SMPTE STANDARD

Vertical Ancillary Data Mapping of Active Format Description and Bar Data

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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 Part XIII of its Administrative Practices.

SMPTE ST 2016-3 was prepared by Technology Committee 22TV.

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.

Introduction

Image formatting information describes certain spatial characteristics of a high definition or standard definition video image. It may be generated and carried through all or some of the video production, distribution, and emission chain. The image formatting metadata types are Active Format Description (AFD), Bar Data, and Pan-Scan information.

AFD and Bar Data are intended to be broadcast with the video signal that they describe. AFD information is intended to guide DTV receivers and/or intermediate professional video equipment regarding the display of video of one aspect ratio on a display of another aspect ratio. Bar Data information is used to signal the precise unused areas of active video when the active image does not completely fill the picture area, in particular widescreen cinema material carried letterboxed in a frame with bars top and bottom.

Pan-Scan information is a set of data that is intended to guide professional video equipment in extracting an image to be presented in an aspect ratio that is different from that in which the material was produced or distributed. Independent parameters are provided for pan (horizontal offset), tilt (vertical offset), vertical size, horizontal size, and output aspect ratio. Pan-Scan information is not intended for use beyond the production and distribution environments.

The following suite of SMPTE standards defines the origination and carriage of AFD, Bar Data, and Pan-Scan information:

SMPTE ST 2016-1   Format for Active Format Description and Bar Data
SMPTE 2016-2   Format for Pan-Scan Information
SMPTE ST 2016-3   Vertical Ancillary Data Mapping of Active Format Description and Bar Data
SMPTE 2016-4   Vertical Ancillary Data Mapping of Pan-Scan Information
SMPTE 2016-5   KLV Data Coding for Active Format Description, Bar Data, and Pan-Scan Information

Other SMPTE standards may be used for alternative transport methods for this data. The relationship among these and related standards is shown in the Road Map in Annex C.

1 Scope

This Standard defines a method of coding that allows Active Format Description (AFD) and Bar Data information to be carried in the 10-bit vertical ancillary (VANC) data space of a standard definition or high definition component television signal. The standard defines how the AFD and Bar Data information is placed into an AFD/Bar Data ancillary data packet for carriage in accordance with SMPTE 291M.

An associated standard, SMPTE ST 2016-1, defines the format for AFD and Bar Data and identifies the video image and interface standards with which it may be associated. Annex C shows the relationship among the standards.

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.

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 2016-1:2009, Format for Active Format Description and Bar Data

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

SMPTE RP 168-2009, Definition of Vertical Interval Switching Point for Synchronous Video Switching

4 Format of VANC Data Packets

Each data packet shall comply with the format defined in SMPTE 291M for a type 2 ANC packet. It consists of the ancillary data flag (ADF), the data ID (DID), the secondary data ID (SDID), the data count (DC), the user data words (UDW), and the checksum (CS). The UDW consists of the data payload.

The DID word shall be set to the value 41_h. The SDID word shall be set to the value of 05_h.

DC is a count of the number of words in the UDW and shall be set to a fixed value of 8 (08_h).

4.1 UDW format

Six bytes of AFD and Bar Data, as well as two reserved bytes, shall be carried in the User Data Words of a SMPTE 291M ancillary data packet as shown in Table 1. The format of the AFD byte and five Bar Data bytes is defined in § 9 of SMPTE ST 2016-1.

The ancillary space (ANC) packet UDW shall be a sequence of eight 10-bit words. The AFD and Bar Data information is transmitted in bits b7 through b0 of the 10-bit data word. Bit b8 is even parity for bits b7 through b0 of the 10-bit data word, and bit b9 equals the complement of bit b8.

Table 1 – ANC data payload

User Data Words		User Data Word bits									
UDW	Function	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
1	AFD	$\overline{b8}$	P	'0'	a3	a2	a1	a0	AR	'0'	'0'
2	Reserved	$\overline{b8}$	P	'0'	'0'	'0'	'0'	'0'	'0'	'0'	'0'
3	Reserved	$\overline{b8}$	P	'0'	'0'	'0'	'0'	'0'	'0'	'0'	'0'
4	Bar Data Flags	$\overline{b8}$	P	Top	Bot.	Left	Right	'0'	'0'	'0'	'0'
5	Bar Data Value 1	$\overline{b8}$	P	f15	f14	f13	f12	f11	f10	f9	f8
6		$\overline{b8}$	P	f7	f6	f5	f4	f3	f2	f1	f0
7	Bar Data Value 2	$\overline{b8}$	P	s15	s14	s13	s12	s11	s10	s9	s8
8		$\overline{b8}$	P	s7	s6	s5	s4	s3	s2	s1	s0

where:
a3 - a0   is the AFD code (see SMPTE ST ST 2016-1 § 9.1);
AR   is the Aspect ratio flag (see SMPTE ST 2016-1 § 9.1);
Top, Bot., Left, Right are Bar Data presence flags (see SMPTE ST 2016-1 § 9.2.1);
f15 - f0   is the first Bar Data value (see SMPTE ST 2016-1 § 9.2.2);
s15 - s0   is the second Bar Data value (see SMPTE ST 2016-1 § 9.2.2);
P   is the even parity bit for b7 through b0.

Two ANC data words as shown in table 1 are reserved for future use. Bits b7 to b0 of these data words shall be set to logical zero.

NOTE – In ATSC standard A/53, the byte coding the Bar Data flags differs from the byte in Table 1 in that it sets the unused bits to logical one, following MPEG practice.

5 Location of the Vertical Ancillary Data

The AFD/Bar Data packet shall be located in the VANC space of every frame. For interlaced video systems, it shall be located in the first field and in the second field. For progressive segmented frame systems, it shall be located in the first frame segment; and may optionally be located in the second frame segment. In all cases, the AFD/Bar Data packet shall be located on one line in the range from the second line after the line specified for switching, as defined in SMPTE RP 168, to the last line before active video, inclusive.

Multiple AFD and Bar Data packets per interlaced field, per progressive frame, or per frame segment of a segmented frame shall not occur at any point in the video chain.

In order to maximize the time available for processing the active video with which the AFD and Bar Data is associated, it is recommended that the AFD/Bar Data packet should be located early in the VANC period (see Annex B for further guidance).

The AFD/Bar Data packet shall be associated with the video frame that is being described.

When the ANC packets defined in this standard are carried in a high definition signal, they shall be carried in the Y stream.

Receiving equipment shall identify the AFD/Bar Data packets on the basis of their DID and SDID fields. This is fundamental to the SMPTE 291M data concept, and all equipment intended to locate, identify, and/or process AFD/Bar Data packets shall comply with this requirement. The requirement is not intended to apply to equipment simply passing, switching, or recording the video signal, where the expectation is that the AFD/Bar Data packets are left unchanged wherever they are placed in VANC space.

NOTES

1 Nothing in this standard prohibits the carriage of multiple VANC packets containing different categories of data on the same line in the VANC space.

2 For high definition signals, the packet location is constrained to the Y stream in order to ensure passage of this data through deployed devices that do not process VANC data in the C stream.

3 Designers should be aware that although this standard specifies the VANC data space as the location for the transport of information in an SD-SDI interface, there are legacy devices that will not pass this information if it is located on video lines where the V-bit (see SMPTE 125M and ITU-R BT.656) is set to logical one.

4. In certain circumstances the AFD/Bar Data values in the first and second fields of an interlaced video frame may not be identical. See the Notes in § 9.3 of SMPTE ST 2016-1 for more information.

Annex A (Informative)
Bibliography

ITU-R BT.656-4, Interfaces for Digital Component Video Signals in 525-Line and 625-Line Television Systems Operating at the 4:2:2 Level of Recommendation ITU-R BT.601 (Part A)

ANSI/SMPTE 125M-1995, Television – Component Video Signal 4:2:2 – Bit-Parallel Digital Interface

SMPTE 352M-2002, Television – Video Payload Identification for Digital Interfaces

SMPTE RP 291-2009, Assigned Ancillary Identification Codes

Annex B (Informative)
Comments on the Preferred Location of VANC Packets

1. Notwithstanding the possibility that the VANC packets may be placed on any line in the vertical ancillary space, it is desirable to further constrain the location to a preferred line to improve the probability of successful passage through the production process. System designers should be aware that many devices in the studio processing chain will pass data on only a small subset of lines in the vertical ancillary space and some devices (e.g., production switchers, digital video effects units, and video servers) may not pass VANC packets at all. For successful implementation of AFD, system designers need to understand the characteristics of all relevant devices and it is essential that the VANC location chosen for inserting AFD packets takes account of downstream equipment in the video chain.

2. Some recording devices record only one line of data from the vertical ancillary space while others may record up to 11 lines. These recorders may select the lines that they record, or have other constraints. However, it is a common practice to set them to record three consecutive lines starting at the second line after the switching line. This typically constrains the available lines to the second line, the third line, and the fourth line after the switching line.

3. In Section 5 of this standard, it is recommended that the AFD/Bar Data packets be located early in the VANC period. In the case of 1080 interlaced signals, there is an emerging practice to place the AFD/Bar Data packets on line 11 (field 1) and 574 (field 2)[1]. Users may, however, have their own priorities for determining the optimum location of the VANC packet for this and other video formats.[2]

Regardless of the line on which the AFD/Bar Data packet is placed, SMPTE 291M-compliant ANC data receivers will detect the packet by its DID and SDID.

4. AFD/Bar Data packets are preferably embedded in the video signal early in the production process, ideally in the camera or image-generating device. It has been observed that some devices handling video signals do not test for existing ANC packets and consequently overwrite them. If such devices are present downstream of an AFD-originating or processing device, it is possible that ANC data, including AFD/Bar Data, could be deleted.

5. Similar considerations apply for closed captioning and other data services carried in VANC.

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[1] Using these lines, which are line 11 of field 1 and line 11 of field 2, enables the AFD ANC packets on both fields to be preserved when passing through some VTRs and servers.

[2] It is possible, though not recommended, that in certain circumstances AFD packets in two fields of the same interlaced frame could be on line numbers that do not correspond (i.e., they could be on different line numbers relative to the start of the field).

Annex C (Informative)
Road Map to Related Standards for AFD, Bar Data, and Pan-Scan
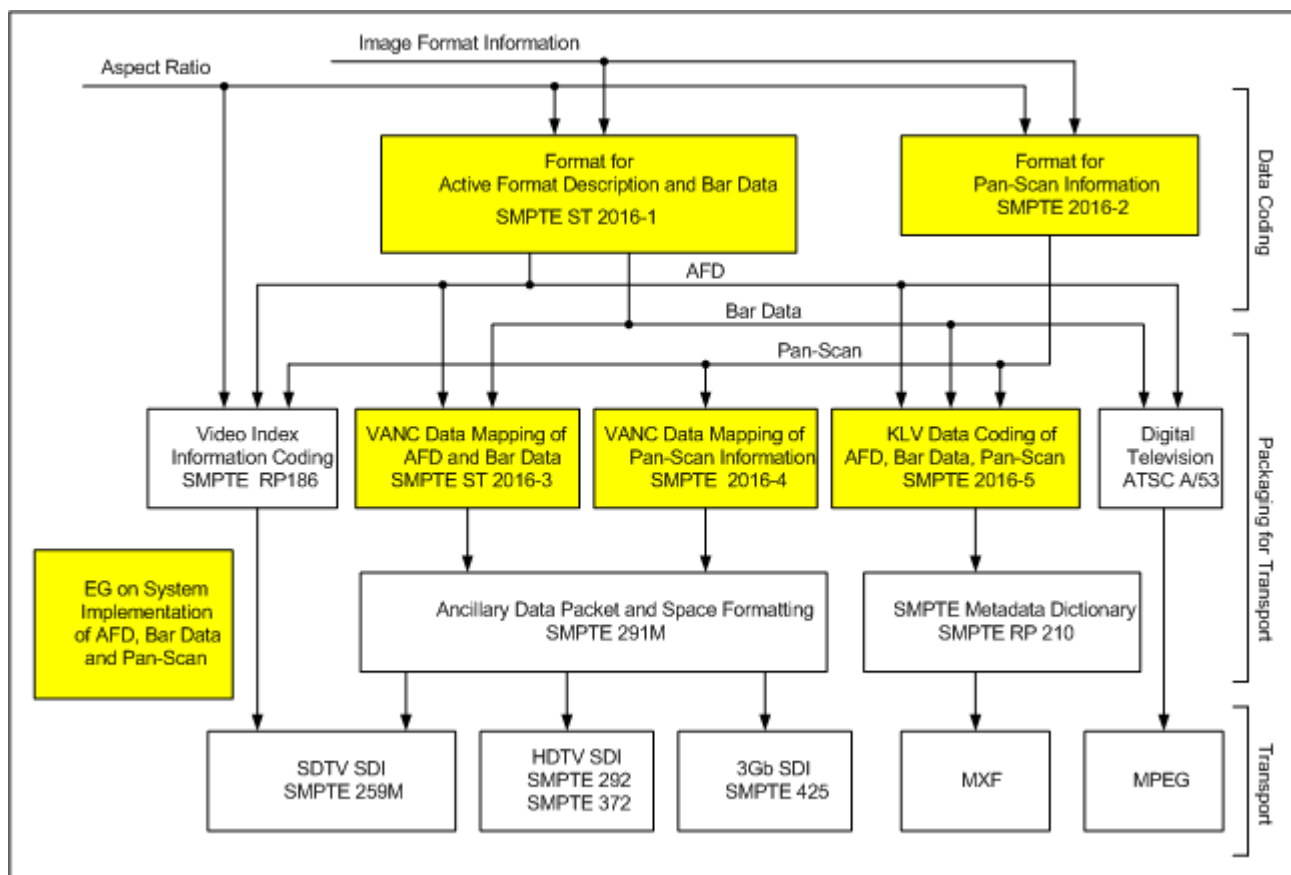

Figure C.1 – Road Map – AFD, Bar Data, and Pan-Scan information

Revision Notes

This revision incorporates Amendment #1 to SMPTE ST 2016-3 approved December 14, 2009.

The changes are summarized below:

1. The Table of Contents and the Foreword section have been revised.

2. An Intellectual Property section has been added to be in conformance with other SMPTE documents.

3. Section 1 (Scope) has been revised

4. Normative References in Section 3 have been updated.

5. Section 5 (Location of the Vertical Ancillary Data) has been revised.

6. Informative References in the Annex A Bibliography have been updated.

7. In Annex C, Figure C.1 (Road Map) has been revised to show updated document reference numbers.