INTERNATIONAL STANDARD

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Digital cinema (D-cinema) distribution master —

Part 19: Serial digital interface signal formatting for additional frame rates level AFR2 and level AFR4

Souche de la distribution du cinéma numérique (cinéma D) — Partie 19: Formatage du signal de l'interface numérique de série pour les cadences de prise de vue supplémentaire de niveaux AFR2 et AFR4

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 26428-19 was prepared by the Society of Motion Picture and Television Engineers (as SMPTE 428-19-2010) 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 7: Subtitle* [equivalent to SMPTE 428-7]

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

— *Part 11: Additional frame rates* [equivalent to SMPTE 428-11]

— *Part 19: Serial digital interface signal formatting for additional frame rates level AFR2 and level AFR4* [equivalent to SMPTE 428-19]

Introduction

This part of ISO 26428 comprises SMPTE 428-19-2010 and Annex ZZ (which provides equivalences between ISO standards and SMPTE standards referenced in the text).

SMPTE ST 428-19:2010

SMPTE STANDARD

D-Cinema Distribution Master — Additional Frame Rates Level AFR2 and Level AFR4 — Serial Digital Interface Signal Formatting

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Approved
August 9, 2010

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 ST 428-19 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 Standard. 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 standard defines the formatting and constraints of the DCDM SMPTE 428-11 AFR Level 2 and AFR Level 4 image Pixel Structure for transmission over the 1.485 Gb/s dual link serial digital interface SMPTE 372M or 3 Gb/s interface SMPTE 424M. The Serial Digital Interface (SDI) container parameters for DCDM AFR Level 2 and AFR Level 4 are given in Table 1.

Table 1 – SDI container pixel array

AFR 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
2	2048 x 1080/25/P	2048	1080	25	74.25	2640	1125
4	2048 x 1080/30/P	2048	1080	30	74.25	2200	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 428-1 2006, D-Cinema Distribution Master (DCDM) — Image Characteristics

SMPTE 428-11-2009, Additional Frame Rates for D-Cinema

4 SDI Image Data Format Constraints

4.1 The serial digital container is a fixed container size with a 2048 x 1080 pixel array. See Figure 1.

4.2 Within the serial digital container not all pixels will form the image as defined by SMPTE 428-11. Pixels not forming the image shall be called padding pixels and have a value of 010h.

4.3 The center of the DCDM Image pixel array shall correspond to the center of the SDI container.

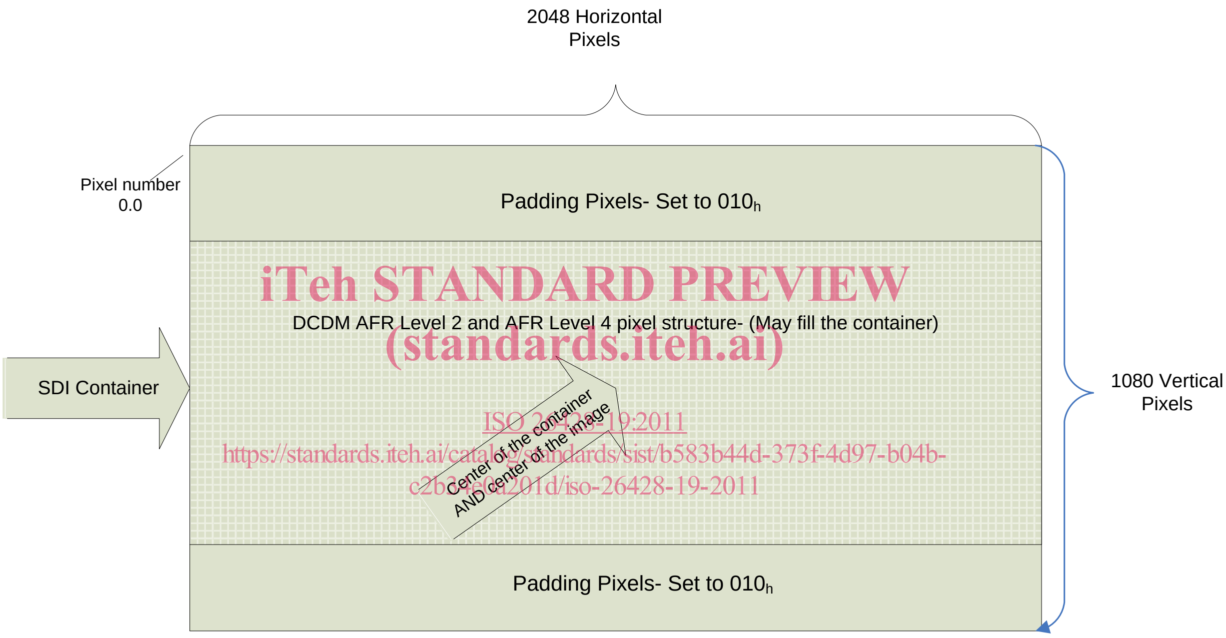

Figure 1 – Serial digital container

4.4 The DCDM AFR Level 2 and AFR Level 4 pixel image structure shall employ *X', Y', Z'* coding as defined in DCDM image pixel structure format, SMPTE 428-1.

4.5 *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.

4.6 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 synchronizing signals (EAV and SAV), the serial digital interface container, horizontal blanking and vertical blanking. See Figures 1 and 2.

5.2 The horizontal blanking area does not contain image pixels and shall be set to the padding pixel value of 010h.

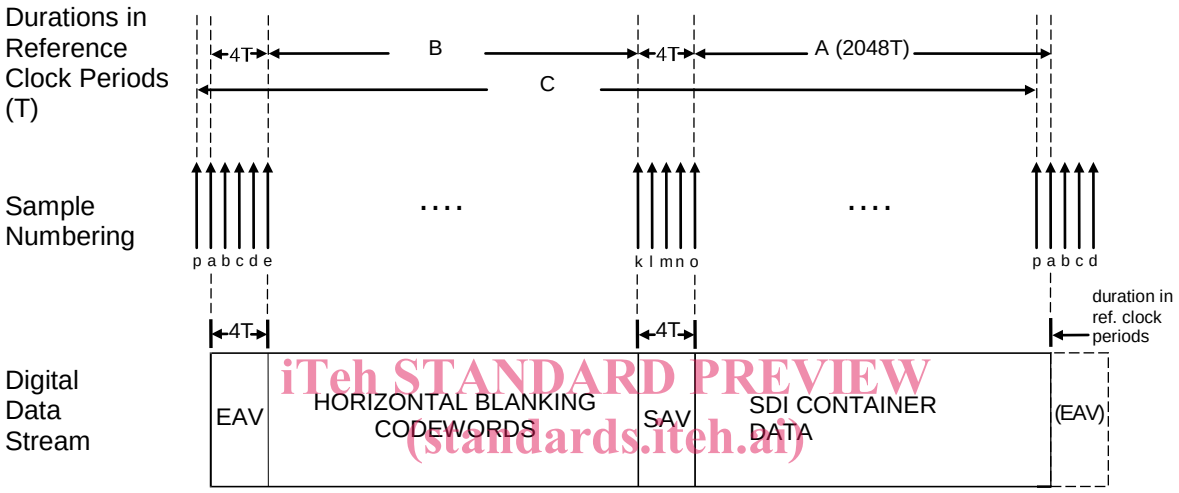

Figure 2 – Data Format – Interface horizontal line

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.

4 The number of reference clock periods per second equals the interface sampling frequency

Table 2 – Values for SDI container array structure

AFR level	fps	Sample numbering											Durations in reference clock periods (T)		
		a	b	c	d	e	k	l	m	N	o	p	A	B	C
2	25	2048	2049	2050	2051	2052	2636	2637	2638	2639	0	2047	2048	584	2640
4	30	2048	2049	2050	2051	2052	2196	2197	2198	2199	0	2047	2048	144	2200

5.3 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.