SMPTE REGISTERED DISCLOSURE DOCUMENT

RDD 8-2008
Revision of
RDD 8-2006

Storage and Distribution of Teletext Subtitles and VBI Data for High-Definition Television

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Proponent contact information:

Mr Roger Bunch
Director of Engineering
Free TV Australia
44 Avenue Road
Mosman, N.S.W. 2088
Australia

Email: rbunch@freetv.com.au

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MOTION PICTURE AND TELEVISION ENGINEERS
3 Barker Avenue, White Plains, NY 10601
(914) 761-1100

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1 Scope

Free TV Operational Practice OP-47 describes the technical/operational practices associated with the storage and distribution of closed caption/subtitling data in the vertical ancillary space of the 10-bit serial HD-SDI signal complying with ITU-R BT.1120-7.

NOTE – This document does not deal with the technical specifications of the actual closed captions/subtitles. It is intended to ensure that closed captioned/subtitled high-definition program material, in accordance with the appropriate Australian and international standards, will be successfully delivered to end users via the broadcasters' storage and distribution processes.

Additional to storage and distribution of subtitles, this operational practice describes the use of other ancillary data such as wide screen signaling (WSS) information via a multi-packet solution.

2 Background

The legislated requirements of digital broadcasting in Australia have prompted an increase in the number of captioned programs. Legacy closed caption data is currently distributed as World System Teletext (WST) subtitles in the vertical interval lines 21/334 of the SD (standard definition) bit serial video stream. The technical standard for closed caption/subtitling teletext data is ITU-R BT. 653-3 System B (refer to Section 8 – Referenced Standards).

In addition, where teletext based subtitles are required to be encoded for DTTB transmissions, this operational practice references ETSI EN 300 472, Specification for Conveying ITU-R System B Teletext in DVB Bitstreams.

As TV networks' distribution and recording/storage systems migrate to digital technology, appropriate technical and operational practices are required to ensure that program material which is produced in accordance with the internationally recognized standards is delivered successfully to the viewing audience via the broadcaster's analog and digital transmissions.

This operational practice is consistent with SMPTE 334M. In particular, SMPTE 344M provides that the VANC data shall be carried in the Y stream.

3 Definition of Terms

The following definitions are consistent with SMPTE 291M.

3.1 Ancillary Data Flag (ADF): An ancillary data flag (ADF) marks the beginning of the ancillary packet.

3.2 Data ID (DID): A data identification word (DID) which defines the use of the user data format carried in the ancillary packet's user data words.

3.3 Secondary Data ID (SDID): Type 2 data identification uses a two-word data identification; defined as a combination of data ID (DID) and secondary data ID (SDID). A secondary data identification word (SDID) is part of the type 2 data identification format.

3.4 Data count (DC): A data count number word (DC) which defines the quantity of user data words in the ancillary packet.

3.5 User Data Words (UDW) : The user data words (UDW) of up to 255 words in each ancillary packet where the user data format is defined in a specific application document.

3.6 Checksum (CS): The checksum word (CS) is used to determine the validity of the ancillary data packet from the data identification (DID) word through the user data words (UDW).

4 Vertical Ancillary Data Packet

4.1 Type 2 Ancillary Data Packet Format

The VANC data packets which carry the WST (teletext) subtitles in the HD-SDI bit stream are located in the active line portion of one or more lines 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.

Each data packet follows the format defined in SMPTE 291M or ITU-R BT.1364 for a Type 2 ANC data 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 Type 2 Ancillary Data Packet is diagrammatically represented in figure 1.

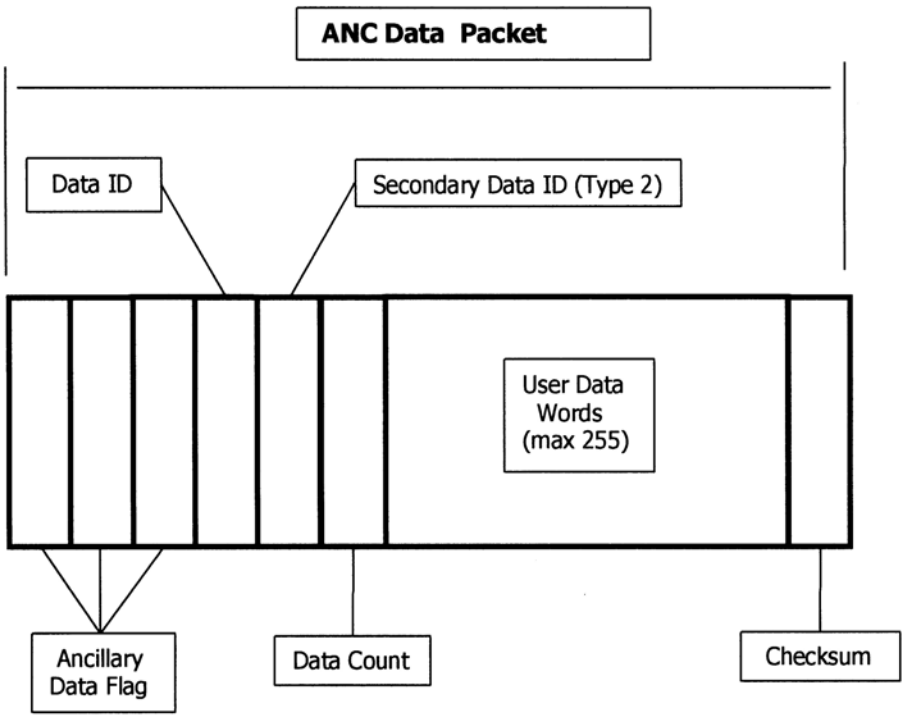

Figure 1 – Type 2 Ancillary Data Packet

4.2 Technical Characteristics of the Type 2 Ancillary Data Packet Format

The technical characteristics of the Type 2 Ancillary Data Packet format are as follows:

(i) The ADF has the value 000h 3FFh 3FFh.

(ii) The VANC WST packet shall be known as the Subtitling Distribution Packet (SDP) with DID and SDID values 143h and 102h, respectively (includes parity). These are also the DID and SDID values when the SDP is transported as an "inner" packet of the Multipacket described in clause 6.

(iii) The VANC Multipacket is for the carriage of a combination of subtitling packets and other ancillary data, such as WSS data packets, and shall have DID and SDID values 143h and 203h, respectively (includes parity).

(iv) WSS data packets shall have DID and SDID values 250h and 101h, respectively, and can be transported as an "inner" packet within a VANC multipacket.

(v) The UDW data words consist 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. The data payload for each service is inserted into the UDW of the ANC packet as 10-bit words. The number of words is indicated in the DC field of the ANC packet header.

(vi) The UDW component of the packets must not exceed 255 words in length (refer to clause 3.11.2 of SMPTE 291M).

(vii) Other VANC ancillary data packets may be required and, therefore, this document may need to define additional SDID and DID values in the future.

5 Subtitling Distribution Packet (SDP) Format

The Subtitling Distribution Packet (SDP), as described in figure 2, consists of a standard ANC header and a UDW payload capable of carrying five (5) packets of the equivalent "vertical interval lines" of WST (teletext) subtitling in the following structure whose UDW size cannot exceed 255 words.

5.1 Syntax of the Subtitling Distribution Packet

The syntax of the subtitling distribution packet is defined as follows:

Header:

ADF (3 words)
DID (143h)
SDID (102h)
DC = (1 word) variable value (as per SMPTE 291M or ITU-R BT.1364)

UDW:

IDENTIFIER (151h)
IDENTIFIER (115h)
LENGTH (total number of words, from the first IDENTIFIER through to SDP CHECKSUM, inclusive.)
FORMAT CODE = 102h, identifying this as WST teletext subtitles
DATA ADAPTION HEADER – fixed length 5 words
VBI Packet 1 Descriptor word Field/Line
Packet Descriptor Structure A (as defined following)
VBI Packet 2 Descriptor word Field/Line
Packet Descriptor Structure A (as defined following)

VBI Packet 3 Descriptor word Field/Line
Packet Descriptor Structure A (as defined following)
VBI Packet 4 Descriptor word Field/Line
Packet Descriptor Structure A (as defined following)
VBI Packet 5 Descriptor word Field/Line
Packet Descriptor Structure A (as defined following)

if (VBI Packet 1 Descriptor ! = 0) {
Packet Descriptor Structure B (as defined following)
}
if (VBI Packet 2 descriptor ! = 0) {
Packet Descriptor Structure B (as defined following)
}
if (VBI Packet 3 descriptor ! = 0) {
Packet Descriptor Structure B (as defined following)
}
if (VBI Packet 4 descriptor ! = 0) {
Packet Descriptor Structure B (as defined following)
}
if (VBI Packet 5 descriptor ! = 0) {
Packet Descriptor Structure B (as defined following)
}

NOTE – Structure B emulates ITU-R System B Teletext VBI line

FOOTER ID (274h)
FOOTER SEQUENCE COUNTER (2 words) (see explanation following)
SDP CHECKSUM (see explanation following)
CS (as per SMPTE 291M)

5.2 Footer Sequence Counter

The Footer Sequence Counter (FSC) is a 16-bit unsigned integer which is set to the value of 1 plus the value of the Footer Sequence Counter in the previous SDP, with the value of the counter wrapping from 65535 to 0. The first word transmitted contains the 8 most significant bits of the 16-bit value and the second word transmitted contains the 8 least significant bits. Bits 8 and 9 of each word contain the parity bits calculated in the same manner as the UDW data words.

5.3 Subtitling Distribution Packet CheckSum

The SDP CheckSum is the 8-bit value required to make the arithmetic sum of the entire received packet (from the first byte of the identifier up to the SDP CheckSum, inclusive) modulo 256, equal to zero. After the 8-bit value is calculated, parity bits 8 and 9 should be calculated in the same manner as other UDW data words.

5.4 Packet Descriptor Structure A

The SDP has five (5) Packet Descriptor A words.

5.4.1 Syntax of the Packet Descriptor Structure A

The syntax of Packet Descriptor Structure A is defined as follows:

```
Packet Descriptor Structure A {
        bits b0 to b4 are line no (range 0 and 6 to 22 for SD video VBI line)
        bits b5 and b6 reserved (set to 0 if no VBI line in this position)
        bit b7 is field no (0 = even field, 1 = odd field)
        bits b8 and b9 are even and odd parity as per UDW data format section 4.2
}
```

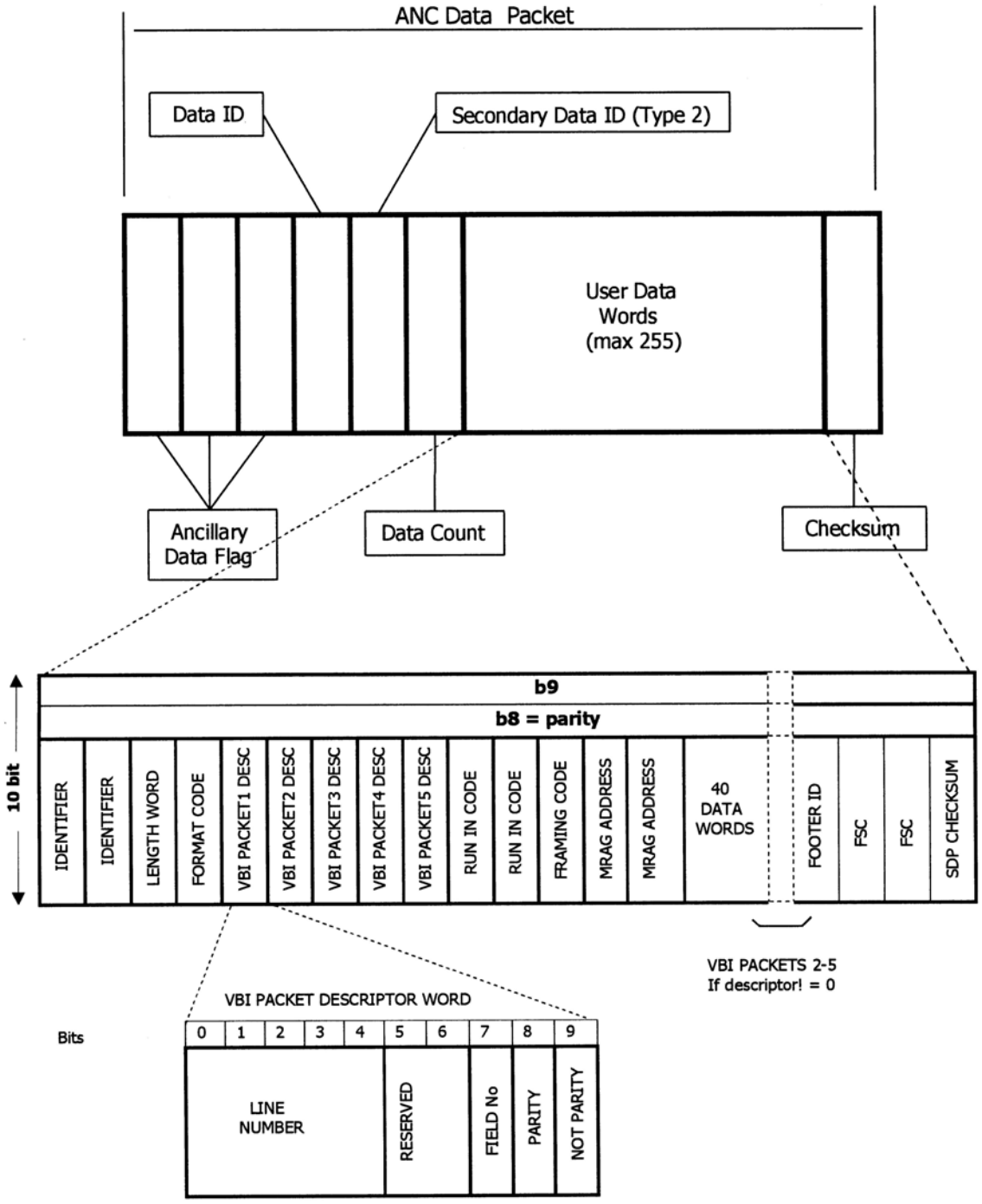

Figure 2 – Subtitling Distribution Packet

5.4.2 Semantics of the Packet Descriptor Structure A

The semantics of Packet Descriptor Structure A is as follows:

When bits b0 to b7 of any VBI Packet *n* descriptor are all set to 0, this indicates that there is no packet data present for that position.

The values of bits b5 and b6 of the packet descriptor are reserved and shall be set to zero if there is no corresponding packet.

Packets sent in this way are transmitted in exact sequence; thus, if a field number encountered is different from the previous field number, then the device will "wait" for the correct field to insert the data. If a further field change is encountered, the device must "wait" for the next field rather than insert the data into a previous field. Line numbers should increase within field; a device may ignore lines out of order. It is possible to transmit illegal line number values and decode devices may choose to ignore these lines; however, the associated Structure B space allocation must be transmitted if this Structure A word is transmitted.

If VBI Packet descriptor *n* is not present, then all following VBI Packet descriptors shall be set to 0.

5.5 Packet Descriptor Structure B

The five Packet Descriptor Structure A words are then followed by five Packet Descriptor Structure B units.

5.5.1 Packet Descriptor Structure B

The Packet Descriptor Structure B units contain the standard WST (System B teletext) 45 byte packet.

5.5.2 Syntax of the Packet Descriptor Structure B

The syntax is defined as follows:

Packet Descriptor Structure B {

run-in code two words containing (255h) each
framing code (227h)
MRAG two words as required including hamming protection + bits b8 and b9 parity (refer to ITU-R BT 653-3)
subtitling data [40 words] including parity (refer ITU-R BT.653-3)
}

6 Vertical Ancillary Multipacket Format

The VANC Multipacket is a Type 2 ancillary data packet as defined in SMPTE 291M or ITU-R BT.1364 and has DID and SDID values of 143h and 203h, respectively. Only one UDW data payload block should be used to emulate the "single packet" requirement limitation of some storage devices.

The UDW payload of this Multipacket consists of one (1) priority word, followed by one or more separate inner packets having a defined Type 2 DID/SDID definition pair and cannot exceed 255 words.

6.1 Syntax of the VANC Multipacket

The syntax of the VANC Multipacket is defined as follows:

Header:

ADF (3 words)
DID (143h)
SDID (203h)
DC = (1 word) variable value (as per SMPTE 291M or ITU-R BT.1364)

UDW:

PRIORITY (1 word). The number of the packet that has priority, for future use)
for (i=0;i<N; i++) {
LINE/FIELD (1 word) (VANC field and line no. see below)
NDID (xxxh)
NSDID (yyyh)
NDC (1 word) value variable (per SMPTE 291M or ITU-R BT.1364)
NUDW
Variable as per UDW data payload words above
}
CS (as per SMPTE 291M)

6.2 Semantics of the VANC Multipacket

The semantics of the VANC Multipacket is defined as follows:

The LINE/FIELD word consists of {
bits b0 to b4 (b0 LSB) representing VANC line no.
bit b5 is field no. (o = even field, 1 = odd field)
bits b6 and b7 unused and set to zero
bits b8 and b9 are even and odd parity as per UDW data format section 4.2
}

The values xxxh and yyyh above will be 143h and 102h respectively for WST SDP packet and 250h and 101h for WSS packet.

The total number of words in the multipacket structure, from the PRIORITY word to the NCS word of the last inner packet, inclusive, must not exceed 255.

If the multipacket contains such inner packets which contain data that is required to maintain relative frame sync it would be desirable to insert the multipacket on field 1 in the case where a storage device may delay the video one field.

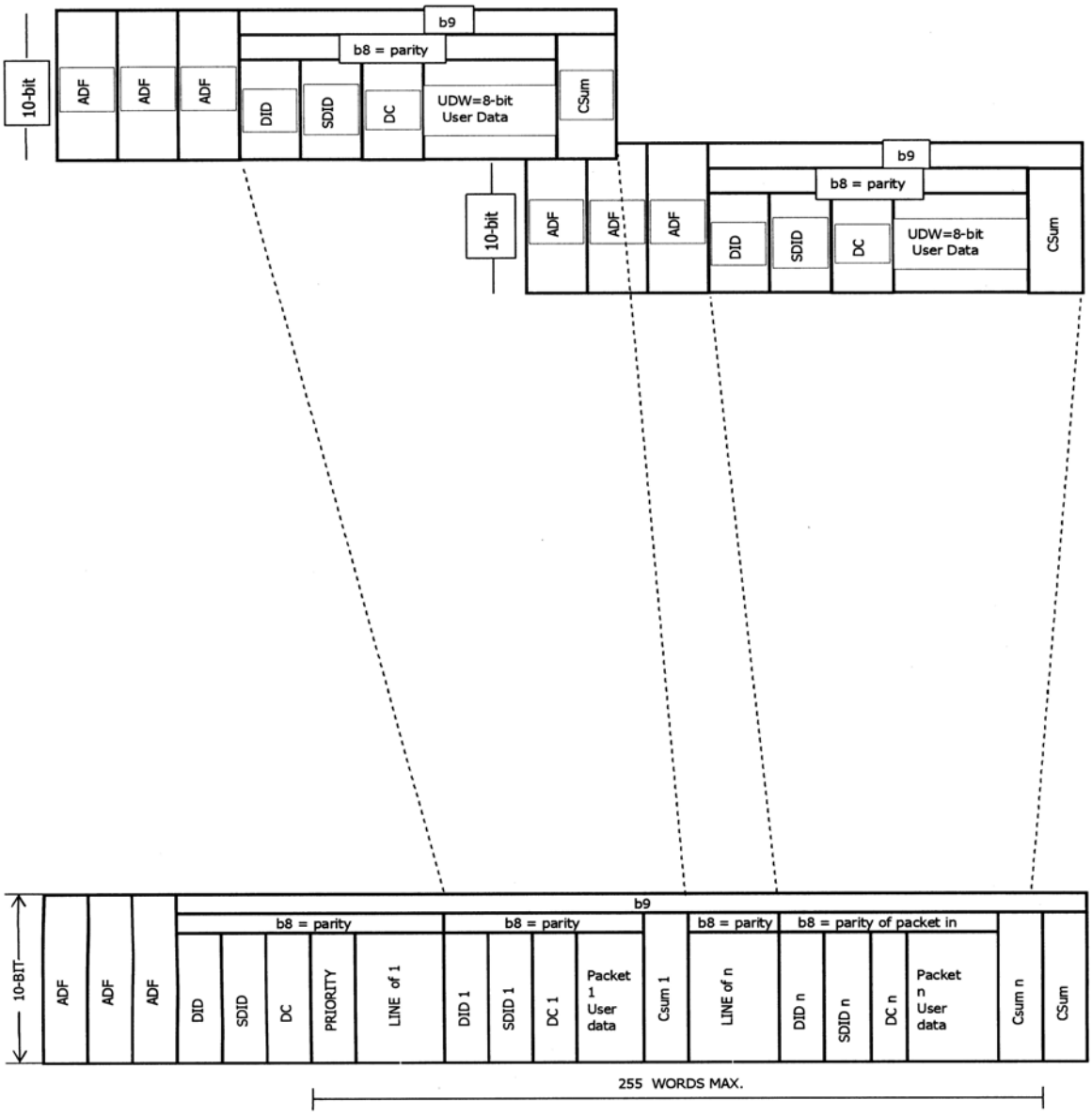

Figure 3 – Multipacket Structure

7 Video and Audio Timing

There is no specific provision in this operational practice for ensuring that the relative timing between the video and its embedded VANC data is correct. The only timing relationship that exists is created when the data is embedded in the video. Once that relationship is established, the deterministic nature of the ITU-R 1364-1 serial bit stream and the SMPTE 291M ANC packets ensures that the relationship is preserved.

8 Interlace Field Designation

It should be noted that interlace field designations are sometimes referred to as odd and even fields, or field one and field two. In the case of this document, field one is the odd field, and field two is the even field.

9 Referenced Standards

ETSI

ETS 300 706 Ed. 1 (1997-05)	"Enhanced Teletext Specification"
EN 300 472 V1.2.2 (1997-08)	Digital Video Broadcasting (DVB) Specification for Conveying ITU-R System B Teletext in DVB Bitstreams.

ITU

Rec ITU-R BT.653-3 1998	Annex 1 "Characteristics of Teletext Systems"
Rec ITU-R BT.1364-1 (08/05)	Format of Ancillary Data Signals Carried in Digital Component Studio Interfaces
Rec ITU-R BT.1120-7 (12/07)	Digital Interfaces for HDTV Studio Signals
Rec ITU-R BT.709-5 (04/02)	Parameter Values for the HDTV Standards for Production and International Programme Exchange

SMPTE

SMPTE 291M-2006	Television — Ancillary Data Packet and Space Formatting
SMPTE 334M-2000	Television — Vertical Ancillary Data Mapping for Bit-Serial Interface

Revision Notes

This RDD has been editorially revised to clarify the terms used to describe the odd and even fields of an interlaced television signal. As written, there may have been some ambiguity. Other changes were incorporated to indicate the latest versions of references. There were no technical changes to the document.

The changes are summarized below:

1. A new Section 8, Interlace Field Designation, has been added to resolve the ambiguity.

2. Section 9, Referenced Standards (previously Section 8) has been updated.