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Technical Report

Television systems; Code of practice for allocation of services in the Vertical Blanking Interval (VBI)

European Telecommunications Standards Institute

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ETSI Secretariat

Postal address
F-06921 Sophia Antipolis Cedex - FRANCE

Office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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c= fr; a=atlas; p=etsi; s=secretariat

Internet
secretariat@etsi.fr
http://www.etsi.fr

Contents

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Foreword

This Technical Report (TR) has been produced the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

European Broadcasting Union
CH-1218 GRAND SACONNEX (Geneva)
Switzerland
Tel: +41 22 717 21 11
Fax: +41 22 717 24 81

1 Scope

The present document is intended as a companion document to ETS 300 706 [1] and ETS 300 708 [2], covering the data format and transmission via Teletext. It is primarily aimed broadcasters and telecommunications network operators with the intention that there is a consistent approach to the positioning of services within the Vertical Blanking Interval (VBI) of 625/50 Phase Alternation Line (PAL) derived services in Europe.

The main area of interest is in the VBI as received at home, and thus the effects of all the telecommunication systems that are used to convey the signal are taken into account. Thus as there are many options available to all the parties involved in creating the total system, some common understanding of the concepts involved is required as well as formal agreements between parties for the use of the VBI.

2 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ETS 300 706: "Enhanced Teletext specification".

[2] ETS 300 708: "Television systems; Data transmission within Teletext".

[3] ETS 300 231: "Television systems; Specification of the domestic video Programme Delivery Control system (PDC)".

[4] ETR 287: "Television systems; Code of practice for enhanced Teletext".

[5] ETR 288: "Television systems; Code of practice for an Electronic Programme Guide (EPG)".

[6] ETS 300 294: "Television systems; 625-line television Wide Screen Signalling (WSS)".

[7] ETS 300 732: "Television systems; Enhanced 625-line PAL/SECAM television; Ghost Cancellation Reference (GCR) signals".

[8] ITU-R Recommendation 473: "Insertion test signals in the field blanking interval of monochrome and colour television signals".

[9] ITU-R Recommendation 567: "Test signals for Television Systems".

[10] EBU Recommendation R26-1981: "The use of Insertion -reference signals(IRS) in television production installations".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions apply:

Data stream: A continuous sequence of related data.

Decoder: A Teletext decoder collects and decodes the transmitted Teletext data. It processes and stores the data and under user control selects the information for display. Decoders can differ in their storage capacity and display capability.

Filler packets: Dummy packets inserted onto otherwise unused VBI lines which exists as a result of obeying the 20 ms page clearing rule.

Level 1, 1.5, 2.5, 3.5: Teletext presentation levels.

20 ms page clearing rule: This rule defines the minimum interval between the transmission of the page header (row 0) of a Teletext page and the transmission of the remaining packets. It is essential for some existing Teletext decoders to give them time to erase the old page from memory. Level 2.5 (and above) decoders can operate without such a delay being necessary. This is referred to as the 20 ms rule in ETS 300 707 [1].

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CNI	Country and Network Identification code
CVBS	Composite Video, Blanking and Synchs
EACEM	European Association of Consumer Electronic Manufacturers
EPG	Electronic Programme Guide
FBI	Field Blanking Interval
GCR	Ghost Cancel Reference
ITS	Insertion Test Signal(s)
LCI	Label Channel Indentifier
NTSC	National Television Standards Committee (TV standard)
PAL	Phase Alternation Line (colour TV system)
PDC	Programme Delivery Control
SECAM	SequentiellE Couleur Avec Mémoire (French colour TV system)
TV	TeleVision
UTC	Universal Time Co-ordinated
VBI	Vertical Blanking Interval
VCR	Video Cassette Recorder
VITC	Vertical Interval Time-Code
VPS	Video Programming System
WSS	Wide Screen Signalling

4 Generalities

The television Vertical Blanking Interval (VBI), also known as the Field Blanking Interval (FBI) consists of the TV lines 623 to 22 in field one and 311 to 335 in field two. By convention, there is an association between a line in field one and the line in field two 313 lines later.

So the complement of line 6 is 319 and the line pair of line 6 and 319 is referred to as 6/319.

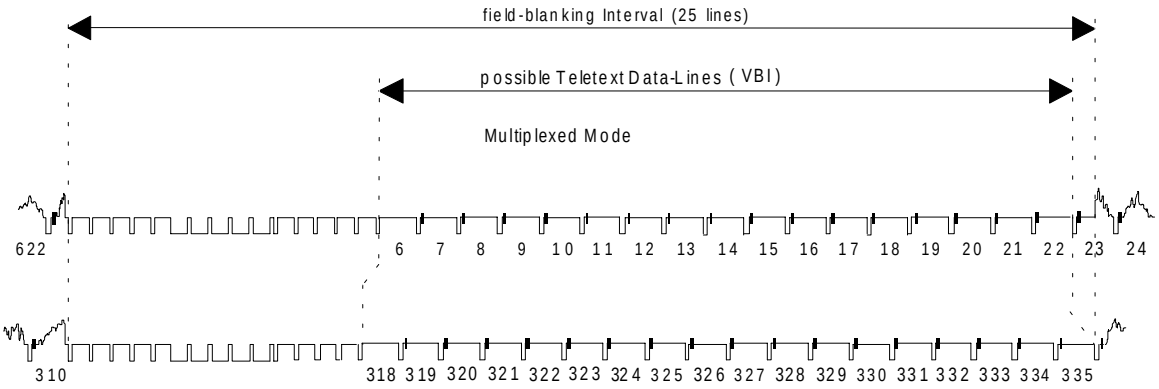

Figure 1: Usable TV lines, when multiplexed with a CVBS signal

ETS 300 706 [1] permits the operation of Teletext signals on lines 6/319 to 22/335 plus line 318.

Broadcasters, regulatory authorities and the common carriers of information such as public telecommunications operators, cable and satellite operators may use lines in this range for a variety of purposes such as:

a) test signals;

b) quiet lines;

c) encryption systems;

d) Teletext based signals;

e) non-Teletext based data broadcasting;

f) closed caption text services.

The present document indicates where these signals may be located and points out the basis on which services are allocated to VBI lines. This may vary from country to country.

5 Signals

5.1 Signals whose line number is specified

5.1.1 Ghost Cancellation Reference (GCR)

This waveform to ITU-R BT 1124 Systems C and ETS 300 732 [7] is carried on line 318.

5.1.2 Wide Screen Signalling (WSS)

As this is carried on the first half of line 23, it does not fall within the strict definition of the VBI. This signal to ETS 300 294 [6] occupies only the first half of the line the remainder being active picture.

5.1.3 Video Programming System (VPS)

This is a bi-phase modulation with a data rate of 2,5 Mbit/s on line 16 used for the record function of some Programme Delivery Control (PDC) systems (see ETS 300 231[3]).

5.2 Frequently used signals

5.2.1 Test signals

The standard test signals used by broadcasters are based on ITU-R Recommendation 473 [8] and ITU-R Recommendation 567 [9] which describe many elements of test signals. There is also EBU Recommendation R 26-1981 [10] which recommends the use of ITU-R Recommendation 473 [8].

These standard test signals are generally repetitive on the two fields and are often on lines 17/330, 18/331 and 19/332 or 19/332 and 20/333.

The elements of these waveforms usually include:

a) luminance bar at 100 %;

b) 2T pulse;

c) T pulse or 20T pulse;

d) chrominance bar on a luminance pedestal;

e) luminance step/stair case;

f) luminance step/stair case with superimposed chrominance;

g) luminance saw-tooth;

h) luminance saw-tooth with superimposed chrominance;

i) colour bars.

In addition there are test signals which include a frequency sweep and a (sin x)/x waveform.

These waveforms are used to assess the quality of the transmitted signal. Action can be taken automatically for instance to adjust the equalization of a radio link or rebroadcast signal or to change over to a standby feed.

As such, these signals are very important to the broadcaster or public telecommunications operator and often test signals will be constructed to meet specific needs.

It is desirable that any new signals are constructed and transmitted to have no effect on Teletext decoders. This may be achieved by ensuring that there is no part of the waveform which a Teletext decoder may interpret as valid Teletext framing code in the presence of noise. It should be noted that some existing decoders will accept a single bit error in the framing code and have a framing code acceptance window which is considerably wider than the transmission limits defined in the present document.

5.2.2 Quiet lines

The measurement of random noise by receivers and by public telecommunications operators and broadcasters is normally made on a quiet line. As many existing Teletext decoders cannot decode line 6/319, one or both of these lines is often used for noise measurement.

5.2.3 Encryption systems

Many broadcasters encrypt their signals and the control of the decrypting systems is carried in the unencrypted VBI.

These systems which are entirely proprietary, can occupy a number of VBI line pairs. For example Videocrypt can be interpreted as valid Teletext by some existing decoders under some circumstances, resulting in corrupted displays.

5.2.4 Teletext broadcasting

This is packet based broadcasting that conforms to ETS 300 706 [1] or ETS 300 708 [2].

Teletext decoders should be designed to be insensitive to non-Teletext waveforms. It is reasonable to assume that on a given channel the type of waveform on a given line will remain constant for one session of viewing.

5.3 Signals that are infrequently used

5.3.1 Teletext-like data broadcasting

Certain forms of data broadcasting and other private data can be carried by a Teletext based waveform that does not fully comply to ETS 300 706 [1] or ETS 300 708 [2]. This can be generated by using a different framing code or inverting the data.

5.3.2 Non-Teletext data broadcasting

There are a number of proprietary data broadcasting systems which do not use a Teletext - like waveform.

5.3.3 Closed captioning

This is a derivative of the closed caption system to EIA 608 (Line 21 Data services for NTSC) used in North America on line 21/334. In Europe this signal is used for internal purposes by some satellite broadcasters, not for general reception in the home, usually on line 22/335. This is also known as NCI (National Captioning Institute) caption.

5.3.4 Vertical interval time code

Broadcasters may inadvertently broadcast this internal signal which is recorded on video tape on lines 19/332 and 21/334. This may occur because the picture has been processed and has slipped by a few lines. In some countries lines 9/322 and lines 22/335 are used for this purpose.

6 Principles applied to the allocation of services to lines

The broadcasters, regulatory authorities and the common carriers of information such as public telecommunications operators, cable and satellite operators lay down the requirements for the signals in the VBI.

Over some years, there has been a general movement to rationalize the use of the VBI, usually to maximize the number lines carrying Teletext. As there are many differing requirements, it has been impossible to get international agreement to any particular arrangement or use of groups of lines. However, there are a few basic trends which broadcasters tend to follow when allocating VBI capacity.

Because the use of the VBI has grown over the years from the early arrangement of test signals on lines 17/330, 18/331, 19/332 and 20/333, there are usually seen to be four main areas:

1) top of VBI

   - Line 318 is either blank or carries the GCR signal to ITU-R BT 1124 System C further specified in ETS 300 732 [7].

   - Lines 6/319 should be used for quiet lines or test signals, because not all exiting Teletext decoders can accept on these lines. It is strongly recommended that one or both of these lines are used for noise measurements.

2) middle/majority of VBI

   - From Lines 7/320 to about line 18/331, there is likely to be Teletext or encryption systems or other non-Teletext data broadcasting. In some countries Teletext or Teletext - like data broadcasting or other non-Teletext data broadcasting is inserted only up to lines 16/329. VPS is located on line 16.

3) test signals

   - Lines 19/332 and 20/333 tend to be used for test signals but are also used for Teletext. In some countries lines 17/330, 18/331 and 19/332 are used for test signals.

4) close to picture

   - Lines 21/334 and 22/335 tend to be used for programme related information, such as Teletext subtitles (In magazine parallel transmission) or closed captioning. It is very likely that Teletext or test signals may also appear here. In some countries also lines 20/333 are used for Teletext.

Because of the way in which a Teletext service may require certain numbers of VBI lines for efficient transmission, typically 12 line pairs, there may be strong commercial incentives to use 12 VBI lines before the ITS which may mean that Teletext is on line 16/329. Similarly, certain decoders may window over only 16 line pairs.

7 Allocation of Teletext services

There can be many Teletext services in the VBI; each of which may be operated by one or several service providers.

The main categories are given in table 1.

Table 1: Allocation of Teletext services

Service	Packets	Specification
Text services	X/0 to X/29	ETS 300 706 [1]
Page based data broadcasting	packets X/0 to X/29	ETS 300 708 [2]
Independent data broadcasting	8/31, 1/31, 2/31, 3/31	ETS 300 708 [2]
Audio data	4/30 and 4/31	ETS 300 708 [2]
Packet 8/30 format 1		ETS 300 706 [1]
Packet 8/30 format 2		ETS 300 231 [3]
VPS		ETS 300 231 [3]

In addition, ETR 287 [4] and ETR 288 [5] provide an insight into the application of the specifications and the organization of Teletext transmission.

Within the lines allocated to Teletext there tends to be an allocation of data broadcasting, both page based and independent packet, onto the lower line numbers.

This is because a few existing Teletext text decoders may malfunction if there are packets X/31 on the highest line numbers in each field used for Teletext.

7.1 Teletext text transmission

As these services usually form the major part of the Teletext service, a brief outline of what may be transmitted may help.

There are three main groups of Teletext text transmission:

1) magazine serial mode;

2) magazine parallel mode; and

3) complex mode.

7.1.1 Magazine serial mode

Quote from annex B of ETS 300 706 [1]:

"In a transmission multiplexed with a video signal, it is likely that each page will be transmitted on the maximum number of VBI lines available, and all the pages from all magazines will be transmitted one after the other, although not necessarily in numerical sequence".

The large number of filler packets are very often transmitted (to comply with the 20 ms rule) may be replaced by data broadcasting, or text enhancement data which does not obey the 20 ms rule.

7.1.2 Magazine parallel mode

This method gives the editor greater control over the cycle times of pages in different magazines and a greater transmission efficiency. The basic operation can be enhanced to give an even more efficient transmission with no packet containing unused filler data.

7.1.2.1 Simple parallel operation

Quote from annex B of ETS 300 706 [1]:

"In a transmission multiplexed with a video signal, it is likely that pages from one or more magazines will be allocated to groups of VBI lines for transmission.

Thus a single VBI can consist of packets from a number of different magazines. Pages within each magazine need not be transmitted in numerical sequence".

This method enables different sources of Teletext to be combined easily and is in any case more efficient to transmit. Thus a line or groups of lines will be allocated to a particular service; for instance data broadcasting or subtitles.

Any filler packets transmitted (to comply with the 20 ms rule) may be replaced by data broadcasting, or text enhancement data which does not obey the 20 ms rule.

7.1.2.2 Complex transmissions

These methods are usually:

- based on a magazine parallel mode of text transmission and aim to remove "ALL" filler packets from the VBI;
- dynamically allocating between services or magazines on a VBI by VBI basis;
- by altering the number and type of packets X/0 to X/29 within the VBI with other packets transmitted.

Even more complex services which are known under trade names such as "Super spiral" and "IPP" can organize the VBI on a super streamed or even individual packet basis.

7.2 Data broadcasting

7.2.1 Page based

This can be considered as being similar to the normal text or enhancement data in a text transmission.

7.2.2 Independent

These are independent packets of data which do not have any affinity for a particular page or magazine. Thus they are a very efficient way of sending information as within a Teletext multiplex. They can be added or subtracted from the Teletext multiplex very easily as they are independent of all other elements.

7.2.3 Audio data

This may be used by broadcasters to provide an "AUDETEL" audio description of television service (packet 4/30) or as an independent sound channel (packet 4/31).

7.3 Packet 8/30 format 1

If this packet is transmitted, it should be in the VBI following the Universal Time Co-ordinated (UTC) second boundary.

7.4 Programme Delivery Control (PDC) 8/30f2

In Teletext this uses packet 8/30 format 2. Packet 8/30s shall be transmitted with at least 200 ms between them. It is usual for them to be transmitted at the 200 ms boundary, but there is no requirement for them to be transmitted in LCI order or to allocate a particular time slot for the LCI.

For non-Teletext VPS method (line 16) see subclause 5.1.3.

7.5 Allocation summary

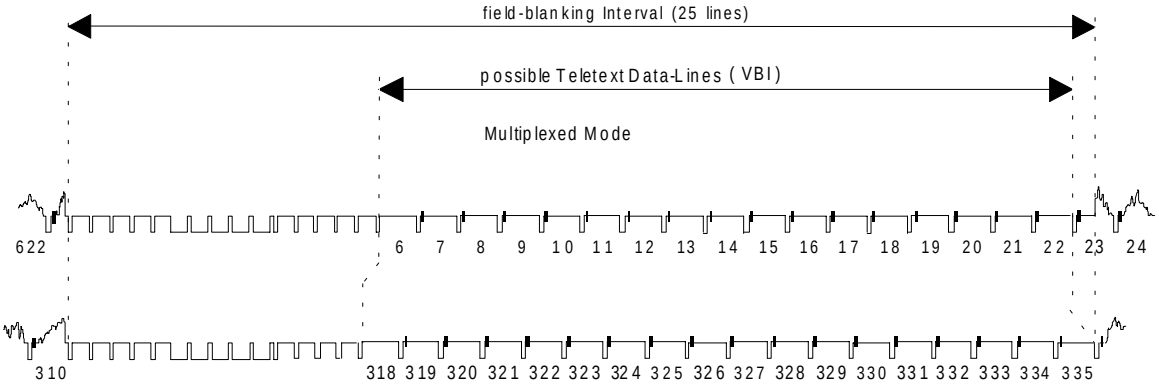

Figure 2: Usable TV lines, when multiplexed with a CVBS signal

Table 2: Allocation of services in the Vertical Blanking Interval (VBI)

LINE	VPS	wss	test	quiet	encryption	Teletext text	Teletext data	Teletext like	non Teletext	closed captioning	VITC
6				¥		I	I				
7						H	H				
8						H	H				
9						H	H	L	L		
10						H	M	L	L		
11					H	H	M	L	L		
12					H	H	M	L	L		
13					H	H	M	L	L		
14					H	H	M	L	L		
15					H	H	M	L	L		
16	S				H	H	M	L	L		
17			¥		H	H	M	L	L		
18			¥		H	H	M	L	L		
19			¥			M	L				B
20			¥			M	L				B
21			H			H	M				B
22			H			H	M			B	B
23		S									
	GCR										
318	S										
319				¥		M	M				
320						H	H				
321						H	H				
322						H	H	L	L		
323						H	M	L	L		
324					H	H	M	L	L		
325					H	H	M	L	L		
326					H	H	M	L	L		
327					H	H	M	L	L		
328					H	H	M	L	L		
329					H	H	M	L	L		
330			¥		H	H	M	L	L		
331			¥		H	H	M	L	L		
332			¥			M					B
333			¥			M					B
334			H			H	M				B
335			H			H	M			B	B

Key:

S = Specified in a standard
H = Highly likely to be used
M = Medium likelihood of usage
L = Low use of usage
B = Broadcasters usage
¥ = Test waveform

Annex A (informative): Examples of VBI allocation

There are many factors which require to be considered when allocating the VBI to services. The whole transmission path from the broadcaster to the home should be considered as the common carriers may have their own restrictions or may bridge Teletext onto different lines.

Given freedom to decide the allocation of the VBI, the following method may be followed.

1) The first is to allocate those services which require a fixed line: GCR line 318, VPS line 16, WSS line 23.

   NOTE: Only VPS occupies key space within the VBI.

2) Then allocate the lines to be used by test signals and quiet lines.

   - These are usually fixed by convention to be test signals on lines 17/330, lines 18/331 and lines 19/332 or on lines 19/332 and lines 20/333 with the quiet lines being at least lines 6/319.

   - As these signals are usually close to picture, they often form a dividing line in the VBI.

3) Then allocate any other signal which shall be on a fixed line; such as encryption or other non-Teletext waveforms.

   - It may be that some of these signals are placed on line close to the picture, thus freeing a contiguous group of lines from the top of the VBI to the test signal lines.

This may give a skeleton allocation like in table A.1.

Table A.1 Allocation method

Line	Line specific	Other signals	Teletext		Teletext	Other signals	Line specific	Line
							GCR	318
6	Quiet						Quiet	319
7			Data		Data			320
8			Text		Text8/30			321
9			Text		Text			322
10			Text		Text			323
11			Text		Text			324
12		Encryption				Encryption		325
13		Encryption				Encryption		326
14		Encryption				Encryption		327
15		Encryption				Encryption		328
16	VPS							329
17			Text		Text			330
18			Text		Text			331
19	Test						Test	332
20	Test						Test	333
21			Text		Text			334
22			Text		Text+sub			335
23	WSS		Picture					

The remainder of the lines can be used for Teletext. The efficient use of these lines is a complex topic, depending on the number of transmitted packets per page, enhancement data or data broadcasting. An introduction to the key issues can be found in ETR 288 [5]. With parallel transmission mode the number of lines or line pairs allocated for each stream shall also be considered.

It is worthwhile using a Teletext packet analyser to check the use of the Teletext lines; particularly if magazine parallelmode is being used.

Annex B (informative): Example of test signal construction

This example uses line 21 and 335 for a test signal to provide all the elements of a test waveform required but only using one line pair. Lines 21/335 were selected to maximize the amount of space available for Teletext services, whilst leaving a blank line pair 22/335 for the use of test signals on point-to-point links in the TV distribution system.

The first part of the test waveform is identical on both lines 21 and 335, so that they can be viewed on a simple waveform monitor/oscilloscope:

- 10 µs luminance bar (ITU-R Recommendation 567 [9], B2);
- 2T sine squared pulse (ITU-R Recommendation 567 [9], B1);
- 10T composite pulse (similar to ITU-R Recommendation 567 [9], F);

then on line 21:

- a five riser staircase with 140 mV superimposed chroma (similar to ITU-R Recommendation 567 [9], D2);

and on line 334:

- 700 mV peak-to-peak chrominance bar on a 350 mV pedestal (similar to ITU-R Recommendation 567 [9], G1);
- 68 bits of data as 200 ns sine squared 462 mV pulses.

History

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