1. SCOPE

Free TV Operational Practice OP-47 describes the technical/operational practices associated with the storage and distribution of Teletext data such as closed captions/subtitles in the vertical ancillary data space of the 10 bit serial HD-SDI signal complying with Recommendation 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. The stl file type is required.

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 Recommendation ITU-R BT. 653-3 System B (refer Section 7 - 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 recognised standards is delivered successfully to the viewing audience via the broadcaster's analogue and digital transmissions.

VANC data packets shall be carried in the Y stream of the HDTV serial interface as defined by Recommendation ITU-R BT.1120.

3. DEFINITION OF TERMS

The following definitions are consistent with Recommendation ITU-R BT.1364:

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. Multiple lines within the ANC can be used to contain multiple Ancillary Data Packets. 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 Recommendation 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:

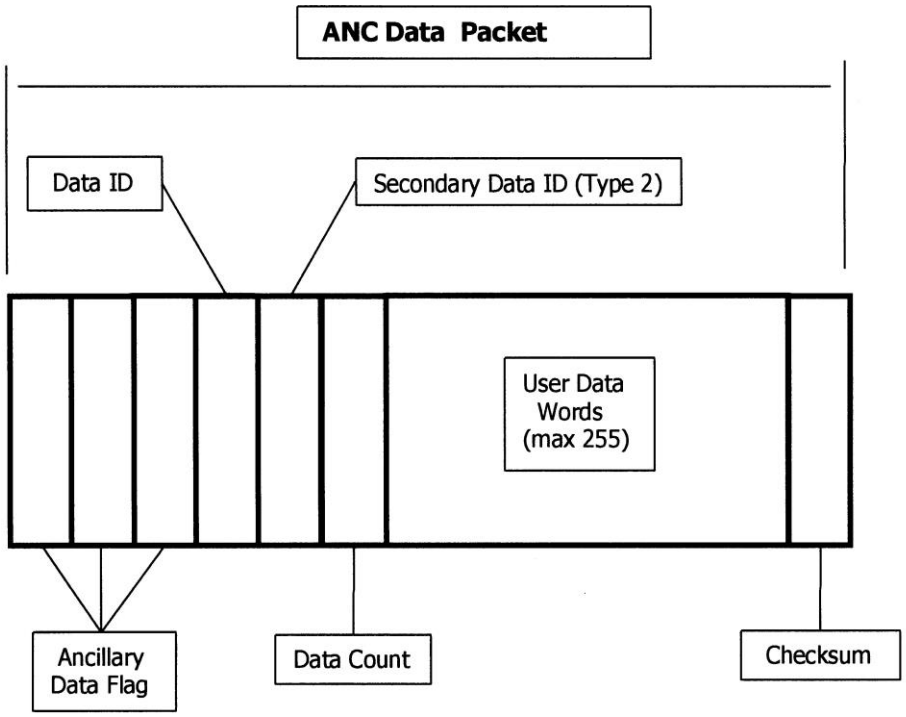

Figure 1: Type 2 Ancillary Data Packet

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 shall not exceed 255 words in length.

(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 Recommendation 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)
}
FOOTER ID (274h)
FOOTER SEQUENCE COUNTER (2 words) (see explanation following)
SDP CHECKSUM (see explanation following)
CS

Note: Structure B emulates ITU-R System B Teletext VBI line

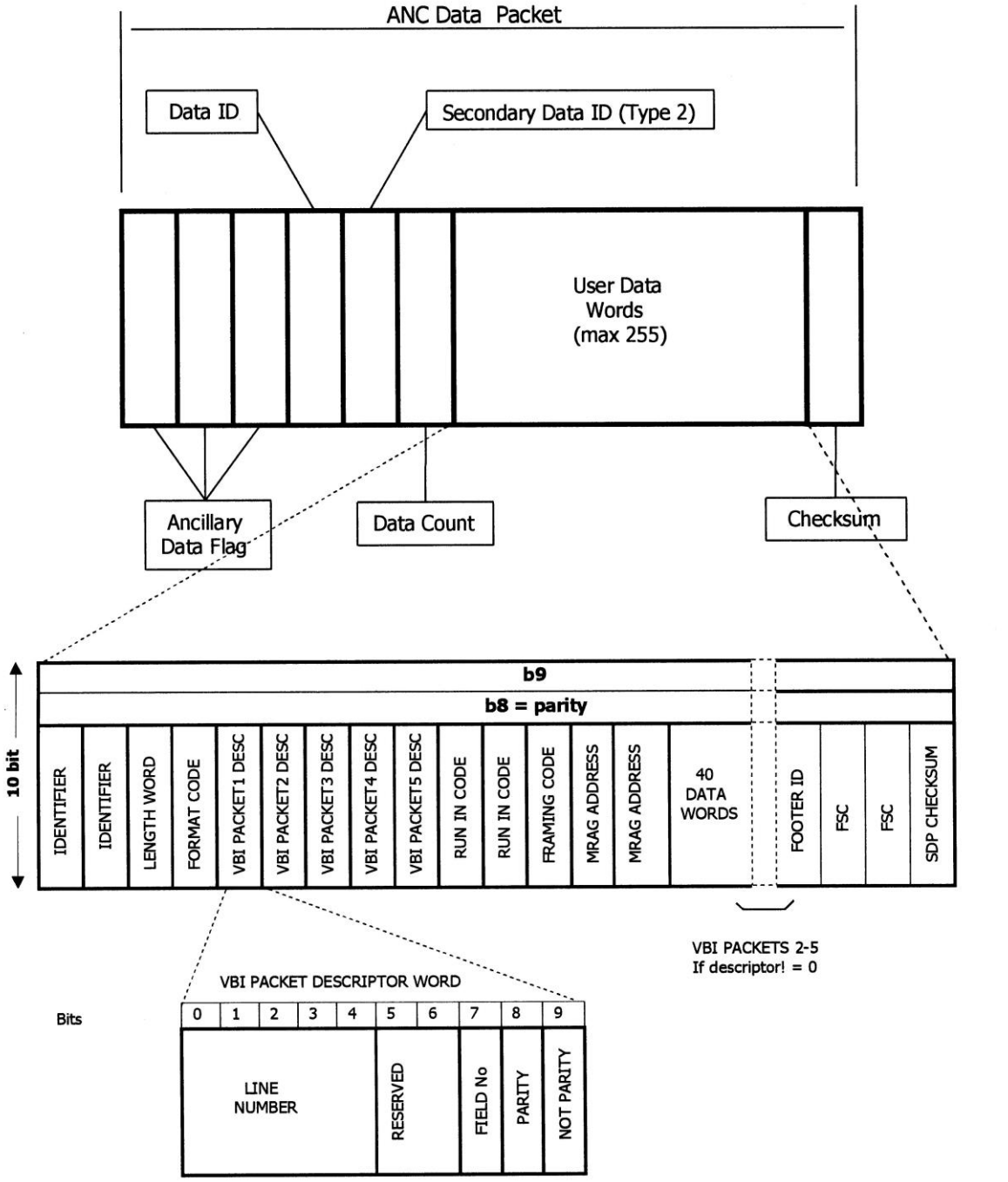

Figure 2: Subtitling Distribution Packet

5.2 Footer Sequence Counter

The Footer Sequence Counter (FSC) is a 16bit 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 16bit 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 (see 5.4.2 below)
        bits b5 and b6 reserved are line no (see 5.4.2 below)
        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
}
```

5.4.2 Semantics of the Packet Descriptor Structure A

The semantics of Packet Descriptor Structure A is as follows:

When b7 is 1 then b0 to b4 represent the lines range 6 to 22 for the odd field or field 1 and when b7 is 0 then b0 to b4 represent the lines range 319 to 335 for the even field or field 2 as defined in Recommendation ITU-R 656-5 Table 1.

If either b5 or b6 is 1 then a Packet Descriptor Structure B exists. Bits b5=1 AND b6=1 indicate a Packet Descriptor Structure B to this specification,

If a Structure A descriptor is present then the associated Structure B descriptor must be present and the associated space allocated in the SDP packet.

The purpose of the VBI Packet Descriptor word and Packet Descriptor Structure A is to indicate that a ‘valid’ WST teletext subtitling packet exists on VBI field x/line xx and to insert the associated data words in the Subtitling Distribution Packet Structure B, carried within the associated VANC packet in the corresponding HD field.

VBI teletext subtitling packets are generated in different methods –

(i) VBI packets appear on every field, repeated and change only with changing payload and/or display;

(ii) ‘bursty’ teletext subtitling, where VBI teletext packets only appear in the field/line where and when required to change display in real time and no VBI packets appear until the next change of payload and/or display;

(iii) VBI teletext packets only appear on field 1 and not field 2 or vice versa, which can corrupt some teletext subtitling systems when carried like this in the HD SDP packet;

Implementation of this operational practice should consider such scenarios and in particular packets should appear on both fields.

It is possible to transmit illegal line number values and decode devices may choose to ignore these lines.

If VBI Packet descriptor *n* is not present then all following VBI Packet descriptors shall be set to 0. Additionally there should be no ANC packets of this type following a part-full packet within the same frame.

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 Recommendation ITU-R BT 653-3)
subtitling data [40 words] including parity (refer Recommendation ITU-R BT.653-3)
}

6. VERTICAL ANCILLARY MULTI-PACKET FORMAT

The VANC Multipacket is a Type 2 ancillary data packet as defined in Recommendation 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 shall not exceed 255 words. :

6.1 Syntax of the VANC Multipacket.

The syntax of the VANC Multi-packet is defined as follows

Header:

ADF (3 words)

DID (143h)
SDID (203h)
DC = (1 word) variable value
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 Recommendation ITU-R BT.1364)

NUDW
Variable as per UDW data payload words above
}
CS

6.2 Semantics of the VANC Multipacket

The semantics of the VANC Multi-packet 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 shall 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 end of NUDW word of the last inner packet, inclusive, shall 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.

The ancillary data flag (ADF) and Checksum word are stripped from the inner packets when they are sequentially inserted into a multipacket (see Figure 3). The delineation of each inner packet must be determined by each inner Data Count (NDC) word.

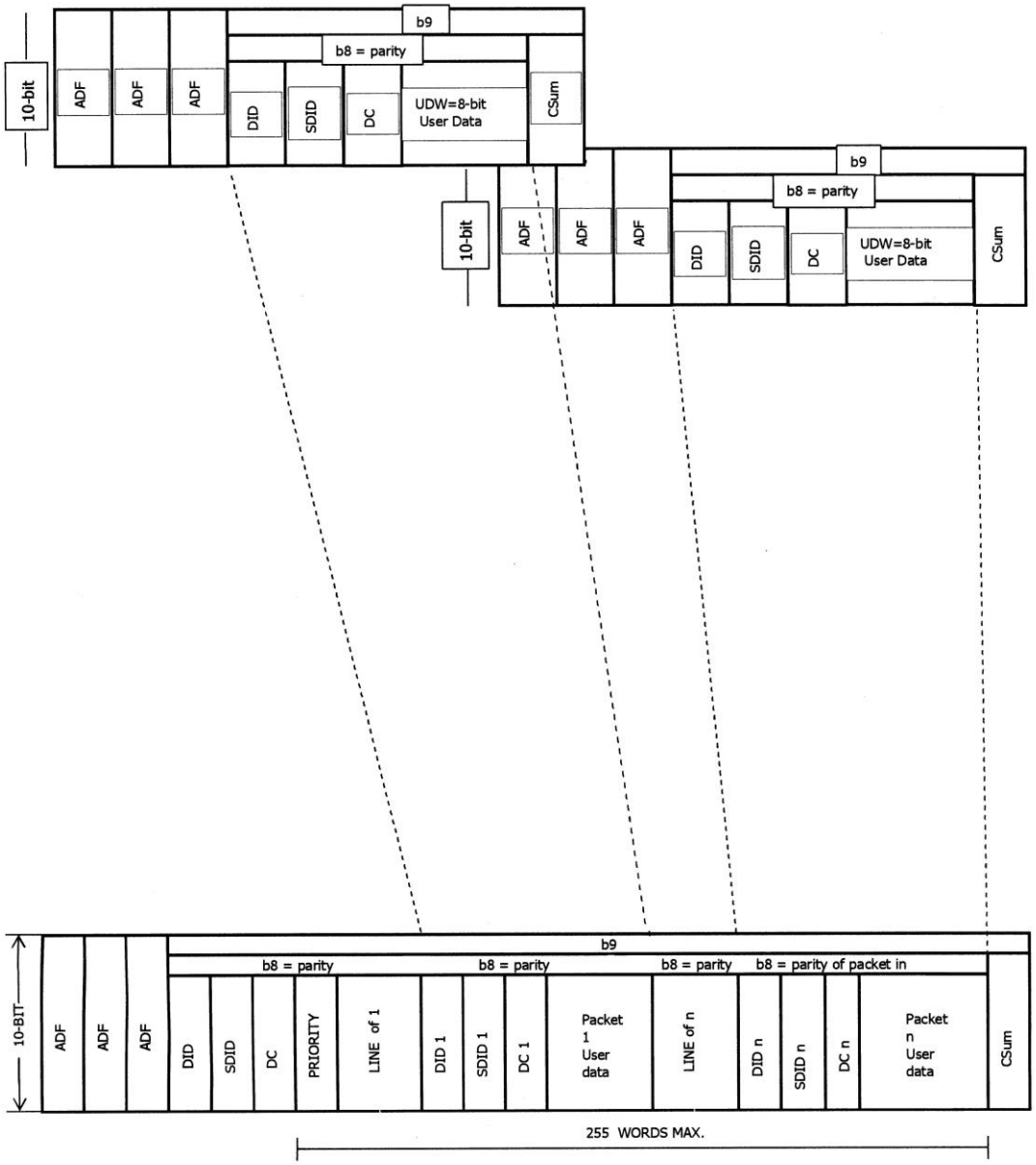

Figure 3: Multipacket Structure

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 serial interface data stream. . Once that relationship is established, the deterministic nature of the ITU-R BT.1120-7 serial bit stream and the Recommendation ITU-R BT.1364 VANC packets ensures that the relationship is preserved.

A Command to clear any existing caption shall be included in the first two (2) seconds of a **program**. A Command to clear shall also be included two (2) seconds before the end of a program.

A Command to clear any existing caption shall be included in the first half (0.5) second of the **commercial**. Where closed caption data is included on the videotape, the caption information should commence no earlier than a half (0.5) second after the start of active video and a caption erase signal is required (last caption time code out) not later than a half (0.5) second before the end of active video. First caption time code in will be at an arbitrary point determined by content.

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 this case of this document, field one is the odd field, and field two is the even field.

9. REFERENCED STANDARDS

ETSI

ETS 300 706 V1.2.1 (2003-04)	*Enhanced Teletext specification*
EN 300 472 V1.3.1 (2003-05)	*Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams*

ITU

Recommendation ITU-R BT.656-5	Interface 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
Recommendation ITU-R BT.653-3 1998	Annex 1 *Characteristics of Teletext systems*
Recommendation ITU-R BT.1364-1 (03/10)	*Format of Ancillary Data Signals Carried in Digital Component Studio Interfaces*
Recommendation ITU-R BT.1120-7 (12/07)	*Digital Interfaces for HDTV Studio Signals*
Reommendation ITU-R BT.709-5 (04/02)	*Parameter values for the HDTV standards for production and international programme exchange*

SMPTE

RDD8	Storage and Distribution of Teletext Subtitles and VBI Data for High-Definition Television

APPENDIX

Closed Caption Conventions used in Australia

The following conventions are applied by all Australian television broadcasters for the implementation of World System Teletext in Australia

1. HD Captions are generally in accordance with OP42 for SD captions. Refer www.freetv.com.au

2. 1080i HD captions are inserted in accordance with OP47 on both the Odd field, HD line 12 (i.e. Line 12, Field 1) and the Even field, HD line 575 (i.e. Line 12, Field 2).

3. Caption data must always be inserted on both fields. Duplication of field 1 data on field 2 is permissible provided fast updates (e.g. Live captions) are not required.

4. OP42 specifies that SD Lines 21 and 334 should carry “Dummy Headers” except during the actual transmission of caption content so this requirement is continued for HD. Apart from providing consistency with SD, this ensures that OP47 packets are always present for captioned HD signals. “Dummy Headers” should be Page 8FF, Subcode 0x3F7E.

5. To allow for down-conversion, the OP47 VBI Packet Descriptor must be set for both the Odd field, SD line 21 (i.e. Line 21, Field 1) and the Even field, SD line 334 (i.e. Line 21, Field 2).

6. Only one OP47 packet is permitted per field. Multi-Packets are not used in Australia as they are not supported by certain broadcast equipment.

7. “Caption Clear” commands must be inserted at the beginning and end of all captioned programs and commercials in accordance with OP 42.