

EBU HDTV Receiver Requirements

User Requirements

Please note that in light of the publication of EBU Tech 3344 (loudness guidelines for distribution), the audio sections of this document are subject to review

Source: D/HDrec

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Contents

1.	Scope	7
2.	Normative references.....	7
3.	Informative references	8
4.	Video	8
4.1	Image formats	8
4.2	Random Access Points	9
4.3	Overscan.....	9
4.4	Scaling between HD and SD	9
4.5	Video Display Characteristics	9
4.5.1	<i>Frame Cropping information</i>	9
4.5.2	<i>Format switching</i>	9
4.5.3	<i>Output format</i>	9
4.5.4	<i>Active Format Descriptor (AFD)</i>	9
4.5.5	<i>Colorimetry</i>	10
4.6	Decoding compliance	10
4.6.1	<i>Minimum bit-rate (e.g. static pictures)</i>	10
5.	Audio	10
6.	SI and PSI	14
6.1	Multiple video compression.....	14
6.2	Logical channel number	14
6.3	HD_simulcast_LCN	14
6.4	Linkage descriptor	14
6.5	Service type (content)	14
6.6	DVB_FTA_Content_Management_Descriptor	14
6.7	EPG	14
6.8	Dynamic switching PMT	14
6.9	Dynamic changes of service_names in SDT	15
6.10	Service_move_descriptor	15
6.11	Event_id	15
7.	Access Services	15
7.1	DVB Subtitles	15
7.2	HD-DVB Subtitles	15
7.3	Clean Audio	15
7.4	Teletext Subtitles	15
7.5	RDS/Radio/Radio text plus	15

7.6	Hard of Hearing	16
7.7	Control of recording devices	16
7.7.1	<i>Source is HDTV Set Top Box</i>	16
7.7.2	<i>HDTV PVRs</i>	16
8.	VBI	16
8.1	Teletext Services	16
8.2	Wide Screen Signalling (WSS)	16
8.3	Signalling over SCART	17
9.	Content Management	17
9.1	Common Interface (CI)	17
9.2	CI+	17
9.3	Analogue HDTV/SDTV component output	17
9.4	HDCP on HDMI	17
9.5	HDCP switchable (via menu in STB)	17
9.6	USB, LAN access to audio/video data	17
9.7	FTA content management according to signalling by FTA content management descriptor ...	17
9.7.1	<i>Semantics for the FTA content management descriptor</i>	18
9.7.2	<i>Fundamental requirements for HD content management</i>	18
10.	System Software Update	18
11.	API	18
12.	RF & Channel	18
12.1	DVB-S	18
12.2	DVB-S2	18
12.3	DVB-C	18
12.4	DVB-T	19
12.4.1	<i>VHF/UHF S Band, 230 - 470 MHz</i>	19
12.4.2	<i>C/N performance</i>	19
12.4.3	<i>Noise Figure</i>	19
12.5	DVB-T2	20
13.	Connectors and Interfacing	20
13.1	DVB-T and DVB-T2	20
13.2	DVB-C	20
13.3	DVB-S/S2	20
13.4	Connectors for iDTV	20
13.5	Connectors for STB	20
13.6	Remote control	20
13.7	HDMI	20
13.7.1	<i>Video</i>	20

13.7.2	<i>Audio</i>	21
13.8	HDMI control data	21
13.9	USB connector	21
13.10	Removable Media (USB-Connector)	21
13.11	LAN-Access (Fast Ethernet, Wireless LAN or Powerline)	21
13.12	Home Networking	21
14.	Usability	22
14.1	Stand-by mode	22
14.2	Power Consumption in stand-by mode	22
14.2	Power Switch-Off	22
14.3	Channel change time	22
14.4	HDCP control by user	22
14.5	Component descriptor display	22
14.6	Means of selecting an alternate language	22
14.7	User controls	22
14.8	Remote control	22
14.8.1	<i>Remote Control Buttons</i>	22
14.8.2	<i>Audible feedback for buttons on the remote control</i>	23
14.9	Display functionalities	23
14.9.1	<i>Alphanumeric</i>	23
14.9.2	<i>Event Name</i>	23
	Appendix A (informative): Signalling for CE-HTML	25
A.1.	Signalling and Application lifecycle	25
A.2.	Transport protocols for HTML applications	25
A.2.1	Bidirectional IP connection	25
A.2.2	DSM-CC via Broadcast channel	25
A.3.	HTML profile	25

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EBU HDTV Receiver Requirements

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1. Scope

This document represents the minimum HDTV receiver requirements of EBU members (the broadcasting organisations) and has been discussed in detail with DIGITALEUROPE (EICTA) representatives. Media industries developing stand-alone receiver (set-top boxes - STB or integrated receiver decoders - IRDs) or receivers with integrated digital televisions (iD TVs) are encouraged to comply with this set of requirements in order to allow interoperability between EBU Members' broadcasts and the receiver device.

Note 1: EBU Members may require additions or changes to these requirements to meet particular national demands (e.g. language).

Note 2: The sections on Audio of this document received substantial contribution from EBU project P/Loud and D/MAE; the sections on LAN/Networking and CE-HTML have been provided in cooperation with the EBU project D/CH.

2. Normative references

The technical requirements or specifications contained in this document refer to standards developed by standard-settings organisations such as DVB; ETSI; DIGITALEUROPE, MPEG; ISO; CEI and CEN. In particular:

EBU Tech 3299	EBU Tech 3321
ETSI TS 101 154 v1.9.1	ETSI EN 300 421 v1.1.2 (DVB-S)
ETSI TS 102 323 v1.3.1	ETSI TS 102 366 v1.2.1
ETSI EN 300 429 v1.2.1 (DVB-C)	ETSI EN 300 744 v1.6.1 (DVB-T)
ETSI EN 300 468 v1.10.1	ETSI EN 302 755 v1.1.1 (DVB-T2)
ETSI EN 300 743 v1.3.1 (DVB subtitling)	ISO/IEC 14496-3
ETSI EN 302 307 v1.1.2 (DVB-S2)	ISO/IEC 14496-10 (2005)
ETSI TR 101 211 v1.8.1	ITU-R Rec. BT 601
ETSI TS 102 114 v1.2.1	ITU-R BS.775
IEC62216-1	IEC 60169-24
ITU-R Rec. BT 709	Dolby Technical Bulletin Number 11
IEC 60169-2	DLNA Guidelines 1.5
CEA-861-D	HDMI 1.3a
DVB TM-GBS0275	

3. Informative references

HDready (1080p) www.swisstxt.ch DIGITALEUROPE HDTV (1080p) <http://www.digitaleurope.org>
>Download > Multimedia Solutions >Teletext - recommendations for the minimum functions of teletext decoders

4. Video

4.1 Image formats

The following image sampling structures shall be supported (see TS 101 154 V1.9.1, which defines further formats beyond those listed here).

1920 x 1080, interlaced, 25 frame/s (50 fields)
 1920 x 1080, progressive, 25 frame/s
 1440 x 1080, interlaced, 25 frame/s (50 fields)
 1440 x 1080, progressive, 25 frame/s
 1280 x 1080, interlaced, 25 frame/s (50 fields)
 1280 x 1080, progressive, 25 frame/s
 1280 x 720, progressive, 50 frame/s
 1280 x 720, progressive, 25 frame/s (carried as 720p/50 with pic_struct=7 (frame doubling). (See ISO/IEC 14496-10).

Note: receiver supporting IP streaming (e.g. Hybrid Receiver), should support native 720p/25.

960 x 720, progressive, 50 frame/s
 720 x 576, interlaced, 25 frame/s (50 fields)
 704 x 576, interlaced, 25 frame/s (50 fields)
 544 x 576, interlaced, 25 frame/s (50 fields)
 480 x 576, interlaced, 25 frame/s (50 fields)

The following Profiles shall be supported:

MPEG-2: MP@ML;
 MPEG-4 - H.264/AVC: MP@L3, MP@L4.0; [HP@L4.0](#)

The receiver shall be able to decode the SVC baseline layer (see TS 101 154 v1.9.1)

1080p/50 & SVC (**): The receiver shall not crash when 1080p/50 is received either as H.264/AVC or SVC. The receiver shall not crash when any other image format with SVC is received. *

Note:* It is expected that new compression/sampling formats or elementary streams with the same coding format and higher levels, such as 1080p/50, will be broadcasted in the future. Current receivers should be designed such that they exploit available information from (P)SI and elementary streams in a way that they safely detect such situations and behave in a stable way in the presence of such signals, e.g. by presenting information to the user through the GUI.

*Note**:* DVB TM-AVC has approved the addition of HP@L4.2 and SVC (includes the 1920x1080p/50-60 image format) to TS 101 154 V1.9.1.

4.2 **Random Access Points**

Receivers must support random access points of maximum 5 seconds (see ETSI TS 101 154).

4.3 **Overscan**

An IDTV receiver shall utilize the appropriate overscan flag as defined by ISO/IEC 14496-10 (2005). A STB receiver shall convey the flag to the display through the AVI_infotrame (HDMI).

Note: see EBU Tech 3321 as background information on overscan.

4.4 **Scaling between HD and SD**

SD to HD up-scaling shall use the centre 702x576 pixels unless this would cause misalignment of SD video and graphics.

HD to SD down-scaling shall use the whole HD image to the centre 702x576 SD image format.

4.5 **Video Display Characteristics**

4.5.1 **Frame Cropping information**

Shall only be used to crop 1088 to 1080 lines. If there is no crop information the receiver shall discard the bottom 8 lines of a frame.

4.5.2 **Format switching**

The receiver shall not crash and must continue operation after format switching (event-based and channel-hopping). Disturbance/distortions to the image should be minimal (e.g. freeze or black frame duration \leq RAP, depending on GOP length).

4.5.3 **Output format**

The default output resolution is HD resolution (either 720p/50 or 1080i/25).

A mode shall be available that allows the output to follow the input format.

It shall be possible to manually switch between 720p/50 and 1080i/25.

Enhanced receivers may also allow switching the output to 1080p/50.

4.5.4 **Active Format Descriptor (AFD)**

(See EN 2216-1, chapter 6.4.3). It is recommended that receivers with HDMI output provide at least one of the following methods of processing 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 section 6.4.3.5, EN 2216-1 for 16:9 displays) of the E-Book.

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 Infotrame 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).

Note: HD broadcasts are always in 16:9 aspect ratio.

4.5.5 Colorimetry

A receiver shall signal the appropriate colour space to the display via the HDMI AVI Infoframe. The default colour space shall comply with ITU-R Rec. BT 709-5.

When converting SD to HD, a receiver should apply a colour transformation from ITU-R BT. 601 colourspace to ITU-R BT.709-5 colourspace. The colour space shall be signalled via the HDMI interface.

4.6 Decoding compliance

4.6.1 Minimum bit-rate (e.g. static pictures)

The receiver shall respect MPEG timing models in ES buffer occupancy. The minimum bit-rate is defined by the shortest syntax according to ISO/IEC 14496-10 for a uniform sequence with maximum redundancy.

5. Audio

HD IRD shall fulfil the minimum decoding requirements for standard definition (SD) according to ETSI TS 101 154. For audio, the HD receiver shall provide at least one stereo decoder MPEG-1 Level 2. The receiver should support audio bitrates of up to 192 kbit/s per single audio channel and up to 384 kbit/s for two-channel stereo. In the case of transmitted stereo, the HD receiver shall support linear PCM at the digital output interface. In the case of a transmitted 5.1 audio signal, the HD receiver shall provide a downmix of the multichannel audio signal. The HD receiver shall provide support for 5-channel plus LFE (Low Frequency Effects), i.e. 5.1-channel surround sound corresponding to the loudspeaker layout described in ITU-R BS.775. In the case of simulcast, i.e. transmitted stereo and 5.1 audio signal, the HD receiver shall provide the transmitted stereo at its analogue and digital stereo output interface.

In this document the following notation is used:

System A: Dolby Digital Plus or E-AC-3 (DD+) transcoded to Dolby Digital or AC-3 (DD)

System B: HE AAC transcoded to DD or DTS

The audio may be carried by **System A** and/or by **System B**, as determined for the relevant network.

Both System A and System B shall be supported for networks where there is no mandatory operator acceptance of IRDs.

Either System A or System B may be required for networks where an operator is in charge of specifying the functionality of the IRDs and ensuring that the minimum requirements are met.

In addition to these requirements for mono/stereo output, HD IRD shall provide outputs for multi-channel audio, as in Table 1 below:

TABLE 1: Audio Requirements for System A and System B

			Status	Comment
System A	Decoding	DD streams at all bitrates and fs=48 kHz according to ETSI TS 102 366 v1.2.1	Mandatory	
		DD+ from 32 kbit/s to 3024 kbit/s and fs=48 kHz according to ETSI TS 102 366 v1.2.1. Other samples rates may be required by local specifications	Mandatory	
	Trans-coding	DD+ to DD according to ETSI TS 102 366 v1.2.1	Mandatory	At fixed rate of 640 kbit/s
	Metadata	A complete set of Dolby metadata	Mandatory	The HD IRD shall use metadata, where provided by the broadcaster, to control for example the stereo down-mix from multi-channel audio, and shall use it, or pass it through, when providing bitstream output of Dolby Digital. Examples of metadata parameters of use are down-mix coefficients, "dialnorm", compression modes, etc.
	HDMI Audio output	Pass-through of native DD and DD+ bitstreams	Mandatory	In order to guarantee compatibility with legacy multichannel audio receivers, the following mechanism should be implemented. If an HDMI sink device indicates in its E-EDID structure that Dolby Digital decoding is supported, but Dolby Digital Plus decoding is not supported, the IRD shall transcode Dolby Digital Plus streams to Dolby Digital prior to HDMI transmission.
		DD+ transcoded to DD according to ETSI TS 102 366 v1.2.1	Mandatory	Fixed bit-rate of 640 kbit/s
		PCM stereo from the decoded or downmixed bitstream	Mandatory	When an HDMI Sink device indicates in its E-EDID structure that it only supports Basic Audio (i.e. two-channel L-PCM from the original stereo signal or from a stereo down-mix from the multi-channel signal), then the HDMI output will provide Basic Audio. This feature would then take precedence over the requirement of DD, DD+ and HE AAC multi-channel in the table above whenever the Sink device indicates that only Basic Audio is supported. The volume control settings of the HD IRD shall not influence the audio playback level on this interface.
		PCM MCA from the decoded bitstream	Optional	The volume control settings of the HD IRD shall not influence the audio playback level on this interface.
		Pass-through of DTS bitstream		Not applicable
	S/PDIF Audio output	DD+ transcoded to DD according to ETSI TS 102 366 v1.2.1	Mandatory	Fixed bit-rate of 640 kbit/s
		PCM stereo from the decoded or downmixed bitstream	Mandatory	The volume control settings of the HD IRD shall not influence the audio playback level on this interface.
		Pass-through of DD bitstream	Mandatory	
	Pass-through of DTS bitstream		Not applicable	

			Status	Comment
System B	Decoding	HE AAC Level 2 (mono, stereo) at fs=48 kHz according to ISO/IEC 14496-3 and as constrained by ETSI TS 101 154 v1.8.1	Mandatory	
		HE AAC Level 4 (MCA up to 5.1) at fs=48 kHz according to ISO/IEC 14496-3 and as constrained by ETSI TS 101 154 v1.8.1	Mandatory	
	Transcoding	HE AAC Level 4 (MCA up to 5.1) at fs=48 kHz according to ISO/IEC 14496-3 and as constrained by ETSI TS 101 154 to DD according to ETSI TS 102 366 v1.2.1 or DTS according to ETSI TS 102 114 v1.2.1.	Mandatory	If DD, at fixed rate of 640 kbit/s. In the case of DTS, fixed bit-rate of 1509 kbit/s
	Metadata	Dynamic Range Compression parameters according to ISO/IEC 14496-3 and "Transmission of MPEG -4 Ancillary Data" as specified in Annex C of ETSI TS 101 154 v.1.8.1		
		Programme Reference Level according to ISO/IEC 14496-3		
		Mixdown parameters according to ISO/IEC 14496-3 and "Transmission of MPEG -4 Ancillary Data" as specified in Annex C of ETSI TS 101 154 v.1.8.1		
	HDMI Audio output	Pass-through of native HE AAC bitstreams	Optional	
		MCA HE AAC bitstream transcoded to DD according to ETSI TS 102 366 v1.2.1 or DTS according to ETSI TS 102 114 v1.2.1.	Mandatory	For DD, a fixed bit rate of 640 kbit/s. For DTS, a fixed bit-rate of 1509 kbit/s. If an HDMI sink device indicates in its E-EDID structure that DD or DTS is supported, but HE AAC decoding is not supported, the IRD shall transcode HE AAC streams to DD or DTS prior to HDMI transmission.
		PCM stereo from the decoded or downmixed bitstream	Mandatory	When an HDMI Sink device indicates in its E-EDID structure that it only supports Basic Audio (i.e. two-channel L-PCM from the original stereo signal or from a stereo down-mix from the multi-channel signal), then the HDMI output will provide Basic Audio. This feature would then take precedence over the requirement of DD, DD+, HE AAC multi-channel and DTS in the table above whenever the Sink device indicates that only Basic Audio is supported. The volume control settings of the HD IRD shall not influence the audio playback level on this interface.
		PCM MCA from the decoded bitstream	Optional	The volume control settings of the HD IRD shall not influence the audio playback level on this interface.
		Pass-through of DTS bitstream	Optional	
	S/PDIF Audio output	PCM stereo from the decoded or downmixed bitstream	Mandatory	The volume control settings of the HD IRD shall not influence the audio playback level on this interface.

			Status	Comment
		MCA HE AAC bitstream transcoded to DD or DTS	Mandatory	For DD, a fixed bit rate of 640 kbit/s. For DTS, a fixed bit-rate of 1509 kbit/s
		Pass-through of DTS bitstream	Optional	
Miscellaneous Requirements	Audio Stream Mixing		Optional	
	Audio Description		Mandatory	Mandatory only for Broadcast-Mix according to DVB EN 300 468 v1.10.1 (supplementary audio descriptor). The receiver should provide a separate audio output (headphone socket preferred) which is switchable to audio description and which is separately adjustable (if headphone). According to the needs of the users, the receiver mix audio description shall be available at the digital output interface. The receiver mix audio description is described in TS 101 154 V1.9.1 Annex E. An alternative is provided by the DD+ stream mixing, which is implemented as part of DD+
	Adjustment of video/audio delay		Mandatory	The HD IRD shall support the possibility to adjust the audio-delay on the S/PDIF output (if available) from 0 to 250 ms and it should be adjustable in 10 ms steps.
	Audio handling when changing service or audio format		Mandatory	The HD IRD should gracefully handle change of service or audio format at the audio outputs without significant disturbances to the end user. The HD IRD shall not store volume control settings for individual TV or Radio channels independently.
	Internal digital audio reference level		Mandatory	The HD IRD shall have an internal digital audio reference level equivalent to the Dolby dialogue normalization reference level of -31 dBFS (equivalent to -20 dBFS Leq for the analogue outputs). The HD IRD shall adjust the output level of all audio decoders to match the internal reference level so that perceived programme loudness is consistent for all audio-coding schemes. For HD IRD featuring DD and DD+, this should be consistent with Dolby Technical Bulletin 11: Requirement Updates for DD and DD+ in DVB Products. HD IRD featuring DD or DD+ decoding shall include the PCM Level Control feature described therein. For example, for MPEG -1 Layer 2 audio streams that have an average loudness of about -20 dBLeq, the IRD shall apply an attenuation of 11 dB for the digital output to match the internal reference level. For information HE AAC has a reference level of -31.75 dBFS. It shall be possible to change the applied gain reduction for the MPEG Layer 2 audio according to future loudness standardization by means of a downloadable software update.
	Lip Sync		Mandatory	HD IRDs shall not introduce a differential delay of more than 5ms between audio and video. An IRD shall support HDMI v1.3 including "Auto-LipSync". The receiver/player should delay the audio on the analogue output (intended for amplifiers) and S/PDIF output by the corresponding amount of time, which is needed to compensate for the different decoding delay of audio and video. Section "Adjustment of video/audio delay" specifies the accuracy required. This delay shall not be applied to audio conveyed through HDMI (even if the audio is decoded and mixed down to stereo PCM).
	Radio Services		Mandatory	Support of the codecs mentioned above.

6. SI and PSI

6.1 *Multiple video compression*

The receiver shall present the H.264/AVC video if there is a choice between AVC and MPEG-2 in the PMT.

6.2 *Logical channel number*

The receiver shall interpret the HD simulcast and logical channel number descriptors according to IEC62216 (2009 version).

The decision to interpret the presence of a HD_Simulcast_LCN as a substitution depends on quality reception condition and is made only at the scanning step.

LCN conflicts shall be handled gracefully by the receiver.

6.3 *HD_simulcast_LCN*

The receiver should ensure that the quality of the HD service is good enough (e.g. BER after viterbi is quasi error free e.g. 10^{-7}) before taking a switch.

6.4 *Linkage descriptor*

Receivers shall interpret linkage descriptors with link types of service replacement service (in the SDT) as described in DIGITALEUROPE's draft 'E-book' (rev end 2008) and event simulcast (in the EIT) as described in document EN 300 468 V1.10.1. This specification is currently under finalisation.

Note on event simulcast: broadcasters must ensure that the SD- and HD-events are temporally aligned.

6.5 *Service type (content)*

Use of 0x0A, 0x16, 0x19, 0x03, 0x0c*, 0x01, 0x02 service types.

Note: platform dependent

6.6 *DVB_FTA_Content_Management_Descriptor*

If the descriptor is available it shall be supported according to the EN 300 468 V1.10.1 and the parameters settings as defined in this document. In the case of absence no restrictions shall apply.

Further information can be found in section 9.7.

6.7 *EPG*

Receivers shall support EIT p/f and schedule, carried in EIT actual and EIT other tables, and shall expose the information to the viewer. Recorders should support CRIDs (TV-Anytime - see document ETSI TS 102 323 v1.3.1, chapter 12) and use them to provide advanced recording functionalities such as series linking, trailer recording and conflict resolution.

6.8 *Dynamic switching PMT*

Dynamic switching PMT shall be supported. The maximum switching time should not be longer as a

manually initiated channel change.

6.9 Dynamic changes of service_names in SDT

Dynamic changes of service_names in SDT shall be supported.

6.10 Service_move_descriptor

Depending on service changings within one platform (i.e. DVB-C) the service_move_descriptor shall be supported.

6.11 Event_id

The receiver shall support automatic PVR recordings by using the EIT actual as trigger (see also 7.7.2).

Note: This functionality requires that the EIT transitions be timely aligned to the event boundaries.

7. Access Services

Receivers shall not simultaneously interpret txt-subtitles and DVB subtitles.

The receiver shall give priority to DVB Subtitles.

7.1 DVB Subtitles

DVB-subtitling to EN 300 743 V1.3.1 is mandatory. Different languages shall be selectable. The default is the preferred language at installation. It is mandatory to be able to select or deselect subtitles and for this choice to be maintained across channel changes.

7.2 HD-DVB Subtitles

Mandatory (EN 300 743 V1.3.1). Different languages shall be selectable. Default is preferred language selected at installation. It is mandatory to be able to select or deselect subtitles and for this choice to be maintained across channel changes.

7.3 Clean Audio

Shall be compliant with TS 101 154 V1.9.1 (draft).

7.4 Teletext Subtitles

Mandatory (Teletext-Subtitle EN 300472, internal decoder), and the STB shall render the graphics.

Note: There is no teletext via HDMI.

7.5 RDS/Radio/Radio text plus

Optional DVB TM-GBS0275.

7.6 *Hard of Hearing*

The receiver shall detect 'normal' DVB Subtitles (component_type=0x14) and Teletext subtitles (component_type=0x02) and when labelled as 'hard of hearing' with component_type=0x24 for DVB Subtitles or teletext_type=0x05 for teletext subtitles. This shall be accessed as a user choice in the subtitling menu.

If 'hard of hearing' content is available in both DVB Subtitling and Teletext, only the DVB Subtitling shall be displayed.

In case of 'hard of hearing' subtitling mode is selected and no 'hard of hearing' pages are received, the receiver shall use 'normal' subtitling from the same selected language.

In case of 'normal' subtitling mode is selected and no 'normal' pages are received, the receiver shall use 'hard of hearing' subtitling from the same selected language.

7.7 *Control of recording devices*

7.7.1 *Source is HDTV Set Top Box*

The Set top box should toggle the SCART pin 8 to signal an external recorder when to start and stop recording an event.

It shall be possible to have a choice between a time based recording or a recording based on the value of the event_id.

7.7.2 *HDTV PVRs*

It shall be possible to have a choice between a time based recording or a recording based on the value of the event_id.

8. *VBI*

8.1 *Teletext Services*

Mandatory: V1.5. Recommended V2.5.

Recommendation: HD appropriate graphics-generator, decoder memory capacity for a minimum of 10 Teletext pages. The Memory should in all cases store the (4) TOP or FLOF (as appropriate) "colour-linked" pages. If the service does not carry one of these page access methods the previous, the next, the next "nn0" (e.g. page number 240, if currently showing 234) and the next "n00" (e.g. page number 300, if currently showing 234) page number.

Teletext should be re-inserted into the baseband video signals on the SCART interface of the STB.

8.2 *Wide Screen Signalling (WSS)*

Mandatory on all analogue outputs on a STB. The information for the AFD needs to be transformed into WSS for the analogue output on SCART.

Note: This requires that broadcaster AFD does not preclude the translation into WSS

8.3 Signalling over SCART

VCR (2nd SCART).

If there is a second SCART, only DVB and teletext subtitling shall be presented, and not OSD.

9. Content Management

9.1 Common Interface (CI)

Mandatory for STB size receiver and IDTV with screen-size bigger than 30 cm diagonal, optional two CI slots.

Optional for small receivers such as USB-sticks or plug-in PC cards.

Not required if CI+ implemented.

9.2 CI+

Recommended one CI+ slot, optional two CI+ slots.

9.3 Analogue HDTV/SDTV component output

If Y Pb Pr outputs are available then the receiver shall support the DVB FTA_Content_Management_Descriptor information as specified in section 9.7.

9.4 HDCP on HDMI

Shall be controlled by the DVB FTA_Content_Management_Descriptor information as specified in section 9.7.

9.5 HDCP switchable (via menu in STB)

It shall be possible to enable and disable HDCP for content with no usage restrictions through a user set-up menu. See section 9.7.

9.6 USB, LAN access to audio/video data

Shall be controlled by the DVB FTA_Content_Management_Descriptor information as specified in section 9.7.

9.7 FTA content management according to signalling by FTA content management descriptor

For SDTV broadcasts no restrictions shall apply.

Note: This section follows the principles of ETSI EN 300 468 V1.10.1; however further definitions are made for the management of HD content.

The FTA content management descriptor provides a means of defining the content management policy for an item of content delivered as part of a free-to-air (FTA) DVB Service.

9.7.1 Semantics for the FTA content management descriptor

The content management descriptor is defined in EN 300 468 V1.10.1 Section 6.2.18.

9.7.2 Fundamental requirements for HD content management

The interpretation on how to apply the functionalities of the content management descriptor is currently under discussion. This document will be updated in due time.

10. System Software Update

DVB-SSU Simple profile mandatory (enhanced profile is strongly recommended).

Default settings for automatic SW update: active in both stand-by and operate mode.

The receiver should support data rates from at least 10 kbit/s*. User shall be able to disable/shift/cancel.

The receiver should allow for an alternative software update (e.g. via USB).

**Note: This data rate is used in the French markets; however users should be aware that this low data rate will require longer down-load times. Consequently higher data rates should be applied in broadcasting and should be supported by the receivers.*

Informative note: typical data rates are in the area of 50 kbit/s to 150 kbit/s.

11. API

The receiver should be able to support the different API (e.g. MHP, MHEG, CE-HTML, etc.) from their hardware structure in markets where these services are available. See also appendix A.

12. RF & Channel

12.1 DVB-S

Tuner/demodulator characteristics in accordance with ETSI EN 300 421 v1.1.2. The receiver shall support symbol rates on the incoming carrier in the range 7.5 Mbaud to 30 Mbaud. The receiver shall accept input signals with a level in the range -25 to -60 dBm.

12.2 DVB-S2

RF/IF characteristics as in ETSI EN 302 307 v1.1.2.

12.3 DVB-C

Tuner/demodulator characteristics in accordance with ETSI EN 300 429 1.2.1. RF frequency range from 110 - 862 MHz. National demands may require an extended frequency range.

Receiver performance: Return loss > 7 dB, Noise figure < 10 dB.

The bit error rate before Reed Solomon decoding is used as the quality criterion. The receiver shall have a BER performance better than- 10^{-4} for the C/N ratios specified below for all specified input levels:

QAM:	C/N:
256	- 32.5 dB
128	- 29.5 dB
64	- 26.5 dB
16	- 20.5 dB

12.4 DVB-T

Tuner/demodulator characteristics in accordance with EN 300 744 v1.6.1. Receiver performance as in ETSI EN 62216-1 - E-book 2008 update.

DVB-T additions are referenced in the relevant E-book sections.

12.4.1 VHF/UHF S Band, 230 – 470 MHz.

Optional. (ref. E-Book 12.2)

12.4.2 C/N performance

The values given in EN 300 744 v1.6.1, (Annex A1, Table 1; reproduced here for convenience) should perform in the same way or better.

Table 2: Required C/N for non-hierarchical transmission to achieve a BER = 2×10^{-4} after the Viterbi decoder

Modulation	Code rate	C/N performance (dB)	
		Gaussian channel	Ricean channel
QPSK	1/2	3.5	4.1
QPSK	2/3	5.3	6.1
QPSK	3/4	6.3	7.2
QPSK	5/6	7.3	8.5
QPSK	7/8	7.9	9.2
16-QAM	1/2	9.3	9.8
16-QAM	2/3	11.4	12.1
16-QAM	3/4	12.6	13.4
16-QAM	5/6	13.8	14.8
16-QAM	7/8	14.4	15.7
64-QAM	1/2	13.8	14.3
64-QAM	2/3	16.7	17.3
64-QAM	3/4	18.2	18.9
64-QAM	5/6	19.4	20.4
64-QAM	7/8	20.2	21.3

12.4.3 Noise Figure

Better than 7 dB. (ref E-Book 12.7.3).

12.5 DVB-T2

Work in progress (16/12/2008).

Tuner/demodulator characteristics in accordance with ETSI EN 302 755 1.1.1.

13. Connectors and Interfacing

13.1 DVB-T and DVB-T2

IEC 60169-2, 75 Ohm antenna socket.

Mandatory: inline power supply for antenna, DC 5V, 30mA (these are recommended values).

13.2 DVB-C

IEC 60169-2, 75 Ohm antenna socket.

13.3 DVB-S/S2

IEC 60169-24, 75 Ohm antenna socket.

13.4 Connectors for iDTV

Mandatory: S/PDIF (either optical or electrical), HDMI input, Common Interface.

Recommended: Ethernet port.

Optional: headphone audio output (i.e. audio description), SCART input (RGB/CVBS), SCART output.

13.5 Connectors for STB

Mandatory: S/PDIF (either optical or electrical), HDMI output, Common Interface, SCART output (RGB/CVBS), SCART input-output for VCR and loop-through to the SCART output.

Recommended: Ethernet port.

Optional: Y Pb Pr, RF loop-through for DVB-C, DVB-T and DVB-T2, headphone audio output (i.e. audio description).

13.6 Remote control

A remote control is mandatory.

13.7 HDMI

13.7.1 Video

Receivers shall provide an output of signals in YCbCr 4:2:2 format and the coding range as specified in ITU-R BT.601 (SDTV) and ITU-R BT.709-5 (HDTV) with a resolution of at least 8 bit. The appropriate colour space needs to be signalled to the display. The HDMI AVI Info frame (CEA-861-D Table 7) shall be supported.

13.7.2 Audio

The receiver shall support multichannel PCM and bitstream outputs over HDMI.

13.8 HDMI control data

CEC shall support, as a minimum, system audio, stand-by, and one-touch play.

13.9 USB connector

Optional. It shall follow the FTA-descriptor specified in this document.

13.10 Removable Media (USB-Connector)

Optional (It shall follow the DVB_FTA_descriptor as specified in this document).

13.11 LAN-Access (Fast Ethernet, Wireless LAN or Powerline)

Access to a private local area network is optional.

An integrated wired or wireless IP-based Interface shall be compliant to Fast Ethernet (IEEE 802.3u) and/or WLAN (802.11g and better). Wireless interface support should be WiFi certified. A Powerline interface should support HomePlug-AV including band-stop filtering to minimise RF-interference with radio-services and wireless transmitters in the home.

13.12 Home Networking

Access to Home Networking is optional.

The following describes the receiver behaviour when Home Networking is supported:

For the integration in a Home Network (HN), the receiver shall support home networking compliant to DLNA Guidelines 1.5 or higher using UPnP-AV, exposing recorded and live content to the HN as a Digital Media Server (DLNA-DMS) (*).

The receiver shall be able of carrying on the IP interface at least one broadcast service (live or pre-recorded) in real time in the original encoding format and resolution. The IP interface should be able to accommodate traffic from the access network as well from the HN at the same time.

The receiver should expose the programme/service guide received on the delivery network on the HN including the option of scheduling recordings by the user (**).

The receiver should provide a Digital Media Player (DLNA-DMP) for the selection, control and rendering of live and stored content from a Digital Media Server (DMS). The Renderer (DLNA-DMR) is part of the Digital Media Player (DLNA-DMP) and should be able to be discovered and controlled by other UPnP Control points in the HN.

Any Digital Rights Management (DRM) and/or Conditional Access (CA) that are integrated in the receiver should support exposing both secure and non-secure content to the HN by following the rules of DVB-CPCM including the DVB FTA_Content_Management Descriptor.

(*) If DLNA Media Profiles are other than those used in the access network, transcoding may not be required.

(**) The exposure on the HN of the programme/service guide should be in accordance with UPnP and/or HTML.

14. Usability

In general it is recommended that internationally agreed icon labelling be applied, instead of textual descriptions.

14.1 *Stand-by mode*

Mandatory.

14.2 *Power Consumption in stand-by mode.*

See EU regulations on power consumption.

14.2 *Power Switch-Off*

It is recommended that STB and IDTV have a physical power-switch.

14.3 *Channel change time*

Not significantly more than RAP period.

14.4 *HDCP control by user*

Mandatory. See 9.5.

14.5 *Component descriptor display*

Mandatory for subtitles and audio descriptions, and audio channels (i.e. different languages). Display of image format changes should be manually selectable.

14.6 *Means of selecting an alternate language*

Mandatory - see above.

14.7 *User controls*

The standby, channel, menu, volume and arrow-keys buttons on the device shall be easily accessible to the user.

14.8 *Remote control*

Buttons should have consistent labelling, using internationally agreed icons wherever possible.

14.8.1 Remote Control Buttons

The following table lists the major functions and buttons preferred on the remote control.

Table 3: Remote Control Button Functions

Button function	Requirement	Comments
Aspect ratio adjustment	Optional,	for use with SD
Audio description on/off	Mandatory,	Including sound indicator. Easily to be identified (i.e. finger sensitive) or on the corner position.
Audio mute	Mandatory	With icon.
Audio volume up/down	Mandatory.	May also control the volume of other equipment when configured appropriately.
Back (menu navigation)	Mandatory.	
Channel up/down	Mandatory.	
Cursor (menu navigation)	Mandatory.	up/down/left/right
Exit to video	Mandatory.	
Guide	Mandatory.	
Help	Recommended	
Info	Mandatory.	
Menu	Mandatory.	
Numeric, 0 - 9	Mandatory.	
OK	Mandatory.	In centre of cursor keys
On/Stand-by	Mandatory.	
Picture-in-picture	Optional.	
Radio/TV select	Mandatory.	
Subtitling on/off	Mandatory,	Should cover all channels over channel changing.
Text applications colour keys	Mandatory.	
Text/TV	Mandatory.	
Video format	Optional,	Recommended.

It would be preferable to mechanically protect the less frequently needed remote control buttons by some sort of flap or cover, or alternatively to access their functions in the graphic menu structure.

14.8.2 Audible feedback for buttons on the remote control

It is recommended that the receiver should generate audible tones to provide feedback that a remote control button press has been acknowledged. The user should be able to turn these tones on or off, as desired, in the receiver.

14.9 Display functionalities

14.9.1 Alphanumeric

Optional but recommended for radio services.

14.9.2 Event Name

Optional but recommended.

Appendix A (informative): Signalling for CE-HTML

A.1. Signalling and Application lifecycle

Interactive services related to one or more services are signalled in a DVB-AIT which is carried in the same MPEG-2 TS as the corresponding service(s).

HTML-applications shall be started and stopped according to DVB-AIT signalling.

Basic lifecycle rules:

- Signalling of applications on broadcasting services is done via broadcast DVB-AIT or SD&S.
- Only those applications signalled in the AIT are allowed to run in the context of the corresponding service (embedding of video, ...)
- When an application tunes to a service and is included in its AIT then the tuning is performed and the application remains active. If the new service signals an autostart application then this application is not started.
- When an application tunes to a service and is not included in its AIT then the tuning is performed and the application is killed. If the new service signals an autostart application then this application is started.
- When an application running on a service starts another application which is not signalled in the AIT of this service then the application is started but the service context has to be cancelled (logical tuning to a "null" or "default service"). The new application can then via tuning put itself into a new service context (if not signalled on the new service it will be killed).

A.2. Transport protocols for HTML applications

Interactive services related to one or more services are signalled in a DVB-AIT, which is carried in the same MPEG-2 TS as the corresponding service(s). Standard DVB-AIT signalling is used for transmitting the related URLs via the broadcast channel.

A.2.1 Bidirectional IP connection

For bidirectional IP communication channels standard http and https protocols are used to carry applications.

A.2.2 DSM-CC via Broadcast channel

DSM-CC implementation is required.

Note: IPTV networks will not use the DSM-CC carousel mechanism within the MPEG-2 TS for the transport of any application or data. Only http requests on web servers via the IP interaction channel will be used to load data. The only exception is the carriage of DSM-CC stream events, which will be used for transmitting time critical information via the MPEG-2 TS.

A.3. HTML profile

The HTML profile used by the services is based Open IPTV Forum Declarative Application Environment (DAE) specification based on the CE-HTML standard (ANSI/CEA-2014.A) plus the additions defined by the Open IPTV Forum.

The minimum requirements for the browser are given by a compliance list that is still under discussion and will be published later.

Scalable Vector Graphics will not be used for the time being.