

BS EN 62216:2011



BSI Standards Publication

Digital terrestrial television receivers for the DVB-T system

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Full document details: BS EN 62216:2011



National foreword

This British Standard is the UK implementation of EN 62216:2011. It is identical to IEC 62216:2009. It supersedes BS EN 62216-1:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 64535 8

ICS 33.160.25

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2011.

Amendments issued since publication

Date

Text affected

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 62216

July 2011

ICS 33.160.25

Supersedes EN 62216-1:2002

English version

Digital terrestrial television receivers for the DVB-T system (IEC 62216:2009)

Récepteur de télévision numérique
terrestre pour le système DVB-T
(CEI 62216:2009)

Fernsehempfänger für das digitale
terrestrische DVB-T-System
(IEC 62216:2009)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Ref. No. EN 62216:2011 E

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Foreword

The text of document 100/1449/CDV, future edition 1 of IEC 62216, prepared by technical area 1, Terminals for audio, video and data services and contents of IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62216 on 2011-01-02.

This European Standard supersedes EN 62216-1:2002.

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The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2011-10-02 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2014-01-02 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62216:2009 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
-	-	Domestic and similar electronic equipment interconnection requirements: Peritelevision connector	EN 50049-1	-
-	-	Common interface specification for conditional access and other digital video broadcasting decoder applications	EN 50221	-
IEC 60958-1	-	Digital audio interface - Part 1: General	EN 60958-1	-
IEC 61169-2	-	Radio-frequency connectors - Part 2: Sectional specification - Radio frequency coaxial connectors of type 9,52	EN 61169-2	-
IEC 61937	Series	Digital audio - Interface for non-linear PCM encoded audio bitstreams applying IEC 60958	EN 61937	Series
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 - Part 2: Video	-	-
ISO/IEC 13818-3	-	Information technology - Generic coding of moving pictures and associated audio information - Part 3: Audio	-	-
ISO/IEC 14496-3	-	Information technology - Coding of audio-visual objects - Part 3: Audio	-	-
ISO/IEC 14496-10	-	Information technology - Coding of audio-visual objects - Part 10: Advanced Video Coding	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 639-2	-	Codes for the representation of names of languages - Part 2: Alpha-3 code	-	-
ETSI EN 300 744	-	Digital Video Broadcasting (DVB): Framing structure, channel coding and modulation for digital terrestrial television	-	-
ETSI EN 300 468	-	Digital Video Broadcasting (DVB): Specification for Service Information (SI) in DVB systems	-	-
ETSI EN 300 743	-	Digital Video Broadcasting (DVB) - Subtitling systems	-	-
ETSI EN 300 706	-	Enhanced teletext specification	-	-
ETSI EN 300 472	-	Digital Video Broadcasting (DVB) - Specification for conveying ITU-R system B teletext in DVB bitstreams	-	-
ETSI EN 300 294	-	Television systems - 625 line television Wide Screen Signalling (WSS)	-	-
ETSI EN 301 775	-	Digital Video Broadcasting (DVB) - Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams	-	-
ETSI EN 300 231	-	Television systems - Specification of the domestic video Programme Delivery Control system (PDC)	-	-
ETSI TS 101 154	-	Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream	-	-
ETSI TS 102 366	-	Digital Audio Compression (AC-3, Enhanced AC-3)	-	-
ETSI TS 101 699	-	Digital Video Broadcasting (DVB) - Extensions to the common interface specification	-	-
ETSI TR 101 211	-	Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)	-	-
ETSI TS 102 006	-	Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems	-	-
ETR 289	-	Digital Video Broadcasting (DVB) - Support for use of scrambling and Conditional Access (CA) within digital broadcasting systems	-	-
ETR 162	-	Digital broadcasting systems for television sound and data services - Allocation of Service Information (SI) codes for Digital Video Broadcasting (DVB) systems	-	-
ITU-R BS.775-2	-	Multichannel stereophonic sound system with and without accompanying picture	-	-
ITU-R BT.470-7	-	Conventional analogue television systems	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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	-	-
R 206-001	-	Guidelines for implementation and use of the common interface for DVB decoder applications	-	-
CEA 770.3	-	High definition TV analog component video interface	-	-
CEA 861	-	A DTV Profile for Uncompressed High Speed Digital Interfaces	-	-

CONTENTS

FOREWORD.....	8
INTRODUCTION.....	10
1 Scope and object.....	11
2 Normative references	11
3 Abbreviations and symbols	13
4 Receiver capabilities	15
4.1 Frequency spectrum.....	15
4.2 Conditional access	15
4.3 Return path	15
4.4 EPG (SI)	15
4.5 Auto installation.....	16
4.6 Teletext carried in digital streams.....	16
4.7 Content protection/copy management.....	16
4.8 Services	16
4.9 API.....	16
4.10 Over-air software update	16
4.11 Audio and video codecs	16
4.12 Future versions of this standard	17
5 Video system characteristics	17
5.1 General.....	17
5.2 Essential requirements	17
5.2.1 Standard services.....	17
5.2.2 Advanced services	17
5.3 Constraints and extensions	17
5.3.1 Support for rapid channel acquisition.....	17
5.3.2 Picture types	18
5.3.3 Compatibility.....	18
5.3.4 User data	19
5.3.5 Video alignment.....	19
5.3.6 Chroma sampling location	20
6 Video display formatting	21
6.1 General.....	21
6.2 Video format.....	21
6.2.1 General	21
6.2.2 Requirements for DVB compliance	21
6.3 Recommendations for signalling in the video stream	22
6.3.1 Sequence header	22
6.3.2 Sequence display extension	22
6.3.3 Constraints on the use of the picture display extension	23
6.3.4 Format switching	23
6.4 Video format signalling extensions	24
6.4.1 General	24
6.4.2 MPEG signalling.....	24
6.4.3 DVB signalling.....	24
6.4.4 Active format description	24
6.5 Recommendations for ISO/IEC 13818-1 signalling.....	24

6.6	Alignment of SD video and graphics	32
6.6.1	Video with graphics	32
6.6.2	Uncertainty of position of graphics over video	32
6.7	Alignment of HD video and graphics	33
7	Audio system characteristics	33
7.1	General	33
7.2	Essential requirements	33
7.2.1	Requirements	34
7.2.2	Synchronisation	34
7.2.3	Audio metadata	34
7.2.4	Decoding requirements	34
7.3	Constraints and extensions	35
7.3.1	Digitally coded	35
7.3.2	Surround sound	35
7.3.3	AC-3 and Enhanced AC-3 audio	35
7.3.4	ISO/IEC 14496-3 audio	36
7.3.5	Receiver downmix	36
7.3.6	Digital audio output	36
7.4	Audio description	36
7.4.1	Background	36
7.4.2	Receiver implementation minima	37
7.4.3	Receiver mix AD signalling	37
7.4.4	Constraints on audio description stream coding	41
7.4.5	Receiver mix AD implementation notes	41
7.4.6	SI/PSI signalling	43
7.5	Audio only services	45
8	Multiplex and transport stream characteristics	45
8.1	Scope	45
8.2	Essential requirements	45
8.2.1	Multiplexing	45
8.2.2	Demultiplexing	46
8.3	Constraints and extensions	46
8.3.1	Multicomponent programs	46
9	Service and program specific information	47
9.1	General	47
9.1.1	General requirements	47
9.1.2	General receiver requirements	47
9.1.3	General broadcaster requirements	48
9.1.4	Notation	49
9.2	SI and PSI specification	49
9.2.1	Summary	49
9.2.2	Program association table	51
9.2.3	Program map table	51
9.2.4	Conditional access table	53
9.2.5	Network information table	54
9.2.6	Bouquet association table	56
9.2.7	Service description table	56
9.2.8	Event information table	59
9.2.9	Time and date table and time offset table	62

9.2.10	Running status table	62
9.2.11	Private data	62
9.2.12	Overview of service-variation options	68
9.3	Receiver functions	69
9.3.1	Information typically available to the user	69
9.3.2	Service change	69
9.3.3	Parental control	72
9.3.4	Receiver behaviour when a service stops	72
9.4	Establishing and maintaining the network connection	73
9.4.1	Use of SI identifiers	73
9.4.2	Auto installation	74
9.4.3	Network evolution	76
9.4.4	Logical channel numbers (LCN)	78
9.4.5	Recommendation for robust SI acquisition	82
9.5	User interface	84
9.5.1	Presentation of text	84
9.5.2	Information presentation	85
9.5.3	Service navigation	87
9.5.4	Display of time	88
9.6	Recording devices	88
9.6.1	General	88
9.6.2	Programming	88
9.6.3	Execution of recording	88
9.6.4	Control of analogue recorders	89
10	Subtitles	89
10.1	General	89
10.2	Broadcast specifications	89
10.2.1	DVB subtitles	89
10.2.2	Signalling	90
10.2.3	DDS	90
10.2.4	Recommendation	90
10.3	Receiver functions	90
10.3.1	Background	90
10.3.2	User control of receiver behaviour	91
10.3.3	Support for DDS	91
11	VBI based services	91
11.1	General	91
11.2	Broadcast specifications	91
11.3	Receiver functions	92
11.3.1	Processing capabilities	92
11.3.2	Control	92
11.4	Extended VBI format support	92
11.4.1	VPS	93
11.4.2	WSS	93
11.4.3	Teletext and teletext subtitles	93
12	RF-part and channel decoder	93
12.1	General	93
12.2	Frequencies and channel bandwidth	93
12.3	DVB-T modes	93

12.4	Tuning procedure	94
12.5	Change of modulation parameters	94
12.6	Connector	94
12.7	Performance.....	94
12.7.1	Failure point criteria.....	94
12.7.2	C/N performance	94
12.7.3	Minimum receiver signal input levels	95
12.7.4	Maximum input level	95
12.7.5	Immunity to analogue and/or digital signals in other channels.....	95
12.7.6	Immunity to co-channel interference from analogue TV signals.....	96
12.7.7	Guard interval utilisation in single frequency networks.....	97
12.7.8	MFN multipath performance.....	97
13	Conditional access and the common interface	98
13.1	General	98
13.2	Minimum requirements	98
13.2.1	Analogue Copy Protection Resource	98
14	System software update	99
14.1	General	99
14.2	Minimum requirements	99
14.3	Recommendations for SSU operators.....	99
15	Application Programming Interface (API)	99
16	Connectors.....	100
16.1	Standard receivers	100
16.2	Advanced receivers.....	100
16.2.1	Without display	100
16.2.2	With display.....	101
Annex A (normative)	SI character set.....	102
Annex B (normative)	DVB-SI PDC descriptor	111
Annex C (normative)	Subtitling	113
Annex D (informative)	An example of frequencies and offsets.....	130
Annex E (informative)	Noise model	131
Annex F (informative)	An example of C/N-performance with a practical transmitter.....	132
Annex G (informative)	Practical 6-path channel models for fixed and portable channels.....	133
Annex H (informative)	Interfering analogue signals	134
Bibliography		135
Figure 1	– Relationship between digital video and analogue video	19
Figure 2	– Receiver and display format processing reference model	26
Figure 3	– HD Receiver and display format processing reference model.....	27
Figure 4	– Uncertainty of positioning graphics over video.....	33
Figure 5	– Illustration of control of audio level.....	38
Figure 6	– Mapping of pan byte onto sound presentation	41
Figure 7	– Example of PMT extract for main programme audio	44
Figure 8	– Example of PMT extract for audio description	44
Figure 9	– Service regionalisation	79
Figure C.1	– High level bitstream organisation.....	114

Figure C.2 – Region depth selection	116
Figure C.3 – Mapping code strings to pixels in “requested” depth region.....	117
Figure C.4 – Mapping code strings to pixels.....	118
Figure C.5 – Subtitle reference decoder model	120
Figure C.6 – The two modelled decoding phases	121
Figure C.7 – Detail of data decoding phase	122
Figure C.8 – Disruption to display at start of new epoch.....	122
Figure E.1 – Tuner noise model	131
Figure H.1 – PAL interfering signals.....	134
Figure H.2 – SECAM L interfering signal.....	134
Table 1 – Broadcast overscan flags	20
Table 2 – Receiver overscan behaviour	20
Table 3 – Overscan signalling on HDMI	20
Table 4 – Horizontal scaling where format is signalled by the sequence header alone	22
Table 5 – Pan scan window	23
Table 6 – Non “full screen”	23
Table 7 – Formats described by the active_format description	25
Table 8 – Processing by STB connected to 4:3 TV.....	28
Table 9 – User options for displaying 16:9 on 4:3.....	29
Table 10 – User options for displaying >16:9 on 4:3.....	29
Table 11 – Processing by STB connected to 16:9 TV.....	30
Table 12 – WSS codes for aspect ratio	31
Table 13 – Values for other WSS bits	31
Table 14 – Audio description descriptor	38
Table 15 – Illustration of PES packet header	40
Table 16 – Key to symbols.....	49
Table 17 – Summary of required tables.....	50
Table 18 – Program descriptors	51
Table 19 – Elementary stream descriptors	51
Table 20 – Network descriptors (first loop).....	54
Table 21 – Transport stream descriptors (second loop).....	55
Table 22 – Service descriptors.....	57
Table 23 – Event information descriptors	60
Table 24 – Time offset table descriptors	62
Table 25 – Private SI recognised by this standard	63
Table 26 – Syntax of the eacem stream identifier descriptor	63
Table 27 – Syntax of the logical channel descriptor	64
Table 28 – Logical channel number	65
Table 29 – Syntax of the preferred name list descriptor	65
Table 30 – Syntax of the preferred name identifier descriptor	66
Table 31 – HD simulcast logical channel descriptor	67
Table 32 – Subtitle preference modes defined	70

Table 33 – Receiver response to missing SI tables	83
Table 34 – Text field lengths	85
Table 35 – Delta values between picture failure point and reference BER	94
Table 36 – C/N (dB) for reference BER	95
Table 37 – Immunity to analogue signals on other channels	96
Table 38 – Immunity to digital signals on other channels	96
Table 39 – Immunity to co-channel interference from analogue signals	96
Table 40 – Long echo test profile	97
Table 41 – Short echo test profile	97
Table A.1 – Allowed character codes in SI text fields	103
Table B.1 – Syntax of the PDC descriptor	111
Table C.1 – Additional display update budget for page/region operations	123
Table C.2 – Example subtitle system performance	126
Table F.1 – C/N (dB) for reference BER	132
Table G.1 – Approximate 6-tap channel for fixed reception (Ricean channel)	133
Table G.2 – Approximate 6-tap channel for portable reception (Rayleigh channel)	133

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**DIGITAL TERRESTRIAL TELEVISION RECEIVERS
FOR THE DVB-T SYSTEM**

FOREWORD

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International Standard IEC 62216-1 has been prepared by technical area 1, Terminals for audio, video and data services and contents, 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
100/1449/CDV	100/1541/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 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

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

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.

Due to the multitude of communities, sometimes single operators, often on a country by country basis dealing with the parameters and standards options of launching Digital Terrestrial services based on DVB, there is a natural tendency to create 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.

In 2000, after over two years of requirement capture in DigiTAG (Digital Television Action Group) EACEM (European Association of Consumer Electronics Manufacturers), which has evolved into EICTA (European Information, Communications and Consumer Electronics Technology Industry Associations), decided to address this situation by developing a basic specification as a minimum platform, providing secure reception of broadcast content and associated services. This resulted in the first revision of this standard. It has been used as a basis in many countries to deploy Digital Terrestrial TV (DTT) with great success.

In 2007, with a new wave of High Definition services being considered to be launched due to the availability of MPEG4 components, EICTA and the French “Forum HD” decided to collaborate to create an update for High Definition, and make some minor adjustments that were due after 7 years of practice with Standard Definition terrestrial TV in the market. The new standard improvements are taking into account contributions and comments from a.o. UK DTG (draft HD D-Book), Nordig and DGTVi. This standard does not yet address new generations of channel coding (DVB-T2) now being considered by DVB. Extensions of this standard in this domain may be foreseen in the future.

DIGITAL TERRESTRIAL TELEVISION RECEIVERS FOR THE DVB-T SYSTEM

1 Scope and object

This International Standard specifies both Standard Definition and High Definition receivers 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 mandatory versus those that are optional. A baseline receiver will support the mandatory features but not all the optional features in this standard. Inclusion of optional features is part of the marketing strategy of the manufacturer.

Subtitling and teletext are considered to be components of TV services. Standalone teletext services (without associated video content) are not part of this standard.

This standard primarily addresses terrestrial delivery of digital transmissions.

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

Two types of systems are considered:

- standard systems where services are all SD and use well-established codecs. Standard receivers which can decode standard services are suitable for these systems;
- advanced systems where some services may use advanced codecs, for example to provide HD video. Advanced receivers which can decode advanced services are suitable for these systems.

Where the term “receiver” or “broadcast” is used without a qualifier, the statement is applicable equally to both types of systems.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61169-2, *Radio-frequency connectors – Part 2: Sectional specification – Radio frequency coaxial connectors of type 9,52*

IEC 60958-1, *Digital audio interface – Part 1: General*

IEC 61937 (all parts), *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958*

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*

ISO/IEC 14496-3, *Information Technology – Coding of audio-visual objects –Part 3: Audio*

ISO/IEC 14496-10, *Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding*

ISO 639-2, *Codes for the representation of names of languages – Part 2: Alpha-3 code*

ITU-R BS.775-2, *Multichannel stereophonic sound system with and without accompanying picture*

ITU-R BT.470-7 *Conventional television systems*

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 300 294, *Television Systems – 625-line television Wide Screen Signalling (WSS)*

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

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

EN 300 743, *Digital Video Broadcasting (DVB) – Subtitling systems*

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

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

ETR 162, *Digital broadcasting systems for television sound and data services; Allocation of Service Information (SI) codes for Digital Video Broadcasting (DVB) systems*

Note that the allocation of identifiers is handled by DVB; up-to-date information on DVB identifiers can be obtained from <www.dvb.org>.

ETR 289, *Digital Video Broadcasting (DVB) – Support for use of scrambling and Conditional Access (CA) within digital broadcasting systems*

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

ETS 300 706, *Enhanced Teletext specification*

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

TS 101 154, *Digital Video Broadcasting (DVB); Implementation guidelines for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream*

TR 101 211, *Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)*

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

TS 102 006, *Digital Video Broadcast (DVB); Specification for System Software Update in DVB systems*

TS 102 366, *Digital Audio Compression (AC-3, Enhanced AC-3) Standard*

CEA 770.3, *High Definition TV Analog Component Video Interface*

CEA 861, *A DTV Profile for Uncompressed High Speed Digital Interfaces*

3 Abbreviations and symbols

AD	Audio Description
AFD	Active Format Description
API	Application Programming Interface
AU	Access Unit
BAT	Bouquet Association Table
bslbf	Bit string, left bit first
CA	Conditional Access
CCO	Centre Cut-Out
DDS	Display Definition Segment

DTS	Digital Theatre System
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcast
EBU	European Broadcast Union
EIT	Event Information Table
EIT _{pf}	EIT present/following
EPG	Electronic Programme Guide
FF	Full Frame
IDTV	Integrated Digital Television
IPPV	Impulse Pay Per View
HD	High Definition
HDCP	High-bandwidth Digital Content Protection
HDMI™ ¹	High Definition Multimedia Interface™
LB	Letter Box
LCN	Logical Channel Number
MFN	Multi Frequency Network
MTBF	Mean Time Between Failure
NIT	Network Information Table
NVOD	Near Video On Demand
PCS	Page Composition Segment
PDC	Programme Delivery Control
PES	Packetised Elementary Stream
PIL	Programme Identification Label
PMT	Program Map Table
PSI	Program Specific Information
PTS	Presentation Time Stamp
RNIB	Royal National Institute for the Blind
RST	Running Status Table
SD	Standard Definition
SDT	Service Description Table
SFN	Single Frequency Network
SI	Service Information
SSU	System Software Update
STB	Set Top Box
TDT	Time and Date Table
TOT	Time Offset Table
TS	Transport Stream

¹ HDMI and High-Definition Multimedia Interface are trade marks of the HDMI Licensing, LLC. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named.

UCS	Universal Character Set
uimbsf	Unsigned integer most significant bit first
UNT	Update Notification Table
UTC	Universal Time, Co-ordinated
VUI	Video Usability Information
VCR	Video Cassette Recorder
VPS	Video Programming System
WSS	Wide Screen Signalling

4 Receiver capabilities

4.1 Frequency spectrum

The receiver shall support:

- UHF and/or VHF (band III);
- 8 MHz and/or 7 MHz channel bandwidth;
- all DVB-T modulation methods;
- both 2K and 8K transmitting methods;
- all code rates;
- all guard intervals;
- hierarchical mode by the demodulator (optional);
- frequency offset management;
- multi-frequency networks (MFNs) and single frequency networks (SFNs);
- support DVB-H service discrimination.

4.2 Conditional access

The receiver is capable of receiving free-to-air services and is recommended to provide access to scrambled services. In order to have the needed flexibility to choose a Conditional Access (CA) system one Common Interface slot (according to EN 50221) is foreseen. In the future other means to add new CA systems might be used instead.

4.3 Return path

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

4.4 EPG (SI)

The electronic programme guide (EPG) shall 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 shall 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. In order to allow for future phase-out, DVB-subtitle decoding is the recommended transmission format for subtitling.

4.7 Content protection/copy management

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

Digital content protection using HDCP on the HDMI output connector should be supported on receivers without integrated video display.

4.8 Services

The receiver shall support the following services and service features:

- free to air broadcast;
- multi-lingual sound;
- multi-lingual subtitles (DVB subtitles);
- audio broadcast;
- screen formatting for ratios of 4:3 and 16:9;
- content rating protection based on DVB standard (see 9.2.8.1.7 and 9.3.3).

In addition, the receiver may support:

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

4.9 API

The receiver may support an API in order to facilitate interactive TV services. See Clause 15.

4.10 Over-air software update

The receiver may support the DVB System Software Update service in order to permit maintenance or functional upgrades once the receiver is deployed in the field. See Clause 14.

4.11 Audio and video codecs

A standard receiver shall at least support MPEG-2 audio and SD video.

An advanced receiver shall, in addition, support:

- ISO/IEC 14496-10 SD and HD video, as specified in TS 101 154;
- either ISO/IEC 14496-3 HE-AAC audio (v1 only, i.e. not including the Parametric Stereo tool) or TS 102 366 Enhanced AC-3 audio, as specified in TS 101 154;

- multi-channel audio, encoded using one of the codecs in the previous bullet, up to 5.1 channels.

4.12 Future versions of this standard

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

5 Video system characteristics

5.1 General

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

It is based on the D-Book version 3.0.

5.2 Essential requirements

5.2.1 Standard services

Broadcast video shall be encoded according to ISO/IEC 13818-2 constrained according to TS 101 154. All receivers should be able to meet the minimum decoding requirements set out in TS 101 154.

Only the '25 Hz MPEG-2 SDTV' variant described in the 'Video' clause of TS 101 154 is relevant to this standard.

5.2.2 Advanced services

Broadcast video shall be encoded according to ISO/IEC 14496-10 (H.264/AVC) constrained according to TS 101 154. All advanced receivers should be able to meet the minimum decoding requirements set out in TS 101 154.

Only the '25 Hz H.264/AVC SDTV' and '25 Hz H.264/AVC HDTV' variants (plus the Common parts) described in the 'Video' clause of TS 101 154 are relevant to this standard.

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 TS 101 154.

5.3.1 Support for rapid channel acquisition

To reduce the typical time taken to start decoding a new service, each video elementary stream carrying ISO/IEC 13818-2 encoded video shall contain a sequence header and associated group of pictures header at an interval no greater than 0,5 s. Also, each such sequence header shall be immediately preceded by a PES packet header carrying a PTS².

For video encoded to ISO/IEC 14496-10, random access points shall be inserted at an interval no greater than 2 s and should be inserted at an interval no greater than 0,5 s where channel change speed is important.

Receivers should still be able to decode the video elementary stream when these figures are exceeded.

² TS 101 154 recommends but does not mandate this.

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.

Advanced services encoded to ISO/IEC 14496-10 shall follow the restrictions of picture and slice types set out in TS 101 154.

5.3.3 Compatibility

5.3.3.1 ISO/IEC 11172-2 compatibility

TS 101 154 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 standard shall not include ISO/IEC 11172-2 'D' pictures or sequences with a horizontal_size greater than 720.

5.3.3.2 ISO/IEC 14496-10 compatibility

5.3.3.2.1 Standard definition

Standard definition video services shall be encoded according to TS 101 154 except that High Profile may be used in markets where HD services are also broadcast. This means that receivers shall support video encoding up to ISO/IEC 14496-10 High Profile level 3. Receiver's support other profiles beyond High Profile is optional. Support of levels beyond level 3 is optional. If the receiver encounters an extension which it cannot decode, it shall discard the following data until the next start code prefix (to allow backward compatible extensions to be added in the future).

Broadcasts conforming to this standard shall not include sequences with a horizontal_size greater than 720.

5.3.3.2.2 High definition

TS 101 154 requires that high definition video encoding shall conform to ISO/IEC 14496-10 High Profile level 4. Receiver's support for profiles other than High Profile or levels outside the range 3.0 to 4.0 is optional. If the receiver encounters an extension which it cannot decode, it shall discard the following data until the next start code prefix (to allow backward compatible extensions to be added in the future).

Broadcasts conforming to this standard shall not include sequences with a horizontal_size greater than 1920.

5.3.3.2.3 Still pictures

Advanced receivers shall support the decoding and display of still pictures for all AVC profiles.

To signal a video stream containing still pictures, the broadcast shall set the AVC_still_present flag in the AVC descriptor, as specified in ISO/IEC 13818-1. The receiver

shall decode the still picture frame and repeat displaying it until the subsequent (still picture) frame is available to display.

NOTE Broadcasts containing still pictures are typically at very low frame rates (for example 1 frame per second).

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 6.4.4. 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 SD output signal

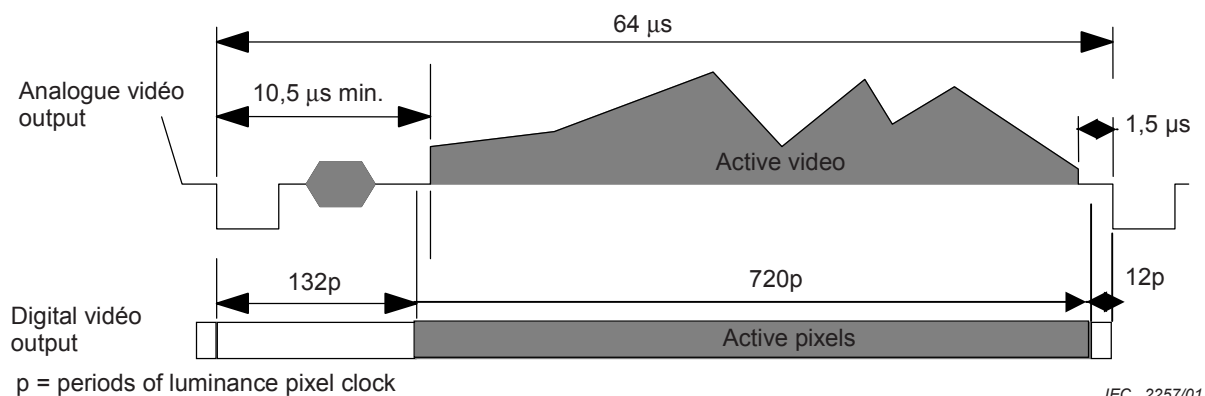


Figure 1 – Relationship between digital video and analogue video

The digital video output of the receiver's video decoder and graphics display system domain contains 720 active pixels per line; these shall be aligned to the SD 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.470-7;
- 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 ($\approx 9,8 \mu\text{s}$) 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 702×576 pixel area is not visible due to overscan on a display.

For services carrying ISO/IEC 14496-10 video, the broadcaster may use the `overscan_info_present` and `overscan_appropriate` flags in the VUI area to indicate whether the receiver should apply this typical overscan or should display the complete broadcast video image. The flags shall be encoded according to Table 1.

Table 1 – Broadcast overscan flags

<code>overscan_info_present_flag</code>	<code>overscan_appropriate_flag</code>	Usage
0x0 or not broadcast	n/a	No preferred display method
0x1	0x0	Important information in entire video region
0x1	0x1	Decoded picture suitable for overscan

Unless the user requests otherwise, integrated digital TV receivers shall interpret and follow the overscan flags according to Table 2.

Table 2 – Receiver overscan behaviour

<code>overscan_info_present_flag</code>	<code>overscan_appropriate_flag</code>	Behaviour
0x0 or not broadcast	n/a	Implementation dependent
0x1	0x0	Overscan not applied
0x1	0x1	Overscan applied

For receivers with HDMI output, the receiver shall pass the video without overscan related reformatting to its output, setting the bits in the AVI Infoframe (see CEA 861) in accordance with Table 3.

Table 3 – Overscan signalling on HDMI

<code>overscan_info_present_flag</code>	<code>overscan_appropriate_flag</code>	<S1,S0> (in HDMI AVI Infoframe)
0x0 or not broadcast	n/a	<0,0>
0x1	0x0	<1,0>
0x1	0x1	<0,1>

5.3.5.3 Downscaling HD video to SD

When downscaling HD video for presentation via an SD output, the HD video should be downscaled to fit in a 702 × 576 window centred in the SD video output.

5.3.5.4 Upscaling SD video to HD

When upscaling SD video for presentation via an HD output, only the 702 × 576 window of the SD video should be upscaled to fit in the HD video output.

5.3.6 Chroma sampling location

When the video is encoded according to ISO/IEC 14496-10, the chrominance locations shall be specified in the VUI by the syntax elements `chroma_sample_loc_type_top_field` and `chroma_sample_loc_type_bottom_field` and both of these values shall be set to “0”.

6 Video display formatting

6.1 General

This clause, which is based on the 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

6.2.1 General

The video format shall be encoded as described in ISO/IEC 13818-1, ISO/IEC 13818-2, ISO/IEC 14496-10 and EN 300 468 constrained and interpreted as described in TR 101 211 and TS 101 154 and as clarified and extended below.

Only the ‘25 Hz MPEG-2 SDTV’ variant described in the ‘Video’ clause of TS 101 154 is relevant for standard services; the ‘25Hz H.264/AVC SDTV’ and ‘25Hz H.264/AVC HDTV’ variants plus the Common parts are in addition relevant for advanced services.

6.2.2 Requirements for DVB compliance

6.2.2.1 Required format information

The following element shall be included for all video services:

- component descriptor (EN 300 468).

The following element shall be included for all ISO/IEC 13818-2 standard video services:

- video sequence header. Restricted to “full screen” luminance pixel resolutions of 720×576 , 704×576 , 544×576 , 480×576 , 352×576 or 352×288 or “less than full screen” resolutions as described in TS 101 154.

The following elements shall be included for all ISO/IEC 14496-10 advanced video services:

- random access point. Restricted to “full screen” luminance pixel resolutions of 720×576 , 704×576 , 544×576 , 480×576 , 352×576 , 352×288 , $1\,920 \times 1\,080$, $1\,440 \times 1\,080$, $1\,280 \times 1\,080$, $960 \times 1\,080$, $1\,280 \times 720$, 960×720 , 640×720 or “less than full screen” resolutions as described in TS 101 154.
- frame cropping information for 1080 line video resolutions to crop the encoded 1088 lines to 1080 lines. Frame cropping shall not be used for any other purpose.

If the frame cropping information is not present in a video stream with 1 088 encoded lines, the receiver shall discard the bottom 8 lines.

6.2.2.2 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 or ISO-IEC 14496-10), provided that the display window has an aspect ratio of 4:3 as described in TS 101 154;

- video picture display extension (ISO/IEC 13818-2), provided that the frame centre vertical offset is zero as described in TS 101 154;
it is mandatory to include the video sequence extension in any video sequence that includes the picture display extension (and hence Pan vectors (as defined in TS 101 154));
- target background grid descriptor (ISO/IEC 13818-1);
- video window descriptor (ISO/IEC 13818-1).

6.3 Recommendations for signalling in the video stream

6.3.1 Sequence header

6.3.1.1 Sequence header (ISO/IEC 13818-2 video)

The minimum video format signalling required is the video sequence header. Table 4 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 4 – 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.					

6.3.1.2 Sequence parameter set (ISO/IEC 14496-10 video)

The minimum video format signalling required is the random access point. The relevant scaling factors, extracted from the VUI, to be used to restore the video to the correct size and aspect ratio are listed in TS 101 154.

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 5 – 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 TS 101 154 and DAVIC quote 363 as an example of $480 \times 3/4$.					

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 6 – 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	Distinguished from Table 5 as display_horizontal_size ≥ horizontal_size
544 528	540	4/3	
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 (known as a pan vector).

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.

6.3.4 Format switching

Receivers complying with this standard 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 (ISO/IEC 13818-2) or random access point (ISO/IEC 14496-10);
- 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 (interlaced video only).

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`).

Broadcasters should avoid changing the format of the video dynamically.

Broadcasters are advised that changing the format of the video will result in temporary artefacts on receivers. A typical receiver may require the time between the first and second random access points for processing a format change. Receivers should minimize the impact of a format change to a few seconds (depending on random access points in the video).

6.4 Video format signalling extensions

6.4.1 General

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

6.4.2 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 or VUI 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.

6.4.3 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”).

6.4.4 Active format description

Active format descriptions as defined in Annex B of TS 101 154 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 7 (copied from TS 101 154) illustrates the various formats.

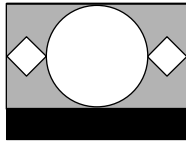
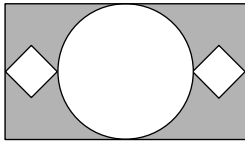
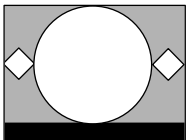
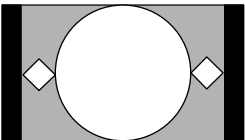
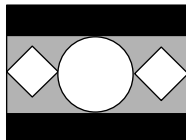
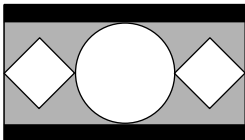
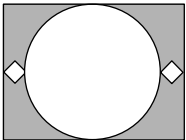
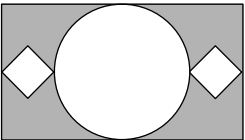
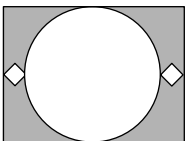
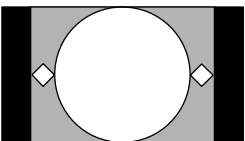
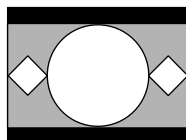
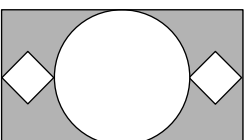
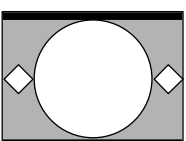
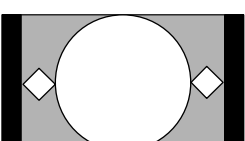
6.4.4.1 Broadcaster rule

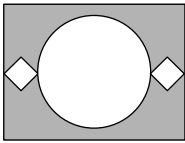
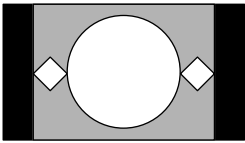
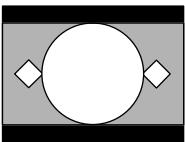
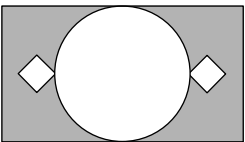
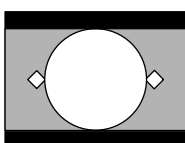
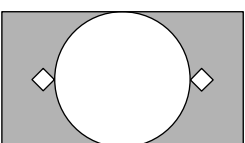
If the area of interest is smaller than the full coded frame then it is recommended to transmit the active format description to indicate the area of interest.

6.4.4.2 Manufacturer rule

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

Table 7 – Formats described by the active_format description

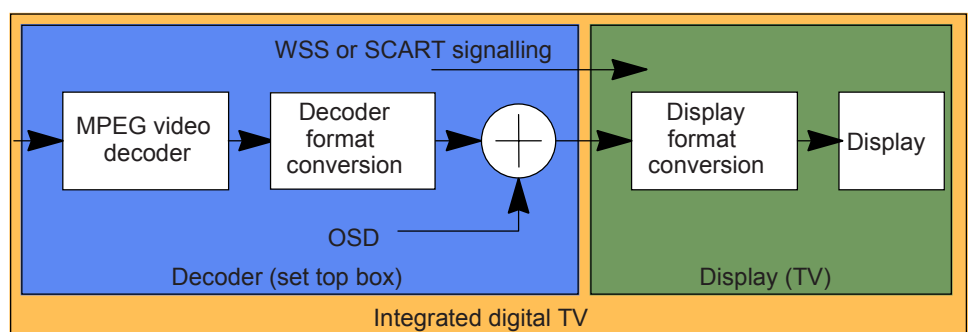
active_format		Full frame aspect ratio	
Value	Meaning	4:3	16:9
0000 – 0001	Reserved for future use		
0010	Box 16:9 (top)		
0011	Box 14:9 (top)		
0100	Box > 16:9 (centre)		
0101 – 0111	Reserved for future use		
1000	Active format is the same as the coded frame		
1001	4:3 (centre)		
1010	16:9 (centre)		
1011	14:9 (centre)		
1100	Reserved for future use		

active_format		Full frame aspect ratio	
Value	Meaning	4:3	16:9
1101	4:3 (with shoot and protect 14:9 centre)		
1110	16:9 (with shoot and protect 14:9 centre)		
1111	16:9 (with shoot and protect 4:3 centre)		
NOTE 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.			

6.4.4.3 Receiver processing

6.4.4.3.1 SD 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 6.4.4.7) 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.



IEC 2258/01

Figure 2 – Receiver and display format processing reference model

In the reference model, the output of the MPEG video decoder is logically 720×576 . 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.

6.4.4.3.2 HD 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 3. 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 the HDMI INFO-FRAME. Within an Integrated Digital TV the signalling is logically equivalent to the INFO-FRAME but could be conveyed by other means.

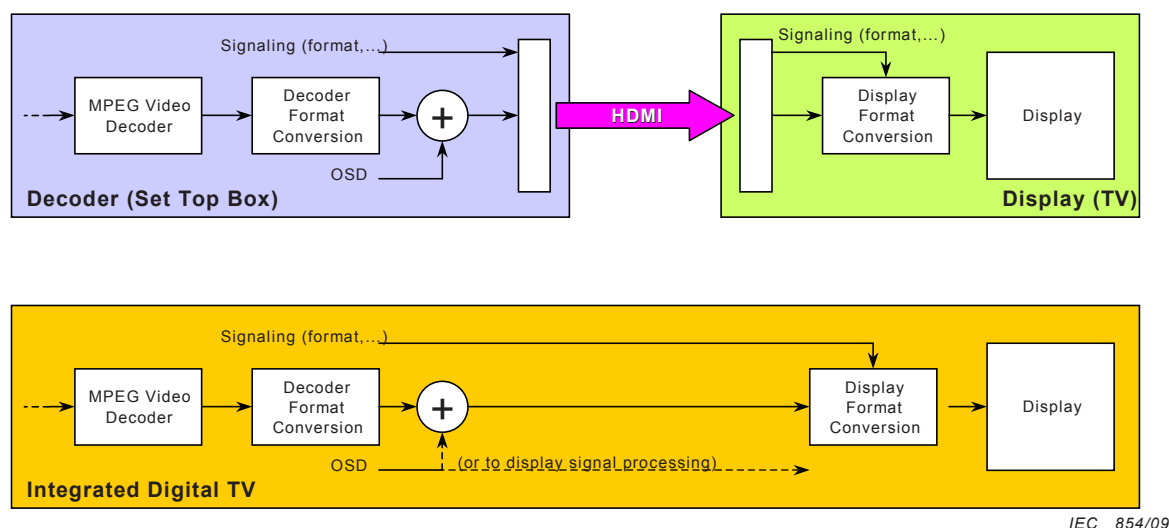


Figure 3 – HD Receiver and display format processing reference model

In the reference model the output of the MPEG Video Decoder is logically 1920×1080 , 1280×720 or 720×576 , the processing applied to this by the Decoder Format Conversion is described previously. 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 format of the video output by an STB to a display will be determined by the capabilities of both devices and may not correspond with the format of the broadcast video. The STB should avoid undue scaling operations as this will degrade the quality of the video.

If the STB or Integrated Digital TV has a secondary SD output, this shall operate according to the reference model in 6.4.4.3.1 with implicit downscaling of the video to 720×576 and optionally the processing of any AFD.

6.4.4.4 STB with 4:3 display

6.4.4.4.1 STB response

Table 8 shows the response of a set top box to all broadcast formats when connected to a 4:3 aspect ratio display.

Table 8 – 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 and protect 14:9		1101		0111	
16:9 LB shoot and protect 14:9		1110		1101	
16:9 (with shoot and protect 4:3 centre)		1111			
16:9 letter box (top)	16:9	0010	According to user preference. See Table 9		
14:9 letter box (top)		0011	CCO ^{a)}	0001	12 V
>16:9 letter box		0100	According to user preference. See Table 10		
16:9		1000	According to user preference. See Table 9		
4:3 pillar box		1001	CCO	0001	12 V
16:9		1010	According to user preference. See Table 9		
14:9 pillar box		1011	CCO ^a	0001	12 V
4:3 PB shoot and protect 14:9		1101	CCO	0001	12 V
Full 16:9 shoot and protect 14:9		1110	According to user preference. See Table 9 ^b		
Full 16:9 shoot and protect 4:3		1111	According to user preference. See Table 9		

^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.

6.4.4.4.2 User preferences for displaying 16:9

Four user preferences for presentation of widescreen material are defined in Table 9. 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 9 – 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

6.4.4.4.3 User preferences for displaying >16:9

4 user preferences for presentation of “cinemascope” material (>16:9) are defined in Table 10. 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 10 – 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 EN 300 294 does not have a way to indicate the active area being less than full frame for the “16:9 anamorphic” mode.			

6.4.4.4.4 Key

The tables in 6.4.4.4 and 6.4.4.5 use the following abbreviations:

- FF Full frame
The output of the decoder is the full width and 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.

6.4.4.4.5 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 12), this signalling is provided to ensure correct behaviour if the video is recorded and then subsequently displayed on a TV that supports WSS.

6.4.4.5 STB with 16:9 display

Table 11 shows the response of a set top box to all broadcast format when connected to a 16:9 aspect ratio display via a peritelevision connector.

Table 11 – 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 and protect 14:9		1101		0111	
16:9 letter box shoot and protect 14:9		1110		1101	
16:9 (with shoot and 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 and protect 14:9		1101	CCO	0111	12 V
Full 16:9 shoot and protect 14:9		1110	FF	1110	6 V
Full 16:9 shoot and protect 4:3			1111		

When the set top box and TV are connected via HDMI, the output of the set top box shall always be formatted for 16:9 display. See 6.4.4.7.4 for further information.

6.4.4.6 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 6.4.4.5) and a 16:9 TV.

6.4.4.7 Wide screen signalling (WSS)

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

6.4.4.7.1 Aspect ratio bits

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

Table 12 – 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 .	

6.4.4.7.2 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 13 – 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	00	See Annex C of EN 300 294 (V1.4.1, 2003-04). Unless specified otherwise, the receiver shall set these bits to 0, 0, reflecting that the output signal of the receiver has no known copyright restrictions and copying is allowed.

6.4.4.7.3 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.

6.4.4.7.4 AFD processing for HDMI output

Receivers with HDMI output are recommended to provide at least one of the following methods to process aspect ratio and AFD information for video output on HDMI:

- provide a reformatting function for the video to match the aspect ratio of the display based on AFD, aspect ratio and user preference as per 6.4.4.5 (for 16:9 displays). Support for scaling to 4:3 aspect ratio for HDMI is optional (since consumer HD displays are 16:9). Aspect ratio signalling in the HDMI AVI Infoframe bits R0..R3, M0, M1 (see CEA 861) shall be set in accordance with the properties of the video on the output;
- pass the video to the HDMI output unprocessed with respect to AFD and aspect ratio scaling, and pass AFD and aspect-ratio signalling in the video to the HDMI output as part of the AVI Infoframe bits R0..R3, M0, M1 (see CEA 861).

6.5 Recommendations for ISO/IEC 13818-1 signalling

As described in TS 101 154 the target background grid descriptor and video window descriptor may be used within broadcasts to position the video output for standard definition video streams within a 720×576 display grid or for high definition video streams within a 1280×720 display grid or a 1920×1080 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 SD video and graphics

6.6.1 Video with graphics

The graphics system used by subtitling addresses a 720×576 pixel space. The output of the MPEG video decoder shall be 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 8), 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 4):

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.

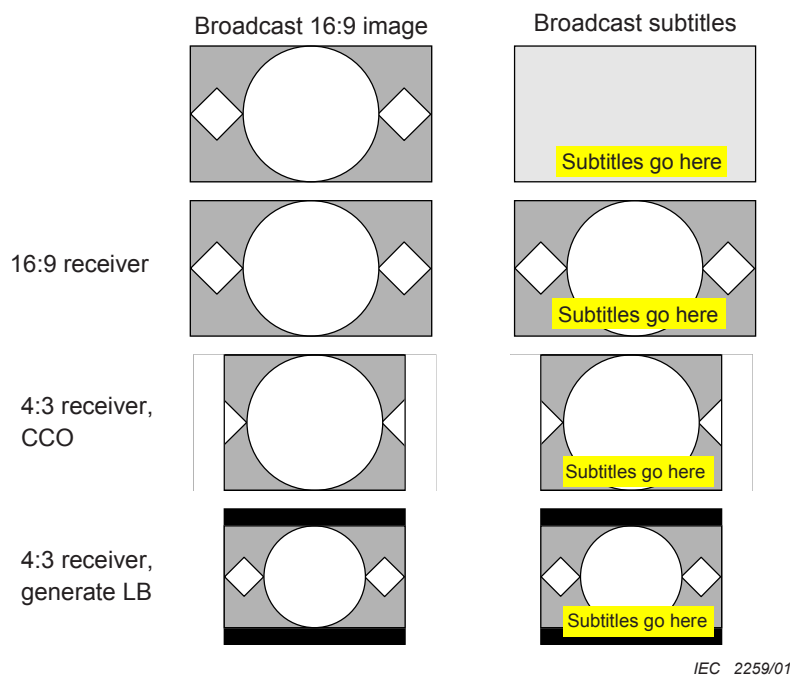


Figure 4 – Uncertainty of positioning graphics over video

6.7 Alignment of HD video and graphics

The graphics system used by the subtitling addresses either a 720×576 , 1280×720 or 1920×1080 pixel space, depending upon the receiver capabilities and the parameters in the display definition segment. The output of the MPEG video decoder is centred vertically and horizontally within a pixel space of 1280×720 or 1920×1080 after upsampling, in a similar manner to that described in 6.6.1. The graphics pixel space does not necessarily match that of the video decoder and it is the role of the receiver to scale one or both of these so that they are the same resolution before output. In this scaling, the graphics plane shall be scaled so that it totally covers the video plane (i.e. the top left hand corner of the video plane corresponds with the top left hand corner of the graphics plane, and similarly for the bottom right corners).

7 Audio system characteristics

7.1 General

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

7.2 Essential requirements

When the video is encoded to ISO/IEC 13818-2 SD, at least one audio component of the broadcast shall be encoded according to ISO/IEC 13818-3. All receivers shall be able to meet the minimum decoding requirements set out in the 'MPEG-1 and MPEG-2 backward compatible audio' clause of TS 101 154.

Where the video is encoded to ISO/IEC 14496-10, the audio components shall be encoded according to ISO/IEC 13818-3, TS 102 366 (AC-3 or Enhanced AC-3) or ISO/IEC 14496-3 (MPEG-4 High Efficiency AAC, but excluding the use of the Parametric Stereo tool). Advanced receivers shall be able to meet the minimum decoding requirements set out in

either the 'AC-3 and Enhanced AC-3 audio' clause or the 'MPEG-4 AAC, MPEG-4 HE-AAC and MPEG-4 HE-AACv2 audio' clause, excluding MPEG-4 HE-AACv2, of TS 101 154³.

In all cases, the audio shall be constrained according to TS 101 154 with a maximum of 5.1 channels per component.

When an audio stream is provided that is intended to be decoded in addition to the main audio and mixed with it, it shall be constrained⁴ according to TS 101 154 Annex E⁵.

7.2.1 Requirements

The requirements in 7.2 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 broadcast 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 Audio metadata

All streams shall contain such metadata that is necessary to allow a receiver to perform the following:

- normalise the level of the audio between services;
- downmix any multichannel audio to stereo;
- mix any secondary decoded audio stream with the main decoded audio stream.

7.2.4 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.

³ Advanced receivers will therefore decode the MPEG-4 HE-AAC part of the MPEG-4 HE-AACv2 stream as a mono track.

⁴ Within the scope of this standard, the transmission part of TS 101 154, Annex E is mandatory.

⁵ It is expected that a new version of TS 101 154 will be released shortly that will cover the application of audio description to audio encodings other than ISO/IEC 13818-3.

7.3 Constraints and extensions

7.3.1 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.775-2.

Multichannel audio streams shall be limited to a maximum of 5.1 channels.

7.3.2 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.

7.3.3 AC-3 and Enhanced AC-3 audio

7.3.3.1 General

This standard allows AC-3 or Enhanced AC-3 audio to be transmitted in accordance with TS 102 366, EN 300 468 and TS 101 154. Receivers conforming to this standard should provide a method to make the AC-3 audio available to the user.

7.3.3.2 Broadcast specifications

7.3.3.2.1 Carriage

AC-3 or Enhanced AC-3 broadcasts, if any, shall be in accordance with TS 102 366, EN 300 468 and TS 101 154. The service information for (Enhanced) AC-3 streams carried in DVB systems shall be as defined in EN 300 468, Annex D. The carriage of (Enhanced) AC-3 elementary streams as private data within MPEG systems is described in the 'Audio' clause of TS 101 154.

7.3.3.2.2 Signalling

AC-3 or Enhanced AC-3 streams shall be signalled in the Program Map Table using stream type 0x06 indicating PES packet private data. See also TS 102 366.

The AC-3 descriptor or Enhanced AC-3 descriptor, as appropriate, defined in the DVB SI specification EN 300 468, Annex D shall be placed in the elementary stream (2nd) loop of the PMT.

7.3.3.2.3 Recommendation

It is recommended that broadcasts only provide AC-3 or Enhanced AC-3 streams where the decoded audio stream is a so-called 'full service' (suitable for decoding and presentation to the listener), as opposed to (Enhanced) AC-3 streams where the decoded audio stream is intended to be combined with another decoded audio stream before presentation to the listener.

7.3.3.3 Receiver functions

It is optional for a standard receiver to implement any AC-3 or Enhanced AC-3 support. If either is supported, it is sufficient to support only one (Enhanced) AC-3 stream (as opposed to having capabilities of combining more streams into one before representing to the user).

If AC-3 or Enhanced AC-3 is supported, the receiver shall support sample rates up to 48 kHz.

7.3.4 ISO/IEC 14496-3 audio

7.3.4.1 General

This standard allows ISO/IEC 14496-3 audio to be transmitted in accordance with EN 300 468 and TS 101 154 but excludes the use of the Parametric Stereo tool (i.e. MPEG-4 HE-AACv2 is not allowed). Advanced receivers conforming to this standard should provide a method to make the ISO/IEC 14496-3 audio available to the user.

7.3.4.2 Broadcast specifications

7.3.4.2.1 Carriage

ISO/IEC 14496-3 broadcasts, if any, shall be in accordance with EN 300 468 and TS 101 154 (up to HE-AAC level 2 for stereo or level 4 for multi-channel (maximum 5.1 channels)). The service information requirements for ISO/IEC 14496-3 streams carried in DVB systems are described in EN 300 468, Annex H.

7.3.4.2.2 Signalling

The AAC descriptor defined in the DVB SI specification EN 300 468, Annex H shall be placed in the elementary stream (2nd) loop of the PMT.

7.3.5 Receiver downmix

Advanced receivers shall be able to downmix a surround sound audio stream, however encoded, to PCM stereo for use where required, for example for output to stereo speakers or on HDMI. For this purpose, they shall use the appropriate metadata in the audio stream as defined in ISO/IEC 14496-3, 4.6.8.3 or TS 102 366, 6.8, as appropriate.

If an output for surround sound audio is provided by the receiver (e.g. SPDIF), it shall be possible for the user to set this output to carry the downmixed audio instead.

7.3.6 Digital audio output

A receiver may have a digital audio output, either via HDMI or via an optical or coaxial SPDIF connector. If such an output exists on a receiver, it shall be capable of carrying at least:

- a) two channel PCM in case of MPEG1-layerII format or any other format audio codec reception;
- b) the original AC-3 bitstream in case AC-3 is supported and being received;
- c) an AC-3 transcoded bitstream in case Enhanced AC-3 is supported and being received;

whereby:

- 1) a transcoded bitstream shall have the same channel layout as the originally received bitstream unless when exceeding the maximum number of channels supported by the transcoded bitstream format, in which case this maximum shall be used, and
- 2) in case ISO/IEC 14496-3 audio is supported, receivers shall support downmix to stereo (as per a) above), and are recommended to support transcoding to DTS or AC-3.

7.4 Audio description

7.4.1 Background

Audio description is an “ancillary service” primarily provided for the visually 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.

Description content is voice only and may be conveyed in one of two ways: receiver mix AD or broadcast mix AD. For receiver mix AD, the spoken description is broadcast as a separate coded mono audio stream. In this case, the receiver decodes the main programme and the description streams and combines the decoded signals as described below. For broadcast mix AD, these streams are mixed by the broadcaster and broadcast as an alternative main programme stream. The user has no control over the relative levels of the primary audio and the spoken description.

Individual AD users will have different aural acuity, different describers will have their own style of vocal delivery (voice pitch and timbre), several voices may be used to describe a single programme and there are, in practice, differences in audio signal level for different home receivers. Loud sound effects or accompanying music can make any description hard to discern. A key requirement of the AD decoder when handling receiver mix AD is therefore to allow the relative level of programme sound in the mix to be adjusted on a description passage-by-passage basis. The programme maker is best able to determine a suitable default relative level under controlled conditions when the AD component is being authored so suitable “fade” information is transmitted with the description stream.

Description is typically confined to gaps in the programme narrative. Some programmes (and genres) are more suited to description than others; one programme may be effectively self-describing whilst another (e.g. a news programme or studio interview) might actually offer no opportunities for descriptive interpolation. AD receivers should therefore provide the user with a means of confirming that, in what may be extended gaps between description passages, description silence does not necessarily imply failure in delivery of the service or in the receiving equipment.

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 decode receiver mix AD by providing two audio decoders, as illustrated in Figure 5.

7.4.3 Receiver mix AD signalling

This subclause 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. If the audio is encoded according to TS 102 366, the mixing metadata may alternatively be provided by the means described in that specification.

7.4.3.1 Level control

Three contributions to the “described” output sound level can be identified. These are illustrated in Figure 5.

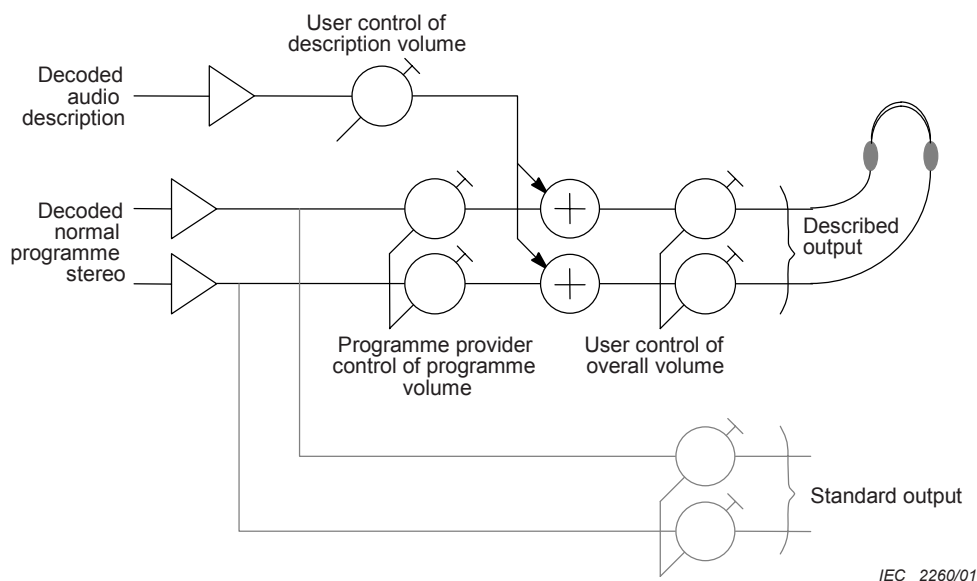


Figure 5 – Illustration of control of audio level

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 and semantics

Audio description streams shall carry the audio description descriptor defined in Table 14 in their PES_private_data field of the PES packet header.

Table 14 – 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	0xFFFFFFFFFFFFFFF	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.