APEK

Agencija za pošto in elektronske
komunikacije Republike Slovenije
Stegne 7, p. p. 418
1001 Ljubljana
telefon: 01 583 63 00, faks: 01 511 11 01
e-naslov: info.box@apek.si, http://www.apek.si
davčna št.: 10482369

Številka: 38101-61/08-002
Datum: 03.11.2008

Subject: **Requirement specifications For DVB-T receivers**
          used in the Republic of Slovenia

Post and Electronic Communications Agency of the Republic of Slovenian announces a Requirement specification For DVB-T receivers used in the Republic of Slovenia.

This document represents minimum requirements for DVB-T receivers used in the Republic of Slovenia. The document is applicable for stand-alone set-top boxes (STB) and also for integrated receivers (iDTV). The document is applicable for SDTV level receivers and HDTV level receivers and replaces previous version of Requirement specifications for DVB-T receivers used in the Republic of Slovenia (issued 25.04.2008).

The purpose of this document is to present general requirements for receiving, decoding and presentation of content distributed on the Slovene DVB-T platform.

Tomaž Simonič
Director

Attachment: Requirement specifications For DVB-T receivers used in Republic of Slovenia – technical document

REQUIREMENT SPECIFICATIONS FOR DVB-T RECEIVERS USED IN REPUBLIC OF SLOVENIA

REQUIREMENT SUMMARY

PROFILE: BASIC,
SDTV – Standard definition television
HDTV – high definition television

Version 1.0, Date: 28.10.2008

Document prepared for

Post and Electronic Communications Agency of the Republic of Slovenia

by

Sintesio, foundation

Ljubljanska 5

SI-4260 Bled - SLOVENIA

www.sintesio.org

Tel.: +386 4 207 3393

Fax: +386 4 207 39 393

Table of contents

1 Introduction

1.1 Terminology

SHALL (mandatory):   Denotes that **the item is mandatory**.

SHOULD (recommended):   Denotes that **the item is not mandatory**, but highly recommended.

In this document universal term "RECEIVER" refers to all devices capable to receive DVB-T signal in order to present AUDIO and VIDEO content (iDTV, STB, other devices).

1.2 Purpose of the document

The document represents **minimum requirements for DVB-T receivers** used in Republic of Slovenia. The document is applicable for stand-alone set-top boxes (STB) and also for integrated receivers (iDTV). **The document is applicable for SDTV LEVEL RECEIVERS and HDTV LEVEL RECEIVERS and replaces previous version of REQUIREMENT SPECIFICATIONS FOR DVB-T RECEIVERS USED IN REPUBLIC OF SLOVENIA (issued 25.04.2008).**

The document shall present technical support for producers and providers of receivers in order to allow them faster implementation of functionality required for DVB-T platform used in Republic of Slovenia. The specifications include following profile:

- ***Basic profile*** defines general requirements for reception of DVB-T broadcasted content in standard and high definition. Requirements are based on international standards and include regional features related to presentation of Slovene characters. For future usage revision of this document is possible. Additional functionality as MHP, interactivity and other are possible but are at the time not defined and therefore not a part of this document.

The purpose of this document is to present general requirements for receiving, decoding and presentation of content distributed in Slovene DVB-T platform.

The HDTV Level receiver shall comply with all basic SDTV Level receiver requirements with some HDTV additions, i.e. HDTV Level receiver shall be backward compatible with SDTV and be able to receive and decode MPEG-2 and MPEG-4 SDTV based services as well as MPEG-4 AVC based SDTV and HDTV services.

HDTV service is defined as a service that includes the MPEG-4 AVC High Definition video stream the surround audio stream and data streams for teletext and subtitling.

1.3 List of Abbreviations

AAC	Advanced Audio Coding
AC3	Digital audio compression standard, known as Dolby Digital
AV	Audio Visual
AVC	Advanced Video Coding
CA	Conditional Access
CAT	Conditional Access Table
CBR	Constant Bit Rate
CI	Common Interface
COFDM	Coded Orthogonal Frequency Division Multiplexing
CVBS	Composite Video Baseband Signal
DVB-T	Digital Video Broadcasting - Terrestrial
E-AC3	Enhanced AC3, known as Dolby Digital Plus
EIT	Event Information Table
EN	European Norm
EPG	Electronic Programming Guide
ETSI	European Telecommunication Standards Institute
HE-AAC	High Efficiency AAC
HDMI	High-Definition Multimedia Interface
HDTV	High Definition Television
iDTV	Integrated Digital TV set
ISO	International Organization for Standardization
ITU	International Telecommunication Union
MFN	Multi Frequency Network
MHP	Multimedia Home Platform
MPEG	Moving Pictures Expert Group
NIT	Network Information Table
PAT	Program Association Table
PCM	Pulse Coded Modulation
PMT	Program Map Table
PSI	Program Specific Information
QAM	Quadrature Amplitude Modulation
QPSK	Quaternary Phase Shift Keying
RF	Radio Frequency
RGB	Red Green Blue
SDT	Service Description Table
SDTV	Standard Definition Television

SFN	Single Frequency Network
SI	Service Information
STB	Set-top Box
TDT	Time and Date Table
TOT	Time Offset Table
TS	Transport Stream
UHF	Ultra-High Frequency
VBI	Vertical Blanking Information
VBR	Variable Bit Rate
VHF	Very-High Frequency

1.4 Reference documents

[1]	EN 300 744 v1.5.1	DVB Framing structure, channel coding and modulation for digital terrestrial television. (ETSI)
[2]	IEC 60169-2, part 2	Radio-frequency connectors. Part 2: Coaxial unmatched connector
[3]	ETSI TS 101 154 v1.8.1	Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications
[4]	ISO/IEC 14496-10	Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding
[5]	ISO/IEC 13818-1	Information technology - Generic coding of moving pictures and associated audio information: Systems.
[6]	ISO 639.2	Code for the representation of names of languages
[7]	ITU-T V.92	Enhancements to Recommendation V.90
[8]	EN 50049-1	Domestic and similar electronic equipment interconnection requirements: Peritelevision connector
[9]	EN 50157-2-1	Domestic and similar equipment interconnection requirements: AV link-Part 2-1: Signal quality matching and automatic selection of source devices
[10]	EN 300 468 v1.7.1	Digital Broadcasting Systems for television, sound and data services; Specification for service information (SI) in Digital Video Broadcasting (DVB) Systems
[11]	ETSI TR 101 211 v1.7.1	Guidelines on Implementation and Usage of Service Information (SI)
[12]	ETSI TS 102 006 v1.3.1	Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems
[13]	ETS 300 231	Television systems; Specification of the domestic video Programme Delivery Control system (PDC)
[14]	ETSI ES 202 130 v1.1.1	Human Factors (HF);User Interfaces; Character repertoires, ordering rules and assignments to the 12-key telephone keypad
[15]	ETSI EN 300 472 v1.3.1	Conveying ITU-R System B Teletext in DVB bitstreams
[16]	ETSI EN 301 775 v1.2.1	Conveying VBI data bitstreams
[17]	ISO/IEC 13818-2	Information technology - Generic coding of moving pictures and associated audio information - Part 2: Video
[18]	ITU-R BT.653-3	Teletext systems
[19]	EN 50221	Common Interface Specification for Conditional Access and other Digital Video Broadcasting Decoder Applications
[20]	IEC 60958	Digital Audio Interface
[21]	IEC 61937	Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 [21]
[22]	ETS 300 706	Enhanced Teletext Specification
[23]	ISO/IEC 8859-2	Information technology -- 8-bit single-byte coded graphic character sets -- Part 2: Latin alphabet No. 2
[24]	ETSI TS 102 114	DTS coherent acoustics; Core and extensions
[25]	IEC 62216-1	Digital terrestrial television receivers for the DVB-T system – Part 1: Baseline receiver specification
[26]	CEA 770.3	High Definition TV Analog Component Video Interface
[27]	EN 300 743 V1.2.1	Subtitling systems

[28]	EN 50049-1	Domestic and similar electronic equipment interconnection requirement: Peritelevision Connector
[29]	HDMI	HDMI Licensing, LLC: HDMI , "High- Definition Multimedia Interface", rev. 1.3A, October 10, 2006
[30]	CEA 861- D	Consumer Electronics Association (CEA): A DTV Profile for Uncompressed High Speed Digital Interfaces, July 18, 2006
[31]	EICTA HD extension to IEC 62216-1	"High Definition" extensions to the IEC 62216-1 "Digital Terrestrial Television Receivers for the DVB-T System"
[32]	IEC 60603-14	Connectors for frequencies below 3 MHz for use with printed boards – Part 14: Detail specification for circular connectors for low-frequency audio and video applications such as audio, video and audio-visual equipment.
[33]	ETSI TS 102 366	Digital Audio Compression (AC-3, Enhanced AC-3) Standard
[34]	ISO/IEC 14496-3	ISO/IEC: Information technology -- Coding of audio-visual objects -- Part 3: Audio, 2005

2 Hardware requirements

2.1 RF part

2.1.1 General

The receiver shall allow reception and demodulation of the DVB-T signal transmitted in accordance with EN 300 744 [1].

The receiver shall allow reception of the DVB-T signal in Single Frequency Networks (SFN) or Multi Frequency Networks (MFN).

The receiver shall allow reception of all channels in UHF (Band IV-V with bandwidth 8 MHz) and reception of all channels in VHF (Band III with bandwidth 7 MHz).

The receiver shall allow reception of the DVB-T signal with all combinations of following parameters:
- Transmission mode: 2k and 8k COFDM
- Modulation: QPSK, 16 QAM, 64QAM
- Code rate: 1/2, 2/3, 3/4, 5/6, 7/8
- Guard interval: 1/4, 1/8, 1/16, 1/32
- Hierarchical mode: not required

The receiver shall allow reception of the DVB-T signal in environment with echoes according to EN 300 744 [1].

The receiver shall support at least -23dBm (≈86dBµV at 75Ohm) of input signal without degradation.

Within the user interface the receiver shall provide the information of signal level and signal quality. The implementation of user interface is responsibility of the producer.

2.1.2 RF input connector

The receiver shall have at least one tuner input connector in accordance with IEC 60169-2, part 2 [2] and shall allow the connection to external antenna with connector type: IEC 169-2 male. The input impedance shall be 75 Ohm.

The receiver input signals should be bypassed independently from the status of receiver (operational or stand-by), so that connected equipment (e.g. TV set) can operate even if the receiver is in standby.

3 Tuning/Scanning procedures

The receiver shall, in case of same Transport stream Id and Service Id on two or more different frequencies save all frequencies, or select the frequency with better signal.

The receiver shall be able to receive and react on tuning parameters in PSI/SI tables (e.g. SDT or NIT information).

In addition to the automatic search, the receiver shall allow a manual search where Channel Id (or frequency) is entered by the end user. The receiver shall tune to this channel, search all available DVB-T modes, add new services and replace existing services in the service list (without considering any quality criteria).

3.1 Dynamic channel management

The receiver shall upgrade modulation parameters according to NIT table.

The receiver shall upgrade »Services lists« according to SDT table.

3.2 Dynamic PMT

The receiver shall be able to handle dynamic changes in the Program Map Table (PMT). A practical use scenario for dynamic PMT changes is for example the requirement to support switching on and off regional variants of programs by a broadcaster.

The receiver shall handle dynamic PMT changes in correct manner and also certain additional restrictions shall be observed:

- Dynamic changes in the PMT shall not produce any disturbances in the Audio/Video output.
- In case switching of elementary audio and/or video streams is triggered, the maximum switching time (measured from PMT update to clear picture) shall be 3 seconds. The maximum switching time shall be met regardless if the elementary streams are scrambled or not.

It is recommended, that the video on the output should freeze (freeze frame), until the new video stream can be decoded and displayed.

4 Interfaces

4.1 SCART interface

The receiver shall have at least one SCART Interface in accordance with EN 50049-1 [8] and EN 50157-2-1 [9].

The following table summarizes input/output signals available at all SCART interfaces:

Table 4-1: SCART requirements

SCART	requirement	CVBS/AUDIO	RGB	PIN 8	PIN 16**
1 TV	Mandatory*	Out	Out	Out (1)	Out (2)
2 VCR	Optional	in and out (3)	In	In	In (2)

* Not relevant for iDTV

** OPTIONAL

(1): Control signal on PIN 8:

        Nom. 0 Volt/DC: internal source of TV set

        Nom. 6 Volt: external source, 16:9 format

        Nom. 12 Volt: external source, 4:3 format

(2): Control signal on PIN 16:

        Nom.0 Volt/DC: CVBS active

        1-3 Volt/DC: RGB active

(3): The OSD graphics should not be present on the VCR SCART output except for DVB subtitling (if present and chosen)

The audio interface of the VCR SCART shall deliver the same audio signal as available at TV SCART Interface. The internal volume control should only affect the audio signal at TV SCART interface, but not the audio signal of the VCR SCART audio interface.

4.2 Interfaces for Conditional Access

The receiver should support at least one DVB Common Interface (for CA module) for conditional access. CI-slot should comply with EN50221 [19].

4.3 Digital Audio Output

The receiver shall have a coaxial or optical S/PDIF interface for digital audio to provide PCM signal according to IEC 60958 [20] or non-linear PCM coded audio stream according to IEC 61937 [21].

4.4 RCA analog video output

As an OPTION HDTV Level STB should provide output of analogue YPbPr video according to CEA 770.3 [26].

The receiver should have at least one analogue audio interface based on two RCA connectors, female type IEC 60603-14 [32].

4.5 HDMI interface

The HDTV Level receiver with display (iDTV) shall support requirements specified for high definition video interfaces by EICTA for compliant HD Ready iDTV-sets [28].

The HDTV Level receiver without display (STB) shall have at least one High-Definition Multimedia Interface (HDMI) with type A connector[29], supporting displays that comply with the EICTA HD-Ready requirements [28].

The HDTV Level STB shall be able to use the EDID information provided by the display to automatically determine the STB output.

The HDTV Level STB shall provide "Original Format" option, i.e. to output same format as received if supported by the display, as indicated by the EDID information. If received format is not supported, the STB shall select display mode providing the best possible video quality. This is required to avoid the STB output to go black, if there is a mismatch between received format and display capabilities.

It shall also be possible to manually set default output format from the HDTV Level STB to a fixed format. Fixed format shall include at least one of the following formats:
- 1920x1080i@25Hz / 1920x1080p@25Hz,
- 1920x1080p@50Hz.

The preferred default output shall be stored in the STB.

The HDMI output shall provide stereo or stereo downmix or multichannel audio, and should be equipped with Auto lip-synch functionality. The HDMI output should be Auto lip-synch aware and should delay audio or video to compensate for latencies in downstream devices. iDTV HDMI input(s) should declare audio/video latency information in their EDIDs.

5 Processor

The receiver shall have a real time clock/calendar running continuously. The clock shall be updated by incoming TDT and TOT from SI.

The receiver should have an internal timer for the possibility to automatically switch from standby mode to the operational mode. This timer shall be initiated locally (accepted by the end user).

6 MPEG Demultiplexer

The Demultiplexer shall be compliant to the MPEG-2 transport layer defined in ISO/IEC 13818-1 [5] and ETSI TS 101 154 [3] and:

- shall be able to decode an ISO/IEC 13818-1 [5] stream with data rates up to 32 Mbit/s,
- shall support variable bitrate elementary streams within a constant bitrate transport stream.

7 MPEG VIDEO Decoder

The decoder of receiver shall fully comply with standard ISO IEC 14496-10 [4] for decoding MPEG-4 and ISO/IEC 13818-2 [17] for decoding of MPEG-2 coded signal. The decoder shall also comply with ETSI TS 101 154 [3] and shall support VBR and CBR.

The decoder of receiver shall ensure synchronization between AUDIO and VIDEO as follows: audio shall never lead the video program by more than 20 ms, and shall never lag the video by more than 45 ms.

The decoder of receiver shall have processing elements for video format conversion to output the decoded video on its HDMI and/or SCART or other analog interface. The display format signaling between the STB and the display device are either LINE23 WSS and/or voltage levels on a SCART PIN8 as defined by IEC 62216-1 [25] or in case of HDMI output comply with EICTA extensions to the IEC 62216-1 (6.4.3.7.4 AFD processing for HDMI output).

Typically a smaller border region inside each edge of the 720x576 pixels area is not visible due to overscan on the SD display. For services carrying ISO/IEC 14496-10 video, the broadcaster may use the overscan_info_present and overscan_appropriate flags to indicate whether the receiver should apply this typical overscan or should display the complete broadcasted video image.

Table A – Broadcast overscan flags

overscan_info_present_flag	overscan_appropriate_flag	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 B.

Table B – Receiver overscan behaviour

overscan_info_present_flag	overscan_appropriate_flag	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 [30].

Table C – Overscan signalling on HDMI

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

7.1 Decoding of SDTV services

The decoder of the receiver shall support profile "H.264/AVC Main Profile at Level 3" (used for H.264/AVC SDTV) and comply with ETSI TS 101 154 [3] (chapters 5.5 and 5.6; 25 Hz SDTV).

The decoder of SDTV Level receiver shall decode also »MPEG-2 Main Profile@Main Level« and comply with ETSI TS 101 154 [3] (chapter 5.1; 25 Hz SDTV).The decoder of receiver shall decode pictures in resolution of 720x576 pixels with minimum data rate of 600 kbit/s.

The decoder of receiver shall be able to switch between 4:3 and 16:9 picture aspect ratio. In case of receiving anamorphic picture and preset 4:3 on TV receiver the DVB-T receiver shall perform conversion to »16:9 letterbox«. Optionally the decoder should perform conversion to »14:9 letterbox«. The »16:9 letterbox« conversion shall be implemented by vertical filtering. Signal degradation due to the filtering should be subjectively imperceptible. Line 23 and line 623 should be masked before the letterbox conversion to avoid the irritating half lines.

7.2 Decoding of HDTV services

The HDTV Level receiver shall fully support decoding of SDTV services according to chapter 7.1 of this document.

Video decoder shall support "H.264/AVC High Profile at Level 4" and comply with ETSI TS 101 154 [3] (chapter 5.7 H.264/AVC HDTV).

In case of SCART, or if any other analogue video output (Y, Pb, Pr or other) is available, the decoded High Definition video shall be down-converted by SD format converter to standard definition (SD) resolution for output via these interfaces. Picture down-conversion shall be implemented from any of the incoming encoded HD full screen luminance resolution of 1920x1080 and 1280x720 (as an OPTION also from 1440x1080, 1280x1080, 960x1080, 960x720 and 640x720) to 720x576 standard definition (SD) resolution. Down-converted video shall be displayed as 16:9 letterbox on 4:3 displays. The SD format converter should apply appropriate re-interlacing.

8   Audio Decoder

8.1 Requirements for Audio Decoder in SDTV Level RECEIVER

The receiver shall provide at least one stereo audio decoder that is able to meet minimum decoding requirements based on MPEG 1 Layer II ("Musicam" ISO/IEC 11172-3) and decoder for AC3. Audio decoder shall support also AAC***** decoding according to ISO/IEC 14496-3 subpart 4 [34] (***mandatory for devices on Slovenian market from 01.01.2010**).

The Audio decoders shall fully comply with DVB Implementation Guidelines for the use of MPEG- 2 Systems, Video and Audio in satellite, cable and terrestrial Broadcasting Applications ETSI TS 101 154 [3].

8.2 Additional Audio Decoder requirements for HDTV Level RECEIVER

8.2.1 General

The HDTV Level receiver shall support reception of multi-channel (up to 5.1) audio in addition to the mandatory audio requirements for SDTV Level receivers. The HDTV Level receiver shall provide analogue audio outputs for stereo/mono, S/PDIF output and an HDMI output for multi-channel audio. Optionally additional analogue outputs may be provided for additional surround sound or audio components for additional languages and/or impaired people.

An audio output of HDTV level iDTV receiver shall be in sync with the displayed video.

The HDTV level receiver shall be capable of decoding and down-mixing following formats for the analogue outputs:

- HE AAC (5.1 channel downmix to stereo), if HE AAC is implemented in the receiver,
- AC3 (5.1 channel downmix to stereo), if AC3 is implemented in the receiver,
- E-AC3 (5.1 channel downmix to stereo), if E-AC3 is implemented in the receiver,
- MPEG1 layer II (Musicam ISO/IEC 11172-3) (2 channels).

The receiver shall always have the audio signal present on the analogue outputs (SCART and stereo out) whenever any of supported four formats is received.

The multi-channel audio may be carried in two formats: HE-AAC [34] or E-AC3 [33]. **For receivers on the Slovenian market after 01.01.2010 both formats shall be mandatory.**

HDTV services with multi-channel audio

External interfacing equipment (like TV display unit) shall not be required to support more than 2 channel PCM audio within main Video/Audio interface (HDMI/SCART).

The HD level receiver shall have an internal digital audio reference level equivalent to the Dolby dialogue normalization reference level of -31 dBFS.

The HD level receiver 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 receivers featuring E-AC3, this should be consistent with Dolby Technical Bulletin 11: Requirement Updates for AC3 and E-AC3 in DVB Products [34]. Receivers featuring AC3 or E-AC3 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 receiver shall apply an attenuation of 11 dB for the digital output to match the internal reference level.

8.2.2 Audio formats

The HDTV Level receiver shall in addition to the audio requirements for SDTV Level receiver support the formats specified in chapters 8.2.2.1 and 8.2.2.2 of this document.

8.2.2.1 System with E-AC3 bitstream

The HDTV Level receiver shall have capabilities for processing AC3 and E-AC3***** streams. **(*E-AC3 mandatory after 01.01.2010)**.

The receiver shall be capable of providing the following formats on the HDMI output connector:
- Pass-through of native bitstream AC3 and E-AC3***** **(*E-AC3 mandatory after 01.01.2010)**
- E-AC3 bitstream transcoded to AC3.
- PCM stereo from the decoded or down-mixed bitstream.

The following formats are optional for the HDMI output connector:
- PCM multi-channel from the decoded bitstream.
- Pass-through of DTS bitstream.

The receiver shall be capable of providing the following formats on the S/PDIF connector:

- E-AC3 bitstream transcoded to AC3
- PCM stereo from the decoded or down-mixed bitstream
- Pass-through of AC3 bitstream

Pass-through of DTS bitstream to the S/PDIF connector is optional.

The receiver shall:

- Decode AC3 streams at all bit rates and sampling rates listed in ETSI TS 102 366 [33] (not including Annex E).
- (additionally) decode E-AC3 streams with data rates from 32 kbit/s to 3 024 kbit/s and support all sample rates listed in TS 102 366 [33] Annex E.
- Be capable of transcoding E-AC3 bitstreams to AC3 bitstreams according to ETSI TS 102 366 [33].

Transcoding to AC3 audio streams shall be at a fixed bit rate of at least 640 kbit/s.

The receiver shall support the use of Dolby metadata [33] embedded in the audio stream when decoding AC3 or E-AC3 bitstreams, transcoding E-AC3 bitstreams to AC3, or creating a PCM stereo downmix from a decoded E-AC3 or AC3 bitstream.

8.2.2.2 System with HE AAC bitstream

The HDTV Level shall have capabilities for processing HE AAC* streams **(*HE-AAC mandatory after 01.01.2010)**.

The receiver shall be capable of providing the following formats on the HDMI output connector:

- Pass-through of native HE AAC bitstream **(*HE-AAC mandatory after 01.01.2010)**
- Multichannel HE AAC bitstream transcoded to AC3 or DTS.
- PCM stereo from the decoded or down-mixed bitstream

The following formats are optional for the HDMI output connector:

- PCM multi-channel from the decoded bitstream.
- Pass-through of DTS bitstream.

The receiver shall be capable of providing the following formats on the S/PDIF connector:

- PCM stereo from the decoded or down-mixed bitstream.
- Multichannel HE AAC bitstream transcoded to AC3 or DTS.

Pass-through of DTS bitstream to the S/PDIF connector is optional.

The receiver shall:

- be capable of decoding HE AAC Level 2 (mono, stereo) at sampling rates of 48 kHz according to ETSI TS 101 154 [3], Annex H.
- be capable of decoding HE AAC Level 4 (multi-channel, up to 5.1) at sampling rates of 48 kHz according to ETSI TS 101 154 [3], Annex H (downmix).
- be capable of transcoding HE AAC Level 4 (multi-channel, up to 5.1) at sampling rates of 48 kHz according to ETSI TS 101 154 [3], Annex H to AC3 or DTS.

If supported, transcoding to AC3 audio streams shall be according to ETSI TS 102 366 [33] at a fixed bit rate of 640 kbit/s.

If supported, transcoding to DTS audio streams shall be according to TS 102 114 [24] at a fixed bit rate of 1,536 Mbit/s.

The HDTV level receiver shall support the use of the following HE AAC metadata embedded in the audio stream when decoding HE AAC and transcoding HE AAC multichannel to AC3 or DTS:

- Dynamic Range Control according to ISO/IEC 14496-3 [34]
- Program Reference Level according to ISO/IEC 14496-3 [34]
- Mix Down Parameters according to "Transmission of MPEG4 Ancillary Data" part of DVB specification ETSI TS 101 154 [3]

9 Radio mode

The STB shall allow basic DVB-T RADIO reception and operation (switching between channels) without a TV screen. This can be done with a Radio/TV button on the front plate or on the remote control.

In case of an alphanumeric display (optional) on STB the display should be large enough to accommodate the full length of the station name (up to 8 characters).

If a DVB stream is labeled as a „Radio Service", it should always be shown by the STB in the radio channel list, even if there might be an elementary video stream sent along.

10 System software upgrade

The receiver shall provide at least one mechanism for upgrading system software.

HDTV Level receivers shall support and use OTA System Software Update procedure according to the ETSI TS 102 006 [12]. The manufacturer shall provide procedure and functions carrying out upgrade in the receiver.

The receiver shall provide a mechanism to detect corrupt downloaded system software before it is used to replace current working software. If received system software is corrupt the receiver shall keep current (working) version of system software, thus making the receiver operational again. If so, the failure to download shall be indicated to the user with an error message that can be used in the contact with the customer relations office. It shall be possible for the user to abort the download (in areas of bad reception quality the download may take too long time) and the receiver shall be operational using the current version of system software.

The receiver manufacturer shall provide the required MPEG-2 TS binary file (containing only applicable SSU service and all its (PSI/SI) signaling necessary for successful upgrade) intended for cyclic broadcast for each new version intended for system software download. For each new version of system software over-the air download, the manufacturer shall provide all necessary description documents to the network operator required for the transmission of the new software. The manufacturer is responsible for providing and distributing new releases of system software.

11 Middleware

11.1 Service information

The receiver shall have system software for interpretation and handling of the active service information and control of the local hardware/software according to EN 300 468 [10] and ETSI TR 101 211 [11].

The receiver shall be able to process the PSI/SI tables for both, the 'Actual' and the 'Other' transport stream.

The following tables are a mandatory set of tables the receiver shall be able to process:
NIT, CAT, PAT, PMT, SDT, EIT, TDT, TOT

The receiver shall offer basic functionality of EPG in order to present following:
- EIT actual (present/following/scheduled)
- EIT other (present/following/scheduled)

11.2   Navigator (USER INTERFACE)

The navigator shall be presented in SLOVENE language and shall support characters from code table ISO/IEC 8859-2 [23].

The user shall be able to set storable preferences for default audio language. If an audio stream for the default audio language is available for the service, the receiver shall automatically choose that audio-stream.

The receiver shall provide a basic EPG for display of EIT Present/Following (short event descriptor, extended event descriptor, content descriptor). Also the EIT Scheduling table should be presented within the proprietary receiver navigator.

11.3   Teletext

The SDTV Level receiver shall offer at least one of following options for presentation of Teletext:
- By insertion of the Teletext data in the VBI of the analogue CVBS video output. Insertion shall conform to ITU-R BT.653-3 [18] and to requirements for level 1.5 defined in ETS 300 706 [22];
- By presentation of Teletext within the navigator of the receiver.

11.3.1   Teletext for HDTV Level RECEIVER

HDTV Level receiver shall be able to display (EBU) Teletext (both normal teletext pages and teletext subtitling pages) using the OSD, meeting the requirements for level 1.5 in ETSI EN 300 706 "Enhanced Teletext Specification". (Re-insertion of teletext data into VBI of the video signal for teletext pages not enough since the VBI signal is not defined for the HDMI. Therefore shall all HDTV Level receivers implement a full Teletext decoder level 1.5).

11.4   Subtitling

The receiver shall be capable of decoding and displaying DVB subtitle services which are transmitted in conformance with ETSI EN 300 743 [27] including characters from code table ISO/IEC 8859-2 [23].

The HDTV Level receiver shall include default font(s) with good readability for all output video resolution modes for SDTV and HDTV.

The HDTV Level receiver should be able to up-scale DVB SDTV subtitling and EBU Teletext subtitling for a service with HDTV video, with the target to keep the same relative size as the DVB SDTV subtitling and Teletext subtitling has within a SDTV video grid. Up-scaling should be done with a good readable result at the HDTV output.

11.5   User settings

The user shall be able to store preferences in persistent memory.

The receiver shall provide a function to reset all parameters to factory mode, thus removing all service lists, user preferences, etc. After reset, the receiver shall enter installation state.

12   Remote control

The receiver shall have an easy to use remote control. The receiver manufacturer will determine the functionality of the remote control.

13   Factory presets

For HDTV Level receivers following pre-settings shall be enabled:

- Default language for User interface and subtitling set to "SLOVENE"
- Default codepage for Slovene language IEC 8859-2 [23]
- Subtitling: ON (enabled)
- Analog video output format: 4:3
- "16:9 letterbox" conversion: ON
- OTA System Software Upgrade: ON (enabled)
- Default digital audio output set to PCM Stereo according to IEC 60958 [20].