INTERNATIONAL STANDARD

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2001-10

Digital terrestrial television receivers for the DVB-T system –

Part 1: Baseline receiver specification

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIGITAL TERRESTRIAL TELEVISION RECEIVERS FOR THE DVB-T SYSTEM –

Part 1: Baseline receiver specification

FOREWORD

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International Standard IEC 62216-1 has been prepared by technical area 1, Digital receiving equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment

The text of this standard is based on the following documents:

CDV	Report on voting
100/211/CDV	100/267/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A, B and D form an integral part of this standard. Annexes C, E, F and G are for information only.

The committee has decided that this publication remains valid until 2003. At this date, in accordance with the committee's decision, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

Television has evolved over the last half century from an up-market entertainment medium to becoming the major information tool around the world.

Television is available to virtually all people around the globe, be it individually or in a community setting.

The advent of the “personal computer”, enabling global reach and instant interaction has escalated the demand for more and more information and the ability to respond to it instantly.

It is thus that the broadcasters and content providers set out to seek new means of delivering higher levels of content, be it in volume or quality using existing or new transport mechanisms available.

Digitalisation, taken from the world of information technology was the obvious choice.

It further brought the added benefits of efficient use of spectrum and energy, not to mention interaction through a return path.

Terrestrial television has to migrate from analogue to digital in order to survive in the new information society.

Without any doubt, all means of information and content dissemination technology will merge over time, provided that sound business models find uptake by consumers at large.

Governments are keen to switch off the inefficient analogue broadcasts for a number of obvious reasons, but only will be able to do so when consumers are confident that the new proposition is attractive and affordable.

Business models are being developed to promote the uptake of digital receivers, however this activity up to now is mainly led by private enterprises targeting the public sector willing to pay for services in addition to those available from established public broadcasters.

This in itself is fine, but will not enable the migration from analogue to digital of all broadcasts, however funded.

The more so as it has led to a variety of incompatible platforms tied to particular TV operators, and this in turn does not allow for economy of scale for all parties concerned, be it content providers, broadcasters, network providers or equipment manufacturers.

After over two years of requirement capture in DigiTAG (Digital Television Action Group) and other fora, EACEM (European Association of Consumer Electronics Manufacturers) decided to address this situation by developing a basic specification as a minimum platform, providing secure reception of broadcast content and associated services. This includes both free to air as well as pay TV services by means of the DVB common interface.

This is in order to provide a stable base from which new applications and services can be built up, and ensuring backwards compatibility for products in the market based on this specification, thus ensuring that the consumer will continue to receive the services they have grown accustomed to.

EACEM has taken into consideration all other documents and specifications that were freely available from various bodies (NorDig Group, ANIEL, etc.) in order to develop a pan European specification.

DIGITAL TERRESTRIAL TELEVISION RECEIVERS FOR THE DVB-T SYSTEM –

Part 1: Baseline receiver specification

1 Scope

This part of IEC 62216 specifies the baseline receiver for the DVB-T system.

It concerns:

- broadcasters, and
- receiver manufacturers.

The objective is to define:

- how to provide broadcasts that are understood by all receivers and enable receivers to provide good facilities to their users;
- the behaviour required from receivers to work well with these broadcasts and to be attractive to consumers.

To avoid doubt, the words “shall”, “should” etc. are used in the traditional way to distinguish issues that are important versus those that are optional. The term “shall” is also used to identify mandatory requirements that are inherited from other specifications that have greater force.

This specification does not consider interactive applications and the data broadcasting that would support them. Subtitling and teletext are considered to be components of TV services. Standalone teletext services are not part of this standard.

This specification primarily addresses terrestrial delivery of digital transmissions.

This specification primarily addresses deployment in countries that use European Latin script based languages.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 62216. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 62216 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60169-2, *Radio-frequency connectors - Part 2: Coaxial unmatched connector*

ISO/IEC 6937, *Information technology – Coded graphic character set for text communication – Latin alphabet*

ISO/IEC 8859-9, *Information technology – 8-bit single-byte coded graphic character sets – Part 9: Latin alphabet No. 5*

ISO/IEC 11172-2, *Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 2: Video*

ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: systems*

ISO/IEC 13818-2, *Information technology – Generic coding of moving pictures and associated audio information: Video*

ISO/IEC 13818-3, *Information technology – Generic coding of moving pictures and associated audio information: Audio*

ITU-R BT.470-6, *Conventional television systems*

ITU-R BS.775-1, *Multichannel stereophonic sound system with and without accompanying picture*

ITU-R BT.1119-2, *Wide-screen signalling for broadcasting (Signalling for wide-screen and other enhanced television parameters)*

ITU-R BT.1359-1, *Relative timing of sound and vision for broadcasting*

EN 50049-1, *Domestic and Similar Electronic Equipment Interconnection Requirements: Peritelevision Connector*

EN 50221, *Common Interface Specification for Conditional Access and Other Digital Video Broadcasting Decoder Applications*

EN 300 468, *Digital Video Broadcasting (DVB) - Specification for Service Information (SI) in DVB systems*

EN 300 744, *Digital Video Broadcasting (DVB) - Framing structure, channel coding and modulation for digital terrestrial television (DVB-T)*

EN 301 775, *Digital Video Broadcasting (DVB) - Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams*

ETR 289, *Digital Video Broadcasting (DVB) - Support for Use of Scrambling and Conditional Access (CA) within digital broadcasting systems*

ETR 154, *Digital Video Broadcasting (DVB) - Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications*

ETR 162, *Digital Broadcasting Systems for Television Sound and Data services; Allocation of Service Information (SI) codes for Digital Video Broadcasting (DVB) systems*

ETR 211, *Digital Video Broadcasting (DVB) - Guidelines on implementation and usage of Service Information (SI)*

ETS 300 231, *Television Systems - Specification of the domestic video Programme Delivery Control system (PDC)*

ETS 300 294, *Television Systems; 625 - Line television Wide Screen Signalling (WSS)*

ETS 300 472, *Digital Video Broadcasting (DVB) - Specification for conveying ITU-R System B Teletext in DVB bitstreams*

ETS 300 706, *Enhanced Teletext specification*

ETS 300 743, *Digital Video Broadcasting (DVB) - Subtitling systems*

R206-001, *Guidelines for Implementation and Use of the Common Interface for DVB Decoder Applications*

TS 101 699, *Digital Video Broadcasting (DVB) - Extensions to the Common Interface Specification*

3 Abbreviations and symbols

BAT	Bouquet Association Table
bslbf	Bit string, left bit first
CA	Conditional Access
DTTV	Digital Terrestrial Television
DVB	Digital Video Broadcast
EIT	Event Information Table

EIT_{pf}	EIT present/following
EPG	Electronic Programme Guide
IDTV	Integrated Digital Television
MFN	Multi Frequency Network
MTBF	Mean Time Between Failure
NIT	Network Information Table
NVOD	Near Video On Demand
PMT	Program Map Table
PSI	Program Specific Information
RST	Running Status Table
SDT	Service Description Table
SFN	Single Frequency Network
SI	Service Information
STB	Set Top Box
TDT	Time and Date Table
TOT	Time Offset Table
TS	Transport Stream
uimsbf	Unsigned integer most significant bit first
UTC	Universal Time, Co-ordinated

4 Receiver capabilities

The list below gives a general overview of receiver capabilities supported by this specification.

4.1 Frequency spectrum

- UHF and/or VHF (band III);
- 8 MHz and/or 7 MHz Channel bandwidth;
- supports all DVB-T modulation methods;
- supports both 2K and 8K transmitting methods;
- supports all code rates;
- supports all guard intervals;
- supports hierarchical mode by the demodulator;
- supports portability.

4.2 Conditional access

The receiver is capable of receiving free-to-air as well as pay services. In order to have the necessary flexibility to choose a conditional access (CA) system one common interface slot (according to EN 50221) is foreseen. In future, other means to add new CA systems might be used such as the IEEE 1394 digital interface.

4.3 Return path

If a modem is not embedded then suitable means should be provided for connection to one (for example RS 232) for further interactive applications (for example IPPV, …).

4.4 Navigator (SI)

The navigator will use the mandatory service information broadcast in the service information table and the event information table to present appropriate service and event information to the user and to allow automatic selection of service features when the user selects a service.

Details can be found in clause 9, which is based on (mandatory) DVB-SI rules.

4.5 Auto installation

The receiver will allow access to all receivable services and will use the mandatory information in the NIT and/or SDT to automate the initialisation of the service list and subsequent updates thereof. See also 9.4.2.

4.6 Teletext carried in digital streams

Support of this feature is the responsibility of the manufacturer. Manufacturers are prepared to support teletext for a transition period. This feature and its signalling is described in clause 11.

4.7 Analogue recording/copy management

Analogue recording via the peritelevision connector (EN 50049-1) is supported.

4.8 Services

The receiver shall support the following services and service features:

- free to air broadcast;
- multi-lingual sound, multi-comments;
- multi-lingual subtitles (DVB subtitles, region based graphics);
- audio broadcast;
- screen formatting for ratios of 4:3 and 16:9.

In addition, the receiver may support:

- teletext linked with a program;
- mosaic services;
- Automatic Format Descriptor (AFD) for flexible screen formatting.

4.9 Future versions of this specification

It is the intention to extend this specification in a backward compatible way towards new types of services and service options and consequent receiver behaviour.

This is the case, in particular for the choice of an API, where it is currently expected that DVB-MHP is an appropriate choice as a generally accepted API for broadly marketable receivers.

In clause 9, the following additions are foreseen:

- Service list and logical channel number handling through the SDT as an additional alternative to the NIT based handling.
- CA replacement service link behaviour (to be confirmed).
- Description of various options available in the present specification to create different variations of services.

- linkage to a software loader.

5 Video system characteristics

5.1 Introduction

This clause defines the digital video encoding standards that shall be used.

It is based on D-Book version 3.0.

5.2 Essential requirements

Broadcast video shall be encoded according to ISO/IEC 13818-2 constrained according to ETR 154. All receivers should be able to meet the minimum decoding requirements set out in ETR 154.

Only the '25 Hz SDTV' variant described in the 'video' clause of ETR 154 is relevant to this specification.

5.3 Constraints and extensions

This clause sets out the additional requirements on the broadcast signals and reception equipment in addition to the DVB requirements in ETR 154.

5.3.1 Support for rapid channel acquisition

To reduce the typical time taken to start decoding a new service, each video elementary stream shall contain a sequence header and associated group of pictures header at an interval no greater than 0,5 s[1)]. Also, each such sequence header shall be immediately preceded by a PES packet header carrying a PTS.

There is no requirement to set the data alignment indicator flag in the PES packet header or for the broadcast to include a data stream alignment descriptor associated with the video elementary stream in the PMT. If a data stream alignment descriptor is included for a video elementary stream then it shall indicate alignment type '04'.

5.3.2 Picture types

Beyond the requirements of ISO/IEC 13818-2 and the requirement for periodic I pictures implied by 5.3.1, no additional constraints are placed on the sequence of coded picture types. Specifically, no additional constraints are placed on the number of B pictures between I and P pictures. As required by the main profile of ISO/IEC 13818-2, broadcasts may use I, P, B and dual-prime frame types.

5.3.3 ISO/IEC 11172-2 compatibility

ETR 154 requires that video encoding shall conform to the ISO/IEC 13818-2 main profile at main level. This requires support for ISO/IEC 11172-2 'D' pictures and "constrained parameters" video.

Broadcasts conforming to this specification shall not include ISO/IEC 11172-2 'D' pictures or sequences with a horizontal_size greater than 720.

1) ETR 154 recommends but does not mandate this.

5.3.4 User data

To ensure good functionality in current and future receiver video decoder implementations, a buffer model for user data within the video elementary stream is defined. The currently proposed use for this is to carry the “active format description” described in 6.4.3. This only exploits a small number of the bytes that might be used. Broadcasts are not required to carry this data.

If user data is carried, it shall meet the following buffer model:

- All user data bytes enter a single buffer of size 16 bytes (the user data start code is discarded before data is delivered to the buffer).
- All the data delivered at one time is removed from the buffer no later than 40 ms after it was delivered.

5.3.5 Video alignment

5.3.5.1 Analogue output signal

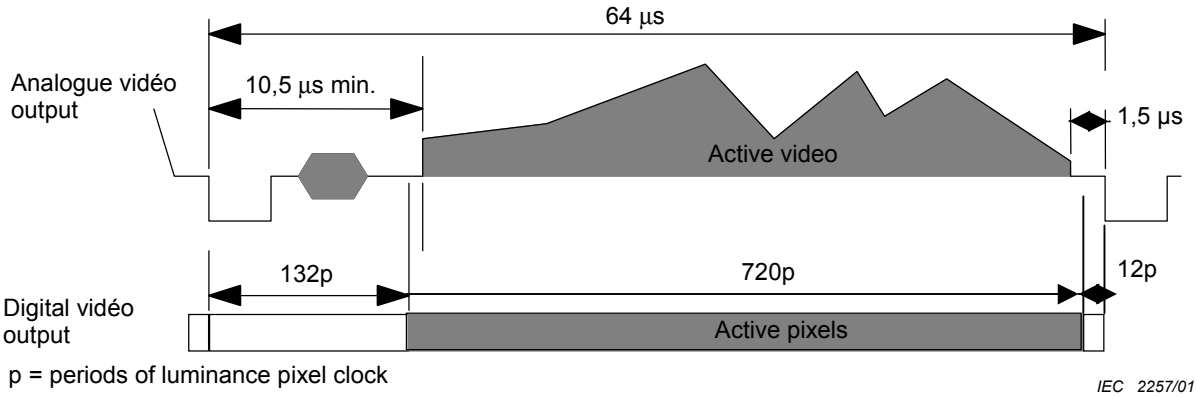


Figure 1 – Relationship between digital video and analogue video

The digital video output of the receiver’s MPEG video decoder and graphics display system domain contains 720 active pixels per line; these shall be aligned to the analogue video output signal as shown in figure 1.

It should be noted that:

- At least the first 9 and the last 9 of the 720 video pixels should be replaced with a blanking level to ensure compliance with ITU-R BT.470-6.
- Optionally, additional blanking may be applied to the start and end of the active video, suppressing further active pixels.
- The position of the first of the 720 active video pixels corresponds to 132 pixel periods (≈9,8 µs) after the falling edge of line sync.
- The figure is specific for PAL output signals. For receivers with SECAM output signals, similar positioning and blanking shall be done.

5.3.5.2 Overscan

Typically a 5 % border region inside each edge of the 702x576 pixel area is not visible due to CRT overscan.

6 Video display formatting

6.1 Introduction

This clause, which is based on D-Book version 3.0, describes the video format signalling and how it may be used. The receiver response to this signalling is defined in this clause.

This clause:

- Provides a summary of the “applicable standards”.
- Introduces “recommendations for signalling in the video stream”.
- Defines “video format signalling extensions”.
- Defines requirements for “alignment of video and graphics”.

6.2 Video format

The video format shall be encoded as described in ISO/IEC 13818-1, ISO/IEC 13818-2 and EN 300 468 constrained and interpreted as described in ETR 211 and ETR 154 and as clarified and extended below.

Only the ‘25 Hz SDTV’ variant described in the ‘video’ clause of ETR 154 is relevant to this specification.

6.2.1 Requirements for DVB compliance

6.2.1.1 Required format information

The following elements must be included for all video services:

- Video sequence header (ISO/IEC 13818-2). Restricted to “full screen” luminance pixel resolutions of: 720x576, 544x576, 480x576, 352x576 or 352x288 or “less than full screen” resolutions as described in ETR 154.
- Component descriptor (EN 300 468).

6.2.1.2 Optional to broadcast, required to decode

All conformant receivers are required to respond to the above mandatory information and shall also respond to the following optionally broadcast information:

- Video sequence display extension (ISO/IEC 13818-2), provided that the display window has an aspect ratio of 4:3 as described in ETR 154.
- Video picture display extension (ISO/IEC 13818-2), provided that the frame centre vertical offset is zero as described in ETR 154.

  It is mandatory to include the video sequence extension in any video sequence that includes the picture display extension (and hence Pan vectors).
- Target background grid descriptor (ISO/IEC 13818-1), provided that the display grid is 720 x 576 as described in ETR 154.
- Video window descriptor (ISO/IEC 13818-1).

6.3 Recommendations for signalling in the video stream

Broadcasts may use any of the formats permitted by DVB (see ETR 154). This clause defines the signalling that must be used when using these formats.

6.3.1 Sequence header

The minimum video format signalling required is the video sequence header. Table 1 tabulates the horizontal scaling factors required to restore video to 720 pixel horizontal resolution with the correct aspect ratio. These factors complement the scaling factors employed by the broadcaster when downsampling the video before encoding.

Table 1 – Horizontal scaling where format is signalled by the sequence header alone

			Source aspect ratio[a]		
horizontal_size	**Nominal "full screen" width**	**Effective horizontal size[b]**	**4:3**	**16:9**	
545 to 720	720	720	1	4/3[c]	1
481 to 544	544	540	4/3	16/9	4/3
353 to 480	480	480	3/2	2	3/2
1 to 352	352	360	2	8/3	2
			4:3 display		**16:9 display**
			Horizontal scaling to fill 720 wide display		

a) From the aspect ratio information.

b) For example, values of horizontal_size from 481 to 544 are treated as 540 when determining the scaling factor to adapt the video for a 720 pixel wide display, i.e. 720/540 = 4/3.

c) These scaling factors apply to a centre cut-out presentation, i.e. the central 3/4 of the coded picture width is scaled by the factor indicated to fill the width of a 4:3 display.

6.3.2 Sequence display extension

6.3.2.1 Pan scan window

Here the sequence display extension describes a 4:3 aspect ratio window within 16:9 coded frame (the position of this window may be controlled by the picture display extension).

Table 2 – Pan scan window

display_horizontal_size			Effective horizontal size[a]	Horizontal scaling	
Min.	**Typical[b]**	**Max.**		**Window fills 4:3 display**	**Full frame fills 16:9 display**
409	540	540	540	4/3	1
364	408	408	405	16/9	4/3
271	360[c]	363	360	2	3/2
1	264	270	270	8/3	2

a) Scaling to make the display window fill 4:3 display is 720/effective horizontal size.

b) Recommended to broadcast. Is 3/4 of the nominal "full screen" width.

c) ETR 154 and DAVIC quote 363 as an example of 480 x 3/4.

6.3.2.2 Non "full screen"

Here the sequence display extension describes a window (4:3 or 16:9) that surrounds the coded frame.

Table 3 – Non "full screen"

display_horizontal_size	effective horizontal size[a)]	horizontal scaling to fill display of same aspect ratio[b)]	note
720 704	720	1	
544 528	540	4/3	Distinguished from table 2 as display_horizontal_size ≥ horizontal_size
480	480	3/2	
352	360	2	

[a)] Scaling to make display window fill appropriate display is 720/effective horizontal size.

[b)] In other words, to fill a 4:3 display if the aspect ratio information is 0010_2 or 16:9 display if the aspect ratio information is 0011_2.

6.3.3 Constraints on the use of the picture display extension

The picture display extension may be included in broadcasts to define non-zero valued frame centre horizontal offsets.

When provided, receivers shall use this information only when configured to display a 4:3 cut-out from a widescreen source on a 4:3 display. The horizontal offset should be ignored if the material is displayed in a letter box on the 4:3 display.

6.3.3.1 Pan vectors

The term "pan vector" is used in DVB documents (for example ETR 154), however, it is not defined. For the purposes of this specification the term is understood to mean an instance of picture display extension with a non-zero valued frame centre horizontal offset.

ETR 154 forbids the use of pan vectors with a vertical component (sometimes referred to as "scan") i.e. picture display extension with non-zero valued frame centre vertical offsets are not permitted.

6.3.4 Format switching

Receivers complying with this specification shall be able to continue outputting decoded video pictures undisturbed by changes in the video format parameters provided that these changes are constrained as follows:

- changes are implemented at a sequence boundary;
- vertical_size and display_vertical_size remain unchanged;
- the buffer models defined by MPEG are met;
- the field parity of the first displayed field of the new sequence complements that of the last displayed field of the preceding sequence.

Specifically, this allows the following parameters to be changed:

- coded picture width (horizontal_size), and
- coded pixel aspect ratio (aspect_ratio_information, display_horizontal_size).

6.4 Video format signalling extensions

DVB requires receivers to support 16:9 and 4:3 coded video (support for 2,21:1 is optional). However, additional origination formats are prevalent in some countries (such as the 15:9

format Super 16 film) and invented formats (such as 14:9) may be used to accommodate the delivery of mixed formats to a heterogeneous receiver population.

This clause describes how these additional formats may be conveyed compatibly within the standard DVB coded picture formats.

6.4.1 MPEG signalling

The use of the signalling methods within the MPEG video elementary stream is unchanged from that described previously, i.e. the sequence header and the sequence display extension parameters describe either a 16:9 or a 4:3 aspect ratio coded frame that is either one of the full screen formats or a cropped version of one of these.

“Pan vectors” may be included in a broadcast that also uses the active format description. “Pan vectors”, and the active format description provide alternative, mutually exclusive, methods of displaying widescreen material on a 4:3 display.

6.4.2 DVB signalling

The EN 300 468 component descriptor shall be appropriate for the coded frame type of the video, i.e. 4:3 or 16:9 (with or without “Pan vectors”).

6.4.3 Active format description

Active format descriptions as defined in annex B of ETR 154 serve to describe the portion of the 16:9 or 4:3 coded frame that is “of interest”. The format descriptions are informative in nature and are provided to assist receivers to optimise their presentation of video.

Table 4 (copied from ETR 154) illustrates the various formats.

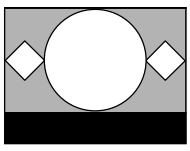
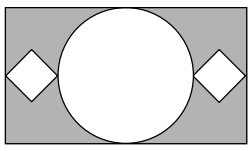
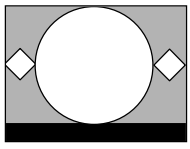
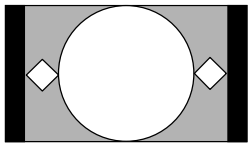
6.4.3.1 Broadcaster rule

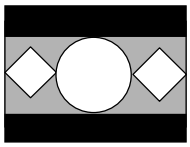
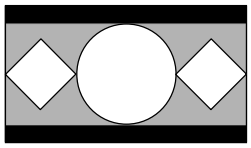
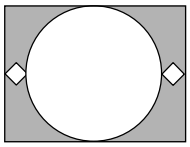
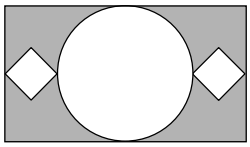
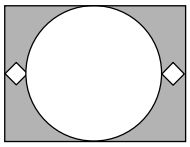
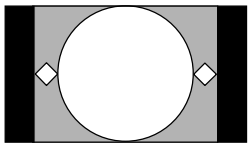
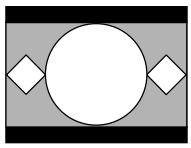
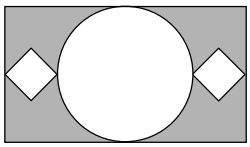
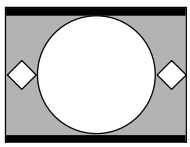
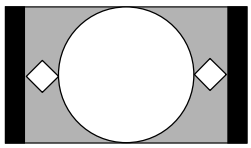
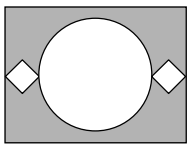
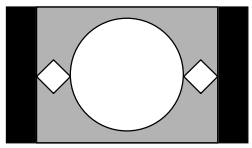
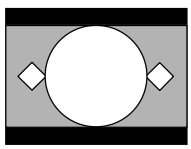
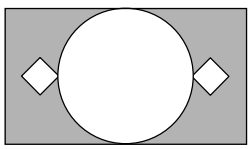
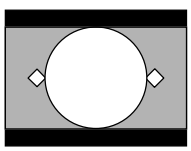
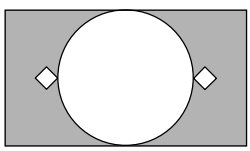
If the area of interest is smaller than the full coded frame then it is recommended to transmit the active format description to indicate the area of interest.

6.4.3.2 Manufacturer rule

It is recommended that receivers use this active format description (if transmitted) to allow optimised presentation.

Table 4 – Formats described by the active_format description

active_format		Full frame aspect ratio	
Value	**Meaning**	**4:3**	**16:9**
0000 – 0001	Reserved for future use		
0010	Box 16:9 (top)		
0011	Box 14:9 (top)		

active_format		Full frame aspect ratio	
Value	**Meaning**	**4:3**	**16:9**
0100	Box > 16:9 (centre)		
0101 – 0111	Reserved for future use		
1000	Active format is the same as the coded frame		
1001	4:3 (centre)		
1010	16:9 (centre)		
1011	14:9 (centre)		
1100	Reserved for future use		
1101	4:3 (with shoot and protect 14:9 centre)		
1110	16:9 (with shoot & protect 14:9 centre)		
1111	16:9 (with shoot & protect 4:3 centre)		

[a] It is recommended to use the 4:3 coded frame mode to transmit 4:3 source material rather than using a pillar box to transmit it in a 16:9 coded frame. This allows for higher horizontal resolution on both 4:3 and 16:9 sets.

6.4.3.3 Receiver processing

6.4.3.3.1 Reference model

The reference model for the video format processing elements in the set top box, TV and integrated digital TV are illustrated in figure 2. The behaviour of the integrated digital TV is logically equivalent to that of a set top box attached to a TV. The display format signalling between the set top box and the display is Line 23 WSS (see 6.4.3.7) and/or peritelevision connector pin 8. Within an integrated digital TV, the signalling is logically equivalent to WSS but could be conveyed by other means.

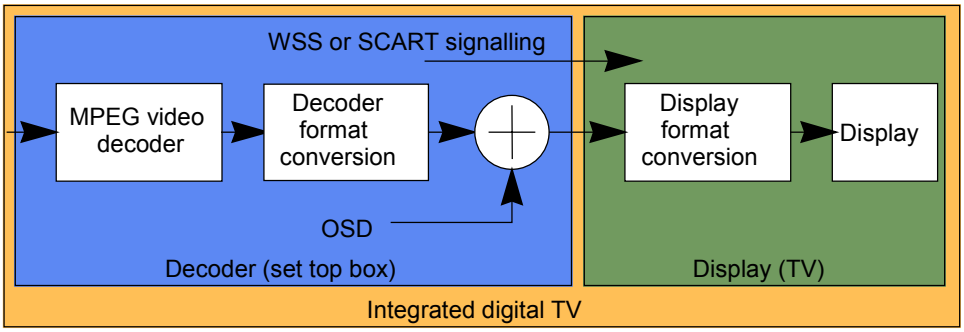


Figure 2 – Receiver and display format processing reference model

In the reference model the output of the MPEG video decoder is logically 720 x 576, the processing applied to this by the decoder format conversion is described in tables 5 and 8. In many practical implementations the processes in the decoder format conversion are an integral part of the MPEG video decoder. This does not affect the logical reference model.

The decoder format conversion is principally concerned with the processing provided in 16:9 displays to accept 4:3 signals.

6.4.3.4 STB with 4:3 display

6.4.3.4.1 STB response

Table 5 shows the response of a set top box to all broadcast formats when connected to a 4:3 aspect ratio display.

Table 5 – Processing by STB connected to 4:3 TV

Broadcast format			STB into 4:3 display		
Description of format	On-air signalling		Decoder format conversion	Signalling to TV	
	MPEG	active_ format		WSS codes for aspect ratio	Peritelevision connector Pin 8
16:9 letter box (top)	4:3	0010	FF	0010	12 V
14:9 letter box (top)		0011		0100	
>16:9 letter box		0100		1011	
4:3		1000		0001	
		1001			
16:9 letter box		1010		1101	
14:9 letter box		1011		1000	
Full 4:3 shoot & protect 14:9		1101		0111	
16:9 LB shoot & protect 14:9		1110		1101	
16:9 (with shoot & protect 4:3 centre)		1111			
16:9 letter box (top)	16:9	0010	According to user preference. See table 6		
14:9 letter box (top)		0011	CCO[a)]	0001	12 V
>16:9 letter box		0100	According to user preference. See table 7		
16:9		1000	According to user preference. See table 6		
4:3 pillar box		1001	CCO	0001	12 V
16:9		1010	According to user preference. See table 6		
14:9 pillar box		1011	CCO[a)]	0001	12 V
4:3 PB shoot & protect 14:9		1101	CCO	0001	12 V
Full 16:9 shoot & protect 14:9		1110	According to user preference. See table 6[b)]		
Full 16:9 shoot & protect 4:3		1111	According to user preference. See table 6		

[a)] Or 14:9 letter box if available.

[b)] A 14:9 letter box is preferable to 16:9 letter box in this case.

Where the active_format code is a reserved value, or the active_format code is absent, the behaviour is as if the active_format code was 1000.

6.4.3.4.2 User preferences for displaying 16:9

4 user preferences for presentation of widescreen material are defined in table 6. In the first three cases, the STB provides processing to format 16:9 video for 4:3 display. In the fourth case, the STB outputs the 16:9 format signal as if it was addressing a 16:9 display. This mode allows a 4:3 display with special features (such as letter box processing) to format the video to its aspect ratio.

Table 6 – User options for displaying 16:9 on 4:3

Selected Mode	Decoder format conversion	WSS codes for aspect ratio	Peritelevision connector Pin 8
16:9 Letter Box	16:9 LB	1101	12 V
14:9 Letter Box	14:9 LB	1000	
Centre Cut-Out	CCO	0001	
Use TV's feature	FF	1110	6 V

6.4.3.4.3 User preferences for displaying >16:9

4 user preferences for presentation of "cinemascope" material (>16:9) are defined in table 7. In the first three cases, the STB provides processing to format >16:9 video for 4:3 display. In the fourth case, the STB outputs the >16:9 format signal as if it was addressing a 16:9 display. This mode allows a 4:3 display with special features (such as letter box processing) to format the video to its aspect ratio.

Table 7 – User options for displaying >16:9 on 4:3

Selected mode	Decoder format conversion	WSS codes for aspect ratio	Peritelevision connector pin 8
16:9 letter box	16:9 LB	1011 (>16:9 LB centre)[a)]	12 V
14:9 letter box	14:9 LB	1101 (16:9 LB centre)[a)]	
Centre cut-out	CCO	1000 (14:9 LB centre)[a)]	
Use TV's feature	FF	1110[b)]	6 V

[a)] The WSS code indicated in this cell probably corresponds to the number of active lines in the output signal of the STB for the material being processed.

[b)] ETS 300 294 does not have a way to indicate the active area being less than full frame for the "16:9 anamorphic" mode.

6.4.3.4.4 Key

FF Full frame

The output of the decoder is the full width & height of the coded frame.

LB Letter Box

The coded frame is reduced to a 16:9 (or 14:9) letter box and presented within a 4:3 raster.

CCO Centre Cut-Out

The central 4:3 aspect ratio region of the 16:9 frame is extracted and output as a 4:3 raster.

6.4.3.4.5 WSS signalling with 4:3 display

Although 4:3 displays generally are not expected to respond to the aspect ratio information WSS codes (see table 9), this signalling is provided to ensure correct behaviour if the video is recorded and then subsequently displayed on a TV that supports WSS.

6.4.3.5 STB with 16:9 display

Table 8 shows the response of a set top box to all broadcast format when connected to a 16:9 aspect ratio display.

Table 8 – Processing by STB connected to 16:9 TV

Broadcast format			STB into 16:9 display		
Description of format	On-air signalling		Decoder format conversion	Signalling to TV	
	MPEG	active_ format		WSS	Peritelevision connector Pin 8
16:9 letter box (top)	4:3	0010	FF	0010	12 V
14:9 letter box (top)		0011		0100	
>16:9 letter box		0100		1011	
4:3		1000		0001	
		1001			
16:9 letter box		1010		1101	
14:9 letter box		1011		1000	
Full 4:3 shoot & protect 14:9		1101		0111	
16:9 letter box shoot & protect 14:9		1110		1101	
16:9 (with shoot & protect 4:3 centre)		1111			
16:9	16:9	0010	FF	1110	6 V
14:9 pillar box		0011			
>16:9 letter box		0100			
16:9		1000			
4:3 pillar box		1001	CCO	0001	12 V
16:9		1010	FF	1110	6 V
14:9 pillar box		1011			
4:3 pillar box shoot & protect 14:9		1101	CCO	0111	12 V
Full 16:9 shoot & protect 14:9		1110	FF	1110	6 V
Full 16:9 shoot & protect 4:3		1111			

6.4.3.6 Integrated 16:9 TV

The response of an integrated 16:9 TV to the broadcast format described in 6.4 should be equivalent to the combined response of a set top box (see 6.4.3.5) and a 16:9 TV.

6.4.3.7 Wide Screen signalling (WSS)

It is recommended to insert WSS according to ETS 300 294/ITU-R BT.1119-2 into the analogue output signal.

6.4.3.7.1 Aspect ratio bits

The aspect ratio bits shall be set according to the previous clauses, with the following meaning (reproduced from ETS 300 294/ITU-R BT.1119-2).

Table 9 – WSS codes for aspect ratio

WSS Code[a] bits 0-3	Description
0001	Full format 4: 3
1000	Box 14:9 centre
0100	Box 14:9 top
1101	Box 16:9 centre
0010	Box 16:9 top
1011	Box > 16:9 centre
0111	Full format 4:3 (shoot and protect 14:9 centre)
1110	Full format 16: 9 anamorphic
[a] This bit ordering follows the ETS specification (i.e. bslbf). The ITU specification writes the bits d_3-d_0. The specifications are identical as in both cases the transmission order is d_0 to d_3.	

6.4.3.7.2 Other WSS bits

The non-aspect ratio bits in the WSS signal (bits b_4...b_{13}) convey additional information. If WSS information is broadcast according to EN 301 775 (see 11.4), the values bits b_4...b_{13} from the broadcast signal can be copied from this information. If no such information is broadcast, the receiver shall set these bits to a meaningful value:

Table 10 – Values for other WSS bits

WSS bit(s)		Value	Comment
b_4	film mode	0	No information regarding field paring is available
b_5	colour coding	0	No Motion Adaptive Colour Plus
b_6	helper	0	No helper signal present
b_7	reserved	0	
b_8	subtitles within teletext	0/1	Set to 1 if DVB SI teletext descriptor with teletext_type=0x02 present
b_9, b_{10}	subtitling mode	00	If no DVB subtitling is inserted
		10/01	If DVB subtitling is inserted, the receiver can deduce whether this subtitling information is placed in the active video part (WSS – see 11.4.2) and/or in the black bar part, and set these bits accordingly
b_{11}	surround sound	0/1	Deduce from DVB SI component descriptor (and MPEG stream_type)
b_{12}, b_{13}	copyright information	...	???

6.4.3.7.3 Additional temporal specification for WSS outputs

If WSS is inserted,

- the WSS shall first be output in line 23 of the first frame to which it applies;
- the same WSS status bits shall be transmitted in each subsequent frame until the video format changes.

6.5 Recommendations for ISO/IEC 13818-1 signalling

As described in ETR 154 the target background grid descriptor and video window descriptor may be used within broadcasts to position the video output within a 720 x 576 display grid.

In addition to this, the position of the video output within the display shall be restricted to even (chroma) pixel and even (field) line ordinates.

6.6 Alignment of video and graphics

6.6.1 Video with graphics

The graphics system used by subtitling addresses a 720 x 576 pixel space. The output of the ISO/IEC 13818-2 video decoder is centred vertically and horizontally within this space after upsampling (see figure 2).

If the result of the upsampling process is *less* than 720 pixels wide then the output of the video decoder shall be centred within the region of 720 active digital video pixels. Also, centring should be used to position the video decoder output vertically within the 576 active lines of the analogue display.

If the result of the upsampling process is *greater* than 720 pixels wide then the output of the video decoder shall be cropped symmetrically to fit within the region of 720 active video pixels.

6.6.2 Uncertainty of position of graphics over video

For some transmission modes, (those labelled with “According to user preference” in table 5), the user is free to choose the processing in the block “Decoder Format Conversion” in figure 2.

Since the insertion of graphics (for example subtitles) is performed after this block, such a choice will influence the positioning of graphics relative to the video signal, as made apparent by the following example (illustrated in figure 3):

Consider a broadcast of 16:9 material with subtitles (top row in the figure) and three viewers, one with a 16:9 set and two with 4:3 sets. The viewer with the 16:9 set sees the entire video frame (the second row in the figure). The first 4:3 viewer has selected the “centre cut out” mode (the third row), while the second 4:3 viewer has selected the “letterbox” mode (the fourth row).

As becomes apparent from the figure, the area of video obscured by the subtitles is different for each of these viewing modes.

Broadcasters shall be aware of this uncertainty.

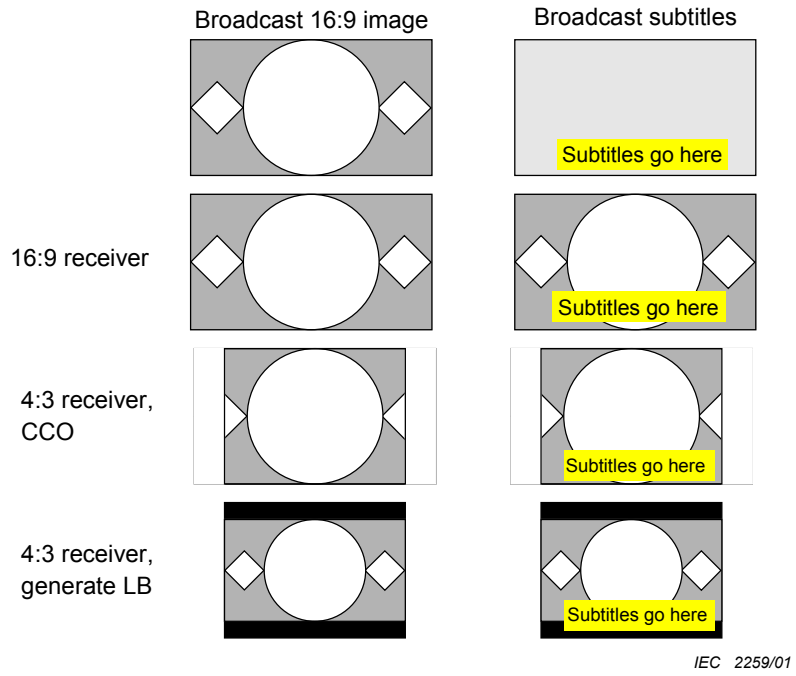


Figure 3 – Uncertainty of positioning graphics over video

7 Audio system characteristics

7.1 Introduction

This clause, based on D-Book version 3.0, defines the digital audio encoding standards that shall be used in all broadcasts.

7.2 Essential requirements

All audio components of the broadcast shall be encoded according to ISO/IEC 13818-3 constrained according to ETR 154.

7.2.1 Scope of requirements

These requirements on audio signals apply to applications including, but not limited to, those listed below:

- primary and other language audio channels for television programmes;
- audio only 'radio' services;
- audio description (for the visually impaired);
- clean dialogue (for the hearing impaired).

7.2.2 Synchronisation

The A/V synchronisation in radiated signals shall be according to ITU-R BT.1359-1.

Receivers are recommended not to introduce more than ±5 ms relative delay between the video and any audio component (relative to the times indicated by their respective PTSs).

NOTE Set top boxes are not required to accommodate any additional relative delay introduced by the TV that presents the signal to the user.

Where additional independent audio components are decoded from the same service (for example normal programme audio and audio description or normal programme and clean commentary) receivers should not introduce more than ±5 ms of relative delay between the audio components.

7.2.3 Decoding requirements

All receivers shall provide at least one audio decoder able to meet the minimum decoding requirements set out in above. Preferably receivers should implement more than one audio decoder to enable, for example, the concurrent decoding of both the normal audio and the audio description for a television programme. See 7.4.2.

7.3 Constraints and extensions

7.3.1 Surround sound

7.3.1.1 Digitally coded

Surround sound may optionally be provided as a digital multichannel audio service component, thereby giving freedom of artistic exploitation to the programme makers. The allocation of channels, particularly for a 5.1 digital multichannel service is given in ITU-R BS.775-1.

7.3.1.2 Surround sound

Multichannel audio signals may optionally be matrixed onto suitably coded MPEG audio stereo signals to generate a service which can be decoded using surround sound decoders. Provision of surround sound decoders in receivers is optional.

7.4 Audio description

7.4.1 Background (informative)

Audio description is an “ancillary service” primarily provided for the visual impaired. It provides a spoken description of the video component of a service.

NOTE Provision of audio description for a proportion of programmes is a licence requirement for digital terrestrial broadcasts in the UK.

The audio description is delivered as a mono audio stream in addition to the normal programme audio. This clause specifies the coding of this audio stream and provides background on how receiving equipment might operate.

7.4.2 Receiver implementation minima

Receivers are recommended to provide at least one method to deliver audio description to viewers.

The preferred method is to provide two audio decoders, as illustrated in figure 4. These could be implemented on a module connected via the common interface.

7.4.3 Signalling

This clause is principally concerned with the signalling used to implement the programme provider control of programme volume. Other controls, and the method for presentation of the “described” and/or “standard” sound outputs are addressed for information below.

7.4.3.1 Level control

Three contributions to the “described” output sound level can be identified. These are illustrated in Figure 4.

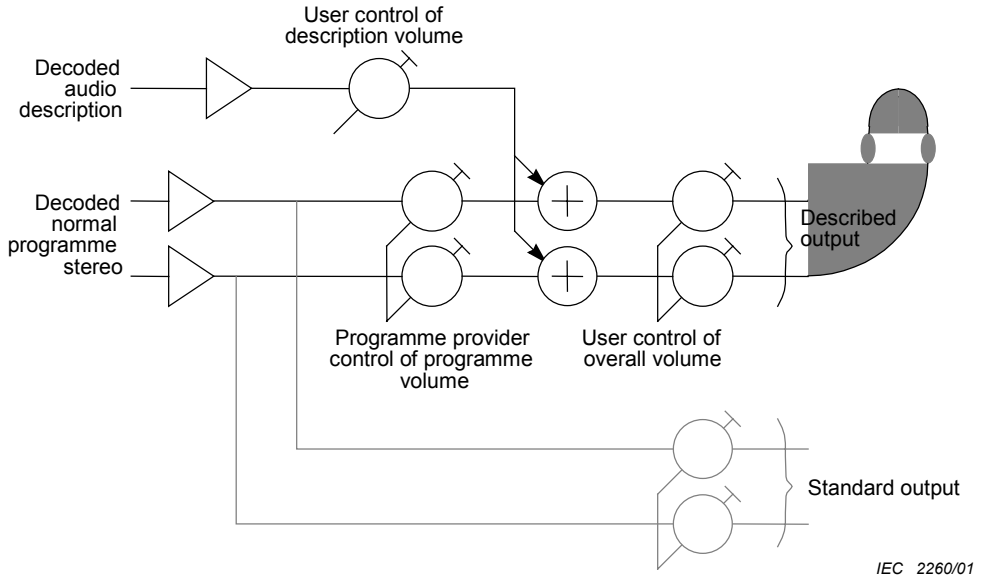


Figure 4 – Illustration of control of audio level

7.4.3.2 Placement control

Signalling is provided to allow the broadcaster to place the “describer” at any preferred horizontal position within the sound field (speech from out-of-vision commentators is often placed to one side in the stereo image).

7.4.3.3 Syntax & semantics

Audio description streams shall carry the audio description descriptor defined in table 11 in their PES_private_data field of the PES packet header.

Table 11 – Audio description descriptor

Syntax	Value	Data	Comment
AD_descriptor(){			
reserved	1111	4 bslbf	
AD_descriptor_length	1000	4 bslbf	
AD_text_tag	0x4454474144	40 bslbf	6 byte string
AD_revision_tag	0x01	8 bslbf	
AD_fade_byte	0xYY	8 bslbf	FADE byte
AD_pan_byte	0xYY	8 bslbf	PAN byte
reserved	0xFFFFFFFFFFFFF	56 bslbf	
}			

7.4.3.3.1 AD_descriptor_length

The descriptor length gives the number of significant bytes following the length field (i.e. 8).

7.4.3.3.2 AD_text_tag

The tag is a 5 character string of ASCII characters as a simple and unambiguous means of distinguishing this from any other PES_private_data.

If a receiver does not recognise this tag it should ignore the audio description stream carrying it.

7.4.3.3.3 AD_revision_tag

The tag is extended by a 1 byte version designator.

Descriptors with the same text tag (0x4454474144) but a higher revision tag shall be backwards compatible with this specification, i.e. the syntax and semantics of the fade and pan byte fields will be identical but additionally some of the reserved bytes may be used for new signalling.

Receivers recognising the main text tag but an earlier revision (lower tag value) should decode the stream based on the fields of the descriptor that it understands and should ignore any additional parameters.

7.4.3.3.4 AD_fade_byte

The fade byte takes values between 0x00, representing no fade of the normal programme sound, and 0xFF, representing no normal programme sound.

Over the range 0x00 to 0xFE one lsb of this field represents an attenuation step of approximately 0,3 dB giving a range of about 77 dB. 0xFF represents no normal programme sound.

7.4.3.3.5 AD_pan_byte

The pan byte takes values between 0x00, representing a central forward presentation of the audio description, and 0xFF, each increment representing a $^{360}/_{256}$ degree (~1,4°) step clockwise looking down on the listener. See figure 5.

7.4.3.3.6 Reserved

The remaining 7 bytes of the PES_private_data field are set to 0xFF and reserved for future use.

7.4.3.4 Example

When including this descriptor in an audio stream PES-packet, the PES-packet header syntax will be as shown in table 12.

Table 12 – Illustration of PES packet header

Syntax	Value	Data	Comment
Packet_start_code_prefix	0x000001	24 bslbf	
stream_id	0xYY	8 uimsbf	Actually '110ZZZZ'
PES_packet_length	0xYYYY	16 uimsbf	As appropriate
'10'	10	2 bslbf	
PES_scrambling_control	YY	2 bslbf	As appropriate
PES_priority	Y	1 bslbf	
data_alignment_indicator	Y	1 bslbf	
copyright	Y	1 bslbf	
original_or_copy	Y	1 bslbf	
PTS_DTS_flags	10	2 bslbf	If PTS present
ESCR_flag	0	1 bslbf	
ES_rate_flag	Y	1 bslbf	As appropriate
DSM_trick_mode_flag	0	1 bslbf	
additional_copy_info_flag	0	1 bslbf	
PES_CRC_flag	Y	1 bslbf	As appropriate
PES_extension_flag	1	1 bslbf	
PES_header_data_length	0xYY	8 uimsbf	As appropriate
'0010'	0010	4 bslbf	
PTS[32..30]	YYY	3 bslbf	As appropriate
'1'	1	1 bslbf	
PTS[29..15]	YYYYYYYYYYYYYYY	15 bslbf	As appropriate
'1'	1	1 bslbf	
PTS[14..0]	YYYYYYYYYYYYYYY	15 bslbf	As appropriate
'1'	1	1 bslbf	
if (ES_rate_flag ==1'1') {etc.}			
if (PES_CRC_flag ==1'1') {etc.}			
PES_private_data_flag	1	1 bslbf	
pack_header_field_flag	0	1 bslbf	
program_packet_sequence_counter_flag	0	1 bslbf	
P-STD_buffer_flag	0	1 bslbf	
reserved	111	3 bslbf	
PES_extension_flag_2	0	1 bslbf	
AD_descriptor(){			
reserved	1111	4 bslbf	
AD_descriptor_length	1000	4 bslbf	In version 1
AD_text_tag	0x4454474144	40 bslbf	6 byte string
AD_revision_tag	0x01	8 bslbf	
AD_fade_byte	0xYY	8 bslbf	FADE byte
AD_pan_byte	0xYY	8 bslbf	PAN byte
reserved	0xFFFFFFFFFFFFFF	56 bslbf	
}			
for (i=0; i<N1; i++) {			
stuffing_byte			If required
}			
// and now follows the PES data //			

7.4.3.5 Interpretation of pan information

The definition of "pan" is compatible with future systems that might employ digital multi-channel surround sound for normal programme audio. Where the normal programme audio is stereo, the range of values for "pan" are limited to the interval 0xEB…0x00…0x15.

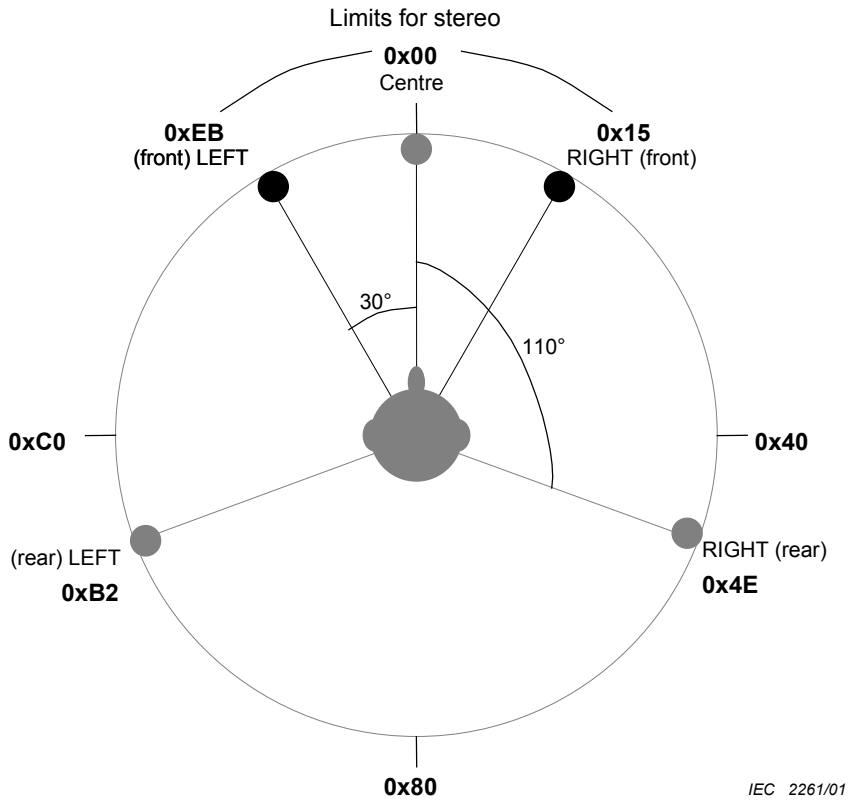


Figure 5 – Mapping of pan byte onto sound presentation

7.4.4 Constraints on audio description stream coding

The audio description stream shall comply with ETR 154 constrained as follows: it shall be encoded as a mono MPEG-1 layer II audio.

7.4.5 Implementation notes

7.4.5.1 Default states and error conditions

Unless signalling in a selected audio description stream indicates otherwise, the normal programme audio should be output without attenuation.

Receivers may ignore the pan information, but if they do so they must position the audio description centrally (i.e. as if pan byte = 0x00).

7.4.5.2 Time of application

All PES packets conveying audio description audio streams shall include an audio description descriptor. The value of fade and pan byte in any PES packet shall apply to all access units commencing within that PES packet.

7.4.5.2.1 Error resilience (informative)

If due to some fault or error condition the audio description descriptor is absent or recognisably corrupted, the receiver should revert to the default state (fade = 0x00, pan = 0x00) after a suitable delay.

7.4.5.2.2 Attack and decay (informative)

Values for “fade” will be transmitted 5 to 10 times per second. This allows the service provider to signal gradual changes of “fade”. Receivers should not implement any additional time constants.

7.4.5.3 Approximation of pan and fade (informative)

7.4.5.3.1 Pan

Receivers may ignore pan information completely. See 7.4.5.1.

7.4.5.3.2 Fade

Receivers may treat all non-zero values of fade as 0xFF, i.e. completely replacing the normal programme audio with audio description when fade is non-zero. This allows audio description and normal programme audio to be decoded with a single audio decoder. However, this is not the preferred implementation.

7.4.5.4 Equalisation of delays (informative)

In certain implementations, for example where the audio description AND normal programme audio are decoded and mixed by a in decoder addition to the normal decoder of the receiver, the listener may be exposed to normal programme audio from two different decoders. It is desirable to minimise or prevent exposing the listener to differential delays of this kind.

7.4.5.5 Implementation routes (informative)

The approach shown in Figure 4 uses two audio decoders (either integrated within a receiver or added in an ancillary decoder module). This is the implementation assumed by service providers.

Figure 6 illustrates an alternative low cost approach where a single decoder can be switched between the normal and description audio streams when ‘fade’ is non-zero.

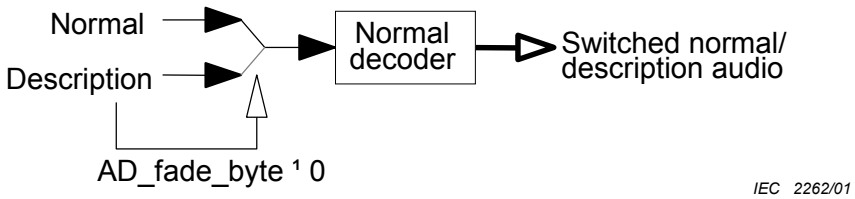


Figure 6 – The “cold-cut” approach

Figures 7 and 8 illustrate a number of alternative approaches where a single decoder in an ancillary decoder module augments the normal decoder in the receiver.

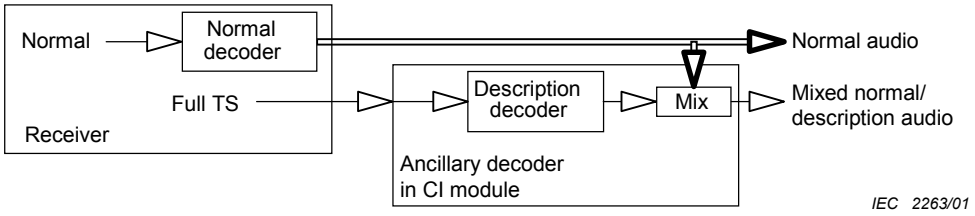


Figure 7 – Generic single external decoder approach

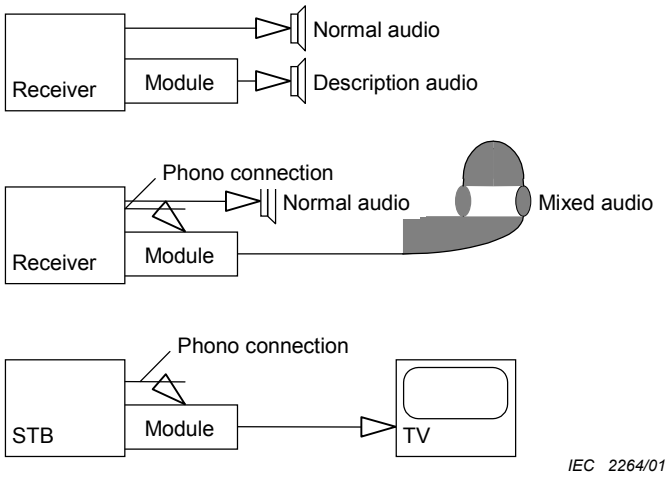


Figure 8 – Possible single external decoder approaches

7.5 Audio only services

It is recommended that if a service only contains an audio component, the receiver should display a banner to indicate the programme or service name.

NOTE However, receivers in “radio mode” may have no functioning display so SI messages such as this may not be presented to the user.

7.6 PSI signalling

The normal programme audio stream and the audio description stream shall be distinguished by signalling in the PSI Program Map table (PMT). In the ISO_639_language_descriptor for normal programme sound, the value of the audio_type field shall be 0x00 (undefined). In the ISO_639_language_descriptor for audio description, the value of the audio_type field shall be 0x03 (visual impaired commentary).

8 Multiplex and transport stream characteristics

8.1 Scope

This clause, based on D-Book version 3.0, defines the transport stream standards that shall be used in all broadcasts.

8.2 Essential requirements

8.2.1 Multiplexing

The multiplexing of baseband signals and associated data conforms to ISO/IEC 13818-1 constrained according to ETR 154.

The PID and section filtering requirements for all broadcasts shall be such that they can be received by receivers meeting the requirements set out below.

8.2.1.1 Multiplex flexing

Broadcasts may instantaneously alter the bit rate allocated to program components or services provided that at all times the multiplex, and the streams within it, continue to comply the with the buffer models defined for them in ISO/IEC 13818-1, ISO/IEC 13818-2, ISO/IEC 13818-3 etc.

NOTE This enables the dynamic allocation of capacity between elementary streams within the transport multiplex. This allows the broadcaster freedom to trade technical quality and quantity of programme services within a

multiplex or to use instantaneous “statistical multiplexing” to allow the best use of capacity between multiple programme services by varying the bit-rate occupied by any programme elementary stream to suit instantaneous demand.

8.2.2 Demultiplexing

All receivers shall be able to meet the minimum demultiplexing requirements set out in ETR 154.

8.2.2.1 Data rates

A receiver should be able to demultiplex ISO/IEC 13818-1 transport streams with data rates of at least 58 Mbit/s.

NOTE While the theoretical maximum payload supported by the DVB terrestrial specification is 31,67 Mbit/s, receivers may include the capability to accept transport streams which have higher rates, via other means.

8.2.2.2 Errors

Receivers shall implement a suitable error concealment or error recovery mechanism on receipt of transport packet errors.

8.2.2.3 PID filters

Receivers shall be able to demultiplex at least 32 different PIDs simultaneously in order to receive any single service.

8.2.2.4 Section filters

Receivers shall be able to implement at least 32 simultaneous section filters, each applying a filter specification to bytes 1 and 4 to 10 of the section, where each bit in the filter is individually maskable. It shall be possible to apply all 32 section filters to each section.

8.2.2.5 Burst rate

The throughput of each PID/section filter shall be at least 5 Mbps (peak burst rate measured over 1 ms).

8.2.2.6 Scrambling control bits

The receiver shall respond appropriately to the DVB use of the transport scrambling control bits defined in ETR 289.

8.3 Constraints and extensions

8.3.1 Multicomponent programs

8.3.1.1 Compatible views

Where the PMT carries more than one audio or video elementary stream for a program they shall provide alternative, but compatible, “views” of a single event. For “simple” receivers this presents the viewer with a choice. However, future receivers may have the ability to decode more than one video or audio component for simultaneous presentation to the viewer.

8.3.1.2 Incompatible views

Where a broadcaster wishes to present an “incompatible” viewing alternative this shall be done as separate programs/services, not as alternative “views” within a single program.

8.3.1.3 Ordering the PMT

The ordering of elementary streams within the PMT is not significant. The selection of an appropriate set of components from a program is facilitated by descriptors in the PMT and the EIT.

9 Service and program specific information

9.1 Introduction

This edition of specification addresses navigation and selection of traditional TV services and their traditional ancillary components (teletext and subtitles). Future and more specialist technologies such as data broadcasting and interactive applications are not considered in this edition. This specification considers broadcasts intended for stationary reception, the SI supporting mobile reception is not considered in this edition.

This clause covers the following topics:

- SI & PSI specification.

  Summarises the requirements on the signalling transmitted by the broadcaster and how the receiver should respond.

- Receiver functions.

  Describes the essential features that all receivers shall provide to give users effective access to the broadcast services considered in this specification.

- Establishing and maintaining the network connection.

Describes how a receiver should understand the broadcast signalling when:

  – first connecting to a network, and when

  – the characteristics of the network change.

- User interface.

  Provides recommendations and ideas to receiver manufacturers on what SI information to present to users and how to present it.

9.1.1 General requirements

Adherence to the DVB SI specification EN 300 468 and the guidelines for its use ETR 211 and on the MPEG systems specification ISO/IEC 13818-1 and the DVB guidelines for its use ETR 154.

9.1.2 General receiver requirements

9.1.2.1 Mandatory signalling

Certain of the SI and PSI are designated as “mandatory to understand”. This indicates signalling that it is essential for the receiver to decode and interpret in order to be able to operate correctly.

9.1.2.2 Unrecognised signalling

Receivers should skip parts of the signalling that they don’t “understand”. The objective of this policy is to enable receivers to continue operating under signals from future versions of this specification or where signals compatible with a version of this specification are extended in a compatible private way.

In particular:

- Receivers shall skip unrecognised descriptors

- Receivers shall skip unrecognised user or private fields in public descriptors
- Receivers shall skip any unexpected additional payload in decriptors that they recognise (i.e where the length of a descriptor is longer than they expect, they shall skip any bytes after the expected length).

9.1.3 General broadcaster requirements

9.1.3.1 PSI information

PSI information is critical to the correct decoding of transport streams. Therefore broadcasters shall follow the rules on how to use PSI information strictly in accordance with this specification.

9.1.3.2 SI information

SI information is intended to be presented to the user (for example service name and event description), or assist in automating the user interface (for example language information and network information). This specification defines rules on how receivers shall present information to the user while leaving a substantial degree of freedom for individual manufacturers to define their implementation.

Broadcasters should provide meaningful SI information such that the user interface of a receiver can function properly in the eyes of the end user. In particular this means that all descriptors used should contain meaningful data. In case of any automated function in the receiver described in this specification, the receiver shall rely on SI information being in accordance with this specification. This implies that specific SI information should be consistent and correct so as not to confuse the receiver or the end user. Applicable rules to this extent have been indicated as broadcaster requirements.

9.1.3.3 DVB compliance

Services outside of the scope of this specification should be signalled in accordance with the appropriate DVB specifications. For example data broadcasts may be identified by the inclusion of the data broadcast descriptor in the SDT.

NOTE Receivers are not required to provide access to these more advanced services. However, if broadcasters observe the appropriate DVB specifications, these services should not disturb older or lower specification receivers and can be available to newer or higher specification receivers at the manufacturer's discretion.

9.1.3.4 Quasi Static elements

The definition "quasi static" is applied to certain elements of the broadcast. The expectation is that these elements only change infrequently, for example when new services are introduced (for example changes are annual rather than daily events).

NOTE Changes to parameters identified as "quasi static" may require user attention. For example, the user may be invited to review their favourite service ordering when a new service is introduced. If this happens very frequently it will not be helpful to the user.

9.1.4 Notation

Table 13 – Key to symbols

Meaning	Specification applies to	
	Broadcast	Receiver
Mandatory to broadcast – this shall be present in all broadcasts	M	
Mandatory to understand – receivers are required to understand and act on this item		m
Conditional to broadcast – this shall be present if certain criteria are met (for example, certain signalling is required for CA controlled services)	C	
Recommended to broadcast – inclusion of this item improves the usefulness of broadcasts to receivers and allows them to provide better facilities to users. It is preferable for broadcasts to include this. However receivers shall be able to work correctly without this information	R	
Optional to broadcast – this item is allowed in broadcasts and has a defined meaning. However, receivers shall be able to work correctly without it	O	
Undefined to broadcast – this item is allowed in broadcasts but has no defined use within this specification. Receivers should ignore this information unless they are designed with information from other specifications that define its use	U	
Forbidden to broadcast – this item is not allowed in broadcasts as it may cause confusion to receivers that conform to this specification	F	

9.2 SI & PSI Specification

9.2.1 Summary

9.2.1.1 Minimum broadcast profile

Table 14 summarises the requirements for inclusion of commonly defined tables in the PSI and SI of every broadcast stream of the same network. The subsequent subclauses provide more detail.

Table 14 – Summary of required tables

Table	Actual	Other
Program association table	M m	N/A
Program map table	M m	N/A
Conditional access table	C	N/A
Network information table (see 9.2.1.1.2)	M m	O
Bouquet association table	U	U
Service description table	M m	M m
Event information table present/following (see 9.2.1.1.1)	M m	M m
Event information table schedule	O	O
Time and date table	M m	N/A
Time offset table	R m	N/A
Running status table	U	N/A

9.2.1.1.1 EIT

Provision of EIT information is mandatory for all services where the EIT_present_following_flag is set to “1”.

9.2.1.1.2 NIT_{other}

In certain environments transmission of NIT_{other} may be more valuable than others. For example, where MFN cells overlap with a SFN transmission, the NIT_{other} may be useful, as it provides cross carriage between networks that are likely to be available at the same place.

9.2.2 Program association table

9.2.2.1 Minimum broadcast profile

This table shall be included in all transport streams to meet the requirements of ISO/IEC 13818-1 and ETR 154.

9.2.2.2 Minimum receiver functionality

Receivers shall respond to this table to meet the requirements of ISO/IEC 13818-1 and ETR 154.

9.2.2.2.1 Dynamic signalling

The PAT as described in ISO/IEC 13818-1 is a dynamic table. As such it may change frequently. The receiver shall correctly reflect these changes.

It may not always be possible for receivers to respond seamlessly to such changes. However, the duration and magnitude of any disturbance should be no worse than that experienced when the user changes service.

9.2.3 Program map table

9.2.3.1 Minimum broadcast profile

This table shall be included for each service in each transport stream to meet the requirements of ISO/IEC 13818-1 and ETR 154. It shall carry descriptors to meet the requirements of ISO/IEC 13818-1, ETR 154, EN 300 468 and ETR 211.

Table 15 – Program descriptors

Descriptor	Tag	Status
Conditional access descriptor	0x09	C
Private data specifier descriptor	0x5F	C

Table 16 – Elementary streams descriptors

Component	Descriptor	Tag	Status
Any	Stream identifier descriptor	0x52	C m
	Conditional access descriptor	0x09	C
	Private data specifier descriptor	0x5F	O
Audio	ISO 639 language descriptor	0x0A	C m
DVB Subtitles	Subtitling descriptor	0x59	C m
Teletext	Teletext descriptor	0x56	C m

9.2.3.1.1 Stream identifier descriptor

Stream identifier descriptors shall be added in at least the minimum cases specified by ETR 211.

9.2.3.1.2 Conditional access descriptor

The conditional access descriptor shall be included in at least the cases specified by ISO/IEC 13818-1.

9.2.3.1.3 ISO 639 language descriptor

This descriptor shall be provided for each audio component if more than one audio component is present. As defined by ISO/IEC 13818-1, this descriptor identifies the language of the audio stream and also the purpose of the stream via the audio_type field. The audio_type 'undefined' shall be used to designate normal program audio.

9.2.3.1.4 Subtitling descriptor

This descriptor shall be provided for any DVB subtitle components (see clause 10). Its use is as defined in EN 300 468.

9.2.3.1.5 Teletext descriptor/VBI data descriptor

One of these descriptors shall be provided for any teletext/VBI data component (see clause 11). Its use is as defined in EN 300 468, ETR 211.

9.2.3.1.6 Download signalling

Download signalling specific to the network, such as a data broadcast ID descriptor, may be included in the PMT. This specification does not address this signalling. However, broadcasters are required to ensure that it is not easily confused with other signalling. Receivers should not respond to such signalling unless it is intended for them. See annex C.

9.2.3.2 Minimum receiver functionality

In addition to the summary below, see also 9.3.2.

9.2.3.2.1 Video

If a video component is present receivers shall start presenting it on selection of the service. If there is more than one video component present the receiver shall provide the user with a method to select between the streams.

9.2.3.2.2 Audio

If an audio component is present, receivers shall start presenting it on selection of the service.

If there is more than one audio component present, the receiver shall attempt to present the stream(s) that best meet the users preferences. See 9.3.2.2.

9.2.3.2.3 DVB subtitles

See 9.3.2.3.

9.2.3.2.4 Teletext

See 9.3.2.4.

9.2.3.2.5 Multiple components of the same type

The PMT may contain multiple instances of components with identical signalling. For example, multiple audio components with the same stream type, language and audio_type.

The receiver behaviour in this circumstance is implementation dependant.

9.2.3.2.6 Dynamic signalling

The PMT as described in ISO/IEC 13818-1 is a dynamic table. As such it may change frequently. The receiver shall correctly reflect these changes.

It may not always be possible for receivers to respond seamlessly to such changes. However, the duration and magnitude of any disturbance should be no worse than that experienced when the user changes service.

9.2.4 Conditional access table

9.2.4.1 Minimum broadcast profile

This table shall be included when one or more components of the transport stream is CA controlled to meet the requirements of ISO/IEC 13818-1.

9.2.4.2 Minimum receiver functionality

This data is CA system specific and therefore outside the scope of this specification.

9.2.5 Network information table

9.2.5.1 Minimum broadcast profile

This table shall be included to meet the requirements of ISO/IEC 13818-1, EN 300 468 and ETR 211. In particular, description of all transport streams in the ‘actual’ network is mandatory. Only one exact NIT ‘actual’ shall be in each transport stream.

The NIT shall carry descriptors to meet the requirements of EN 300 468 and ETR 211.

9.2.5.1.1 Quasi static information

All of the information in the NIT is quasi static (see 9.1.3). Changes in this information are typically associated with evolution of the network, for example, the introduction of new relay transmitters or new services.

The service_list_descriptor in the NIT carries information about services in other transport streams. Changes in the set of services in the network are reflected in this service list. Such changes are expected to be infrequent.

9.2.5.1.2 Network descriptors (first loop)

Table 17 – Network descriptors (first loop)

Descriptor	Tag	Status	
		Actual	Other
Network name descriptor	0x40	M m	M m
Multilingual network name descriptor	0x5B	O m	O m
Linkage descriptor	0x4A	C	C
Private data specifier descriptor	0x5F	C	C
Eacem stream identifier descriptor	0x86	R	O

9.2.5.1.2.1 Linkage descriptors

Where the network provides a multiplex that carries EIT schedule information for all of the services in the network (a “barker” service), then broadcasts shall include a single linkage

descriptor of type 4 (“TS containing complete Network/Bouquet SI”) to identify the location of this additional SI. Linkage descriptors of type 4 shall not be included unless at least this SI information is provided on the referenced multiplex.

Linkage descriptors with other type values are undefined in this location.

9.2.5.1.2.2 Eacem stream identifier descriptor

This descriptor provides a high level signal indicating that all of the service information for a network complies with this specification. Transmission of this descriptor is recommended (when conforming to this specification) because the receiver can “behave in a more reliable way” when this descriptor is seen in incoming streams.

NOTE For example, when presenting extended event information, receivers can rely on the semantic defined under 9.2.8 that extended information complements the information in the short event descriptor.

9.2.5.1.2.3 Download signalling

Download signalling specific to the network, such as a linkage descriptor, may be included in the NIT. This specification does not address this signalling. However, broadcasters are required to ensure that it is not easily confused with other signalling. Receivers should not respond to such signalling unless it is intended for them. See annex C.

9.2.5.1.3 Transport stream descriptors (second loop)

Table 18 – Transport stream descriptors (second loop)

Descriptor	See also	Tag	Status	
			Actual	Other
Terrestrial delivery system descriptor		0x5A	M	M
Frequency list descriptor		0x62	R	R
Service list descriptor		0x41	M	M
Private data specifier descriptor	9.2.11.1	0x5F	C	C
Logical channel descriptor	9.2.11.2.2	0x83	O	O

9.2.5.1.3.1 Cross carriage of SI

The NIT_{actual} lists all of the transport streams and services in the actual network (i.e. the network of which this transport stream is part).

There is no requirement to cross-carry information about other networks. However, if such information is carried, it shall be complete.

9.2.5.1.3.2 Frequency list descriptor

This descriptor should be included for terrestrial delivery systems where the same transport stream is transmitted on more than one frequency.

Where included, it shall provide a complete list of alternative frequencies and shall be structured as recommended by ETR 211.

9.2.5.1.3.3 Logical channel descriptor

This descriptor may optionally be included in broadcasts to provide a default channel number label for services. See 9.2.11.2.2.

9.2.5.2 Minimum receiver functionality

See 9.4.

9.2.5.2.1 Linkage descriptor

Receivers are not required to take advantage of linkage descriptors.

9.2.6 Bouquet association table

No additional semantics are defined on this table.

NOTE There is no requirement for receivers to provide features based on this table.

9.2.7 Service description table

9.2.7.1 Minimum broadcast profile

This table shall be included to meet the requirements of EN 300 468 and ETR 211. The SDT shall carry descriptors to meet the requirements of EN 300 468 and ETR 211.

9.2.7.1.1 Quasi static information

Much of the information in the SDT is quasi static (see 9.1.3). Changes in this information are typically associated with evolution of the network, for example, the introduction of new services.

The following descriptors shall be quasi-static (when present):

- service_descriptor
- multilingual_service_name_descriptor
- preferred_name_list_descriptor

The running status of the service is not quasi static and may change frequently. Also, any linkage descriptor of type 5 (service replacement service) are not quasi static.

Table 19 – Service descriptors

Descriptor	See also	Tag	Status	
			Actual	Other
CA identifier descriptor		0x53	C	C
Service descriptor	9.5.1.1	0x48	M m	M m
Multilingual service descriptor	9.5.1.1	0x5D	O m	O m
NVOD reference descriptor		0x4B	F	F
Time shifted service descriptor		0x4C	F	F
Private data specifier descriptor	9.2.11.1	0x5F	C	C
Mosaic descriptor		0x51	O	O
Linkage descriptor		0x4A	O	O
Preferred name list descriptor	9.2.11.2.3	0x84	O	O

The requirements below are in addition to those listed in EN 300 468 and ETR 211.

9.2.7.1.2 Cross carriage of SI

The SDT_{actual} and SDT_{other} shall list all of the services for all of the transport streams of the actual network.

The description of a service in the SDT_{other} of other transport streams shall be identical to the description of that service in the SDT_{actual} in the transport stream that carries it.

9.2.7.1.3 CA identifier descriptor

The CA identifier descriptor shall be included if scrambling is generally applied to the service.

NOTE Service providers should be aware that some receivers may have a user option to conceal CA controlled services that are not compatible with the CA systems available to the receiver. So, services that are only infrequently scrambled should not be identified with a CA identifier descriptor.

9.2.7.1.4 Linkage descriptor

Where the network provides one or more services which are not always in the “running”[1] state, broadcasters can optionally include a linkage descriptor of type 5 (service replacement service) for those services, to identify a service that can be presented if a receiver selects this service at a time when the it is labelled as “not running”.

Linkage descriptors with other type values are undefined in this location.

Broadcasters should be aware of some of the consequences from the prescribed receiver behaviour for this service replacement linkage descriptor (see 9.3.2.6.1) when using this descriptor:

The receiver will not follow the linkage descriptor:

- if the replacement service is in a multiplex not receivable at the receiver’s location.
- when the replacement service is “not running” (irrespective of a potential service linkage descriptor accompanying this replacement service).

When the original service becomes “running” again, the receiver will switch back immediately to this original service. Broadcasters are advised to broadcast audio-visual signals on the original and replacement services in such a manner that this switchback is perceived logically by and is comprehensible to the viewer.

In case the original service and the replacement service are in different multiplexes, and when the SDT_{other} containing the information of the original service is not cross-carried into the multiplex of the replacement service, this automatic switch-back will not occur, as the receiver cannot monitor the status of the original service.

Broadcasters are urged to prevent cyclic loops of non-running services with linkage descriptors of type 5 pointing to other non-running services.

9.2.7.1.5 NVoD Services

NVoD reference descriptor and time shifted service descriptor are not supported in this specification. Each component of an NVoD service can however be described as a normal service.

NOTE The reasons for this deprecation are:
- that the NVoD use of DVB SI is not backwards compatible with traditional SI;
- it requires further technical precision to ensure interoperability;
- NVoD is generally uneconomic in the bandwidth constrained terrestrial environment.

[1] The term “running” in this context means user recognisable service content, as distinct from service maintenance content such as software update download.

9.2.7.1.6 Download signalling

Download signalling specific to the network, such as a data broadcast descriptor, may be included in the SDT. This specification does not address this signalling. However, broadcasters are required to ensure that it is not easily confused with other signalling. Receivers should not respond to such signalling unless it is intended for them. See annex C.

9.2.7.2 Minimum receiver functionality

See 9.4.

9.2.7.2.1 Service types

Receivers should only list a service in their service selection interfaces where the service is of a type that the receiver is able to present to the user.

NOTE Users may be confused or frustrated if the receiver presents for selection services that are not decodable by the receiver (such as future interactive services) or are not intended for user selection (such as receiver firmware update broadcasts).

Receivers are required to support at least the following service types:

type = 0x01, digital television service

type = 0x02, digital radio sound service

Support for other service types (for example type = 0x06, mosaic service) is optional.

9.2.8 Event information table

9.2.8.1 Minimum broadcast profile

This table shall be included to meet the requirements of EN 300 468 and ETR 211. The EIT shall carry descriptors to meet the requirements of EN 300 468 and ETR 211.

Table 20 – Event information descriptors

Descriptor	See also	Tag	Status			
			Present/following		Schedule[a)]	
			Act	Oth	Act	Oth
short event descriptor	9.5.1.1	0x4D	M m	M m	M	M
extended event descriptor		0x4E	O	O	O	O
component descriptor	9.5.1.1	0x50	M	M	O	O
CA identifier descriptor		0x53	C	C	C	C
content descriptor		0x54	R	R	R	R
multi lingual component descriptor	9.5.1.1	0x5E	O	O	O	O
parental rating descriptor		0x55	O	O	O	O
time shifted event descriptor		0x4F	F	F	F	F
private data specifier descriptor	9.2.11.1	0x5F	C	C	C	C
PDC descriptor	B.2	0x69	C	C	C	C
Preferred name identifier descriptor	9.2.11.2.4	0x85	O	O	O	O

[a)] It is optional for broadcasts to include EIT schedule information. However, if EIT schedule information is present, then it shall be as specified here.

The requirements below are in addition to those listed in EN 300 468 and ETR 211.

9.2.8.1.1 Cross carriage of SI

All broadcasts shall carry $EIT_{present}$ and $EIT_{following}$ information for ALL services in the actual network.

The description of an event in the $EIT_{present}$ and $EIT_{following}$ of other transport streams shall be identical to the description of that event in the $EIT_{present}$ and $EIT_{following}$ in the transport stream that carries the event.

Cross carriage of schedule information between transport streams is optional.

9.2.8.1.2 Present/following

For all services where EIT_present_following_flag is set to “1” broadcasts shall provide EIT present following information on all transport streams of the same transmission network.

9.2.8.1.3 Schedule

The broadcasting of schedule information is not required or fully specified by this specification. The only requirement currently placed on schedule information is that includes a short event descriptor conforming to the same rules on the use of that descriptor in the present/following information.

9.2.8.1.4 Time shifted events

Time shifted events/services are not supported. Broadcasters wishing to operate an NVoD service should use the SI for stand-alone services.

9.2.8.1.5 CA identifier descriptor

The CA identifier descriptor shall be included if scrambling is applied to the event. The set of CA system IDs signalled in the EIT augments any possible values signalled in the SDT.

9.2.8.1.6 Content descriptor

This recommended descriptor is as defined in EN 300 468.

9.2.8.1.7 Parental rating

This optional descriptor is as defined in EN 300 468 and shall conform to appropriate applicable regulation.

9.2.8.1.8 Short event descriptor

The short event descriptor provides the basic description of the event that can be presented to users. The information in this descriptor should be self contained to accommodate receivers that only show this information and not any of the possible extended event information.

9.2.8.1.9 Extended event descriptor

No semantics are specified for the item_char and item_description_char part of this descriptor.

NOTE The receiver treatment of this itemised information is not defined. Receivers may not have a method to display this information to the consumer.

The text_char part of the descriptor provides an element of a longer text string. This allows strings of up to 3984 bytes to be transmitted.

The information in the text_char part of the descriptor should complement that in the short event descriptor.

NOTE The information should make sense whether the receiver presents a display where the text_char follows the short event description or as an alternative display.

9.2.8.1.10 PDC descriptor

If the event information for a service includes the PDC descriptor then a teletext stream including PDC data conforming to ETS 300 231 shall be one of the components of the service or accurate EIT timing shall be provided.

If a teletext stream including PDC data conforming to ETS 300 231 is one of the components of the service then all provided EIT sections (present, following and schedule) shall include a PDC descriptor.

See also items d) and e) under clause 9.6.2.

9.2.8.2 Minimum receiver functionality

See 9.5 and 9.3.3.

9.2.9 Time and date table and time offset table

9.2.9.1 Minimum broadcast profile

Each multiplex shall carry the TDT to meet the requirements of EN 300 468 and ETR 211. The value of time described by the TDT when it is emitted shall be within ±2 s of UTC.

Additionally it is recommended that each multiplex also carry the TOT in accordance with EN 300 468 and ETR 211.

Table 21 – Time offset table descriptors

Descriptor	Tag	Status
Local time offset descriptor	0x58	M m

The TOT shall carry one or more local time offset descriptors. These shall provide the local time offsets at least for the countries where the service is intended to be received.

The 900 series country codes registered in ETR 162 shall not be used in the local time offset descriptor.

NOTE This exclusion is for the following reasons:

- The 900 code for Scandinavia covers more than one time zone;
- The 900 series are not suitable for direct presentation to the user.

The local time offset descriptor shall be updated to reflect the next time offset and the time of next change as soon as practical after a change in the current time offset.

9.2.9.2 Minimum receiver functionality

The receiver shall maintain a clock based on the time signalled in the TDT. This shall be used for time based functions such as the presenting event running times.

The receiver shall provide a method for the user to enter the local offset from UTC to enable correct receiver operation in areas where broadcasts don’t include the TOT.

If the receiver is intended for sale into countries in different time zones, it should provide a method for configuring the country of installation so that the TOT (when available) can be used.

Where a country spans more than one time zone, the receiver shall provide a method for configuring the country and region of installation.

9.2.10 Running status table

No additional semantics are defined on this table.

NOTE There is no requirement for receivers to provide features based on this table.

9.2.11 Private data

9.2.11.1 Private data signalling

Where any private descriptors are present in a broadcast, a private data specifier descriptor (EN 300 468) shall be present to identify the definer of the private descriptor. The semantics of the scope of the private data specifier descriptor are as defined in ETR 211.

The private data specifier value [TBD] is registered in ETR 162 to designate private data defined by this specification. Table 22 lists this value and the private SI items that are defined within its scope.

Table 22 – Private SI recognised by this specification

Organisation/ specification	PDSD	Private SI information	Value	Type
EACEM	0x00000028	Eacem stream identifier descriptor	0x86	Descriptor tag
		Logical channel descriptor	0x83	Descriptor tag
		Preferred name list descriptor	0x84	Descriptor tag
		Preferred name identifier descriptor	0x85	Descriptor tag

Broadcasts may include other private data specifier descriptors to introduce other private data.

9.2.11.2 Private descriptors

This clause defines private descriptors recognised by this specification.

9.2.11.2.1 Eacem stream identifier descriptor

The eacem_stream_identifier_descriptor is a descriptor defined for use in the first loop of the NIT, it identifies a network which conforms completely with this specification.

Table 23 – Syntax of the eacem stream identifier descriptor

Syntax	No. of bits	Type
eacem_stream_identifier_descriptor () {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
version_byte	8	uimsbf
}		

9.2.11.2.1.1 descriptor_tag

This 8 bit field with a value of 0x86 identifies this descriptor.

9.2.11.2.1.2 descriptor_length

This 8 bit integer identifies the number of bytes following this length field.

9.2.11.2.1.3 version_byte

This 8 bit integer identifies the version of this specification that broadcasts conform to. Value '1' indicates this edition, higher values imply backward compatible supersets of this specification.

9.2.11.2.2 Logical channel descriptor

The logical channel descriptor provides a default channel number label for services. This information is quasi-static. The logical channel descriptor may be inserted once in the second descriptor loop of the NIT. The logical channel number should be unique within the same network_id (except when its value is zero) but may be re-used for regional variants of a service normally under different network_ids. Hence the number is not unique within the original network. The logical channel number does not take into account the service type. See 9.4.4.

Table 24 – Syntax of the logical channel descriptor

Syntax	No. of bits	Type
logical_channel_descriptor{		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0; i<N; i++){		
service_id	16	uimsbf
visible_service_flag	1	bslbf
reserved	5	bslbf
logical_channel_number	10	uimsbf
}		
}		

9.2.11.2.2.1 descriptor_tag

This shall be assigned to be 0x83.

9.2.11.2.2.2 service_id

This is a 16-bit field which serves as a label to identify this service from any other service within the network. The service_id is the same as the program_number in the corresponding program_map_section. Services shall be included irrespective of their running status.

9.2.11.2.2.3 reserved

All "reserved" bits shall be set to '1'.

9.2.11.2.2.4 visible_service_flag

When set to '1', this 1-bit field indicates that the service is normally visible and selectable (subject to the service type being suitable, etc.) via the receiver service list. When set to '0'

this indicates that the receiver is not expected to offer the service to the user in normal navigation modes. However, the receiver should provide a mechanism to access these services (for example, by direct entry of the logical channel number).

See also 9.4.4.2.

9.2.11.2.2.5 logical_channel_number

This is a 10-bit field which indicates the broadcaster preference for ordering services. Its use is defined in table 25:

Table 25 – Logical channel number

logical_channel_number	Description
0	Service not suitable for selection by the user[a)]
1 – 999	logical_channel_number
1000 – 1023	rfu
[a)] For example, the value zero may be used for data services only intended for selection from interactive applications or for firmware download services, etc.	

See also 9.4.4.2.

For ease of use, it is recommended not to use logical channel numbers greater than 99 where possible.

9.2.11.2.3 Preferred name list descriptor

The preferred name list descriptor provides a list of alternative names, and name identifiers, for the service. This information is quasi-static. The preferred name list descriptor may be inserted once in the SDT for each value of service_id.

Table 26 – Syntax of the preferred name list descriptor

Syntax	No. of bits	Type
preferred_name_list_descriptor{		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0; i<N; i++){		
ISO_639_language_code	24	bslbf
name_count	8	uimsbf
for (j=0; j<N; j++){		
name_id	8	uimsbf
name_length	8	uimsbf
for (j=0; j<N; j++){		
char	8	uimsbf
}		
}		
}		
}		

9.2.11.2.3.1 descriptor_tag

This shall be assigned to be 0x84.

9.2.11.2.3.2 ISO_639_language_code

This 24 bit field defines the language of the service name.

9.2.11.2.3.3 name_count

This 8 bit field specifies the number of alternative preferred names that are defined for this service.

If preferred names are provided in more than one language, then the same number of names shall be provided and the set of name identifiers shall be the same in all languages.

No more than 5 preferred names shall be defined for each service.

9.2.11.2.3.4 name_id

This 8 bit integer provides an identifier for the preferred name.

The service name provided by the service_descriptor and the multilingual_service_ name_descriptor are assigned the identifier 0 (zero). In this way, the name_id is always greater than 0.

9.2.11.2.3.5 name_length

This 8 bit integer specifies the number of bytes in the service name.

9.2.11.2.3.6 char

This is an 8 bit integer. A string of these char specify a preferred name for the service. The text is coded as in the service_descriptor char field.

9.2.11.2.4 Preferred name identifier descriptor

The preferred name identifier descriptor may be used in the EIT. It identifies the preferred service name at the time of an event and so allows a schedule of service names. In the absence of the descriptor, the default service name is that defined by the service_descriptor and the multilingual_service_name_descriptor. These names can also be specified explicitly by setting the name identifier to 0 (zero).

Table 27 – Syntax of the preferred name identifier descriptor

Syntax	No. of bits	Mnemonic
preferred_name_identifier_descriptor () {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
name_id	8	uimsbf
}		

9.2.11.2.4.1 descriptor_tag

This shall be assigned to be 0x85.

9.2.11.2.4.2 name_id

This 8 bit integer identifies a preferred service name within the list of service names defined by the preferred name list descriptor.

9.3 Receiver functions

This chapter describes the basic functionality of the receiver in viewing mode and while zapping between digital TV services. Basic receiver installation is addressed in 9.4.2. Reference is made to settings, such as user preferences, that are assumed to be set during the installation process.

The functionality listed is just a minimum requirement. It is up to the manufacturer to offer additional features in their particular product. The actual implementation and the user interface for the features described are beyond the scope of this specification.

Where a feature is appropriate to all forms of receiver (digital television or set top box) the term “receiver” is used. Where a feature is particular to one or other implementation, the abbreviations DTV and STB are used.

9.3.1 Information typically available to the user

Below is a list of the information displays that a typical receiver will be able to present to the user. These are described in more detail in 9.5.2.

- Information about the current event being decoded.
- Overview of available events for one or more services.
- Overview of available services.

9.3.2 Service change

When changing services, there are certain options to deal with video formats, languages and unexpected failures in service selection. The minimum requirements for receiver behaviour during service change are outlined in the following paragraphs.

9.3.2.1 Video format settings

See 6.4.

9.3.2.2 Audio language

It is assumed that the user has entered one or more language preferences during the receiver installation process. If the selected service has audio tracks in more than one language, the language is selected according to the user preferences.

If no language in the preference list matches the languages available, any of the languages available is selected. It is up to the manufacturer to define a policy for this case.

In addition to this automatic soundtrack selection, it shall always possible for the user to manually select any of the available languages.

9.3.2.3 Subtitling

Receivers are recommended to allow the following user preferences to be set:

- specification of the user’s preferred speech language (this can be a single preference or, optionally, an ordered list).

- specification of the user's preferred subtitling mode from: "for translation" or "for the hearing impaired".

The required behaviour for these modes is described in table 28 below:

Table 28 – Subtitle preference modes defined

For translation	Present the "normal" subtitle stream (if one is available) that has the best match to the user's preferred speech language
For the hearing impaired	Present the "for the hearing impaired" subtitle stream. If no "for the hearing impaired" subtitle stream is available, then present the "normal" subtitle stream (if one is available). In either case, present subtitles that have the best match to the user's preferred speech language

In either mode, the user shall be able to toggle the presentation of subtitles "on" or "off" and shall be able to select alternative subtitle languages if they are available.

The recommended factory default is "on" "for translation".

9.3.2.4 Teletext

The receiver behaviour depends upon both the service type (teletext service or TV/Radio service) and the receiver's capabilities (local decoding or insertion into the VBI output of the receiver). See clause 11 "VBI based services".

9.3.2.5 CA controlled services

When any component(s) of the selected service remain scrambled (because they are not compatible with the receiver's CA system or the receiver has no CA system), the receiver shall behave in the following way:

9.3.2.5.1 TV services

The receiver shall try to present all of the components of the service in accordance with the user's preferences.

Where any components cannot be presented due to scrambling, an error message shall be presented.

9.3.2.5.2 Radio services

The receiver shall try to present all of the components of the service in accordance with the user's preferences.

Where any components cannot be presented due to scrambling, an error message shall be presented (in case the main TV display is not active when in radio mode, alternative methods of presenting error messages may be necessary).

9.3.2.5.3 Teletext services

The receiver shall try to present all of the components of the service in accordance with the user's preferences.

Where any components cannot be presented due to scrambling, an error message shall be presented.

9.3.2.6 Service not available

A service may be not available for various reasons. The required receiver behaviour is described below:

9.3.2.6.1 Service is not running, and a linkage descriptor of type 5 is present

Linkage type 5 is the “service replacement service” linkage. Receiver support for this link is optional. If it is supported, the receiver shall perform the following:

- Switch to the service indicated in this descriptor.
- If the replacement service cannot be presented to the user, the receiver shall treat this as in the case “service not running, no link present”.

  NOTE This situation might happen when the replacement service is in a multiplex with does not cover the receiver’s location. It can also happen when the replacement service is “not running”.
- While displaying the replacement service, the receiver shall monitor the status of the original service through the running_status in SDT_{actual} or SDT_{other}. When the running_status of the original service changes to “running”, the receiver shall switch back to this original service immediately.

  If the original service and the replacement service are not in the same multiplex, and no SDT_{other} concerning the original multiplex is present in the multiplex of the replacement service, the receiver cannot monitor the running_status of the original service, and will not perform such a switch-back when the original service becomes “running” again.

  NOTE Hence cross-carriage of SDT_{other} is required for the switch-back after a service replacement action.
- See 9.5.3.2 for UI-consequences in perceived behaviour when zapping.

9.3.2.6.2 Service is not running, and no linkage descriptor of type 5 is present (or is not supported by the receiver)

The receiver shall present a message that the service is not available at that moment. If an $EIT_{following}$ section for this service is broadcast, the starting time of this next event may be used in this message to indicate when the service will probably be resumed.

9.3.2.6.3 If any part of the service cannot be rendered because of the scrambling

See 9.3.2.5.

9.3.2.6.4 If any part of the service cannot be rendered because the hardware and software resources in the receiver cannot handle this type of stream

With compliant DVB transmissions and DVB receivers, this case should not happen. In this case, an error message is presented to the user indicating that some components of the service cannot be rendered.

The receiver shall present all components of the service it can present.

9.3.2.6.5 If any part of the service cannot be rendered because it is simply not available on the advertised parameters (frequency, PIDs, etc.)

An error message is presented to the user indicating that some components of the service can currently not be rendered.

The receiver shall present all components of the service it can present.

9.3.2.6.6 If the service cannot be received, because of weak or missing RF-signal

An error message should be presented to the user giving the troubleshooting techniques for lost signal (check antenna cable, etc.).

9.3.3 Parental control

The receiver should make use of the parental rating signalled through the parental_rating_ descriptor to inform about the age rating of events containing such information.

NOTE CA systems may also be able to provide parental control through their own private methods.

The manufacturer defines the user interface for parental control. It should be configurable and sufficiently safe and shall conform to appropriate applicable regulation.

9.3.4 Receiver behaviour when a service stops

It may happen that transmission of a particular service stops. This can happen for several reasons:

9.3.4.1 Service stop correctly signalled in SI

- The service has a schedule of events and the schedule ends according to service information after a particular event and the running status is updated accordingly.
- The service does not have a schedule of events and ends without notification. However, the running status of this service is indicated correctly in the SDT.

The subsequent receiver behaviour depends on whether a linkage descriptor of type 5 is present (and supported by the receiver) or not. See 9.3.2.6.

9.3.4.2 Service stop not signalled in SI

- The service stops while the running status still indicates “running”. In this case, the receiver has to assume that this is a temporary transmission error and notifies the user accordingly. The receiver keeps on waiting until the transmission resumes or the user selects a new service.
- The service stops, because the multiplex is switched off without notification. In this case, the receiver has to assume that this is either a temporary transmission error or the antenna connection has been lost. The user is notified accordingly. The receiver keeps on waiting until the transmission resumes or the user selects a new service.

9.3.4.3 Smartcard is removed or entitlements expire or preview period expires, etc.

In these cases, the CA system is responsible for notifying the user accordingly.

If just one of the currently rendered components of the service is stopped for one of the above reasons, an appropriate message is presented while the remaining components keep on being rendered.

9.4 Establishing and maintaining the network connection

9.4.1 Use of SI identifiers

9.4.1.1 Original network ID

One original_network_id should be allocated per country in the case of a DVB-T network. The list of registered values is published in ETR 162. This ETR allocates the values 0xFF00-FFFF for “Private_temporary_use”. For example, these can be used for test networks. See 9.4.2.4 for recommended receiver reaction.

9.4.1.1.1 Reception of multiple networks

In some situations, DTV signals can be received at the user’s premises originating from different networks belonging to the same original_network_id or even belonging to different original_network_ids. The receiver shall be able to deal with such a situation and display the

available services in a single list and make no distinction in behaviour when for example navigating between services within a network and between services in different networks.

NOTE 1 In most cases, there will not be event information cross-carriage between the original networks.

NOTE 2 It is not possible on the basis of SI to automatically discriminate instances of the same service in different original networks.

9.4.1.2 Network ID

For DVB-T systems, the “network” is the infrastructure that corresponds to a single geographical region in which one or more transport streams are provided. Each transport stream is identical within the whole region. The only exception allowed is to use different regional components if the corresponding SI remains unaffected. A network might be composed of one or more transmitters (for example rebroadcast relays).

Furthermore, it is allowed to have a “stack” of networks, so that more than one network is receivable at one specific location. This is necessary in order to be prepared for network extension once the national network structure has been designed.

The information about other networks can be provided by NIT_{other}. Because of the coverage area in terrestrial systems, it is not necessary to cross-carry every NIT_{other} of the countrywide DVB-T network, only the NIT of receivable networks. In most cases, these networks are adjacent.

The process for allocating network IDs within a country is similar to the frequency planning process. This allows network ID values to be re-used provided that different networks with the same network ID are not receivable at a single location.

9.4.1.3 Service ID

Within a DVB-T network of a single country (the scope of an original_network_id), each service_id applies uniquely to one service.

Where two services have the same service_id value, they shall have the same SI and substantially the same program content, for example, differing in advertising content. Conversely, services that are identical shall typically have the same service_id while services that have differences in the events described in their service information shall have different service_id values, For example, services that differ in their regional carriage shall have different values of the service_id.

NOTE Receivers will treat services with the same original network ID/service ID in different networks as the same and will not provide a method to select between these two services. So, a danger of concealing significant differences in programme content in two services with the same service ID is that consumers in border areas will not be able to select the regional variant of their choice.

It is recommended no to re-allocate service IDs from deleted services to new services within a short period, unless the intention is that the new service replaces the old service.

9.4.1.4 Transport stream ID

The transport_stream_id shall be used to uniquely identify a transport stream within the original network. It carries a specific combination of services and components.

The same transport_stream_id may be used for transport streams transmitted on more that one network ID, provided that the differences between the transport streams with the same transport_stream_id is limited (see “service ID” above).

9.4.1.5 Local administration of identifiers

The following IDs shall be administered by the appropriate authorities (for example national regulators):

- original network ID. This shall be registered in ETR 162;
- network ID;
- transport stream ID;
- service ID;
- logical channel number.

9.4.2 Auto installation

The purpose of the auto installation is to find as many receivable services as possible.

There are two strategies for scanning for services to set up the network information in the receiver. One is to perform a full, sequential scan from the bottom to the top of a particular frequency range and the other is using the information in the NIT to improve the performance of the scan algorithm.

The NIT delivers two kind of information:

- The frequency that is used to transmit a certain multiplex.
- Other tuning parameters for the multiplex (for example 2k/8k, guard interval, etc.).

9.4.2.1 Cross carriage of NIT_{other}

In most cases there is no cross carriage of the NIT in other networks. In these networks, the NIT only provides information on the actual network. It follows from that that only multiplexes of the current network can be found and tuning to all remaining channels is necessary anyway. The frequency information does not therefore provide sufficient information for the setup of all networks.

The conclusion is that for auto installation a full, sequential scan is the preferred solution. Additional usage of the NIT might bring some benefit.

9.4.2.2 The scan process

The following requirements apply to the scan process:

- An initial service search will be carried out during the first installation.

  This search finds all of the multiplexes and services in the relevant frequency range. The NIT is used with or without the frequency and service list for network information and the SDT to detect whether the services are running.

  A service is listed in the service list only if it is found in the SDT_{actual} (as services listed in the SDT_{other} etc. may not be available at the receiver's physical location) and it can be rendered with the receiver's resources.
- The services and certain SI data will be entered into a list and stored in non-volatile memory.
- Besides the automatic full service search, the receiver should provide a manual service search, where the tuning parameter (frequency or channel number) of a multiplex can be entered manually. The receiver tunes to this frequency only and updates the service list.
- The signal quality will be measured for all multiplex channels. If the same service is found on more than one TS, the signal quality of the particular RF-signals will be used as a selection criterion. In some cases, it may be beneficial to allow the user to make the final decision.
- It is not mandated to present running audio and video services during the scan procedure, but the user shall be informed about the progress of the scan in a appropriate manner (OSD, animation). The implementation of this is up to the manufacturer.

9.4.2.3 Conditionally accessed services

Receivers shall retain information about CA controlled services as signalled in the SDT, that are not accessible with the CA mechanisms available to the receiver at the time of installation.

The receiver shall allow CA controlled services to become selectable by the user when suitable CA means become available to the receiver without the receiver having to perform a re-installation.

NOTE For example, non-accessible CA controlled services might initially be greyed out or concealed (possibly as a user option) but become selectable when a suitable CI module is inserted.

9.4.2.4 Test networks

ETR 162 allocates the values 0xFF00-FFFF for “Private_temporary_use”. For example, these can be used for test networks. It is recommended for normal use to ignore the multiplexes, which are part of such a test network, and not to include their services in the service list.

9.4.3 Network evolution

During the evolution of a nationwide network, services, multiplexes, transmitters and networks may be added, removed or changed. The receiver recognises these changes, by monitoring the version numbers of PSI/SI tables.

The minimum requirements for the handling of such occurrences are described below. As a result of these processes, a receiver may detect a possible permanent change in the service configuration for which it first needs further confirmation or information.

It is recommended that the receiver first asks for user confirmation before proceeding in case it requires a substantial time (for example longer than 10 s) to obtain this additional information (for example tune to a new multiplex or new frequency or even scanning the whole band). Any (confirmed) resulting updates of the service list should be handled as described in clause 9.5.2.2.

9.4.3.1 Network change

This will be detected when a new NIT_{actual} or NIT_{other}, as recognised by its network_id, appears and/or an existing one disappears.

NOTE For example, a new NIT_{other} may appear if a new network starts operating nearby.

If the actual network changes its ID, the receiver shall assume that the current network no longer exists and has been replaced by another.

NOTE The network_id of the NIT_{actual} may change following network reconfiguration, changes in reception conditions or physical relocation of the equipment.

Additionally, the set of transport streams within an existing network may change, this is reflected in the structure of the NIT and its version number.

9.4.3.1.1 Receiver reaction

A new or changed network may provide additional services. To offer the user these services, at least a network scan is necessary.

When a network is deleted (can no longer be received or its network_id has changed) the receiver shall not delete its services automatically from the service list without user confirmation.

When a transport stream is deleted (its transport_stream_id is removed from the NIT), then any resulting service list changes can be represented in the service list automatically without user confirmation.

9.4.3.2 Transmitter change

In most cases, this will be a frequency change and will be reflected in the delivery information in the 2nd loop of the NIT:

- When a main transmitter changes, then the delivery_system_descriptor is changed accordingly.
- When repeaters are added, removed or their frequency is changed, the changes are reflected in the frequency_list_descriptor.

9.4.3.2.1 Receiver reaction

The receiver shall update the service list with the new reception information. This requires testing of the frequencies to see if they provide better signal quality, or to find the next better alternative frequency, if the previously selected one is no longer available.

The manufacturer can implement a default handling routine for this purpose, for instance at power on/off.

If a transport stream disappears, the rules for network changes (see 9.4.3.1) shall be applied.

9.4.3.3 Multiplex change

These changes are reflected in the structure of the NIT (as it has a loop-over transport stream ID) and the instances of the SDT_{actual} and SDT_{other}. There will also be changes in the set of services listed where appropriate.

There may also be a change in the ID of the transport stream. This may happen because the set of services or the regionality of services within a transport stream has changed.

9.4.3.3.1 Receiver reaction

The receiver shall tune to the changed multiplex and verify the SI_{other} with SI_{actual} and PSI before updating the service list.

Where there is a new transport stream, a partial scan can be used, which scans only the necessary frequencies. The manufacturer can implement a default handling routine for this purpose, for instance at power on/off.

Note that the effect of any consequent changes in the service configuration of the network are described under service change (see 9.4.3.4).

9.4.3.4 Service change

Two service change cases that the receiver shall discriminate are considered: permanent and temporary changes.

9.4.3.4.1 Temporary change: service present, but “not running”

A temporary change is reflected in SDT running_status flags and also in the PSI. There may be temporary a “null service” which is signalled in the SDT as “not running” and is not in listed in the PSI.

The presence of such a service is not considered a service change as relevant for the context of this section, for example there is no need for a receiver to start looking for an alternative location, and no potential need to update the service list.

The subsequent receiver behaviour depends on whether a linkage descriptor of type 5 is present (and supported by the receiver) or not. See 9.3.2.6.

9.4.3.4.2 Permanent changes

Permanent changes shall be signalled through both the SDT_{actual} and SDT_{other} and the NIT service_list_descriptor. This affects the whole entry in the second loop of the SDT and the service list in the NIT.

Three kinds of changes can be distinguished:

- addition of a new service;
- moving the service between transport streams (or even between networks);
- permanent deletion of a service.

9.4.3.4.3 Cross carriage of information when moving a service

Note for network operators: receivers complying with this specification may check all NIT_{actual} and NIT_{other} broadcasts on the network when trying to locate a “moved” service, by checking for <original_network_id> and <service_id> of such a presumably moved service. In case the service is moved to another network (which could happen when moving a service from a network with national coverage to one or more of regional networks or vice versa), the NIT_{other} will be consulted to check for the new location of the missing service. If such a new location cannot be found, the receiver might remove the service from the service list.

It is therefore recommended that network operators cross-carry NIT_{other} information accordingly when such a move between networks is to be handled automatically by receivers with the highest degree of success.

9.4.3.4.3.1 Receiver reaction

There is an order of trust between the different service information levels. SI_{other} should be seen as rough information and shall always be double checked with the corresponding SI_{actual}.

9.4.3.4.4 Addition of a new service

If a service has been added to the NIT_{actual} (or NIT_{other}) and it has been checked that it can be properly received in the SDT_{actual}, it shall be added to the service list according to 9.5.2.2.

9.4.3.4.5 Move of a service

If a service is removed from the SDT_{actual}, the receiver shall infer that the service has been deleted from the multiplex. It is recommended that the receiver then uses the information available in NIT_{actual} and NIT_{other} to decide whether the service has been deleted from the network(s), moved inside the network or moved to another network, by looking for the <original_network_id> and <service_id> of the service in these tables.

As it cannot be guaranteed that NIT_{other} is always fully cross-carried, the receiver may scan all receivable networks in the original network (either NIT_{actual} or NIT_{other}) if necessary. This may happen automatically upon service selection and should also be part of the receiver’s installation functions.

If the receiver detects such a “moved” service elsewhere in the network or in another network, and after checking the SDT_{actual} (at the new location), it may replace the service’s reception details in its internal database without consulting the user. No change to the service list visible to the user is needed in this case, since in the user’s view the service remains accessible as it was.

If the service cannot be found in the receivable transport streams, the receiver shall consider the service to be deleted (see 9.4.3.4.6).

9.4.3.4.6 Permanent deletion of a service

If a service is removed from the NIT_{actual} and SDT_{actual}, the receiver shall infer that the service has been deleted from the network. If the service cannot be found elsewhere in a receivable network, it shall consider the service as no longer available, and represent this as such in its service list (see 9.5.2.2).

9.4.4 Logical channel numbers (LCN)

The LCN serves at the same time two different but related purposes:

- Enabling user presentation of service numbers in a convenient and familiar form.
- Allowing receivers to identify regional variants of the same core service.

9.4.4.1 Broadcaster rules

Different broadcasters operating within one country can elect to choose a service numbering scheme amongst each other, probably in conjunction with appropriate coordinating authorities. This specification defines the logical channel number concept for conveying such service numbering information to receivers. Broadcasters should obey the following specification rules in order for receivers to be able to properly operate.

A second property of the LCN is that it provides a reference that associates regional variants of a service.

Logical channel numbers allocated should be useable directly as service numbers in a set. Therefore large gaps in assigning service numbers or the use of 3 digit numbers should be avoided.

Services with the same original_network_id/service_id shall have the same logical_channel_ number. Within the scope of one network, logical channel numbers shall be allocated uniquely. When defining regional variants of a service, the same logical_channel_number can be used (for example in neighbouring networks). This facilitates defining a consistent and compact national/regional/local channel numbering scheme, as well as indicating to the receiver that services with the same logical_channel_number are similar (regional variants).

9.4.4.1.1 Services becoming more regional

When a service becomes more regional, the existing service will be replaced by the regional service. Consequently, the service_id will be changed, the transport_stream_id may change, and the network_id will be the same. If the logical_channel_number stays the same, it indicates that the new service is a successor to the previous.

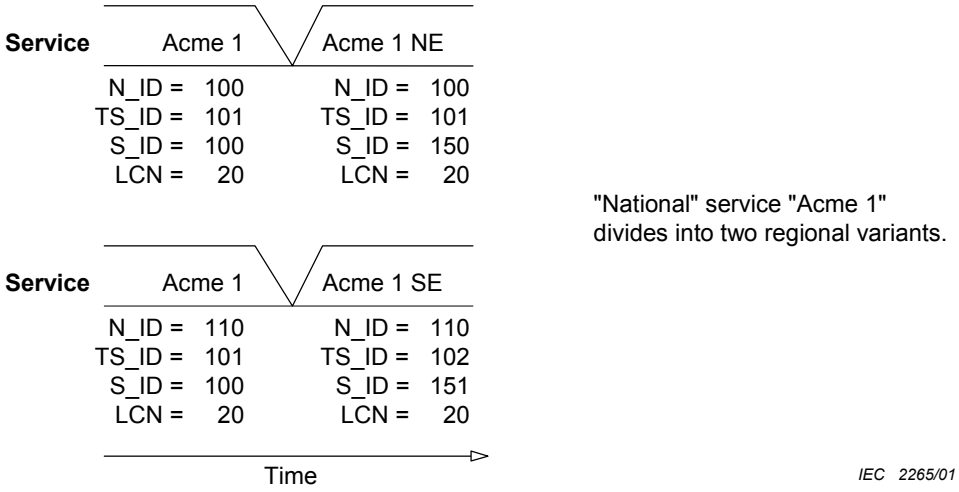


Figure 9 – Service regionalisation

9.4.4.1.2 Invisible services

It is recommended to allocate high service numbers to services marked as invisible to avoid accidental collision of service numbers with those of visible services when they are being automatically or manually reallocated.

9.4.4.2 Receiver rules

It is a manufacturer option to provide an automatic service numbering facility on the basis of logical channel numbers. However, when the manufacturer supports logical channel numbers for automatic service numbering, he shall comply to the rules set out below.

NOTE Receivers are recommended to support logical channel numbering, as they aid communication between the broadcaster and the consumer. For example, they provide a concise method for one service to describe viewing options on another service. In addition, they provide a convenient method for providing references from other media – such as printed event listings.

9.4.4.2.1 Logical channel number zero

Services associated to logical channel number 0 should be disregarded as part of the process below (irrespective of the value of the visible_service_flag). These services are not intended to be presented as part of the viewer's service list. These services are not intended to be selectable by viewers.

9.4.4.2.2 Invisible services

- Receivers shall support a "default" mode in which they will not show services marked "invisible" in their user service list or selectable in normal P+/P- browsing. The receiver may ignore the presence of "invisible" services when (re-)allocating services to service numbers requested by "invisible" services.
- Receivers shall support a mode (for example as a service mode or as an installation option) in which it will allow direct selection of all services (irrespective of being marked invisible) by the user. It may display all services also as part of the user service list in this mode.
- It is a manufacturers option to combine the two modes mentioned above, by allowing direct selection of "invisible" services while not showing them as part of the service list.

9.4.4.2.3 First initialisation

When a receiver service list is first initialised, the receiver shall perform in accordance with the following rules:

a) It shall attempt to allocate the services to a service number equal to the logical_ channel_ number for that service. This rule implies that if there is only one service with a particular logical_channel_number available it shall (initially) be allocated to this service number.

b) It shall resolve any conflict between services that use the same logical channel number.

   – National preference: it is recommended to give preference to services of one original_network_id when allocating service numbers in case of a conflict (effectively implementing a country preference).

   – Regional preference: since networks shall broadcast non-conflicting logical channel numbers, the receiver may choose to give preference of one network over the other (effectively implementing a certain regional preference) in assigning services to service numbers. It may also assume that services with the same logical_channel_ number are regional variants as long as they have the same original_network_id.

c) It is recommended to keep services from the same network that cannot be assigned to their logical_channel_number grouped together in the service list. It is recommended to preserve any ordering information among such services. In particular, in countries that plan appropriate gaps in the logical channel numbering, it is appropriate to allocate regional variants of services to the next “gap” in the service list.

If some services do not have an associated logical_channel_number, they shall get the lowest priority in the assignment of a service number. The only exception is an original_ network_id preference, which allows a receiver to first allocate service numbers to all services of an original_network_id before allocating service numbers of any other original_network_id.

9.4.4.2.4 Adding a new service

If a receiver decides to add a new service to the service list, it shall first try to allocate a service number according to the successor service rules (see 9.4.4.2.6) and secondly, according to its logical channel number. In case of a conflict, it should try to allocate a free service number.

9.4.4.2.5 Removing a service

If the receiver decides a service can be removed from the service list, it will visibly delete the service and its service number from the service list. It shall preserve the information about the removed service in case a successor service is found later (see below) to allow such a successor service to take the place of the removed service in the service list. This retention mechanism also improves the robustness of the receiver against network SI errors (wrongfully signalled deletion of a service) or otherwise unintentionally removed services.

It should be noted that the (temporary) inability to receive a service as such should not be the sole reason for a receiver to delete a service from the service list: in general, additional user intervention is recommended in such a case. However, deletion of a service from the NIT_{actual} and SDT_{actual} shall be considered positive confirmation of the deletion of a service by a receiver.

9.4.4.2.6 Network re-configuration

When the receiver detects a service offer change including the addition and deletion of multiple services and/or networks it shall first remove all services which it can (positively) determine to be permanently removed from the service list and then add the new services. Where possible, the receiver shall attempt to find suitable successor services for those services (previously) removed from the service list applying the following successor service rules:

a) The receiver shall first try match to a new service (successor service) to a logical_channel_number and network_id and original_network_id from a service previously removed from the service list.

B) Any remaining new services shall be allowed to replace services of other networks no longer available (match only on logical_channel_number and original_network_ id), taking

into account rule b) under 9.4.4.2.3 (use national and regional preference) to select the most suitable candidate.

Any new services that remain after successor service rules have been applied shall be assigned in accordance with the service number allocation rules as mentioned under 9.4.4.2.3, but shall not change already existing service number allocation. Such services may take any free position in the service list, thereby potentially using the service number of a removed service that might be replaced later and thus blocking such a future successor. Receiver manufacturers should attempt to minimise such events.

It is suggested to mark (for example using an alternate colour or an icon) those services with changed status (added, deleted, or changed) in order to indicate the changes to the user.

9.4.4.2.7 Change of LCN numbering scheme

Any re-arrangement by the broadcaster of LCN numbering of services will be treated as above under network re-configuration. This implies that user changes and non-default allocation of services to service numbers by the receiver will be preserved as much as possible unless a reinstallation is done.

9.4.5 Recommendation for robust SI acquisition

9.4.5.1 Philosophy

DTT systems are typically complicated DVB systems. This complication derives from:

- distributed coding and multiplexing sites using systems from multiple suppliers;
- regional variations of services and grouping of services;
- receiver installation determining the number of multiplexes that may be received (sub-set or super-set of a single network), with variation over time;
- number of remultiplexing stages;
- separate paths taken by PSI and SI information;
- distribution of SI insertion equipment.

Due to this complexity there is a risk of there being an increased number of possible failure modes, and consequent reduced MTBF, compared with a satellite or cable installation. Therefore, it is important that the receiver is as rugged as possible to failures in SI so that, as far as possible, failures in SI do not by themselves result in the inability of the receiver to receive television, data or other service components.

Wherever possible, the receiver shall use SI for information purposes only. In particular:

- When the viewer requests a service in a different transport stream to that currently selected, the receiver should attempt to select the service irrespective of the service's running status as indicated in SDT_{other}.
- Selection of service components for immediate decoding shall be based on the components present in the PMT, rather than those listed in the component_descriptor in the EIT. If found, the corresponding component in the component_descriptor in the EIT (as identified by the component_tag) can be used to provide extra information about the component to assist the selection process. Selection of service components for future decoding should be based on the components listed in the component_descriptor in the EIT.
- The receiver shall store sufficient information in non-volatile memory, such that a service may be selected and decoded even if there is no SI present at all.
- The receiver should never 'hang' when an attempt to acquire an SI sub-table fails.

Cross-carriage of information means that the receiver may have multiple paths to the same information. In general, information provided by 'actual' tables should be considered to be more reliable and up to date than information provided by 'other' tables.

9.4.5.2 Missing SI subtable

If acquisition of a SI subtable fails because the subtable cannot be found, the receiver should assume that the contents of that subtable have not changed.

Where the receiver has cached the information contained by that subtable, that information should be considered to be valid.

Where the receiver has not cached the information contained by that sub-table, suitable benign defaults should be used:

- services and events should be considered to be running;
- components should be derived from PSI;
- text should default to null strings.

The following table lists the behaviour expected of the receiver in the event that the corresponding sub-table is missing:

Table 29 – Receiver response to missing SI tables

Missing subtable	Response by receiver
NITactual	All information in the NIT required to select a service should be cached in non-volatile memory by the receiver such that, provided that there are no changes to the network or bouquet configuration, the receiver will continue to operate normally. Changes to network configuration that result in the receiver being unable to acquire a multiplex or service should be handled by appropriate error/information messages to the viewer.
SDTactual	All information in the SDT required to select a service should be cached in non-volatile memory by the receiver such that, provided that there are no changes to the location of the service, the receiver will continue to operate normally. Changes to service configuration that result in the receiver being unable to acquire the service (for example service not running) should be handled by appropriate error/information messages to the viewer.
EITpfactual	The receiver shall use information in PSI to select and decode service components such that the loss of the EIT_{pf} will have no impact on the selection and decoding of the service. Where the viewer requests information about the event (for example start time, duration, name, etc.), the information fields should be left blank, or appropriate error/information messages should be displayed.
TDT, TOT	The receiver shall maintain a real-time clock that shall continue to run in the absence of TDT. The receiver shall store the current offset value in non-volatile memory, and the next offset value and time of change, such that the change occurs correctly in the absence of the TOT.
RST	The receiver shall not rely on the use of the RST and therefore shall not be aware that this table is missing.
NITother, SDTother and EITpf other	Information in the NIT_{other} and SDT_{other} required for presentation in the browser should be cached in non-volatile memory such that the presentation is not affected by the absence of these tables. Missing $EIT_{pf\ other}$ should result in the associated fields in the browser being set to a null state, or appropriate error/information messages should be displayed.

9.4.5.3 Inconsistent SI information

A possible failure mode of the cross-carriage of SI is that information provided in one multiplex may differ from that referring to the same entity but provided by the SI in another multiplex. For example, these inconsistencies may be due to inconsistent subtable contents.

In addition, information may be present in more than one ‘actual’ subtable (for example a service may be referenced in the NIT and SDT), again leading to possibilities for inconsistent information.

To minimise the impact of inconsistent SI, the following rule applies:

> The receiver should acquire information that is not stored in non-volatile memory (for example event information) from any convenient source, and accept the information from the subtable most recently received.

9.4.5.4 Inaccurate SI information

The receiver shall discard invalid tables (for example incorrect CRC). Otherwise, it is expected that the receiver will not be able to detect that SI information is inaccurate or inconsistent. Where the inaccuracies relate to information that is not stored in non-volatile memory, the impact will be to frustrate the viewer, but should not prevent the viewer from selecting services. However, where this relates to information that is stored in non-volatile memory, measures must be taken to ensure that the likelihood of the selection of a valid service being prevented are minimised. The mechanism for this is provided by the rules for the removal of services, transport streams and/or networks given in subclause 9.4.5.3.

9.4.5.5 Excessive SI

The receiver may find that there is excessive SI due to:

- excessive sub-table repetition rates;
- rapid increment of sub-table version numbers.

It is recommended that receivers are tolerant to a moderate amount of excessive SI.

9.5 User interface

This clause describes the minimum set of views of the SI information that receivers are recommended to present to the user.

9.5.1 Presentation of text

9.5.1.1 Size of text fields

Broadcasters are advised not to exceed the maximum lengths for text fields (including multi-lingual variants where supplied) defined in the following table, as receivers may not be able to display excess characters. Note that the figures given are for the number of displayable characters (including spaces) required to represent the text field. The number of bytes required will depend on the use of control codes and whether one or two byte character representation is used.

Table 30 – Text field lengths

Field name	Field length in displayable characters	Comments and examples
Network Name	24	“Crystal Palace”
Service Provider Name	20	“BBC”
Service Name or Preferred Name	32	“BBC 1 North-East” Full name for display on set-up menus
	8	“BBC 1” A short version for display on browse and listing display. Shortened from full name by use of escape characters as defined in ETR 211.
Event Name	40	“Casualty” Individual broadcasters are free to add an episode title to the title within the space, for example “Brit Girls: Marianne”
Short Event Description	200	“Out of control. When Mark steps in, he faces his own past and is forced to reveal a secret.” Broadcasters must ensure that the text does not overflow the maximum descriptor size.
Extended Event Text	3984	The extended event text complements the short event description.
Component Description	32	“Casualty: guess the injury game”

All name fields shall contain meaningful data. Description fields may be empty at the broadcaster’s discretion, although it is recommended to fill them at all times for user convenience.

Where any text fields are transmitted with text lengths greater than those specified in the table, the receiver shall attempt to fit the text into the display area without truncation. If such a fit is not possible, the receiver shall take into account any escape codes, and display the broadcaster shortened version of the text. If no such codes are present, or if the shortened version does not fit either, the text shall be truncated, and this shall be made obvious, for example, by the use of an ellipsis (…) at the end of the text.

The receiver shall take into account CR/LF and emphasis escape codes as defined in EN 300 468 and ETR 211 where included in the text string.

9.5.1.2 Language selection

If multilingual descriptors are broadcast in one or more of the SI tables, the UI screens shall choose the information for the language matching the user’s preferred language.

9.5.1.3 Set of characters

Table A-1 lists the minimum set of characters in SI text fields that receivers shall be able to represent. Receivers are required to understand the following two formats for character encoding and transmission:

- ISO/IEC 6937 – the default character table for SI text (table 00)
- ISO/IEC 8859-9 – SI character table 05

See annex A “(normative) SI character set”.

9.5.2 Information presentation

All information screens discussed in this clause are merely to illustrate the principles, and do not imply any proposed graphical or textual layout or display or any functionality. They should not be considered to be the only screens which can be implemented. Receiver manufacturers

are free to implement alternative methods of navigation and functionality which they consider to be “better” within the guidelines for information presentation laid out in this document.

9.5.2.1 Information screens

The following SI related information screens shall be supplied:

- information about the current event being decoded;
- overview of available events for one or more services;
- overview of available services.

These screens are defined below.

9.5.2.1.1 Information about the current event being decoded

When entering a service, some information about the event should be presented for a certain period, such as service name, event name, time interval of the event, current time. Optionally more information can be presented, such as information about the genre and availability of subtitles and possible availability of multilingual audio or subtitles. Such a screen can also be presented when the user presses a button called ‘info’ or similar on the remote control.

If the preferred_name_identifier_descriptor is broadcast for the service, and supported by the receiver, the preferred service name shall be displayed instead of the ‘normal’ service name.

9.5.2.1.2 Overview of available events for one or more services

A list of current, current/next and/or future events (if EIT/schedule information is broadcast) for one or more services. If the preferred_name_identifier_descriptor is broadcast for the service, the preferred service name shall be displayed, not the ‘normal’ service name.

9.5.2.1.3 Overview of available services

A list of services available, possibly with network name and service provider name.

In such a service list screen, the ‘normal’ service_name shall be presented, and if supported by the broadcast and receiver, additionally a list of all of the preferred service names if this information is broadcast. In this case it can be useful to indicate (for example using an alternate colour or an icon) which of these preferred service names is currently applicable.

Services which are not active (running_status field in SDT) at the current time can be indicated in an alternative manner (for example using an alternate colour or an icon).

9.5.2.2 Management of service list

The receiver user interface shall provide a method for maintaining the service list.

9.5.2.2.1 Service numbering

Support receivers of logical channel numbering is optional.

9.5.2.2.2 Initial ordering

In case the receiver supports logical channel numbers and logical channel numbers are broadcast, service numbers shall be allocated in accordance with 9.4.4. Otherwise, services should be given a service number by the receiver.

9.5.2.2.3 Re-initializing

The receiver shall provide a function for the user to re-initialize the receiver's service list as if it was previously empty.

9.5.2.2.4 Re-ordering by user

Users shall be able to re-order the list of services as they like.

9.5.2.2.5 Re-ordering by the system

If the receiver supports logical channel numbers and logical channel numbers are broadcast, service numbers shall be updated in accordance with 9.4.4. Otherwise the following applies:

- When the list of services has to be updated (for example adding services, deleting services or changing regionalisation of services), the receiver should attempt to minimise the disturbance to the existing service list.
- If services are deleted the receiver shall not automatically renumber the remaining services but keep remaining services on their previously assigned service number.

It is suggested to mark (for example using an alternate colour or an icon) those services with changed status (added, deleted, ….) in order to indicate these changes to the user.

9.5.3 Service navigation

Where the receiver supports "up/down" channel zapping, the order of the service list from 9.5.2.2 shall define the sequence in which services are accessed.

If not all services in the service list are running or accessible, there may be a need for on-screen messages and/or an automatic switch to an alternate service. See 9.3.2.6.

Some user interface consequences of these cases are discussed below.

9.5.3.1 Not running, no replacement

If a service is not running, and no service replacement service linkage descriptor is present in the SDT, the unavailability of the service shall be communicated to the user and the user shall be able to continue navigating.

9.5.3.2 Not running, replacement present

If a service is not running, and a service replacement service linkage descriptor is present, and if service linkage is supported by the receiver, then the receiver shall present this replacement service.

9.5.3.3 Navigation order when a replacement service is activated

In the above case where a replacement service is presented rather than the selected service, the logical navigation position in the ordered set of services shall remain that of the logically selected service, NOT its actual replacement.

This ensures that by navigating in a single direction, the user will eventually visit all available services.

In a similar manner, when the user has selected a service using the number keys, and a replacement service is presented rather than the selected service, the service to be selected when pressing "P+" or "P–" is the service following or preceding the originally selected service, NOT its actual replacement.

9.5.4 Display of time

Time shall always be displayed as local time.

The event following a time change should indicate on the display that the time has changed in a suitable manner.

Time shall be displayed either as the 24 hour clock, or as the 12 hour clock followed by either am or pm.

9.6 Recording devices

This clause is concerned with SI (and other triggering means) which are useful for a device which has functionality to record (part of) an incoming transport stream.

This applies to both traditional analogue recorders (which record the analogue output of a digital receiver and are possibly controlled by the digital receiver (see 9.6.3)) and digital recorders (which record the compressed video and audio as it is broadcast).

9.6.1 Programming

Various methods are possible for the defining the event(s) to be recorded:

- Manual entry of service, date, start time and end time. All receivers shall support at least this method.
- When a receiver supports $EIT_{schedule}$ information, it is recommended to support programming from the event overview screen and from an event information screen.
- Other programming methods, for example from a teletext based EPG.

9.6.2 Execution of recording

The actual start and end time of an event may differ somewhat from the scheduled start and end times, due to operational situations in the broadcast centre.

The recording of the programmed events can be performed in various ways:

a) Using literally the start and end time configured by the user.

   In this case, the user is responsible for including any guard-band before and/or after the advertised timing of the event.

b) Using the start and end time of the event signalled in the SI schedule

   In this case, it is recommended that the receiver adds a guard-band of several minutes before and after the signalled timing of the event.

c) As b), but also with monitoring of the $EIT_{present}$ to get a more precise indication of the actual timing of the event.

   If the broadcaster changes the running_status of the event in $EIT_{following}$ from “not running” to “starts in a few seconds” some time in advance of the actual start of the event and the rollover from $EIT_{following}$ to $EIT_{present}$, the recording device could use this indication to start the recording.

d) Where PDC triggering is supported by the broadcast.

   Using a PDC trigger carried in a teletext stream to provide a precise indication of the actual transmission period of an event.

   This requires the digital receiver (and possibly the analogue recorder) to have access to the PIL (Programme Identification Label) from PDC for each event. This PIL normally carries the local announced broadcast time (day, month, hour, minute) identifying an event.

In order to make this feasible, the broadcaster must broadcast the PIL labels for the events in the EIT using the PDC descriptor (annex B). This descriptor is placed in the descriptor loop of an event in the EIT. This provides a binding between the SI identification of an event (original network ID/service ID/event ID) and the PDC identification (PIL).

e) Where PDC descriptors are in the EIT and EIT times are monitored.

As in case d) but the trigger event is the SI time base rather than the teletext stream. This mode of operation relies on broadcasters providing accurate EIT timing, particularly with regard to the roll over from following to present of an event.

NOTE In this specification, the RST is not a required part of the broadcast signal and so cannot be relied upon by receivers as a method of controlling recording. In general, the specification of the RST is such that in a compliant broadcast, the transition of EIT for an event from following to present is only a second or so different from when an RST could be transmitted.

9.6.3 Control of analogue recorders

It is recommended to provide a method for automatically controlling analogue video recorders for example using infra-red control or via commands over the peritelevision connection; if no such method is available, the end user has to program the recording event both in the digital receiver and in the analogue recorder.

Alternative methods to indicate the time window to the analogue recorder are:

- Select input signal and start instant recording (at the actual time of recording)
- Program the recording of scheduled events or a time window of a service (in advance)

To ensure energy efficiency when controlling recording:

- The receiver shall be able to wake from stand-by to support recording and then return to stand-by when the recording is complete.
- If control of the analogue recorder is implemented, the receiver shall be able to wake the recorder from stand-by at the start of the recording time interval and return it to stand-by afterwards.

10 Subtitles

10.1 Introduction

This specification allows subtitles to be delivered to receivers using DVB Subtitles as in ETS 300 743. All receivers conforming to this specification shall provide access to these subtitles.

One of the objectives of the approach described here is to allow broadcasters to rely on DVB subtitles where in-vision subtitles might have been used previously for translation.

10.2 Broadcast specifications

10.2.1 DVB subtitles

DVB Subtitles, when broadcast, shall be encoded according to ETS 300 743 as corrected, clarified and extended by D-Book version 3.0 with the following additional requirement:

- The ‘End of display set’ (EDS) segment introduced by D-Book version 3.0 shall be mandatory in all broadcasts.

The subtitle specification from D-Book version 3.0, is reproduced in annex D.

Signalling shall be as specified in 9.2.3.

10.2.2 Signalling

Subtitling streams shall be signalled in the program map table using stream type 0x06 indicating PES packet private data.

The subtitling descriptor defined in the DVB SI specification EN 300 468 enables different subtitling streams to be distinguished by their ISO-639_language_code, subtitling_type, composition_page_id and ancillary_page_id.

- If no ancillary page is transmitted, the values of ancillary_page_id and composition_ page_id in the subtitling descriptor shall be the same.
- The subtitling_type “normal” shall be used for subtitles intended primarily to provide translation.
- A type “normal” subtitle stream may be substantially empty, only having brief periods of subtitling where the audio channel is carrying a foreign language.

  NOTE For example, during a news programme foreign news items may have only a foreign language soundtrack. During such items the subtitle stream may carry a subtitles providing translation while for other items, the subtitles stream might logically exist, but be empty.

  In this scenario the main programme audio stream (type undefined) will normally be signalled with the natural language of the TV service, even if it periodically carries foreign speech.
- A subtitle stream “for the hearing impaired” for a fully subtitled service will normally contain subtitles comparable to the verbal content of the soundtrack.

  An exception to this occurs where the programme has in-vision subtitles and the “for the hearing impaired” subtitle stream is used to convey a visual representation of sound effects, etc.
- The signalling of the subtitle stream should change no more frequently than on event boundaries. Finely timed changes in the subtitle stream should be implemented by changes to the subtitle data in the stream rather than changing the stream signalling.

10.2.3 Recommendation

It is recommended that broadcasts do not provide subtitles in the same language as in-vision subtitles.

10.3 Receiver functions

10.3.1 Background

Subtitles serve more than one purpose:

- they can be used to translate the dialogue of foreign language programme content;
- they make dialogue available to those with hearing impairments;
- they can provide a visual representation of sound effects, etc. to those with hearing impairments.

The process that controls the presentation of subtitles should accommodate these different needs.

NOTE It is recognised that the relative emphasis on subtitles for translation vs. hearing impairment varies significantly between countries.

The intention of the scheme described here is that the control of the subtitle decoder within the receiver should be relatively static.

NOTE For example, where the user’s need is for subtitles for translation, the receiver should be able to activate a subtitle decoder operating continuously alongside the video and audio decoders. The broadcaster then addresses this decoder by sending subtitle data or not, depending on the needs of the programme.

Possible user requirements include:

- A user with hearing disability wants subtitles presented in their preferred language by default.
- A user with normal hearing wants to be able to periodically activate subtitles in their preferred language, for example, when the background noise is high.
- A user wants subtitles to appear if the language of the audio track is less comfortable to them than the language one of the provided subtitle streams (i.e. for translation).

It is undesirable to display subtitles over a program that already has in-vision subtitles.

10.3.2 User control of receiver behaviour

Receivers are recommended to allow the following user preferences to be set:

- specification of the user's preferred speech language (this can be a single preference or, optionally, an ordered list).
- specification of the user's preferred subtitling mode from: "for translation" or "for the hearing impaired".

The required behaviour for these modes is described in table 31 below:

Table 31 – Subtitle preference modes defined

For translation	Present the "normal" subtitle stream (if one is available) that has the best match to the user's preferred speech language.
For the hearing impaired	Present the "for the hearing impaired" subtitle stream. If no "for the hearing impaired" subtitle stream is available, then present the "normal" subtitle stream (if one is available). In either case, present subtitles that have the best match to the user's preferred speech language.

In either mode, the user shall be able to toggle presentation of subtitles "on" or "off" and shall be able to select alternative subtitle languages if they are available.

The recommended factory default is "on" "for translation".

11 VBI based services

11.1 Introduction

This specification allows teletext data to be transmitted in accordance with ETS 300 472, EN 300 468 and ETR 211. Receivers conforming to this specification should provide a method to make basic teletext services available to the user.

11.2 Broadcast specifications

Teletext broadcasts, if any, shall be in accordance with ETS 300 472.

The signalling associated with these broadcasts shall conform to the requirements of EN 300 468 and ETR 211.

The teletext data, may either be associated with a TV service as a component of that service or may exist as a viewable teletext service in its own right.

There shall be at most one teletext stream associated with each service.

11.3 Receiver functions

11.3.1 Processing capabilities

11.3.1.1 Data rates

The facility to decode or re-insert teletext data is provided primarily to allow the transcoding of pre-existing analogue video + teletext domestic TV services into the DVB domain. Receivers are not required to address full raster/high data rate teletext services.

11.3.1.2 STBs

Set top boxes should support re-insertion of the teletext data into the VBI of their analogue outputs. Optionally, they may also include a teletext decoder supporting at least teletext level 1.5 (as defined in ETS 300 706).

11.3.1.3 IDTVs

As a minimum, IDTVs are recommended to include a teletext decoder supporting at least teletext level 1.5 (as defined in ETS 300 706).

11.3.2 Control

11.3.2.1 VBI insertion

Where the VBI data is re-inserted into the analogue output of the receiver, activation of this process is a side effect of channel selection. No direct user control is required.

11.3.2.2 Local decoding

Where the VBI data is decoded by the receiver, the user controls are:

- activation of the teletext decoder function (except for teletext only services where this is a side effect of service selection).
- navigation within the teletext service (for example page number selection).

It is sufficient for the receiver to rely on user navigation of the teletext service.

It is optional for the receiver to take advantage of the possible page type information in the teletext_descriptor.

NOTE This specification does not place detailed requirements on the SI signalling associated with teletext services. Therefore, receivers should not rely on particular information in the teletext_descriptor.

11.4 Extended VBI format support

EN 301 775 provides a VBI data delivery specification that extends that specified in ETS 300 472. Support for reception of signals encoded in accordance with this new specification is optional.

Only some of the additional data formats described in EN 301 775 are considered relevant to receivers conforming to this specification:

- VPS
- WSS

Other additional formats (for example inverted teletext, closed captioning, monochrome samples) are not relevant.

11.4.1 VPS

VPS data can be remodulated into the analogue output of the receiver (where appropriate) to provide one method for controlling an attached analogue video recorder.

11.4.2 WSS

WSS data as conveyed in EN 301 775 may optionally be remodulated on to the analogue output of the receiver (where appropriate) to signal the video format to the attached display or recording device. This broadcast WSS data will only be appropriate if no “decoder format conversion” has been performed (see 6.4.3.3).

The preferred broadcast signalling for video format is the “active format description” (see 6.4.3).

11.4.3 Teletext and teletext subtitles

The preferred broadcast method for traditional teletext data and teletext subtitles is ETS 300 472.

12 RF-part and channel decoder

12.1 General

This clause covers the parameters and functions related to the RF- and channel decoder parts of a terrestrial receiver. The input signal for this part is a signal from a terrestrial transmitter, broadcasting in accordance with EN 300 744. The output signal is a TS-stream for the CA/Demux parts.

The digital transmissions may share frequency bands with other transmissions; successful reception will depend on for example network configuration, channel characteristics, time varying interference from other “analogue” or “digital” transmitters and the receiver performance. The transmission networks of DVB-T may include single frequency Networks (SFN).

References in this clause to the DTG D-Book are based on version 3.1.

12.2 Frequencies and channel bandwidth

The receiver shall be able to receive all channels in the VHF band III and/or UHF bands IV and V. An example of channel centre frequencies and offsets is given in annex D.

12.3 DVB-T modes

The receiver shall be capable of correctly demodulating all modes specified in EN 300 744. The frontend shall therefore be able to work with any combination of:

- constellation (QPSK, 16-QAM, 64-QAM, hierarchical 16-QAM, hierarchical 64-QAM),
- code rate (1/2, 2/3, 3/4, 5/6 or 7/8),
- guard interval ($T_U/4$, $T_U/8$, $T_U/16$ or $T_U/32$),
- transmission mode (2K or 8K),
- where applicable, α (1, 2, or 4).

During channel search, the receiver shall automatically detect which mode is being used. The receiver, when fed with one of the hierarchical modes (16-QAM or 64-QAM) specified in EN 300 744, shall be capable of correctly demodulating whichever of the high or low priority streams is selected by the user.

12.4 Tuning procedure

The receiver shall be able to provide a channel search. It shall also be able to receive information regarding tuning parameters found in PSI/SI (see 9.4.2).

12.5 Change of modulation parameters

Receiver behaviour in case of change of modulation parameters is to be defined.

12.6 Connector

The receiver shall have one input tuner connector, type: IEC female in accordance with IEC 60169-2. The input impedance shall be 75 Ω. If a loop through connection is provided, the output connector shall be IEC male in accordance with IEC 60169-2, part 2.

12.7 Performance

12.7.1 C/N performance

The receiver should have the performance given in table 32 when noise (N) is applied together with the wanted carrier (C) in a signal bandwidth of 7,61 MHz. The values are calculated using the noise model given annex F, with an implementation margin of 2,5 dB and a receiver excess noise source value P_x of -33 dBc. An ideal transmitter is assumed. An example of the effects in transmitter degradation on the C/N-values is given in annex G.

NOTE 1 Reference BER is defined as BER = 2 x 10^{-4} after Viterbi decoding.

NOTE 2 The figures in EN 300 744 are all the result of early simulation work, and could change as a result of improved simulations.

NOTE 3 The figures for the fixed reception (“Ricean”) and portable reception (“Rayleigh”) channels make use of the information given in EN 300 744. These particular channels are too complicated for practical implementation and it is proposed that simpler channels be defined and the new figures quoted.

Table 32 – C/N (dB) for Reference BER

Modulation	Code rate	Gaussian	Fixed	Portable
QPSK	1/2	5,6	6,1	7,9
	2/3	7,4	8,2	10,9
	3/4	8,4	9,3	13,2
	5/6	9,4	10,5	15,7
	7/8	10,2	11,2	19,0
16-QAM	1/2	11,3	12,1	13,8
	2/3	13,7	14,2	16,8
	3/4	15,1	15,6	19,4
	5/6	16,1	17,0	22,1
	7/8	16,5	17,6	26,1
64-QAM	1/2	17,0	17,3	18,7
	2/3	19,2	19,8	22,1
	3/4	20,8	21,4	24,8
	5/6	22,1	22,9	29,4
	7/8	23,0	24,0	33,9

12.7.2 Minimum receiver signal input levels

The receiver shall have a noise figure better than 8 dB.

The receiver should provide reference BER for the minimum signal levels (P_{min}) stated below and higher.

P_{min} = –97,2 dBm + C/N [dB], [for 8 MHz]

P_{min} = –97,8 dBm + C/N [dB], [for 7 MHz]

where C/N is specified in table 32.

NOTE These figures are based on an ideal transmitter. An example of non-ideal transmitter figures can be achieved using the C/N-table in annex G.

D-Book version 3.1 [chapter 11.12.4] gives further useful information on the power levels.

12.7.3 Maximum input level

The receiver shall be able to handle DVB-T signals up to a level of -35 dBm while providing the performance specified in this clause. D-Book version 3.1 [chapters 11.3 and 11.13]. Maximum level for analogue signals is -25 dBm.

12.7.4 Resistanceto analogue and/or digital signals in other channels

The requirements in this clause refer to the modes:

{8K, 64-QAM, R = 2/3, Δ/T_u = 1/8},

{8K, 64-QAM, R = 2/3, Δ/T_u = 1/4},

{2K, 64-QAM, R = 2/3, Δ/T_u = 1/32}.

The following performance is only provided when the input level restrictions in 12.7.3 apply and the unwanted signal is at the highest allowed level.

The receiver should provide reference BER with adjacent channel PAL G or I1 signals with 35 dB higher power than the DVB-T signal. (The level of the FM sound relative to the vision carrier is –13 dB. The level of the NICAM signal relative to the analogue vision carrier is –20 dB. Modulating signals are 75 % colour bars, and 1 kHz FM sound with ±50 kHz deviation.)

The receiver should provide reference BER with PAL B/G or I1 signals on any other channel with up to 46 dB higher in level than the DVB-T signal.

The receiver should provide reference BER with DVB-T signals on adjacent channels up to 25 dB higher power than the wanted DVB-T signal. For all other channels, excluding image channels, it should be possible to have DVB-T signals with up to 40 dB higher level while providing reference BER. For image channels, it should be possible to have DVB-T signals with up to 30 dB higher level while providing reference BER.

Performance with SECAM, PAL A2, PAL D/K and PAL B with Nicam is under investigation.

D-Book version 3.1 [chapter 11.13] gives further useful information on the resistance requirements.

12.7.5 Resistance to co-channel interference from analogue TV signals

The resistance to interference from analogue TV-signal is specified as the minimum carrier to interference ratio, C/I, required for reception. For the mode {64QAM, R = 2/3}, the required C/I is 4 dB. The reception criterion used should be the picture failure point, defined as the minimum C/I value for more than 1 TS-packet error in 10 s plus 0,5 dB. This is more convenient for the measurement of co-channel interference performance than the normal reference BER criterion.

The interfering analogue signal is defined in 12.7.4. The digital signal should be at the -50 dBm level.

Performance with other DVB-T modes and with SECAM, PAL A2, PAL D/K is under investigation.

12.7.6 Guard interval utilisation in single frequency networks

For the modes:

{8K, 64-QAM, R = 2/3, Δ/T_u = 1/8},

{8K, 64-QAM, R = 2/3, Δ/T_u = 1/4},

{8K, 64-QAM, R = 3/4, Δ/T_u = 1/4}.

The receiver shall provide the reference BER when the channel contains two static paths with relative delay from 0,2 µs up to 0,9 times the guard interval length independently of the relative amplitudes and phases of the two paths. No noise is added.

13 Conditional access and the common interface

13.1 Introduction

Digital terrestrial receivers should be prepared to receive existing and future pay-TV services. This requires that the receiver can accommodate conditional access (CA) systems chosen by service providers.

13.2 Minimum Requirements

To enable receivers with a built-in CA system to receive additional services via simulcrypt techniques the DVB common scrambling algorithm shall be implemented according to ETR 289. It is recommended that CA modules support simulcrypt on the same basis.

Receivers shall implement the DVB Common Interface (CI) to allow later adoption of a CA system by means of a plug-in CA module. At least one CI connection shall be implemented complying with the following ETSI and CENELEC standards:

A011 rev.1

EN 50221

ETR 289

R206-001

TS 101 699

Profile 2 as defined in TS 101 699 shall be implemented as minimum. With respect to features being mandatory or optional, the guidelines in R206-001 shall only be interpreted as further refinements on EN 50221 and TS 101 699 to improve interoperability, not as functional extensions to EN 50221 and TS 101 699. This is also stipulated in the profile definitions of TS 101 699.

If the CA system on the CI module requires a smart-card reader, this reader shall be implemented on the CI module.

Annex A
(normative)

SI character set

This annex tabulates the minimum character codes that receivers support for their presentation of text delivered by SI.

NOTE The design of this table intends, as far as possible, to ensure that it is a subset of the character set being considered for use in the DVB multimedia home platform. However, at the time of writing, both specifications are under review, so some minor adjustments may be required.

A.1 Set of languages supported

The set of languages supported by the characters listed in table A-1 is:

Afrikaans	Estonian	Italian	Scots Gaelic
Albanian	Faroese	Lapp (Sami)	Slovak
Basque	Finnish	Latvian	Slovene
Breton	French	Lithuanian	Sorbian
Catalan	Frisian	Maltese	Spanish
Croat	Galician	Norwegian	Swedish
Czech	German	Occitan	Turkish
Danish	Greenlandic	Polish	Welsh
Dutch	Hungarian	Portuguese	
English	Icelandic	Rhaeto-Romanic	
Esperanto	Irish	Romanian	

A.2 Structure of character table

A.2.1 ISO/IEC 6937

The first column of table A.1 shows the minimum supported character codes when signalled using the ISO/IEC 6937 character set. ISO/IEC 6937 allows characters to be coded using either 1 or 2 bytes. This is the default character set for text fields in DVB SI.

The set shown is the full set defined in the standard augmented by a small number of additional characters required to support particular languages. These additional characters (labelled with footnotes b) and c) in the table) have 16 bit Unicode representations 0x01CD, 0x01CE, 0x1E80-0x1E85 and 0x1EF2-0x1EF3.

A.2.2 ISO/IEC 8859-9

The second column of table A.1 shows the minimum supported codes based on the ISO/IEC 8859-9 character set. This is the full set defined in the standard.

As described in EN 300 468, strings must start with the byte 0x05 to select this character table.

A.2.3 Character name

These character names are those defined by Unicode.

A.2.4 UCS-2

The right-hand column of table A.1 lists the UCS2 (16 bit Unicode) equivalent of the character codes. This is informative and is provided as a “common interface” to other possible applications of the character set (for example for mapping into standard fonts or APIs). Receivers are not required to support UCS2 encoded text.

A.2.5 Count

The right most column shows a character count. This is not a normative part of the table. It is provided just to count the number of characters in the table.

A.2.6 Character table

Table A.1 – Allowed character codes in SI text fields

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0x20	0x20		Space	0x0020	1.
0x21	0x21	!	Exclamation Mark	0x0021	2.
0x22	0x22	“	Quotation Mark	0x0022	3.
0x23	0x23	#	Number Sign	0x0023	4.
0x24	0x24	$	Dollar Sign	0x0024	5.
0x25	0x25	%	Percent Sign	0x0025	6.
0x26	0x26	&	Ampersand	0x0026	7.
0x27	0x27	‘	Apostrophe	0x0027	8.
0x28	0x28	(	Left Parenthesis	0x0028	9.
0x29	0x29	)	Right Parenthesis	0x0029	10.
0x2A	0x2A	*	Asterisk	0x002A	11.
0x2B	0x2B	+	Plus Sign	0x002B	12.
0x2C	0x2C	,	Comma	0x002C	13.
0x2D	0x2D	–	Hyphen-Minus	0x002D	14.
0x2E	0x2E	.	Full Stop	0x002E	15.
0x2F	0x2F	/	Solidus	0x002F	16.
0x30	0x30	0	Digit Zero	0x0030	17.
0x31	0x31	1	Digit One	0x0031	18.
0x32	0x32	2	Digit Two	0x0032	19.
0x33	0x33	3	Digit Three	0x0033	20.
0x34	0x34	4	Digit Four	0x0034	21.
0x35	0x35	5	Digit Five	0x0035	22.
0x36	0x36	6	Digit Six	0x0036	23.
0x37	0x37	7	Digit Seven	0x0037	24.
0x38	0x38	8	Digit Eight	0x0038	25.
0x39	0x39	9	Digit Nine	0x0039	26.
0x3A	0x3A	:	Colon	0x003A	27.
0x3B	0x3B	;	Semicolon	0x003B	28.
0x3C	0x3C	<	Less-Than Sign	0x003C	29.
0x3D	0x3D	=	Equals Sign	0x003D	30.
0x3E	0x3E	>	Greater-Than Sign	0x003E	31.

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0x3F	0x3F	?	Question Mark	0x003F	32.
0x40	0x40	@	Commercial At	0x0040	33.
0x41	0x41	A	Latin Capital Letter A	0x0041	34.
0x42	0x42	B	Latin Capital Letter B	0x0042	35.
0x43	0x43	C	Latin Capital Letter C	0x0043	36.
0x44	0x44	D	Latin Capital Letter D	0x0044	37.
0x45	0x45	E	Latin Capital Letter E	0x0045	38.
0x46	0x46	F	Latin Capital Letter F	0x0046	39.
0x47	0x47	G	Latin Capital Letter G	0x0047	40.
0x48	0x48	H	Latin Capital Letter H	0x0048	41.
0x49	0x49	I	Latin Capital Letter I	0x0049	42.
0x4A	0x4A	J	Latin Capital Letter J	0x004A	43.
0x4B	0x4B	K	Latin Capital Letter K	0x004B	44.
0x4C	0x4C	L	Latin Capital Letter L	0x004C	45.
0x4D	0x4D	M	Latin Capital Letter M	0x004D	46.
0x4E	0x4E	N	Latin Capital Letter N	0x004E	47.
0x4F	0x4F	O	Latin Capital Letter O	0x004F	48.
0x50	0x50	P	Latin Capital Letter P	0x0050	49.
0x51	0x51	Q	Latin Capital Letter Q	0x0051	50.
0x52	0x52	R	Latin Capital Letter R	0x0052	51.
0x53	0x53	S	Latin Capital Letter S	0x0053	52.
0x54	0x54	T	Latin Capital Letter T	0x0054	53.
0x55	0x55	U	Latin Capital Letter U	0x0055	54.
0x56	0x56	V	Latin Capital Letter V	0x0056	55.
0x57	0x57	W	Latin Capital Letter W	0x0057	56.
0x58	0x58	X	Latin Capital Letter X	0x0058	57.
0x59	0x59	Y	Latin Capital Letter Y	0x0059	58.
0x5A	0x5A	Z	Latin Capital Letter Z	0x005A	59.
0x5B	0x5B	[	Left Square Bracket	0x005B	60.
0x5C	0x5C	\	Reverse Solidus	0x005C	61.
0x5D	0x5D	]	Right Square Bracket	0x005D	62.
0x5F	0x5F	_	Low Line	0x005F	63.
0x61	0x61	a	Latin Small Letter A	0x0061	64.
0x62	0x62	b	Latin Small Letter B	0x0062	65.
0x63	0x63	c	Latin Small Letter C	0x0063	66.
0x64	0x64	d	Latin Small Letter D	0x0064	67.
0x65	0x65	e	Latin Small Letter E	0x0065	68.
0x66	0x66	f	Latin Small Letter F	0x0066	69.
0x67	0x67	g	Latin Small Letter G	0x0067	70.
0x68	0x68	h	Latin Small Letter H	0x0068	71.
0x69	0x69	i	Latin Small Letter I	0x0069	72.
0x6A	0x6A	j	Latin Small Letter J	0x006A	73.
0x6B	0x6B	k	Latin Small Letter K	0x006B	74.

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0x6C	0x6C	l	Latin Small Letter L	0x006C	75.
0x6D	0x6D	m	Latin Small Letter M	0x006D	76.
0x6E	0x6E	n	Latin Small Letter N	0x006E	77.
0x6F	0x6F	o	Latin Small Letter O	0x006F	78.
0x70	0x70	p	Latin Small Letter P	0x0070	79.
0x71	0x71	q	Latin Small Letter Q	0x0071	80.
0x72	0x72	r	Latin Small Letter R	0x0072	81.
0x73	0x73	s	Latin Small Letter S	0x0073	82.
0x74	0x74	t	Latin Small Letter T	0x0074	83.
0x75	0x75	u	Latin Small Letter U	0x0075	84.
0x76	0x76	v	Latin Small Letter V	0x0076	85.
0x77	0x77	w	Latin Small Letter W	0x0077	86.
0x78	0x78	x	Latin Small Letter X	0x0078	87.
0x79	0x79	y	Latin Small Letter Y	0x0079	88.
0x7A	0x7A	z	Latin Small Letter Z	0x007A	89.
0x7B	0x7B	{	Left Curly Bracket	0x007B	90.
0x7C	0x7C	|	Vertical Line	0x007C	91.
0x7D	0x7D	}	Right Curly Bracket	0x007D	92.
0x7E	0x7E	~	Tilde	0x007E	93.
0xA0	0xA0	þ	No-Break Space	0x00A0	94.
0xA1	0xA1	¡	Inverted Exclamation Mark	0x00A1	95.
0xA2	0xA2	¢	Cent Sign	0x00A2	96.
0xA3	0xA3	£	Pound Sign	0x00A3	97.
0xA5	0xA5	¥	Yen Sign	0x00A5	98.
0xA7	0xA7	§	Section Sign	0x00A7	99.
0xD3	0xA9	©	Copyright Sign	0x00A9	100.
0xE3	0xAA	ª	Feminine Ordinal Indicator	0x00AA	101.
0xFF	0xAD		Soft Hyphen[a)]	0x00AD	102.
0xD2	0xAE	®	Registered Sign	0x00AE	103.
0xB0	0xB0	°	Degree Sign	0x00B0	104.
0xB7	0xB7	·	Middle Dot	0x00B7	105.
0xEB	0xBA	º	Masculine Ordinal Indicator	0x00BA	106.
0xBC	0xBC		Vulgar Fraction One Quarter	0x00BC	107.
0xBD	0xBD		Vulgar Fraction One Half	0x00BD	108.
0xBE	0xBE		Vulgar Fraction Three Quarters	0x00BE	109.
0xBF	0xBF	¿	Inverted Question Mark	0x00BF	110.
0xC1 0x41	0xC0	À	Latin Capital Letter A With Grave	0x00C0	111.
0xC2 0x41	0xC1	Á	Latin Capital Letter A With Acute	0x00C1	112.
0xC3 0x41	0xC2	Â	Latin Capital Letter A With Circumflex	0x00C2	113.
0xC4 0x41	0xC3	Ã	Latin Capital Letter A With Tilde	0x00C3	114.
0xC8 0x41	0xC4	Ä	Latin Capital Letter A With Diaeresis	0x00C4	115.
0xCA 0x41	0xC5	Å	Latin Capital Letter A With Ring Above	0x00C5	116.
0xE1	0xC6	Æ	Latin Capital Letter Ae	0x00C6	117.

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0xCB 0x43	0xC7	Ç	Latin Capital Letter C With Cedilla	0x00C7	118.
0xC1 0x45	0xC8	È	Latin Capital Letter E With Grave	0x00C8	119.
0xC2 0x45	0xC9	É	Latin Capital Letter E With Acute	0x00C9	120.
0xC3 0x45	0xCA	Ê	Latin Capital Letter E With Circumflex	0x00CA	121.
0xC8 0x45	0xCB	Ë	Latin Capital Letter E With Diaeresis	0x00CB	122.
0xC1 0x49	0xCC	Ì	Latin Capital Letter I With Grave	0x00CC	123.
0xC2 0x49	0xCD	Í	Latin Capital Letter I With Acute	0x00CD	124.
0xC3 0x49	0xCE	Î	Latin Capital Letter I With Circumflex	0x00CE	125.
0xC8 0x49	0xCF	Ï	Latin Capital Letter I With Diaeresis	0x00CF	126.
0xE2			Latin Capital Letter Eth	0x00D0	127.
0xC4 0x4E	0xD1	Ñ	Latin Capital Letter N With Tilde	0x00D1	128.
0xC1 0x4F	0xD2	Ò	Latin Capital Letter O With Grave	0x00D2	129.
0xC2 0x4F	0xD3	Ó	Latin Capital Letter O With Acute	0x00D3	130.
0xC3 0x4F	0xD4	Ô	Latin Capital Letter O With Circumflex	0x00D4	131.
0xC4 0x4F	0xD5	Õ	Latin Capital Letter O With Tilde	0x00D5	132.
0xC8 0x4F	0xD6	Ö	Latin Capital Letter O With Diaeresis	0x00D6	133.
0xB4	0xD7		Multiplication Sign	0x00D7	134.
0xE9	0xD8	Ø	Latin Capital Letter O With Stroke	0x00D8	135.
0xC1 0x55	0xD9	Ù	Latin Capital Letter U With Grave	0x00D9	136.
0xC2 0x55	0xDA	Ú	Latin Capital Letter U With Acute	0x00DA	137.
0xC3 0x55	0xDB	Û	Latin Capital Letter U With Circumflex	0x00DB	138.
0xC8 0x55	0xDC	Ü	Latin Capital Letter U With Diaeresis	0x00DC	139.
0xC2 0x59			Latin Capital Letter Y With Acute	0x00DD	140.
0xEC			Latin Capital Letter Thorn	0x00DE	141.
0xFB	0xDF	ß	Latin Small Letter Sharp S	0x00DF	142.
0xC1 0x61	0xE0	à	Latin Small Letter A With Grave	0x00E0	143.
0xC2 0x61	0xE1	á	Latin Small Letter A With Acute	0x00E1	144.
0xC3 0x61	0xE2	â	Latin Small Letter A With Circumflex	0x00E2	145.
0xC4 0x61	0xE3	ã	Latin Small Letter A With Tilde	0x00E3	146.
0xC8 0x61	0xE4	ä	Latin Small Letter A With Diaeresis	0x00E4	147.
0xCA 0x61	0xE5	å	Latin Small Letter A With Ring Above	0x00E5	148.
0xF1	0xE6	æ	Latin Small Letter Ae	0x00E6	149.
0xCB 0x63	0xE7	ç	Latin Small Letter C With Cedilla	0x00E7	150.
0xC1 0x65	0xE8	è	Latin Small Letter E With Grave	0x00E8	151.
0xC2 0x65	0xE9	é	Latin Small Letter E With Acute	0x00E9	152.
0xC3 0x65	0xEA	ê	Latin Small Letter E With Circumflex	0x00EA	153.
0xC8 0x65	0xEB	ë	Latin Small Letter E With Diaeresis	0x00EB	154.
0xC1 0x69	0xEC	ì	Latin Small Letter I With Grave	0x00EC	155.
0xC2 0x69	0xED	í	Latin Small Letter I With Acute	0x00ED	156.
0xC3 0x69	0xEE	î	Latin Small Letter I With Circumflex	0x00EE	157.
0xC8 0x69	0xEF	ï	Latin Small Letter I With Diaeresis	0x00EF	158.
0xF3			Latin Small Letter Eth	0x00F0	159.
0xC4 0x6E	0xF1	ñ	Latin Small Letter N With Tilde	0x00F1	160.

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0xC1 0x6F	0xF2	ò	Latin Small Letter O With Grave	0x00F2	161.
0xC2 0x6F	0xF3	ó	Latin Small Letter O With Acute	0x00F3	162.
0xC3 0x6F	0xF4	ô	Latin Small Letter O With Circumflex	0x00F4	163.
0xC4 0x6F	0xF5	õ	Latin Small Letter O With Tilde	0x00F5	164.
0xC8 0x6F	0xF6	ö	Latin Small Letter O With Diaeresis	0x00F6	165.
0xB8	0xF7	÷	Division Sign	0x00F7	166.
0xF9	0xF8	ø	Latin Small Letter O With Stroke	0x00F8	167.
0xC1 0x75	0xF9	ù	Latin Small Letter U With Grave	0x00F9	168.
0xC2 0x75	0xFA	ú	Latin Small Letter U With Acute	0x00FA	169.
0xC3 0x75	0xFB	û	Latin Small Letter U With Circumflex	0x00FB	170.
0xC8 0x75	0xFC	ü	Latin Small Letter U With Diaeresis	0x00FC	171.
0xC2 0x79			Latin Small Letter Y With Acute	0x00FD	172.
0xFC			Latin Small Letter Thorn	0x00FE	173.
0xC8 0x79	0xFF	ÿ	Latin Small Letter Y With Diaeresis	0x00FF	174.
0xC5 0x41			Latin Capital Letter A With Macron	0x0100	175.
0xC5 0x61			Latin Small Letter A With Macron	0x0101	176.
0xC6 0x41			Latin Capital Letter A With Breve	0x0102	177.
0xC6 0x61			Latin Small Letter A With Breve	0x0103	178.
0xCE 0x41			Latin Capital Letter A With Ogonek	0x0104	179.
0xCE 0x61			Latin Small Letter A With Ogonek	0x0105	180.
0xC2 0x43			Latin Capital Letter C With Acute	0x0106	181.
0xC2 0x63			Latin Small Letter C With Acute	0x0107	182.
0xC3 0x43			Latin Capital Letter C With Circumflex	0x0108	183.
0xC3 0x63			Latin Small Letter C With Circumflex	0x0109	184.
0xC7 0x43			Latin Capital Letter C With Dot Above	0x010A	185.
0xC7 0x63			Latin Small Letter C With Dot Above	0x010B	186.
0xCF 0x43			Latin Capital Letter C With Caron	0x010C	187.
0xCF 0x63			Latin Small Letter C With Caron	0x010D	188.
0xCF 0x44			Latin Capital Letter D With Caron	0x010E	189.
0xCF 0x64			Latin Small Letter D With Caron	0x010F	190.
0xE2			Latin Capital Letter D With Stroke	0x0110	191.
0xF2			Latin Small Letter D With Stroke	0x0111	192.
0xC5 0x45			Latin Capital Letter E With Macron	0x0112	193.
0xC5 0x65			Latin Small Letter E With Macron	0x0113	194.
0xC7 0x45			Latin Capital Letter E With Dot Above	0x0116	195.
0xC7 0x65			Latin Small Letter E With Dot Above	0x0117	196.
0xCE 0x45			Latin Capital Letter E With Ogonek	0x0118	197.
0xCE 0x65			Latin Small Letter E With Ogonek	0x0119	198.
0xCF 0x45			Latin Capital Letter E With Caron	0x011A	199.
0xCF 0x65			Latin Small Letter E With Caron	0x011B	200.
0xC3 0x47			Latin Capital Letter G With Circumflex	0x011C	201.
0xC3 0x67			Latin Small Letter G With Circumflex	0x011D	202.
0xC6 0x47	0xD0		Latin Capital Letter G With Breve	0x011E	203.

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0xC6 0x67	0xF0		Latin Small Letter G With Breve	0x011F	204.
0xC7 0x47			Latin Capital Letter G With Dot Above	0x0120	205.
0xC7 0x67			Latin Small Letter G With Dot Above	0x0121	206.
0xCB 0x47			Latin Capital Letter G With Cedilla	0x0122	207.
0xCB 0x67			Latin Small Letter G With Cedilla	0x0123	208.
0xC3 0x48			Latin Capital Letter H With Circumflex	0x0124	209.
0xC3 0x68			Latin Small Letter H With Circumflex	0x0125	210.
0xE4			Latin Capital Letter H With Stroke	0x0126	211.
0xF4			Latin Small Letter H With Stroke	0x0127	212.
0xC4 0x49			Latin Capital Letter I With Tilde	0x0128	213.
0xC4 0x69			Latin Small Letter I With Tilde	0x0129	214.
0xC5 0x49			Latin Capital Letter I With Macron	0x012A	215.
0xC5 0x69			Latin Small Letter I With Macron	0x012B	216.
0xCE 0x49			Latin Capital Letter I With Ogonek	0x012E	217.
0xCE 0x69			Latin Small Letter I With Ogonek	0x012F	218.
0xC7 0x49	0xDD		Latin Capital Letter I With Dot Above	0x0130	219.
0xF5	0xFD	i	Latin Small Letter Dotless I	0x0131	220.
0xE6			Latin Capital Ligature Ij	0x0132	221.
0xF6			Latin Small Ligature Ij	0x0133	222.
0xC3 0x4A			Latin Capital Letter J With Circumflex	0x0134	223.
0xC3 0x6A			Latin Small Letter J With Circumflex	0x0135	224.
0xCB 0x4B			Latin Capital Letter K With Cedilla	0x0136	225.
0xCB 0x6B			Latin Small Letter K With Cedilla	0x0137	226.
0xF0			Latin Small Letter Kra	0x0138	227.
0xC2 0x4C			Latin Capital Letter L With Acute	0x0139	228.
0xC2 0x6C			Latin Small Letter L With Acute	0x013A	229
0xCB 0x4C			Latin Capital Letter L With Cedilla	0x013B	230.
0xCB 0x6C			Latin Small Letter L With Cedilla	0x013C	231.
0xCF 0x4C			Latin Capital Letter L With Caron	0x013D	232.
0xCF 0x6C			Latin Small Letter L With Caron	0x013E	233.
0xE7			Latin Capital Letter L With Middle Dot	0x013F	234.
0xF7			Latin Small Letter L With Middle Dot	0x0140	235.
0xE8			Latin Capital Letter L With Stroke	0x0141	236.
0xF8			Latin Small Letter L With Stroke	0x0142	237.
0xC2 0x4E			Latin Capital Letter N With Acute	0x0143	238.
0xC2 0x6E			Latin Small Letter N With Acute	0x0144	239.
0xCB 0x4E			Latin Capital Letter N With Cedilla	0x0145	240.
0xCB 0x6E			Latin Small Letter N With Cedilla	0x0146	241.
0xCF 0x4E			Latin Capital Letter N With Caron	0x0147	242.
0xCF 0x6E			Latin Small Letter N With Caron	0x0148	243.
0xEE			Latin Capital Letter Eng	0x014A	244.
0xFE			Latin Small Letter Eng	0x014B	245.
0xC5 0x4F			Latin Capital Letter O With Macron	0x014C	246.

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0xC5 0x6F			Latin Small Letter O With Macron	0x014D	247.
0xCD 0x4F			Latin Capital Letter O With Double Acute	0x0150	248.
0xCD 0x6F			Latin Small Letter O With Double Acute	0x0151	249.
0xEA		Œ	Latin Capital Ligature Oe	0x0152	250.
0xFA		œ	Latin Small Ligature Oe	0x0153	251.
0xC2 0x52			Latin Capital Letter R With Acute	0x0154	252.
0xC2 0x72			Latin Small Letter R With Acute	0x0155	253.
0xCB 0x52			Latin Capital Letter R With Cedilla	0x0156	254.
0xCB 0x72			Latin Small Letter R With Cedilla	0x0157	255.
0xCF 0x52			Latin Capital Letter R With Caron	0x0158	256.
0xCF 0x72			Latin Small Letter R With Caron	0x0159	257.
0xC2 0x53			Latin Capital Letter S With Acute	0x015A	258.
0xC2 0x73			Latin Small Letter S With Acute	0x015B	259.
0xC3 0x53			Latin Capital Letter S With Circumflex	0x015C	260.
0xC3 0x73			Latin Small Letter S With Circumflex	0x015D	261.
0xCB 0x53	0xDE		Latin Capital Letter S With Cedilla	0x015E	262.
0xCB 0x73	0xFE		Latin Small Letter S With Cedilla	0x015F	263.
0xCF 0x53			Latin Capital Letter S With Caron	0x0160	264.
0xCF 0x73			Latin Small Letter S With Caron	0x0161	265.
0xCB 0x54			Latin Capital Letter T With Cedilla	0x0162	266.
0xCB 0x74			Latin Small Letter T With Cedilla	0x0163	267.
0xCF 0x54			Latin Capital Letter T With Caron	0x0164	268.
0xCF 0x74			Latin Small Letter T With Caron	0x0165	269.
0xED			Latin Capital Letter T With Stroke	0x0166	270.
0xFD			Latin Small Letter T With Stroke	0x0167	271.
0xC4 0x55			Latin Capital Letter U With Tilde	0x0168	272.
0xC4 0x75			Latin Small Letter U With Tilde	0x0169	273.
0xC5 0x55			Latin Capital Letter U With Macron	0x016A	274.
0xC5 0x75			Latin Small Letter U With Macron	0x016B	275.
0xC6 0x55			Latin Capital Letter U With Breve	0x016C	276.
0xC6 0x75			Latin Small Letter U With Breve	0x016D	277.
0xCA 0x55			Latin Capital Letter U With Ring Above	0x016E	278.
0xCA 0x75			Latin Small Letter U With Ring Above	0x016F	279.
0xCD 0x55			Latin Capital Letter U With Double Acute	0x0170	280.
0xCD 0x75			Latin Small Letter U With Double Acute	0x0171	281.
0xCE 0x55			Latin Capital Letter U With Ogonek	0x0172	282.
0xCE 0x75			Latin Small Letter U With Ogonek	0x0173	283.
0xC3 0x57			Latin Capital Letter W With Circumflex	0x0174	284.
0xC3 0x77			Latin Small Letter W With Circumflex	0x0175	285.
0xC3 0x59			Latin Capital Letter Y With Circumflex	0x0176	286.
0xC3 0x79			Latin Small Letter Y With Circumflex	0x0177	287.
0xC8 0x59		Ÿ	Latin Capital Letter Y With Diaeresis	0x0178	288.
0xC2 0x5A			Latin Capital Letter Z With Acute	0x0179	289.

ISO/IEC 6937	ISO/IEC 8859-9		Character name	UCS2	
0xC2 0x7A			Latin Small Letter Z With Acute	0x017A	290.
0xC7 0x5A			Latin Capital Letter Z With Dot Above	0x017B	291.
0xC7 0x7A			Latin Small Letter Z With Dot Above	0x017C	292.
0xCF 0x5A			Latin Capital Letter Z With Caron	0x017D	293.
0xCF 0x7A			Latin Small Letter Z With Caron	0x017E	294.
0xCF 0x41			Latin Capital Letter A With Caron[b)]	0x01CD	295.
0xCF 0x61			Latin Small Letter A With Caron[b)]	0x01CE	296.
0xC1 0x57			Latin Capital Letter W With Grave[c)]	0x1E80	297.
0xC1 0x77			Latin Small Letter W With Grave[c)]	0x1E81	298.
0xC2 0x57			Latin Capital Letter W With Acute[c)]	0x1E82	299.
0xC2 0x77			Latin Small Letter W With Acute[c)]	0x1E83	300.
0xC8 0x57			Latin Capital Letter W With Diaeresis[c)]	0x1E84	301.
0xC8 0x77			Latin Small Letter W With Diaeresis[c)]	0x1E85	302.
0xC1 0x59			Latin Capital Letter Y With Grave[c)]	0x1EF2	303.
0xC1 0x79			Latin Small Letter Y With Grave[c)]	0x1EF3	304.
0xA9		‘	Left Single Quotation Mark	0x2018	305.
0xB9		’	Right Single Quotation Mark	0x2019	306.
0xAA		“	Left Double Quotation Mark	0x201C	307.
0xBA		”	Right Double Quotation Mark	0x201D	308.
0xD4		™	Trade Mark Sign	0x2122	309.
0xAC			Leftwards Arrow	0x2190	310.
0xAD			Upwards Arrow	0x2191	311.
0xAE			Rightwards Arrow	0x2192	312.
0xAF			Downwards Arrow	0x2193	313.
0xD5			Eighth Note	0x266A or 0x266B	314.

[a)] As described in ETR 211 [14], the SHY character indicates a position where long words can be hyphenated. If when presented, there is no requirement to hyphenate the word this behaves as a non-printing, non-spacing character. If the word is hyphenated to break it across one or more lines then behaviour is as if the SHY character is replaced by a normal hyphen character (unicode 0x002D) followed by a carriage return.

[b)] These characters are added to support Norwegian.

[c)] These characters are added to support Welsh.

Annex B
(normative)

DVB-SI PDC descriptor

B.1 Introduction

This annex describes a descriptor which has been agreed by DVB SI-DAT, but not yet published in EN 300 468 and ETR 211. Since a definition of this descriptor is essential for understanding of the text on recording (see 9.6), the definition of the descriptor is reproduced here. The conditions for inclusion of this descriptor are addressed under 9.2.8.

NOTE This description is based on documents SI_DAT 460, SI_DAT 480 and SI_DAT 441r7.

B.2 PDC descriptor

This descriptor, for use in the EIT, defines a programme identification label (PIL) as defined in ETS 300 231 for an event.

Table B.1 – Syntax of the PDC descriptor

Syntax	No. of bits	Type
PDC_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reserved_future_use	4	bslbf
programme_identification_label	20	bslbf
}		

B.2.1 descriptor_tag

This 8 bit field with value 0x69 identifies this descriptor.

B.2.2 descriptor_length

This 8 bit integer identifies the number of bytes following this length field.

B.2.3 programme_identification_label

This 20-bit field gives the programme identification label.

The structure of the programme identification label (PIL) is as follows:

Programme identification label																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M				L	M			L	M				L	M					L
Day					Month				Hour					Minute					

The PIL contains date and time of the first published start time of a certain event.

Within analogue systems, the PIL is either broadcast in the teletext format (PDC) or as a part of the VPS label in dataline 16. The values for the day, month, hour and minute are binary coded.

No change is made to the PIL once it has been made publicly available, provided the transmission time remains within the validity time window (as defined in ETS 300 231).

Annex C
(informative)

Bootloader and software download

This annex provides an overview of some of the issues associated with over air download of firmware updates.

C.1 Overview

The software download mechanism described here is intended to deliver a standard framework for manufacturer and broadcaster to update the system software in the receiver to deliver bug fixes or provide new functionality. So it is used for drivers, operating system and resident applications only.

The software download concept requires a bootloader which is usually part of the receiver firmware. There are different ways to download new software:

- over air download via broadcast channel;
- download using the CI;
- download over the serial connection (RS 232).

Only the first method is addressed here, however the other concepts can be implemented in a similar fashion.

The preferred data transport protocol shall be based on MPEG data structures, for example DSM-CC data carousel. The security aspects are the responsibility of the service provider, i.e. manufacturer. As an authentication schema, a private/public key cryptographic algorithm is recommended.

C.2 Signalling

The signalling of the over air download service depends on the possibilities of the network operator and the construction of the network. The software download data component can represent an own service or can be assigned to any other service.

The signalling of the download stream can be done in PSI and SI. It marks the download data component providing the entry point to the DSM-CC carousel and optionally provides additional information about the kind of software transmitted.

The PSI signalling shall be done using the data_broadcast_id_descriptor in the elementary stream (2nd) loop of the PMT which corresponds to the relevant download data component. The signalling in SI provides a high level link to the relevant data component. This link can be located in the 1st loop of the NIT or BAT using a linkage descriptor with a dedicated linkage type or in the 2nd loop of the SDT using the data_broadcast_descriptor. The latter case requires that the software download service represents an own service with a dedicated service_id.

A data structure can be transmitted along with the linkage and data broadcast (id) descriptor in its private data area. This structure supports the receiver identifying whether the data component contains relevant software, such as the same model and more recent software version. The definition of this structure is closely related to the registration of the data broadcast ID for the data broadcast (id) descriptor or the linkage type for the linkage descriptor. Table C.1 shows an example of such a structure:

Table C.1 – Example download information structure

Syntax	Number of Bits	Remarks
data_info_structure() {		
manufacturerId	24	IEEE OUI
model	16	Defined by manufacturer
version	16	Defined by manufacturer
start_time	40	Defined by broadcaster
}		

C.2.1 start_time

This is a 40-bit field that defines at what time and date the software will be available to download.

This field is coded as the UTC_time field in the TDT.

C.3 User interface

The receiver should offer the user the availability of new software (automatic detection of new software and display a pop-up screen), but the starting of the actual updating process shall always be the responsibility of the user.

The software download function should be part of the resident firmware. The navigator or an EPG application must be able to discriminate a software download service from other services which offer applications or any other content. This is necessary to fulfil the requirement of not showing the download service in a service browser.

The process of downloading new software shall be indicated to the user when the download prevents the user from using all receiver features. The receiver shall either present an animated OSD to inform the user about download progress or at least indicate that the receiver is still running.

When the receiver is about to switch to the new software, this shall be indicated and confirmed by the user.

The user shall have the opportunity to cancel the software download in a decent way, for example via an exit key.

Annex D
(normative)

Subtitling

This annex is reproduced from the DTG “D Book” version 3 with permission.

D.1 Introduction

This clause defines the graphics standards to be used for providing subtitles that shall be used in all UK UHF terrestrial television broadcasts.

This specification is based on ETS 300 743 but with a number of clarifications, corrigenda and extensions detailed here. These proposals will be presented to the DVB for consideration.

D.2 Essential requirements

Subtitles in DTG television broadcasts shall be encoded as bitmaps according to ETS 300 743. The RNIB font Tiresias has been designed for this purpose.

All receivers shall include provision to decode and display subtitles conforming to ETS 300 743 corrected with regard to the corrigenda in D.3 and as clarified in D.4 and as modified in D.5.

D.3 Corrigenda to ETS 300 743

This clause identifies corrections to ETS 300 743.

Table D.1 – Corrigenda to ETS 300 743

Location in ETS 300 743	Current Text	Corrected Text
5.1.1 paragraph 1	Decoders that have already acquired the service shall only look for development of the existing display (for example new graphical objects to be decoded)	Decoders that have already acquired the service are only required to look for development of the existing display (for example new graphical objects to be decoded). Re-decoding of previously received segments is optional
5.1.1 paragraph 3	A page state of “normal case” indicates that the set of RCS may not be complete (it shall only include the regions into which objects are being drawn in this display set)	A page state of “normal case” indicates that the set of RCS may not be complete (the set is only required to include the regions whose region data structures (bitmap or CLUT family) are to be modified in this display set).
5.1.4	Display sets with a PCS with page state of “normal case” shall only contain regions whose contents are to be modified	Display sets with a PCS with page state of “normal case” are only required to contain regions whose region data structures (bitmap or CLUT family) are to be modified
5.1.5 bullet 2	An RCS shall be present in a display set if its contents are to be modified	An RCS shall be present in a display set if the region data structure (bitmap or CLUT family) is to be modified
5.1.5 bullet 2	However, the RCS shall not be in the PCS region list. This allows regions to be modified while they are not visible	However, the RCS is not required to be in the PCS region list. This allows regions to be modified while they are not visible

Location in ETS 300 743	Current Text	Corrected Text
5.1.5 bullet 4	A decoder shall inspect every RCS in the display set to determine which (if any) require pixel buffer modifications.	A decoder shall inspect every RCS in the display set to determine which (if any) require pixel buffer modifications or where there is a modification to the associated CLUT family.
7.2.1	The time-out period starts at the first reception of the page_composition_segment.	The time-out period starts when the page_composition_segment is first displayed.
7.2.2	region_version_number: This indicates the version of this segment data. When any of the contents of this segment, other than the lower_level_change_flag, change this version number is incremented (modulo 16).	region_version_number: This indicates the version of this region. The version number is incremented (modulo 16) if one or more of the following conditions is true: - the region fill flag is set; - the region's CLUT family has been modified; - the region has a non-zero length object list.
	region_level_of_compatibility: This indicates the minimum type of CLUT that is necessary in the decoder to decode this region:	region_level_of_compatibility: This indicates the minimum type of CLUT that is necessary in the decoder to decode this region as defined in table 4.
	region_depth: Identifies the maximum pixel depth which shall be used for this region.	region_depth: Identifies the maximum pixel depth which shall be used for this region as defined in table 4.

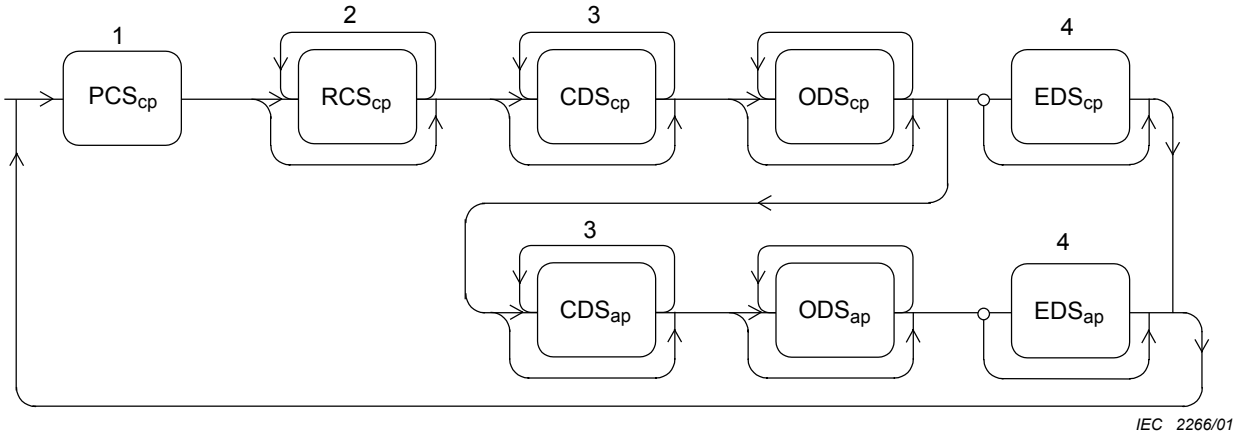
7.2.4.1	`pixel-data_sub-block() {`
	`  sync_byte`
	`  segment_type`
	`  page_id`
	`  segment_length`
	`  data_type`
	`  if data_type =='0x10' {`
	`  :`
	`  :`
		`pixel-data_sub-block() {`
		`  data_type`
		`  if data_type =='0x10' {`
		`  :`
		`  :`

8.5	Avoiding excess pixel-data capacity The run length coding that is applied to the pixel data shall result in a reduction of data. If the coding results in an expansion of data, it shall not be applied.	a)
a) Deleted		

D.4 Clarifications to ETS 300 743

D.4.1 Sequence of segments

Figure D-1 illustrates the allowed sequence of segments in a subtitle stream. Each PCS indicates the start of a display set. The set of segments that follows will depend on the operation being performed in that display set.



PCS = Page Composition Segment
RCS = Region Composition Segment
CDS = Clut Data Segment
ODS = Object Data Segment
EDS = End of Display set Segment

cp = Composition Page
ap = Ancillary Page

Note	page_state		
	Normal case	**Acquisition point**	**Mode change**
NOTE 1	All display sets start with a PCS		
NOTE 2	Optional unless the region is to be operated upon.	All regions must be present to reserve memory for them during the remainder of the epoch.	
NOTE 3	CDSs are only required if non-default colours are to be defined.		
		CDSs are not required at the beginning of an epoch to reserve memory, references to CLUT families from regions are sufficient to declare the memory required.	
NOTE 4	Each display set has at most one EDS. This is a recommended but not mandatory segment. Receivers can take advantage of it but should not rely on it. The EDS is either the last segment of the ancillary page or the last segment of the composition page, depending on the presence or absence of ancillary data in the display set.		

Figure D.1 – High level bitstream organisation

D.4.2 Indication of Updates

The version number fields in the PCS, RCS & CDS [1)] segments are significant to the decoder.

Subtitle encoders *increment* the version number (modulo 16) to indicate changes. Decoders should respond to a *change* in the version number.

D.4.2.1 Dependence on version number changes

When decoding a display set *it is sufficient* for a decoder to look for changes in page_ version_number and region_version_number. If a change in region_version_ number is observed for a region, the decoder shall also look for a change in the CLUT_version_number of the CLUT associated with that region.

1) It is possible that the version number of object data segments may be significant in the common interface low-level MMI use of DVB subtitles, this needs further consideration.

D.4.2.2 page_version_number

Changes to the page_version_number indicate that the data in the PCS has changed. For example, one or more regions might be repositioned or the set of visible regions might be changed.

A change in the visual appearance of regions does not require the page_version_number to increment. So, decoding an object into a region, or modifying a region's CLUT does not require the page_version_number to increment.

D.4.2.3 region_version_number

Changes to the region_version_number indicate either that the data in the RCS has changed or that a graphics operation is to be performed on the region as a result of:

- the region fill flag being set;
- the contents of the region's CLUT being modified;
- one or more objects being in the region's object list.

NOTE This definition is in accord with bullet 4 under 5.1.5 in ETS 300 743 but contradicts the semantics of region_version_number in 7.2.2 hence a corrigenda to 7.2.2 is identified in table D.1.

D.4.2.4 CLUT_version_number

Changes to the CLUT_version_number indicate that one or more locations in the CLUT family held by the receiver are to be modified.

NOTE So, at (or after) an acquisition point when the encoder delivers the initial state of a CLUT family, the CLUT_version_number may remain constant if that state is consistent with the state held by receivers that have previously acquired the service.

Decoder behaviour when a CLUT is modified is only defined if ALL regions dependent on that CLUT are present with changed version numbers.

D.4.3 Colour translation during object decoding

D.4.3.1 Requested and allocated region depths

A region's region_depth specifies the "requested" pixel depth for that region. A region's region_level_of_compatibility (RLOC) indicates the minimum pixel depth that shall be "allocated" to the region.

D.4.3.1.1 Background (informative)

ETS 300 743 was developed at a time when it was not practical for all receivers to deliver the "requested" pixel depth because of either memory limitations or hardware CLUT limitations. This precipitated the concept of an "allocated" pixel depth which might be less than the "requested" depth.

The UK receiver profile requires the full logical decoder memory model to be implemented by all compatible receivers. So, the "allocated" region depth shall in all cases be the "requested" depth. The descriptions provided here are provided for the benefit of other application domains that may wish to define subtitle interoperability on lower profile receivers.

D.4.3.1.2 Determining if a region can be displayed on reduced profile hardware

If a decoder cannot allocate a region depth compatible with the region's RLOC, then the region shall be ignored.

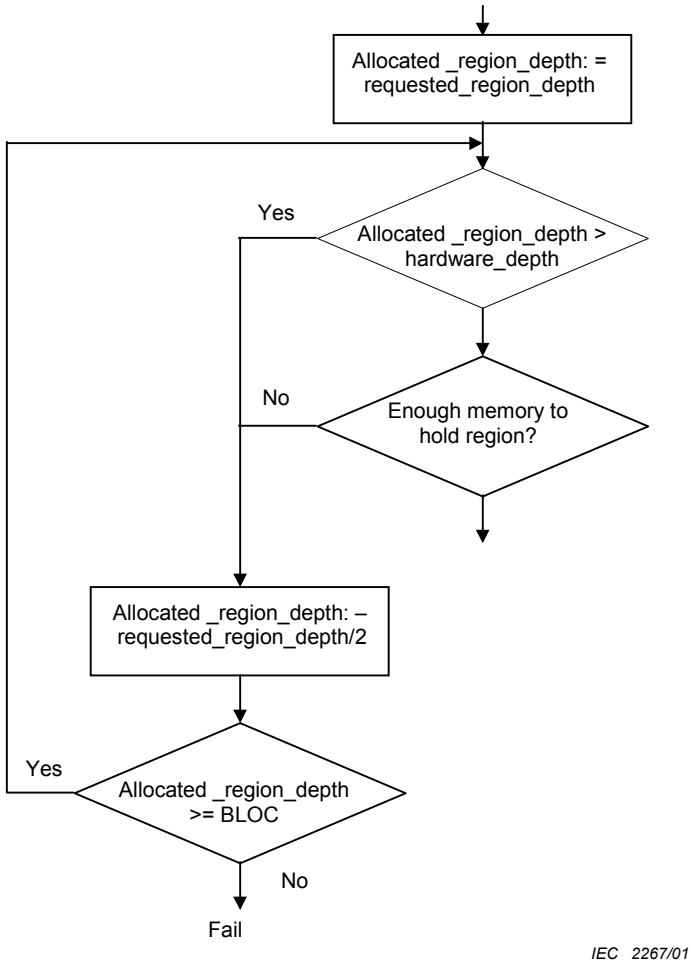


Figure D.2 – Region depth selection

D.4.3.2 Object decoding

D.4.3.2.1 Code string expansion

Bitmap objects are decoded with reference to the “requested” **region_depth** of the region that receives them.

The compressed data yields 2, 4 and 8 bit values which are mapped via map-tables into colour indexes appropriate for the receiving region. For example, an object destined for a region with a “requested” depth of 8 bits per pixel might contain 2-bit/pixel and 4-bit/pixel code strings. The 2_to_8 and 4_to_8 map tables (either the default tables or those embedded in the object) yield 8 bit values.

If the same object is also instanced in a region with a different depth, such as 4 bits, then the same 2-bit/pixel and 4-bit/pixel code strings are mapped through the 2_to_4 and the “unity” 4 to 4 mapping tables to yield 4 bit values.

In effect, the object is decoded twice (once for each instance). This burden is already understood in the ETS 300 743 decoder model. Manufacturers may be able to make more efficient implementations, but this is not relied upon by the encoder.

This mapping from code strings, through the map tables, to pixels in destination regions with the “requested” pixel depth is illustrated in figure D.3.

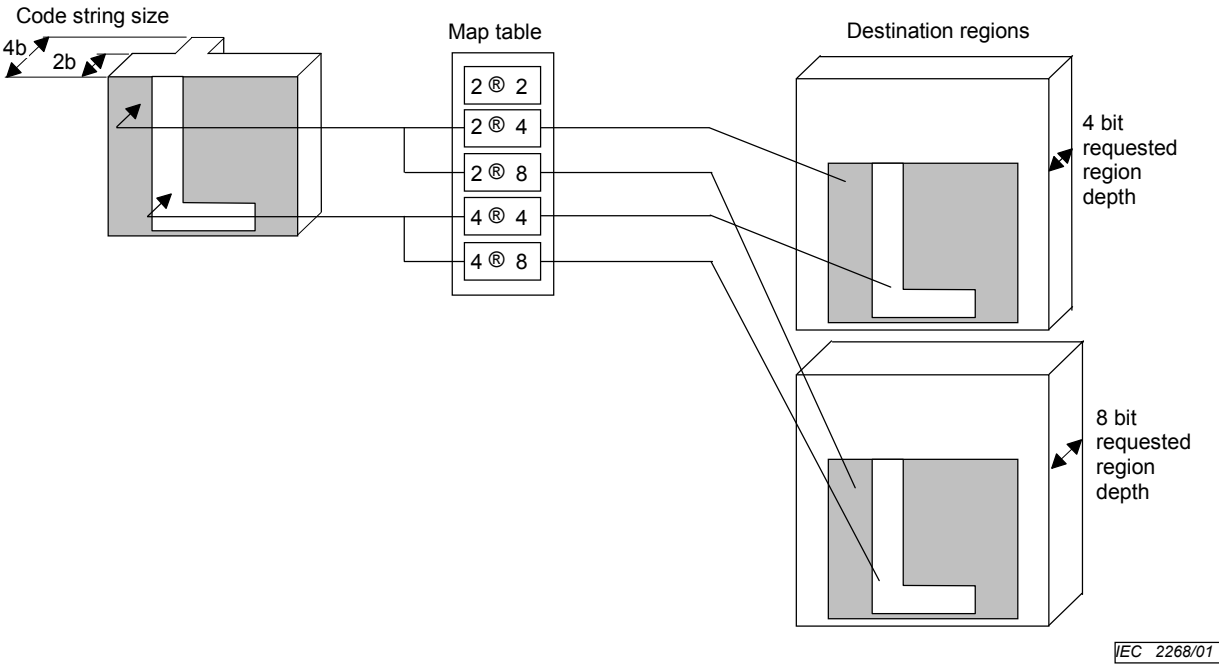


Figure D.3 – Mapping code strings to pixels in "requested" depth region

NOTE See D.5.3.1.4.

D.4.3.2.2 When "allocated" depth is less than "requested"

Figure D-4 shows the complete set of code string expansions and also shows the subsequent pixel reduction that applies if the "allocated" depth of the region is less than the "requested" depth. Figure D-4 clarifies figure 10.1 in section 9 of ETS 300 743.

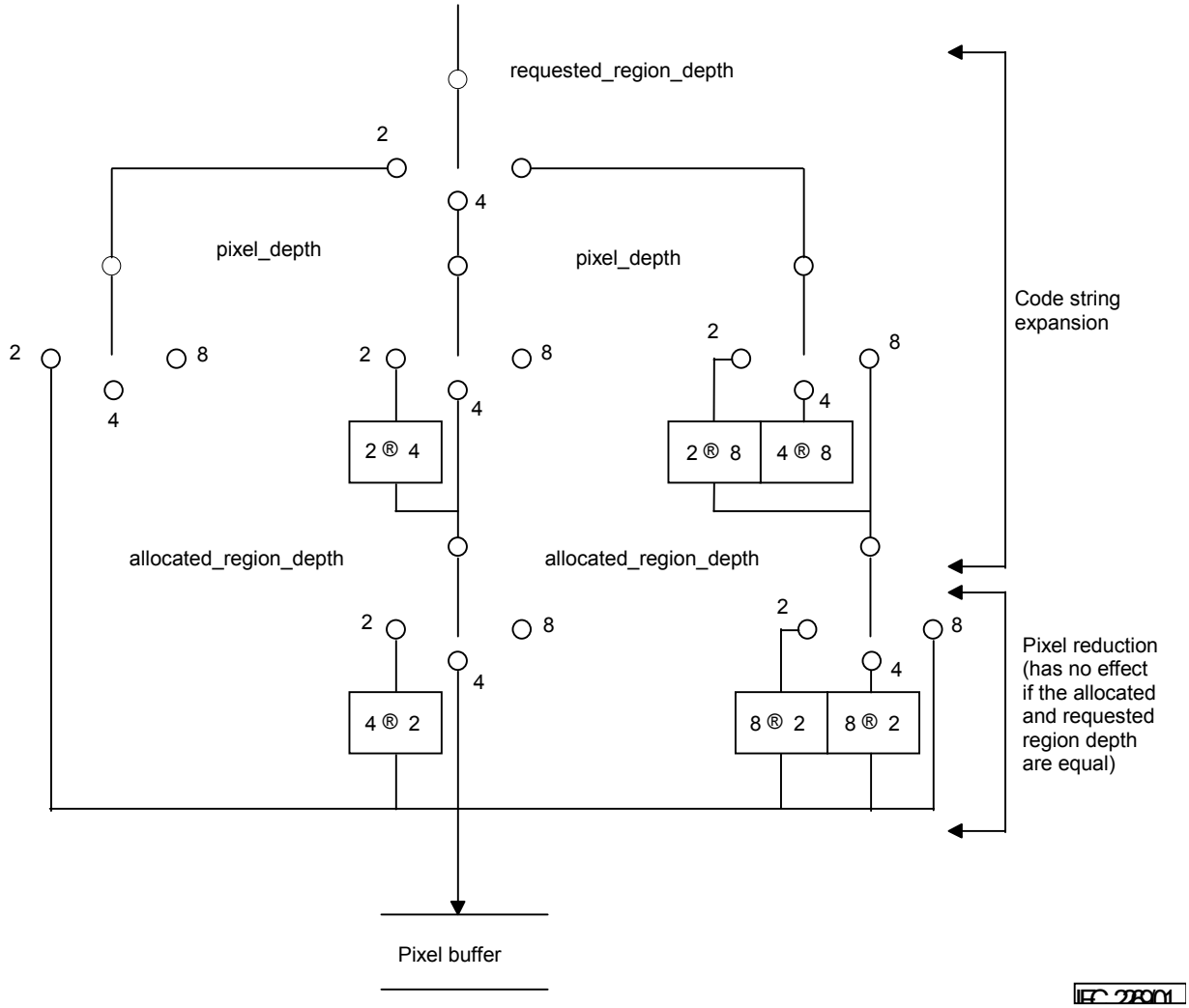


Figure D.4 – Mapping code strings to pixels

D.4.3.2.3 Clarifications

- Coded objects shall not have code strings with more bits per pixel than the “requested” pixel depth of any region in which the object is instanced.
- At the start of decoding an object data segment, the map tables used whilst decoding are reset to the default values given in tables 11 to 13 of ETS 300 743. New map table definitions delivered by “n_to_n-bit map table data” pixel data sub blocks have affect until the earlier of the end of the object data segment or a further “n_to_n-bit map table data” pixel data sub block.
- The order of decoding is strictly the order in which the data is delivered by the object data segment.
- The top and bottom field data blocks in an object are relative to the top of the object (i.e. top field data block delivers pixels on the same scan line as the object_vertical_position).

  Whether the top field data block corresponds to pixels in the upper field of an interlaced display will depend on the position of the object within the region and the position of the region. The bitmap data is split into 2 fields as it is more convenient for some OSD implementations.

D.4.4 Page time out

D.4.4.1 When page time out matures

The behaviour of the receiver when a page time out matures is as if a PCS_{normal_case} with an empty region list was used to update the display. In other words, all regions are removed from the display, but in other respects the state of the decoder remains intact.

When a receiver subsequently receives a PCS with a non-empty region list, the display will be updated in the normal way. If the time-out is known to the decoder, then it should comprehend the display update burden to re-display the regions cleared by the page time-out. If the time-out resulted from an error (as broadcast or in transmission), the receiver is responsible for recovering as best it can from the transient display update overload that may happen.

D.4.4.1.1 Time out is zero

ETS 300 743 defined page_time_out as:

"*The period, expressed in seconds, after which the page is no longer valid*".

Accordingly, the value 0 means an immediate time out (i.e. within 0 s to 5 s after the PTS time for the display set).

D.4.5 Other clarifications

D.4.5.1 Region instances in PCS

Each region shall be instantiated at most once in a PCS.

D.4.5.2 Temporal scope of object references

No object caching is assumed in broadcast subtitle streams. Therefore, the scope of an object_id in an RCS is constrained to objects within the display set carrying the RCS [1)]. Also, the scope of an object_id is the composition and the ancillary pages for the display set. Therefore, an object_id used in one page cannot also be used in the other.

D.4.5.3 Repetition of segments in a display set

Decoder behaviour is not defined if segments of the same type and ID value are repeated within a single display set. For example, if two ODS with the same **object_id** are found in a display set, it is not defined if the decoder decodes the first, the second or both objects.

D.4.5.4 Segments are not fragmented between PES packets

Each PES packet carries an integer number of complete subtitle segments.

NOTE Encoders may benefit from fragmenting large bitmap objects so that they are represented by more than one ODS. See D.9.1

D.5 Revised decoder model

D.5.1 Background (informative)

The subtitle decoder model in ETS 300 743 was developed in the context of systems where the subtitle decoder was the only user of a region based, indexed colour, graphics system. In the UK environment, the subtitle decoder is no longer guaranteed sole access to the display (for example MHEG-5 applications may also concurrently be present) and the use of region based, indexed colour graphics hardware can no longer be assumed.

———————

[1)] Object caching applies in the common interface low-level MMI use of DVB subtitles, this needs further consideration.

The decoder model applied here offers comparable system functionality to that in ETS 300 743, but additionally constrains the encoding process to ensure interoperability in the UK DTT context.

D.5.2 Decoder model

This a conceptual model used to define these terms precisely and to model the decoding process. The model decoder is defined only for this purpose. Neither the architecture of the model decoder, nor the timing described precludes uninterrupted, synchronized play-back of streams from a variety of decoders with different architectures or timing schedules.

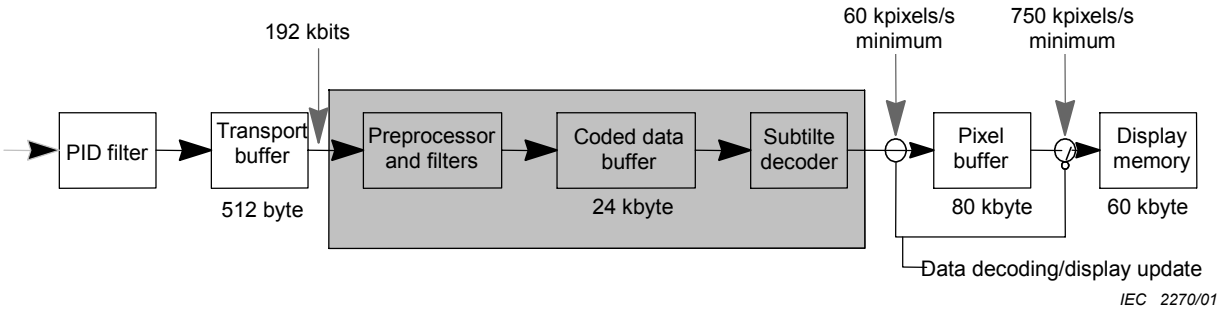


Figure D.5 – Subtitle reference decoder model

D.5.2.1 Transport buffer

As defined in ETS 300 743.

This 512 byte buffer is analogous to the buffers TB_n defined in ISO/IEC 13818-1. It fills at the transport stream rate and, if it contains data, empties at a rate (Rx_n) of 192 kbit/s.

D.5.2.2 Preprocessor & filters

As defined in ETS 300 743.

This selects appropriate PES packets and then subtitling segments on the basis of their page_id values.

D.5.2.3 Coded data buffer model

As in ETS 300 743 the coded data buffer is a 24 000 byte buffer. However, buffer fullness is modelled as the coded data being removed instantaneously at the time defined by the PTS for the display set [1)].

D.5.2.4 Pixel buffer

In the model decoder, the output of the subtitle decoder is considered to be written to an 80 000 byte off-screen “pixel buffer” as data is decoded. The decoder is then considered to update the “display memory” starting at the time defined by the PTS for the display set.

D.5.2.5 Display memory

Compatible with ETS 300 743, 60 000 bytes of display memory are available for visible pixels. As broadcasts are only allowed to use regions with 4 or 8 bits per pixel (see D.6.3) the maximum number of displayed pixels is 120 000.

———————

[1)] In many practical implementations, decoding will start earlier than the PTS time but not “instantaneously” (but not slower than the 60 000 pixel per second minimum). In this case, the actual decoder buffer fullness will be less than predicted by this model.

D.5.2.6 Timing model

Two consecutive phases of processing are recognised:

- Data decoding (from coded data buffer to pixel buffer), and
- Display updating (from pixel buffer to display memory).

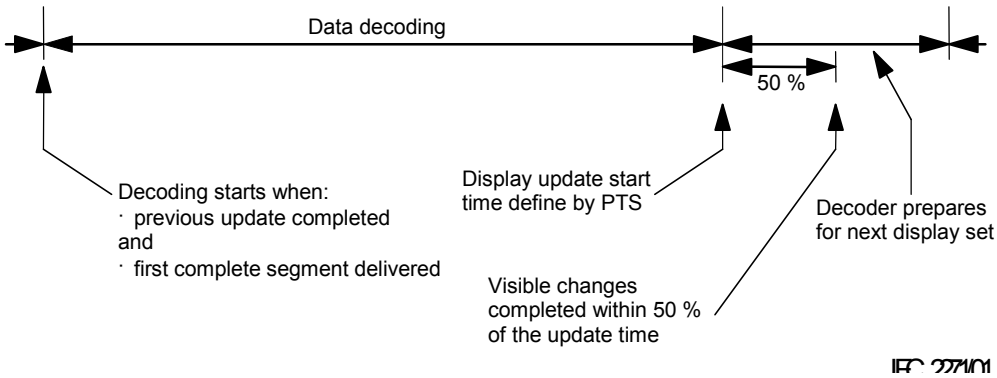


Figure D.6 – The two modelled decoding phases

The decoding process can start when the display updating process of the previous display set has completed and the first segment has been completely delivered to the decoder. The display update process starts at the time defined by the PTS of the display set.

D.5.2.6.1 Data decoding

The data decoding phase starts when the preceding display update phase is complete.

D.5.2.6.2 Epoch set-up

If the PCS has page_state = ‘mode change’ or ‘acquisition point’ then there is a [200 ms] delay after complete reception of the PCS and the RCSs that define the memory use before any further segments are processed. During this time and segments delivered accumulate in the coded data buffer.

NOTE This allows for the memory management tasks required by a decoder acquiring the stream at this point.

The decoding of PCSs with the page_state ‘normal case’ and all segment types other than ODSs are assumed to be instantaneous.

D.5.2.6.3 Bitmap decoding

For each ODS, the model decoder decodes data at a rate of at least 60 000 pixels per second independent of the pixel depth of the region. Decoding starts when previous decoding tasks have been completed and the segment has been completely delivered to the decoder (see D.9.1).

D.5.2.6.4 Race avoidance

In addition to the above, condition the last ODS of a display set is allowed at least 25 ms to decode.

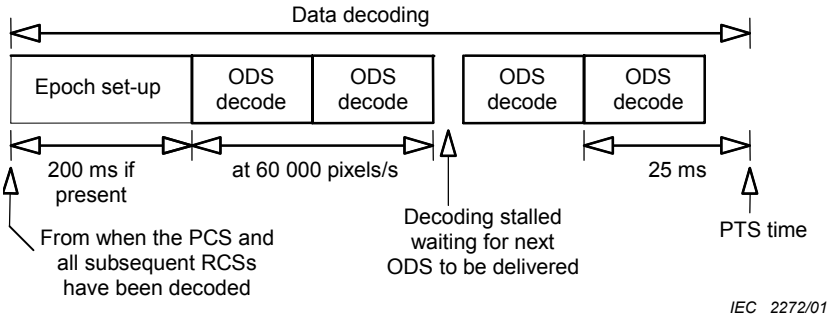


Figure D.7 – Detail of data decoding phase

D.5.2.6.5 Display update model

The display update process starts at the time indicated by the PTS of the display set. Except in the first display set of an epoch, no modifications are made to the display before the time indicated by the PTS.

The duration of the display update phase is based on an update rate of 375 000 pixels per second. However, modifications to the display shall be completed within 50 % of the time available.

NOTE This requirement requires an effective "display paint" rate of 750 000 pixels per second. This enables a 60 000 pixel subtitle to be transferred to the display in 80 ms. The balance of the time after display modification has been completed allows other operations that don't modify the display.

D.5.2.6.6 Start of epoch

The display update for the first display set of an epoch starts, as normal, at the PTS time for the display set, however, to allow the decoder to construct a new memory configuration, the display may be cleared for an implementation dependent time before this and remain clear until the PTS time. In the limiting case, the display may be cleared as soon as the **PCS$_{\text{mode change}}$** is decoded; in which case, the preceding display set may be only displayed for a very short time.

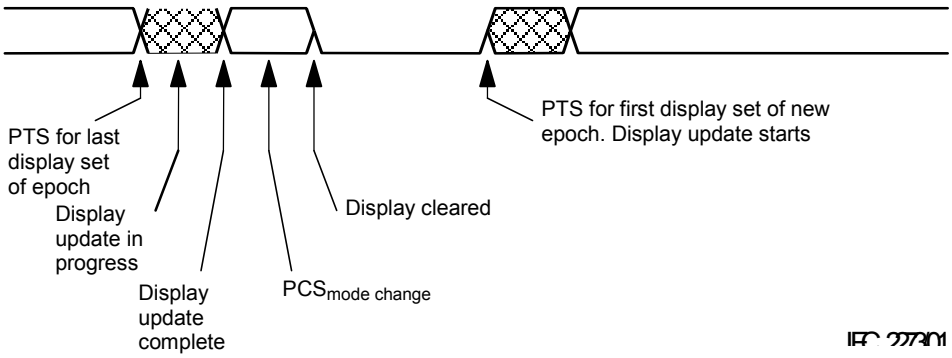


Figure D.8 – Disruption to display at start of new epoch

D.5.2.6.7 Updating within already visible regions

Where an object is decoded into regions that are already on-screen and are not being repositioned (i.e. the position of the region is the same in the page composition segment of the display set that is currently being decoded as in the previous display set), the display update burden is the number of pixels in the smallest rectangle that will enclose the object for each instance of that object. The region depth is not considered.

Here, objects are considered to be decoded into an off-screen copy of the “live” region and then copied to the “live” region during the update process.

D.5.2.6.8 Updating within off-screen regions

If objects are decoded into an off-screen region (i.e. a region that is not currently displayed) there is no display update burden unless the region becomes visible in this display set. In this case, the display update burden is that for the entire region (as described below) and the display update for objects newly decoded into the region is not considered.

D.5.2.6.9 Repositioning regions

Similarly, if a currently visible region is repositioned within the page, the display update burden is that for the entire region and the burden for newly decoded objects is not considered.

D.5.2.6.10 Updating pages and regions

All operations that modify the display memory are comprehended in the display update budget. Table D.3 defines the “weighting” for each pixel affected. For example, if a page composition segment provides a new definition for the position of a region, then the impact on the display update budget is twice the number of pixels in that region.

Table D.3 – Additional display update budget for page/region operations

Operation	Weighting per pixel
page_state = ‘mode change’[a)]	1
Removing a region from the page composition segment	1
Adding a region to the page composition segment	1
Moving a region within a page	2
Redefining any of the values within the CLUT associated with Region[b)]	1
[a)] In other words, all previously existing regions in the display memory are re-drawn as transparent before their definition is deleted. [b)] This affects all the pixels in any region using a redefined CLUT.	

D.5.3 Encoding constraints

All broadcasts shall be encoded as specified in ETS 300 743 but addressing the modified decoder model (described above) and observing the following constraints.

D.5.3.1 Affecting memory requirements

This specification replaces the ETS 300 743 “composition buffer” with constraints on the number or regions, CLUT families and lists of objects that a decoder is required to handle. The size of this memory will be implementation dependent. This memory is in addition to the memory illustrated in figure D.5.

NOTE ETS 300 743 specifies a 4 kbyte “composition buffer”. This was intended to comprehend the memory required to store static data structures describing the set of regions and their CLUTs used through an epoch and the transient data structures required to hold the list of objects used while decoding a display set.

D.5.3.1.1 Number of regions

The maximum number of regions defined in any epoch shall be 8.

Implicitly, this limits the number of CLUT families that can be defined to 8.

D.5.3.1.2 Number of objects

The maximum number of instances of objects in a single display set shall be 128.

D.5.3.1.3 Number of colours

Only 64 different colours with indices 0 to 63 may be used in any display.

To enable a receiver to determine the number of colours in use, the following restrictions apply:

- Where a display contains one or more regions with 8 bit depth, then only a single CLUT family (i.e. a single CLUT ID) shall be referenced by all of the regions concurrently displayed.
- Where a display contains only regions with 4 bit region depth, then up to 4 different CLUT families (i.e. ≤ 4 different CLUT IDs) may be referenced by all of the regions concurrently displayed.

D.5.3.1.4 Pixel depths

Regions shall not have a region_depth of 2 bits per pixel.

D.5.3.2 Affecting graphics system complexity

D.5.3.2.1 Levels of transparency

Broadcasts should not rely on receivers implementing colour resolution greater than the non-full range mode.

Broadcasts should not rely on receivers implementing more than one intermediate (i.e. not 0 % or 100 %) level of transparency per screen.

See D.6.2.

D.5.3.2.2 Region line exclusivity

Each region monopolizes the scan lines of which it occupies any part; no two regions can be presented horizontally next to each other.

D.5.3.2.3 Region width and position

The width of each region (region_width) shall be an even number of pixels. The horizontal position (region_horizontal_address) of each region shall be an even number of pixels.

D.5.3.3 Others

D.5.3.3.1 Successive display sets

The value of PTS for successive display sets shall be at least 120 ms apart.

D.6 UK specific features

D.6.1 End of display set segment

In UK, DTT transmissions the “private” segment with segment_type [0x80] identifies the end of a display set. It should be present in all transmissions. It is optional for decoders to take advantage of this segment.

If the subtitle streams use just the composition page, then the page_id of the end_of_display_set_segment shall be the composition page. If both a composition and ancillary page are used, then the page_id of the end_of_display_set_segment shall be the ancillary page. In either case, the segment shall be inserted just after the last ODS of the display set.

Table D.4 – End of display set segment syntax

Syntax	Size	Type
end_of_display_set_segment() {		
sync_byte	8	bslbf
segment_type	8	bslbf
page_id	16	bslbf
segment_length	16	bslbf
}		

D.6.2 Limitations and approximation of transparency

The coding provided by ETS 300 743 allows multiple intermediate levels of transparency per region.

D.6.2.1 Receiver requirement

Receivers are required to implement at least one intermediate level of transparency (in addition to opaque and complete transparency) per screen. Implementation of additional levels of transparency is optional.

D.6.2.2 Approximations

Where receiver hardware has limited ability to implement the number or values of semi-transparent colours encoded, the following approximations shall be applied:

- Where receiver hardware implements fewer values of semi-transparency than are required by a CLUT family, then the receiver shall combine two or more consecutive semi-transparent values into a single implemented transparency. When reducing the set of levels of semi-transparency, lower transparency shall replace higher transparency.

  For example, if a receiver implements a single value of transparency per region and CLUT family includes the transparency levels 10 %, 20 %, 30 % and 40 % then all semi-transparent levels shall be implemented as 10 %. Similarly, if the receiver can implement 2 levels of semi-transparency, then the recommended mapping is 40 %->30 %, 30 %->30 %, 20 %->10 %, 10 %->10 %.

- Where the receiver cannot implement the encoded value of semi-transparency, it shall replace it with the nearest value of semi-transparency it can implement.

NOTE Semi-transparency shall not be approximated as either 0 % or 100 % transparency.

For example, if a receiver can implement 33 % and 66 % transparency and a CLUT family uses 15 %, then 33 % shall be used rather than 0 %.

Further example, if a CLUT family uses the following levels of transparency 25 %, 50 % and 75 %; and a receiver only allows a single intermediate level of transparency which could be 33 % or 66 %, then 33 % shall be used in all cases.

D.7 OSD Conflicts

D.7.1 Spatial

Spatial conflicts between subtitles and graphics generated by other processes (for example MHEG-5 or user interface) shall be resolved by receivers in an implementation dependent way. Broadcasters requiring deterministic behaviour should avoid possible conflicts.

Conflicts between MHEG-5 and subtitles may occur if the bounding box of any MHEG-5 visible (except those of RTGraphics, video and bitmaps encoded as MPEG I frames) shares the same scan line with any region in the subtitles.

D.7.2 Transparent colours

The transparency of the semi-transparent colours available to MHEG-5 may be affected if the subtitle stream uses a level of transparency different from the default defined for MHEG-5.

D.8 System capabilities (informative)

Table D.5 characterises the behaviour of the above ETS 300 743 based subtitling system for certain “typical” forms of subtitle. The 3 columns on the left describe the way in which new text is delivered (for example infrequent blocks of text or frequent individual words). The right-hand columns illustrate the decode and display times for these subtitles.

Table D.5 – Example subtitle system performance

Unit of added subtitle text	Area	Repetition rate	Decode time [a]	Display update time [b]
Three rows of text	64 kpels	One every 5 s	1000 ms	80 ms
One row of text	21 kpels	One every 1 s	330 ms	<50 ms
Single word (average 5 characters)	4 kpels	5 per s	75 ms	<40 ms

[a] At 60 000 pixels per second.

[b] Starting at the nominal time defined by the PTS, this is the time until all display modification has been completed. This point is half way through the overall display update. See figure D.6.

D.9 Encoding Guidelines (informative)

D.9.1 Fragmentation to improve decoding

Encoders should not assume that decoders can start decoding a segment any sooner than when the last byte of that segment has been delivered to the decoder. If a large bitmap is transmitted this may result in significant delay before the decoder can “start work”. Encoders, by dividing large bitmaps into a number of small bitmap fragments that are then encoded as separate Object Data Segments, can overlap segment delivery with segment decode and thus allow segment decode to start earlier.

D.9.2 Definition of CLUTS at acquisition points

When CLUTs are introduced, they are initialised to hold the default CLUT described in section 10 of ETS 300 743. The CDS may redefine some or all of the locations in a CLUT. Display sets that are also acquisition points must contain one or more CDSs to reserve the memory for the CLUTs to be used by the regions in the epoch.

It is the encoder's responsibility to provide colour definitions in CDSs at (or shortly after) an acquisition point to ensure that decoders acquiring the stream at the current acquisition point have colour definitions consistent with those in decoders that acquired the service at an earlier acquisition point.

D.9.3 Efficient use of non_modifying_colour_flag

Decoder performance is likely to be affected if an object's non_modifying_colour_flag is set even if the object does not use any non-modifying colours. It is recommended that encoders should not set this flag for an object unless a non-modifying colour is used in the object.

D.10 Decoder treatment of errors

This is a non-exhaustive list of known errors. It identifies issues that are illegal encodings.

If these conditions reach the receiver, its behaviour is not prescribed. However, there are likely to be a range of responses depending on the specific error, the context etc. It is an implementation issue to develop error management techniques that ensure robustness without unnecessarily disturbing the display.

D.10.1 Segment Order

- Consecutive PTSs differ but by less than 120 ms.
- No PTS change preceding a PCS.
- PTS change preceding RCS, CDS or ODS.
- More than one PCS.
- ODS or CDS precedes RCS.
- Segment type is not one of 0x10-0x13, 0x080 or 0xFF.
- Segment is not aligned with PES packets because the PES payload does start with sync byte.
- Segment is not aligned with PES packets because the segment extends beyond the length of the PES packet.

D.10.2 PCS

- Page_time_out is zero.
- Page state is '11'.
- Region_id is unknown.
- Duplicate region_id in PCS.
- Region horizontal/vertical address cause off screen or overlapping graphics.
- Region horizontal address is not even.
- Regions not listed in order of incrementing vertical address.
- Total memory for visible region exceeds 60 Kbytes.
- Segment length < 2.
- Region entry incomplete (<6 bytes).

D.10.3 RCS

- Region_id unknown.
- Duplicate RCS (same region_id) within a display set during acquisition or after a mode_change.
- Duplicate RCS (same region_id) within a display set during normal operation.
- More than eight distinct RSCs are received during acquisition or after a mode_change.
- Region width, height, depth, region_level_of_compatibility or CLUT_id are inconsistent with region definitions.
- region_width is not even during acquisition or after a mode_change.
- region_width is zero or > 720 during acquisition or after a mode_change.
- region_height is zero or > 576 during acquisition or after a mode_change.
- region_level_of_compatibility is not one of 0x01-0x03 during acquisition or after a mode_change.
- region_depth is not either 0x02 or 0x03 during acquisition or after a mode_change.
- region_level_of_compatibility is greater than region_depth.
- object_type is not 0x00.
- object_provider is not 0x00.
- Vertical and/or horizontal position are not within the region.
- Total number of objects referenced in all RCSs exceeds 128.
- Total memory for declared regions exceeds 80 Kbytes.
- Segment length < 10.
- Incomplete object entry.

D.10.4 CDS

- CLUT_id unknown.
- Is not referenced in all required preceding RCSs.
- Duplicate CDS (same CLUT_id) within a display set.
- CLUT_entry_id > 15 and 4-bit/entry_CLUT_flag is set.
- 2-bit/entry_CLUT_flag is set.
- Illegal colour i.e. $Y/C_r/C_b$ out of range for 601.
- Illegal $C_r/C_b/T$ values of transparent entry.
- Segment length < 2.
- Incomplete CLUT entry.

D.10.5 ODS

- Object_id is not referenced in a preceding RCS.
- Object coding method is not 0x00.
- Top field length is zero.
- Object data type is not one of 0x10-0x12, 0x20-0x22 or 0xF0.
- Object targeted at a 4-bit region contains an 8-bit/pixel_code_string().
- Object extends beyond region boundaries.
- Segment length < 7.

Annex E
(informative)

An example of frequencies and offsets

E.1 UHF

Where UHF IV and V bands are used, the centre frequencies f_c of the incoming DVB-T RF signals are:

f_c = 474 MHz + (N - 21) x 8 MHz + f_{offset}

N = {21, ..., 69} (UHF channel number)

In some countries offsets may be used:

- In the UK, f_{offset} is ± 1/6 MHz or 0 MHz.
- In Sweden, f_{offset} is between -10 kHz and +10 kHz (continuous fine frequency offset range)

E.2 VHF

Where VHF band III is used, the centre frequencies f_c of the incoming DVB-T RF signals are:

- For countries using 8 MHz channel raster:

  f_c = 178 MHz + (N - 6) x 8 MHz + f_{offset}

  N = {6, ..., 12} (VHF channel number)
- For countries using 7 MHz channel raster:

  f_c = 177,5 MHz + (N - 5) x 7 MHz + f_{offset}

  N = {5, ..., 12} (VHF channel number)

In some countries, offsets may be used.

Annex F
(informative)

Noise model

A useful model for calculating receiver noise performance is illustrated below. The model comprises the following representative components:

- A front-end stage with noise figure F, and 'perfect' automatic gain control (AGC).
- An excess noise source of power P_x at a point following the gain-controlled stage.
- A practical, but unimpaired demodulator; that is, a demodulator with a fast channel equaliser and a consequent implementation margin of (2-3) dB.

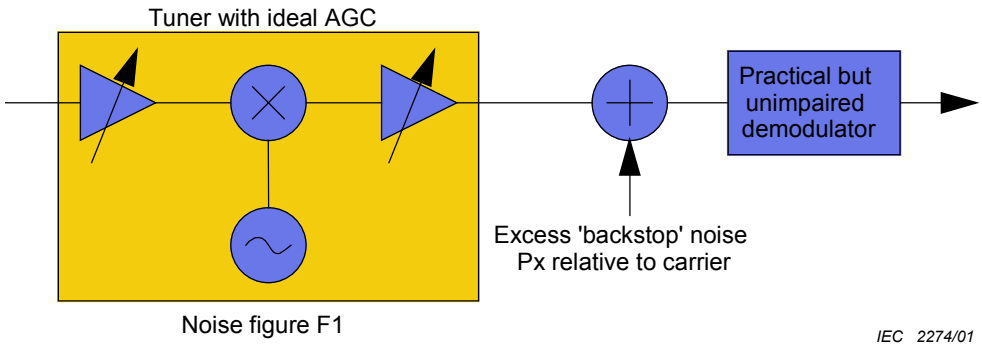


Figure F.1 – Tuner noise model

Note that the excess noise source P_x will include contributions from the following:

- Local oscillator phase noise.
- Quantisation noise introduced by the demodulator analogue-to-digital converter.
- Backstop thermal noise.
- Intermodulation products.

The carrier-to-noise ratio at the input to the model is $10 \log_{10} [C/kTB]$

The carrier-to-noise ratio at the input to the 'practical' demodulator is given by:

$$C/N \text{ (dB)} = 10 \log_{10} [C/(kTBF_1 + CP_x)]$$

where

C = signal input power

k = Boltzmann's constant (k = 1,38 x 10^{-23} J/K)

T = Reference temperature (290 K)

B = system noise bandwidth (7,61 MHz or 6,65 MHz)

Annex G
(informative)

An example of C/N-performance with a practical transmitter

C/*N* values for IL = 2,5 dB, receiver Px = -33 dBc, transmitter ENF = -34 dBc.

Table G.1 – C/N (dB) for reference BER

Modulation	Code rate	Gaussian	Fixed	Portable
QPSK	1/2	5,6	6,1	7,9
	2/3	7,4	8,2	10,9
	3/4	8,4	9,3	13,3
	5/6	9,4	10,5	15,7
	7/8	10,2	11,3	19,1
16-QAM	1/2	11,4	12,2	13,8
	2/3	13,7	14,2	16,9
	3/4	15,1	15,6	19,5
	5/6	16,2	17,1	22,4
	7/8	16,6	17,7	26,9
64-QAM	1/2	17,1	17,4	18,8
	2/3	19,3	20,0	22,4
	3/4	21,0	21,6	25,4
	5/6	22,4	23,3	31,2
	7/8	23,4	24,5	49,0

NOTE 1 Reference BER is defined as BER = 2×10^{-4} after Viterbi decoding.

NOTE 2 The figures in EN 300 744 are all the result of early simulation work, and could change as a result of improved simulations.

NOTE 3 The figures for the fixed reception (“Ricean”) and portable reception (“Rayleigh”) channels make use of the information given in EN 300 744. These particular channels are too complicated for practical implementation and it is proposed that simpler channels be defined and the new figures quoted.

Bibliography

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