RP 215-2001

SMPTE RECOMMENDED PRACTICE

Encoding Film Transfer Information into Vertical Ancillary Data for SMPTE 292M Bit-Serial Interface

1 Scope

This practice specifies a method of encoding video tape time code, film edge numbers, production time code, and other production data into the vertical ancillary data space of a bit-serial high-definition component television signal conforming with SMPTE 292M. This practice is intended for use in post-production as a means of conveying the essential elements that define the film-to-tape transfer. Normally this information is not intended for inclusion in the released program.

Despite the reference to SMPTE 292M, nothing in this specification precludes its use in a parallel digital interface for component digital HDTV signals.

2 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.

ANSI/SMPTE 270-1994, Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information

ANSI/SMPTE 271-1994, Motion-Picture Film (16-mm) — Manufacturer-Printed Latent Image Identification Information

SMPTE 12M-1999, Television, Audio and Film —Time and Control Code

SMPTE 254-1998, Motion-Picture Film (35-mm) — Manufacturer-Printed Latent Image Identification Information

SMPTE 291M-1998, Television — Ancillary Data Packet and Space Formatting

SMPTE 292M-1998, Television — Bit-Serial Digital Interface for High-Definition Television Systems

SMPTE 309M-1999, Television — Transmission of Date and Time Zone Information in Binary Groups of Time and Control Code

SMPTE 313-1999, Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information — 120 Perforation Repeat

SMPTE RP 135-1999, Use of Binary User Groups in Motion-Picture Time and Control Codes

SMPTE RP 195-1998, Use of the Reference Mark in Manufacturer-Printed Latent Image Key Numbers for Unambiguous Film Frame Identification

SMPTE RP 201-1999, Encoding Film Transfer Information Using Vertical Interval Time Code

ISO/IEC 646:1991, Information Technology — ISO 7-Bit Coded Character Set for Information Exchange

ISO/IEC 2022:1994, Information Technology — Character Code Structure and Extension Techniques

3 Relationship to existing recommended practices

SMPTE RP 201 specifies a method of encoding video and production time code and film edge number information into standard definition video using vertical interval time code. This practice provides the mapping of these data and data required in the high-definition post-production flow into the SMPTE 292M video bitstream using SMPTE 291M ancillary data packets. Encoding in this practice has been designed to have a maximum data rate requirement of 215 bytes per

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field (per frame for progressive video formats) which has been found to be appropriate for all existing equipment.

During the post-production process when high-definition video is down-converted to standard-definition video, it may be necessary to map the data encoded in the HD ancillary data into SMPTE RP 201. Annex A shows how the SMPTE RP 201 data maps into the encoding method specified in this practice.

The data described in this practice may also be transported using the SMPTE K-L-V data encoding protocol. Annex B shows how the encoding method specified in this practice maps into the K-L-V format.

4 Location of vertical ancillary data

The data packets are located in the active line portion of one line in the vertical ancillary space. Data may be located in any lines in the area from the second line after the line specified for switching to the last line before active video, inclusively. On segmented frame progressive formats, the film transfer descriptor data packet shall occur in the vertical blanking area at the start of the frame (see figure 1).

Receiving equipment should identify the film transfer descriptor data on the basis of its ANC DID and SDID fields.

Because ANC data may be located in the lines immediately preceding active video, manufacturers of video compression equipment should ensure that these data bits are not included in video compression calculations.

The chrominance (C_b/C_r) and luminance (Y) data are carried in two separate streams within the SMPTE 292M signal, complete with their own ANC data flags and CRCs. The film transfer data shall be carried in the Y stream. Other ancillary data may be inserted into either one of these streams without restrictions.

5 Format of VANC data packets

Each data packet follows 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.

5.1 ANC packet header format

The ADF has the value 000_h $3FF_h$ $3FF_h$.

The value of DID used for the film transfer data packet defined in this practice is 151_h (51_h plus parity bits per SMPTE 291M). The value of SDID will be set to 101_h (1_h plus parity bits per SMPTE 291M). The specified value of DID (51_h) identifies type 2 ANC packets.

DC is a count of the number of words in the UDW; bits b7-b0 of DC represent the number of words of user data; bits b8 and b9 are parity per SMPTE 291M.

The format of the data in the UDW is defined in 5.2 of this practice.

The format and method of calculating the checksum (CS) are defined in SMPTE 291M.

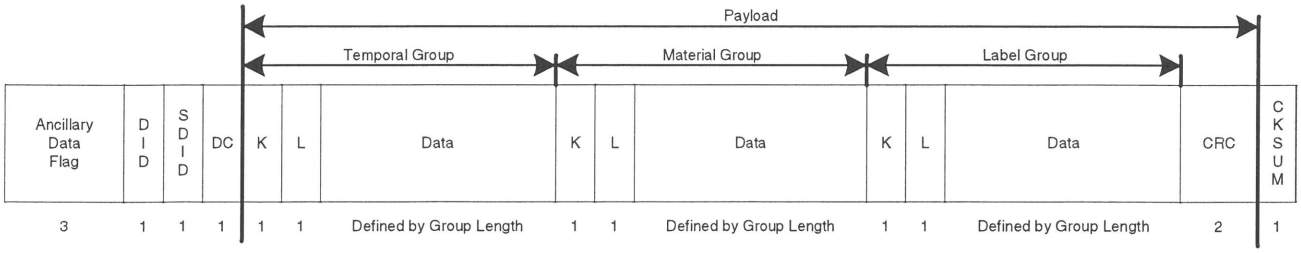

Figure 1 – Structure of the film descriptor ANC packet

5.2 UDW format

All film transfer data information consists of 8-bit data bytes, which are transmitted in bits b7-b0 of the 10-bit data word. Bit b8 is even parity for b7 through b0, and b9 = not b8. In addition to providing a simple error detection capability, this avoids transmitting data that matches one of the code words 0-3 and 1020-1023 that are prohibited by SMPTE 292M. Throughout this practice, the term byte shall refer to 8-bit values unless otherwise stated.

The data payload is inserted into the UDW of the ANC packet as a sequence of 10-bit words. The number of words is indicated in the DC field of the ANC packet header.

5.3 Overview of the film transfer descriptor packet

The payload of the film transfer descriptor packet consists of several groups of individual data items that are defined below. Each group consists of a 1-byte key which identifies the group, a 1-byte length, and one or more data items of a similar type which are placed in a specific sequence within the group. The last 2 bytes of the payload are a 16-bit CRC that serves to identify when bit errors have occurred in the transmission of the packet. Decoders should parse the individual group keys to see if the data are of interest and skip the number of bytes identified by the group length byte + 1 to find the start of the next group (see tables 1-4; table 1 shows the groups with their respective keys and length values).

5.4 CRC error check code

The last two bytes of the payload contain a 16-bit cyclical redundancy checkword. This checkword will catch all single and double errors, all errors with an odd number of bits, all burst errors of length 16 or less, and over 99.9% of 17-bit and longer burst errors. The generating polynomial of the CRC is the industry standard CRC-CCITT polynomial. This polynomial is defined as: $G(x) = X^{16} + X^{12} + X^5 + 1$ with an initial condition of all zeroes.

The generating polynomial shall be applied to all bits in the temporal, material, and label groups. The remainder is then encoded into the CRC group as shown in table 1, most significant bits first. Applying the generating polynomial to the temporal, material, and label groups of the received payload data shall result in a value that matches the CRC group of the received payload when no error exists.

5.5 Data order

Data items that represent numeric data (BCD or hex) are ordered with the most significant byte first. Data items that represent ISO character strings are ordered with the leftmost character first.

Table 1 – Groups in the film transfer descriptor

Group key	Group length	Total size	Name	Description
10_h	44	46	Temporal	Data required to identify individual frames. The data are the minimum required to generate three-line vertical interval time code conforming to SMPTE RP 201 when the video is down-converted to legacy formats; e.g., time code, key number, ink numbers, etc.
20_h	67	69	Material	Data that identify individual shots. The data will generally remain constant throughout a complete shot or take; e.g., scene, take, cam roll, sound roll, etc.
30_h	96	98	Label	Data that identify the video tape. The data will generally remain constant throughout a complete video tape; e.g., VT roll, production name, episode, etc.
	2	2	CRC	CRC-CCITT error detection code.
Payload byte count		215		

Table 2 – Temporal group data items

Data item number	Length	Name	Description
1	4	Video TC	Video time address (BCD)
2	4	Video BG	Video binary groups (hex)
3	4	Audio TC	Audio time address (BCD)
4	4	Audio BG	Audio binary groups (hex)
5	1	Audio phase	Audio to video bit phase
6	1	KK MFG	Film manufacturer letter (ISO)
7	1	KK emulsion	Film emulsion letter (ISO)
8	8	KK	Key number (BCD)
9	4	Ink prefix	Ink number prefix (ISO)
10	3	Ink	Ink feet + frames (BCD)
11	1	Pulldown	Film pulldown
12	1	Sequence	Film sequence
13	4	ABS frames	Absolute film frames
14	1	Video format	Video format ID
15	1	Audio modulus	Audio frame modulus
16	1	Film format	Film format ID
17	1	Film rate	Film transfer rate
Temporal group length	44		

Table 3 – Material group data items

Data item number	Length	Name	Description
18	4	Tags	Database index tag
19	3	Flags	RP 135 film TC flags (bitmapped)
20	4	Equip ID	RP 135 film TC equipment ID (ISO)
21	4	Prod date	Date of production
22	8	Daily roll	Daily roll (ISO)
23	8	Cam roll	Camera roll (ISO)
24	8	Sound roll	Sound roll (ISO)
25	8	Lab roll	Lab roll (ISO)
26	8	Scene	Scene number (ISO)
27	4	Take	Take number (ISO)
28	8	Slate	Slate number (ISO)
Material group length	67		

Table 4 – Label group data items

Data item number	Length	Name	Description
28	8	VT roll	Video tape roll (ISO)
29	20	Title	Show title (ISO)
30	8	Episode	Episode number (ISO)
31	20	Facility	Facility name (ISO)
32	40	Misc	Miscellaneous data
Label group length	96		

6 Data item descriptions

6.1 Temporal group items

6.1.1 Time code data items

The video and audio time code data items each consist of 4 bytes of packed BCD data in the following format:

10 Hr	1 Hr	10 Min	1 Min	. . .

. . .	10 Sec	1 Sec	10 Fr	1 Fr

Time code flag bits shall be encoded in the bit positions shown in table 5.

Table 5 – Time code flag positions

SMPTE 12M flag bit name	Encoding location
Drop frame flag	Bit 6 of frames byte
Color frame flag	Bit 7 of frames byte
Field flag	Bit 7 of seconds byte
BGF0	Bit 7 of minutes byte
BGF1	Bit 6 of hours byte
BGF2	Bit 7 of hours byte

The field flag shall be set in accord with table 6.

Table 6 – Field flag

Video format	Field flag encoding
Interlaced	Each time code word refers to two fields. The field flag is set to 0 for the first field and set to 1 for the second field.
Segmented progressive	Each time code word refers to one frame. The field flag is set to 0.
Progressive (24, 25, 30 f/s)	Each time code word refers to one frame. The field flag is set to 0.
Progressive (60 f/s)	Each time code word refers to two distinct frames. The field flag is set to 0 for the first of these frames and set to 1 for the second of these frames.

6.1.2 Binary group data item

The video and audio binary group data items each consist of 4 bytes of packed hexadecimal data in the format:

BG8	BG7	BG6	BG5	. . .

. . .	BG4	BG3	BG2	BG1

6.1.3 Film manufacturer, film emulsion and key number data items

The film manufacturer data item carries the ISO character code for the manufacturer letter of the human readable part of the edge number.

The film emulsion data item carries the ISO character code for the emulsion letter of the human readable part of the edge number.

The key number data item consists of 8 bytes of packed BCD data in the following format:

10 Mfg	1 Mfg	10 Film	1 Film	. . .

. . .	Prefix 1	Prefix 2	Prefix 3	Prefix 4	. . .

. . .	Prefix 5	Prefix 6	1000 Feet	100 Feet	. . .

. . .	10 Feet	1 Foot	10 Frame	1 Frame

The manufacturer byte is a packed BCD digit pair containing the manufacturer type corresponding to the encoded value as recovered from the machine readable bar code.

The film byte is a packed BCD digit pair containing the film emulsion type corresponding to the encoded value as recovered from the machine readable bar code.

The prefix consists of six BCD digits containing the film prefix.

The feet consist of four BCD digits containing the film feet.

The frame consists of two BCD digits containing the film frame offset.

6.1.4 Ink prefix and ink number data items

The ink prefix data item contains four ISO character bytes corresponding to the three digits and one letter of the ink number prefix. If there is no letter part to the ink number prefix, the ISO character value for a space (20_h) is encoded into the fourth byte.

The ink number data item consists of 3 bytes of packed BCD data in the following format:

1000 Feet	100 Feet	10 Feet	1 Foot	10 Frame	1 Frame

The feet consist of four BCD digits containing the footage part of the ink number.

The frame consists of two BCD digits containing the frame part of the ink number.

6.1.5 Audio time code phase data item

The audio time code phase data item contains a 1-byte signed binary encoded number. This byte contains the bit number of the audio LTC at the beginning of the video frame. If the audio frame identified in the audio TC data item begins before the beginning of the video frame, then the phase number encoded will be the actual bit number of the audio LTC that is coincident with the beginning of the video frame (a positive number). If the audio frame identified in the audio TC data item begins after the beginning of the video frame, then the phase number encoded will be encoded as a negative number and will be the number of bits from the beginning of the video frame to the beginning of the audio LTC bit 0. Valid values for the audio phase data item are –79 and +79. (Annex D shows examples of how to encode the audio phase information.)

6.1.6 Pulldown data item

The film sequence data item contains a 1-byte binary encoded pulldown number. The lower 7 bits indicate where the film frame is in a multiframe pulldown sequence. The upper bit is a mixed image flag. For interlaced video formats, the most significant bit indicates that the video frame has the same film image in both fields when it is set to zero, and that the video frame has different film images in each field when it is set to one. For progressive video formats, the most significant bit of the pulldown shall always be set to zero. (Annex C shows examples of how to encode the pulldown information for different video formats and film transfer rates.)

6.1.7 Film sequence data item

The film sequence data item contains a 1-byte binary encoded film sequence number. For interlaced video formats, the film sequence number indicates how many video fields have contained this film image. The film sequence will return to 1 on the first field of each new film image. For progressive video formats, the film sequence number indicates how many video frames have contained this film image. The film sequence will return to 1 on the first frame of each new film image. (Annex C shows examples of how to encode the pulldown information for different video formats and film transfer rates.)

6.1.8 Film frames data item

The film frames data item contains a signed 4-byte binary film frame number. This number is a count of the film frames before or after a specific reference frame (e.g., a punch frame).

ABS Frames (MS byte)	ABS Frames	ABS Frames	ABS Frames (LS byte)

6.1.9 Video format data item

This data item contains 1 byte consisting of a bit-mapped video format identifier indicating the original transfer video format. Bit 0 is set to 0 when the video frame rate is an integer, and is set to 1 when the frame rate is reduced by a factor of 1/1.001. Bits 1 to 3 encode the video frame rate. Bits 4 and 5 are reserved at this time and shall be set to 0. Bits 6 and 7 are used to encode whether the video format is interlaced, segmented progressive, or true progressive. Table 7 shows the encoding of bits 0 to 3. The frame rate of the video implies the frame modulus of the video time code to the nearest integer, but not necessarily whether it is drop frame or not. The drop frame information is carried in the flag bits of the time code data item. Table 8 shows the encoding of bits 6 and 7.

Table 7 – Video frame rate encoding (bits 0 to 3)

Video frame rate				1/1.001	Time code frame modulus
	Bit 3	Bit 2	Bit 1	Bit 0	
24	0	0	1	0	24
23.98	0	0	1	1	24
25	0	1	0	0	25
30	0	1	1	0	30
29.97	0	1	1	1	30
60	1	0	0	0	30
59.94	1	0	0	1	30

Table 8 – Progressive / interlaced encoding (bits 6 and 7)

	Bit 7	Bit 6
Reserved	0	0
Interlaced	0	1
Progressive	1	0
Segmented progressive	1	1

6.1.10 Audio frame modulus data item

This data item contains a 1-byte binary encoded audio time code frame modulus. Table 9 shows the common audio frame rates with their associated identifiers. The audio frame modulus identifier values are shown in hexadecimal notation.

Table 9 – Audio frame modulus identifiers

Frame modulus	Frame modulus ID
30	1_h
25	3_h
24	4_h

6.1.11 Film format data item

The film format data item contains 1 byte consisting of a counting direction flag in the most significant bit and a 7-bit binary encoded film format identifier in the remaining bits. When the count direction bit is set to one, it implies that the feet and frame numbers are decrementing when the film is traveling in a forward direction. The film format identifier implies a particular film type with its corresponding key number and ink number repetition rate, and a particular frame repetition rate. Table 10 shows the common film formats, their associated feet frame counts, and the film format ID codes. The film format identifier values are shown in hexadecimal notation.

6.1.12 Film rate data item

This data item contains a 1-byte binary encoded film transfer rate identifier. The upper bit shall be set to 1 when the frame rate is other than one of the standard transfer rates. When the upper bit is set to 0, the lower 7 bits determine one of the standard film transfer rates as shown in table 11. When the upper bit is set to one, the lower 7 bits are used to binary encode the film transfer rate to the closest integer value. When the film transfer rate in unknown, the value 80_h shall be encoded into the film rate data item.

6.2 Material group items

6.2.1 Database tag data item

The database index tag data item consists of 4 bytes of packed hexadecimal data in the format.

TAG8	TAG7	TAG6	TAG5	. . .

. . .	TAG4	TAG3	TAG2	TAG1

This data item will serve as an index into computer databases that may contain additional data about the transfer. Tag8 is the most significant digit of the tag number.

Table 10 – Film format identifiers (frames per foot for different film formats)

Film format	Key number repetition rate (perf / key)	Frame repetition rate (perf / frame)	Feet frame count (frame / key)	Ink number frame modulus (frame / ink #)	Film format code (7 LS bits)
16 mm	20	1	20	40	1_h
	40	1	40	40	2_h
35 mm 3 perf	64	3	21 (perf 1)	21 (perf 1)	11_h
			21 (perf 2)	21 (perf 2)	12_h
			22 (perf 3)	22 (perf 3)	13_h
35 mm 4 perf	64	4	16	16	14_h
35 mm 8 perf	64	8	8	8	15_h
65 mm	80	5	16	16	21_h
		8	10	10	22_h
		10	8	8	23_h
65 mm	120	5	24	24	31_h
		8	15	15	32_h
		10	12	12	33_h
		15	8	8	34_h

Table 11 – Film transfer rate identifiers

Frame rate	Bit 7	Film rate ID Bits 0 to 6
30	0	1_h
29.97	0	2_h
25	0	3_h
24	0	4_h
23.98	0	5_h
60	0	6_h
59.95	0	7_h
Unknown	1	0
Varispeed	1	Closest integer frame rate (binary encoded)

6.2.2 Production roll number data items

The daily roll, camera roll, sound roll, and lab roll data items each contain 8 bytes containing the ISO character values for the respective alphanumeric roll numbers. Roll numbers are encoded left justified within the data item. For roll numbers less than the data item length, the remaining bytes will be encoded with the ISO character value for a null (00_h).

6.2.3 Scene, take and slate data items

The scene data item contains 8 bytes containing the ISO character values for the alphanumeric scene number. The take data item contains 4 bytes containing the ISO character values for the alphanumeric take number. The slate data item contains 8 bytes containing the ISO character values for the alphanumeric slate number. Scene, take, and slate numbers are encoded left justified within the data item. For numbers less than the maximum data item length, the remaining bytes will be encoded with the ISO character value for a null (00_h).

6.2.4 Production date data item

The production date data item consists of 4 bytes and is encoded in accordance with SMPTE 309M. The format may be either 4 bytes of packed BCD data or modified Julian dates as specified in SMPTE 309M. The date 4 byte corresponds to the byte defined in SMPTE 309M consisting of BG8 and BG7. The most significant bit of the date 4 byte indicates the formatting of the remainder of the bytes.

Date 4	Date 3	Date 2	Date 1

The production date usually consists of the date that the original material was exposed onto the film. This value may be read directly from film time code binary groups that have been encoded according to SMPTE RP 135, or may be entered into the encoder by the user.

6.3 Label group items

6.3.1 Video tape roll number data item

The VT roll data item contains 8 bytes containing the ISO character values for the alphanumeric video tape roll number. The roll number is encoded left justified within the data item. For roll numbers less than the data item length, the remaining bytes will be encoded with the ISO character value for a null (00_h).

6.3.2 Other label data items

The title, episode, facility, and miscellaneous data items each contain the number of bytes shown in table 4 and contain ISO character values. These data items are encoded left justified within each data item. For items less than the data item length, the remaining bytes will be encoded with the ISO character value for a null (00_h).

Annex A (informative)
Mapping into SMPTE RP 201 data constructs

During the post-production process when high-definition video is down-converted to standard-definition video, it may be necessary to map the data encoded in the HD V-ANC data into SMPTE RP 201 format data (see table A.1).

Table A.1 – Mapping of V-ANC packet data into SMPTE RP 201 data structure

Description	V-ANC data item	SMPTE RP 201 data item
Video time address	1	Video tape data block time bits
Video binary groups	2	Video tape data block user bits
Audio time address	3	Production data block time bits
Audio binary groups	4	Production data block user bits
KK	8	Film data block with manufacturer ID nonzero (manufacturer ID, emulsion, prefix, feet, and offset bytes)
Ink numbers	9 and 10	Film data block with manufacturer ID equal zero (manufacturer ID, emulsion, prefix, feet, and offset bytes)
Pulldown	11	Film data block pulldown bits
Film format	16	Film data block manufacturer ID (not all formats are supported)
Film rate	17	Implied from sequence of pulldown bits over multiple fields

Annex B (informative)
Mapping film transfer metadata from the HD V-ANC packet to the K-L-V data encoding protocol for data sets

Although the film ancillary data described in this practice are encoded in type 2 ancillary data packets as defined by SMPTE 291M, they can also be mapped into a key-length-value construct as defined by SMPTE 336M. The packet starts with a start code, the ADF word sequence that is unique in the digital video interface. This is followed by DID and SDID words which define the data type, a data count, and the data (the HD film transfer metadata has three variable-length data packs — using the term packs as defined in the K-L-V data encoding protocol document). The packet is completed with a checksum to detect possible errors. If the ADF and CS words are removed, then the data structure is a key-length-value. Thus the value of the V-ANC packet can be mapped into the K-L-V protocol of a metadata set (see figure B.1 and table B.1). The recommended values for the SMPTE metadata set universal label (UL) are shown in table B.2.

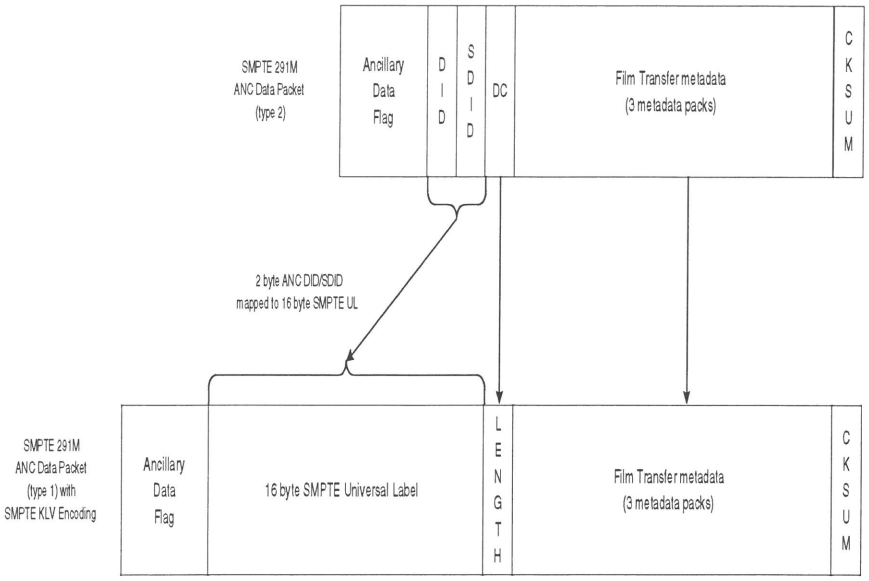

Figure B.1 – Mapping the VANC packet into the K-L-V metadata set

Table B.1 – Mapping of VANC packet data into the K-L-V data set construct

Data structure	V-ANC packet	K-L-V protocol
Key:	DID + SDID	16-byte universal label
Length:	DC	Variable length
Value:	Film transfer metadata	Film transfer metadata

Table B.2 – Recommended value for SMPTE metadata set universal label

Byte No.	Description	Value (hex)
1	Object identifier	06_h
2	Label size	$0E_h$
3	Designation: ISO	$2B_h$
4	Designation: SMPTE	34_h
5	Registry: Sets and packs	02_h
6	Registry: Local sets	03_h
7	Standard: Default tag and length usage	01_h
8	Version number	01_h
9	Metadata sets	01_h
10	Film industry class 1	01_h
11	Telecine transfer packed metadata	01_h
12	Standard	01_h
13	Version number	01_h
14	Zero fill	00_h
15	Zero fill	00_h
16	Zero fill	00_h
NOTE – The above 16-byte universal label value is shown for guidance only.		

Annex C (informative)
Pulldown sequence encoding examples

Tables C.1, C.2, and C.3 show examples of how the pull-down and sequence data will be encoded for common film transfer rates to common video formats.

Table C.1 – 23.98 f/s pulldown flags — 1080i/59.94 systems

Film frame	Pulldown data item		Sequence	Video frame example
	Bit 7	Bits 6-0		
A	0	1_h	1_h	0:00
	0	1_h	2h	
B	0	2_h	1h	0:01
	0	2_h	2h	
	1	2_h	3h	0:02
C	1	3_h	1h	
	1	3_h	2h	0:03
D	1	4_h	1h	
	0	4_h	2h	0:04
	0	4_h	3h	
A	0	1_h	1h	0:05
	0	1_h	2h	

Table C.2 – 23.98 f/s — 1080p/23.98 systems

Film frame	Pulldown data item		Sequence	Video frame example
	Bit 7	Bits 6-0		
A	0	1_h	1_h	0:00
	0	1_h	1h	
A	0	1_h	1h	0:01
	0	1_h	1h	

Table C.3 – 29.97 f/s — 1080i/59.94 systems

Film frame	Pulldown data item		Sequence	Video frame example
	Bit 7	Bits 6-0		
A	0	1_h	1_h	0:00
	0	1_h	2h	
A	0	1_h	1h	0:01
	0	1_h	2h	

Annex D (informative)
Examples of audio time code encoding when the frame rate of the video time code is slower

When the video frame rate is slower than the audio frame rate, each video frame corresponds to parts of two different audio frames. The ANC packet in each video frame contains only one of these audio time code numbers. When the audio time code referenced in the ANC packet starts before the beginning of the video frame, the bit number of this audio time code that coincides with the beginning of the frame is encoded into the audio phase data item. When the audio time code starts after the beginning of the video frame, the number of (audio LTC) bits from the beginning of the video frame to the start of the audio LTC word is encoded as a negative number. Figure D.1 shows an example of video and audio time codes and the bit numbers of the audio time code at the start of each video frame. Table D.1shows two different ways that the audio time code numbers and audio phase can be encoded in the ANC packets in each of the video frames. Both methods of encoding are equivalent and will produce the same results at the decoding end.

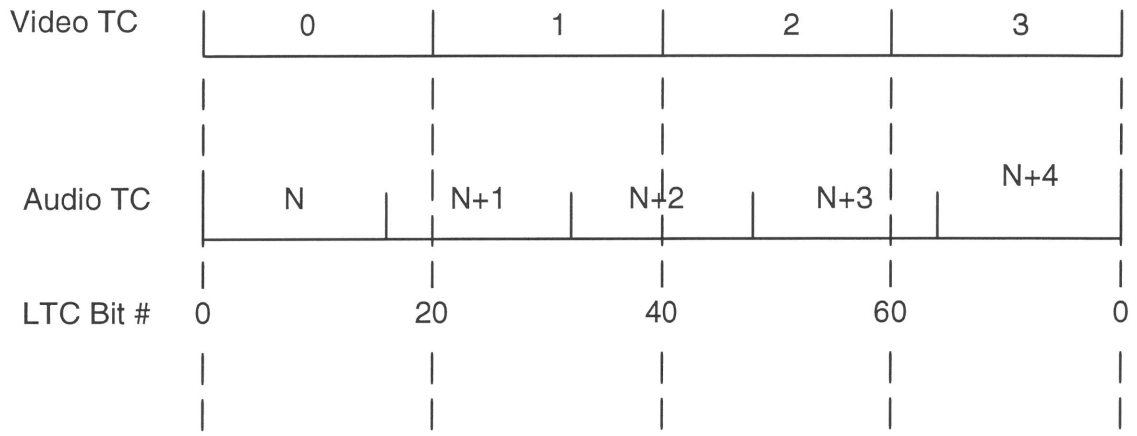

Figure D.1 – Video and audio time codes at the start of each video frame

Table D.1 – Encoding of audio time code numbers and audio phase

Method 1:

Video TC	00	01	02	03
Audio TC	N	N+1	N+2	N+3
Audio phase	0	20	40	60

Method 2:

Video TC	00	01	02	03
Audio TC	N	N+1	N+3	N+4
Audio phase	0	20	–40	–20

Annex E (informative)
Definitions and glossary

E.1 Terms defined by SMPTE 254M, ANSI/SMPTE 270M, ANSI/SMPTE 271M and SMPTE 313M

E.1.1 key number: A number, sometimes referred to as an edge number or footage number, that is printed with ink or exposed onto the film at the time of manufacture. The numbers are placed at regular intervals, typically one foot. Film that conforms to SMPTE 254M, ANSI/SMPTE 271M, ANSI/SMPTE 270M, or SMPTE 313M use a 12-character alphanumeric key number. For the purposes of this practice, references to key number will refer to the machine-readable key number unless otherwise stated.

E.1.2 key number repetition rate: The interval at which key numbers repeat on the film stock, measured in perforations.

E.2 Terms defined by SMPTE RP 195

E.2.1 frame repetition rate: The interval at which exposed film images occur along the film, measured in perforations.

E.3 Terms defined by SMPTE RP 201

E.3.1 film feet: The least significant four digits of the key number. This number increments every *n* frames where *n* is calculated by dividing the key number repetition rate by the frame repetition rate.

E.3.2 film prefix: The part of the key number that is not contained in the film feet. This number is used to identify the stock or batch of film. Normally this number does not increment during a single roll of film.

E.3.3 film frame offset: This is the frame offset away from the key number. It is not included as part of the key number. SMPTE RP 195 specifies the procedure for unambiguously identifying the film frame numbers from exposed latent-image key numbers.

E.3.4 feet frame count: This is the number of film frames in the current film foot. For film formats where the key number repetition rate is not evenly divisible by the frame repetition rate, the feet frame count identifies which foot has an extra frame.

Annex F (informative)
Bibliography

SMPTE 336M-2001, Television — Data Encoding Protocol using Key-Length-Value