of active video) and EAV (end of active video) digital synchronizing sequences shall define synchronization across the serial digital interface. Figures 1, 2, and 3 show the relationship of the SAV and EAV sequences to SDI container data.

5.3 An SAV or EAV sequence shall comprise four consecutive code words: a code word of all ones, a code word of all zeros, another code word of all zeros, and a code word including F (frame), V (vertical), H (horizontal), P3, P2, P1, and P0 (parity) bits. An SAV sequence shall be identified by having H = 0; EAV shall have H = 1 (tables 3 and 4 show details of the coding).

5.4 Interface line numbers –

The interface shall have 1125 total number of lines, 1 thru 1125 inclusive. See Annex B.

5.5 In a progressive system, the EAV and SAV of all lines shall have F = 0;

- The EAV and the SAV of lines 1 through 41 inclusive and lines 1122 through 1125 inclusive shall have V = 1;
- The EAV and SAV of lines 42 through 1121 inclusive shall have V = 0.

5.6 In a PsF system:

- The EAV and SAV of lines 1 through 563 inclusive shall have F = 0. The EAV and SAV of lines 564 through 1125 inclusive shall have F = 1;
- The EAV and SAV of lines 1 through 20, lines 561 through 583, and lines 1124 and 1125 shall have V = 1;
- The EAV and the SAV of lines 21 through 560 and lines 584 through 1123 shall have V = 0.

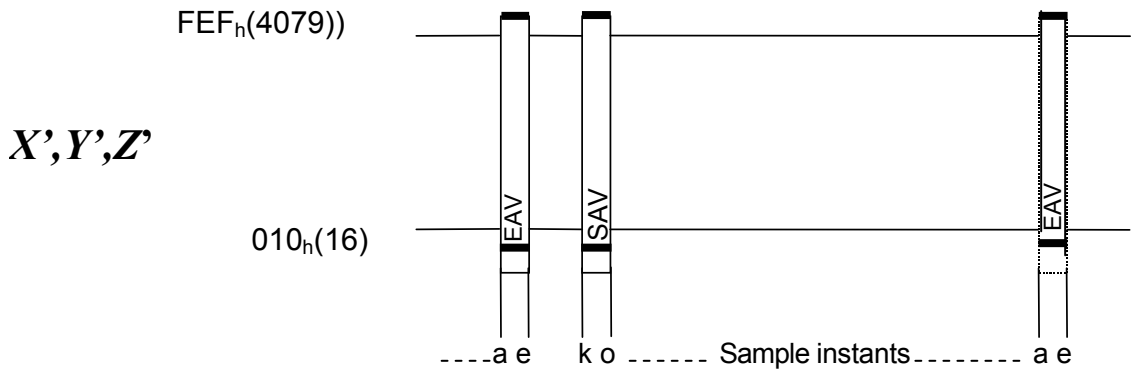


Figure 3 – Digital levels and timing

Table 3 – Timing reference codes[1]

Bit number		11 (MSB)	10	9	8	7	6	5	4	3	2	1	0 (LSB)
Word	Value												
0	FFFh (4095)	1	1	1	1	1	1	1	1	1	1	1	1
1	000h (0)	0	0	0	0	0	0	0	0	0	0	0	0
2	000h (0)	0	0	0	0	0	0	0	0	0	0	0	0
3		1	F	V	H	P3	P2	P1	P0	0	0	0	0

Table 4 – Protection bits for SAV and EAV

Bit number	11	10	9	8	7	6	5	4	3	2	1	0
Function	1 Fixed	F	V	H	P3	P2	P1	P0	0 Fixed	0 Fixed	0 Fixed	0 Fixed
0	1	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	1	1	1	0	1	0	0	0	0
2	1	0	1	0	1	0	1	1	0	0	0	0
3	1	0	1	1	0	1	1	0	0	0	0	0
4	1	1	0	0	0	1	1	1	0	0	0	0
5	1	1	0	1	1	0	1	0	0	0	0	0
6	1	1	1	0	1	1	0	0	0	0	0	0
7	1	1	1	1	0	0	0	1	0	0	0	0

5.4.4 The assignment of lines numbers within an interface frame shall be:

VANC data area: Lines 1 though 41 inclusive and lines 1122 through 1125.

SDI Image container: 1080 lines, 42 (top of container) through 1121 (bottom of the container) inclusive.

[1] Terminology used in Table 3 is consistent with terminology used for television signals

Annex A (Normative)
Ancillary Data

A.1 Ancillary data may optionally be included in the blanking intervals of the digital interface according to this standard.

A.2 The interval between the end of EAV and the start of SAV may be employed to convey HANC data packets[2].

A.3 The interval between the end of SAV and the start of EAV of any line that is outside the container boundary, as defined in § 4.5, may be employed to convey VANC data packets.

A.4 ANC data packets may be conveyed across each of the *X', Y' and Z'* channels.

A.5 The ANC data is defined by the most significant 10 bits of the 12-bit data and the least significant 2 bits shall be set to zero.

A.6 Intervals not used to convey SAV, image data, EAV, or ancillary data shall convey the code word 010_h(16) (black) in the *X', Y', Z',* channels.

A.7 The ANC data format is defined by, SMPTE 291M.

[2] Designers should be aware that when the serial interface is employed in accordance with the mapping structures defined in SMPTE 372M or SMPTE 425M, the first eleven samples after EAV of Line 10 are reserved for video payload identifier usage.

Annex B (Normative)
Progressive Segmented Frame System

B.1 A Progressive segmented Frame system shall transmit a progressive image as if it were an interlaced Image. This provides a means of carrying a progressive image as two equally divided segments mapped onto an interlace interface.

B.2 In a Progressive segmented Frame system, the assignment of lines within a progressive image shall be the same as that of an interlaced image. More specifically, the assignment of each even line of a progressive image shall correspond to lines 1 through 562 of a segmented frame system image, and each odd line of a progressive image shall correspond to lines 563 through 1125 of a segmented frame system image. The relationship of line N of a progressive system image nd line M of a segmented frame system image shall be as shown by the following equation and as shown in Figure B.1.

M = N/2 where N= 2, 4, 6,…1124
M = (N+1125)/2 where N= 1, 3, 5,…1125

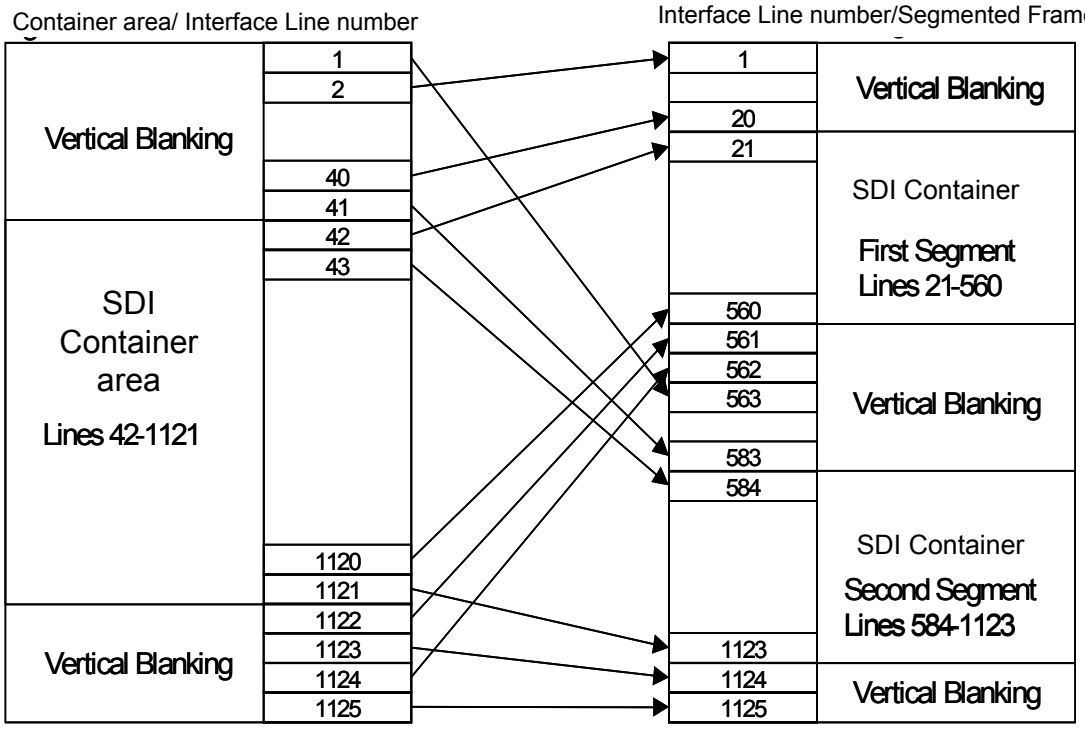


Figure B.1 – Progressive segmented Frame system

Annex C (Informative)
Bibliography

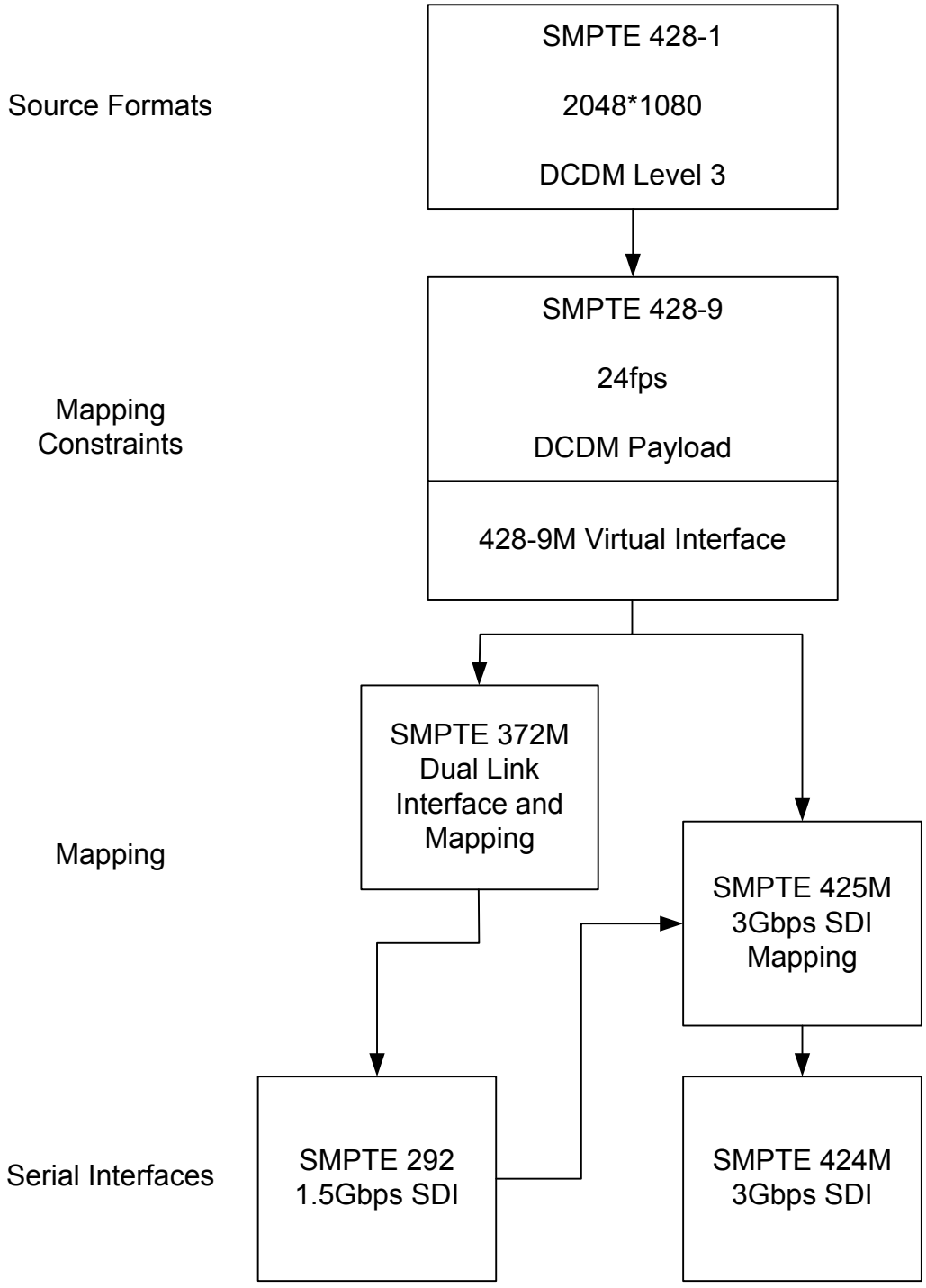
SMPTE 292-2008, 1.5 Gb/s Signal/Data Serial Interface

SMPTE 372M-2002, Television — Dual Link 292M Interface for 1920 × 1080 Picture Raster

SMPTE 424M-2006, Television — 3 Gb/s Signal/Data Serial Interface

SMPTE 425M-2006, Television — 3 Gb/s Signal/Data Serial Interface — Source Image Format Mapping

Annex D (Informative)
Document Road Map



Annex ZZ
(informative)

Corresponding International Standards for which equivalents are not given in the text

At the time of publication of this part of ISO 26428, the following ISO standards are equivalent to the SMPTE standards referenced in the text.

SMPTE 428-1-2006	ISO 26428-1:2008, *Digital cinema (D-cinema) distribution master — Part 1: Image characteristics*

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