MinDig TV

General Receiver Requirements

Specification for Digital Television Receivers for use in the Hungarian Digital Terrestrial Television Broadcasting

Part of the MinDig TV Receiver Specification

Version 0.9.7

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Created by: Viktor Till
Edited by: András Gnandt
Company: Antenna Hungária
Contact: gnandta@ahrt.hu
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1. Introduction

1.1. Scope

The present document is part of “MinDig TV Receiver Specification” which involves the present document and all the related guidelines listed below:

- “MinDig TV Service Management Implementation Guideline”, v1.0.1,
- “MinDig TV Video Decoding Implementation Guideline”, v1.0.1,
- “MinDig TV System Software Update Implementation Guideline”, v1.0.1.

The present document defines the basic requirements for a MinDig TV compliant receiver.

To develop a MinDig TV compliant receiver, all the mandatory requirements of the present document shall be satisfied, while it is strongly recommended to follow its recommendations too. Furthermore, a MinDig TV receiver shall satisfy all the related implementation guidelines as well, which expand the general descriptions of the features defined here.

During the development of the MinDig TV Receiver Specification, the IEC 62216 and NorDig Unified Requirements were used as reference. Although the implementation of these specifications is not required, on those fields where no requirement is described in the MinDig TV Receiver Specification, the IEC 62216 should be handled as guideline.

1.2. Document History

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<td>0.1.x</td>
<td>09.10.2009</td>
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<td>V. Till</td>
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<td>V. Till</td>
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<td>14.04.2014</td>
<td>Usage of TOT. Original and local audio languages for audio preference settings.</td>
<td>A. Gnandt</td>
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<td>0.9.6</td>
<td>02.09.2014</td>
<td>Interface specifications, audio preferences, Time settings, installation, EIT based maturity rating</td>
<td>A. Gnandt</td>
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<td>0.9.7</td>
<td>16.12.2014</td>
<td>PVR, HbbTV, CA handling</td>
<td>A. Gnandt</td>
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1.3. References

[1] ETSI EN 300 294 Television systems; 625-line television Wide Screen Signalling (WSS)
[2] ETSI EN 300 468 Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems
[4] ETSI EN 300 706 Enhanced Teletext specification
[5] ETSI EN 300 743 Digital Video Broadcasting (DVB); Subtitling systems
[6] ETSI EN 300 744 Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television
[7] ETSI EN 301 755 Digital Video Broadcasting (DVB); Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams
[8] 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
[9] ETSI TS 101 162 Digital Video Broadcasting (DVB); Allocation of Service Information (SI) and Data Broadcasting Codes for Digital Video Broadcasting (DVB) systems
[10] ETSI TR 101 202 Digital Video Broadcasting (DVB); Implementation guidelines for Data Broadcasting
[12] ETSI TS 101 699 Digital Video Broadcasting (DVB); Extensions to the Common Interface Specification
[13] ETSI TS 102 006 V1.3.2 Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems
[14] ETSI TS 102 201 Digital Video Broadcasting (DVB); Interfaces for DVB Integrated Receiver Decoder (DVB-IRD)
[16] ETSI ETR 289 Digital Video Broadcasting (DVB); Support for use of scrambling and Conditional Access within digital broadcasting systems.
[19] ISO/IEC 11172-3 Information technology - Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s -- Part 3: Audio
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[21] ISO/IEC 13818-2 Information Technology - Generic Coding of Moving Pictures and Associated Audio; Part 2: Video

[22] ISO/IEC 13818-3 Information Technology - Generic Coding of Moving Pictures and Associated Audio; Part 3: Audio

[23] ISO/IEC 13818-6 Information technology - Generic coding of moving pictures and associated audio information; Part 6: Extensions for DSM-CC


[26] ISO/IEC 7816, 1-3 Identification cards - Integrated circuit cards, Parts1-3

[27] IEC 60169-2 Radio-frequency connectors, Part 2: Coaxial unmatched connectors

[28] IEC 60958 Digital Audio Interface - Part 3: Consumer Applications


[36] NorDig Unified ver 2.1 NorDig Unified Requirements for Integrated Receiver Decoders for use in cable, satellite, terrestrial and IP-based networks

[37] DGTVi D-Book 1.3 Compatible DTV receivers for the Italian market: baseline requirements

[38] RRC06 Final Acts of the Regional Radio communication Conference for planning of the digital terrestrial broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-862 MHz
1.4. **Terminology**

Shall (must, mandatory, required) These words mean that the item is mandatory.

Shall not (must not) These words mean that the item is forbidden.

Should (recommended, preferred) These words mean that the item is not mandatory, but is highly recommended.

MinDig TV receiver (receiver) The device suitable for handling DVB-T services according to the requirements of the MinDig TV General Receiver Requirements and the related guidelines. The MinDig TV receiver may be an STB or an IDTV device or a part thereof.

1.5. **Definitions**

Static PSI/SI The PSI/SI data that shall be updated by the receiver in initialization mode.

Quasi static PSI/SI The PSI/SI data that shall be updated by the receiver in Automatic update mode.

Dynamic PSI/SI The PSI/SI data that must be updated by the receiver in Active (operation or TV viewing) mode.

STB Set-Top-Box, a stand-alone or combined receiver that enables the television sets or display devices which are suitable for the reception of output signals met with the requirements of this document to present DVB-T services.

IDTV Integrated Digital TV, a stand-alone receiver combined with a display which is suitable for the reception, decoding and output of DVB-T services, and which has embedded speakers or output connections to external speakers in order to present the audio.

Service For the purposes of the present specification, all the available television, radio or data service transmitted by terrestrial digital television broadcasting, which are identified with their unique combination of the original_network_id, transport_stream_id and service_id identifiers.

1.6. **Abbreviations**

<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>DTT</td>
<td>Digital Terrestrial Television</td>
</tr>
<tr>
<td>LCN</td>
<td>Logical Channel Numbering</td>
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<td>MFN</td>
<td>Multi Frequency Network</td>
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<tr>
<td>NID</td>
<td>Network_ID</td>
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<tr>
<td>ONID</td>
<td>Original_Network_ID</td>
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<td>ES</td>
<td>Elementary Stream</td>
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<td>NIT</td>
<td>Network Information Table</td>
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<tr>
<td>PSI</td>
<td>Program Specific Information</td>
</tr>
<tr>
<td>SDT</td>
<td>Service Description Table</td>
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<tr>
<td>SI</td>
<td>Service Information</td>
</tr>
<tr>
<td>TS</td>
<td>Transport Stream</td>
</tr>
<tr>
<td>RF</td>
<td>Radio Frequency</td>
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<tr>
<td>FTA</td>
<td>Free To Air</td>
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<tr>
<td>STB</td>
<td>Set Top Box</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>IDTV</td>
<td>Integrated Digital Television</td>
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<tr>
<td>CA</td>
<td>Conditional Access</td>
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<tr>
<td>CI</td>
<td>Common Interface</td>
</tr>
<tr>
<td>CVBS</td>
<td>Composite Video Baseband Signal</td>
</tr>
<tr>
<td>SCART</td>
<td>Syndicat des Constructeurs d’Appareils Radiorecepteurs et Televiseurs</td>
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<tr>
<td>PAL</td>
<td>Phase Alternating Line</td>
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<tr>
<td>OTA</td>
<td>Over The Air</td>
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<tr>
<td>OAD</td>
<td>Over the Air Download</td>
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<tr>
<td>SSU</td>
<td>System Software Update</td>
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<tr>
<td>HDMI</td>
<td>High-Definition Multimedia Interface</td>
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<td>HDCP</td>
<td>High-bandwidth Digital Content Protection</td>
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<tr>
<td>WPA</td>
<td>Wi-Fi Protected Access</td>
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2. Overview

2.1. Reference Block Diagram

Figure 1.1 shows a high level block diagram presenting how the functional units, specified in the present document, are logically connected to each other.

![Functional block diagram of the receiver](image)

2.2. Functional Units

2.2.1. Tuner/Demodulator

The receiver shall be capable to receive DVB-T signal, conforming to ETSI EN 300 744 [6], transmitted in the VHF band III (174-230 MHz) with 7 MHz raster and in the UHF bands IV-V (470-862 MHz) with 8 MHz raster, as it is defined in Chapter 3.

The tuner/demodulator unit performs channel (frequency) selection, demodulation and error correction of the incoming signal. Output from the tuner/demodulator unit shall be a transport stream, conforming to ISO/IEC 13818-1 [20], that is fed to the demultiplexer block, or - if present - the Conditional Access (CA) module.

All channel selections in the tuner/demodulator unit and the managing of the obtained services are controlled by the central Controller unit. See also Chapter 5.

Implementation of RF-bypass is recommended.
2.2.2. RF Modulator (option)

Implementation of RF PAL-B/G modulator is optional. If it is present, the output channel number should be adjustable from CH21 to CH69, with default setting of CH 43.

2.2.3. Demultiplexer

The demultiplexer unit synchronises with the transport stream, conforming to ISO/IEC 13818-1 [20], coming from the tuner/demodulator or the CA module, and obtains the appropriate audio, video and/or private data elementary streams, as well as program specific and service information sections (e.g. EIT data), according to the viewer selections.

The demultiplexer unit also contains functions related to descrambling of services that are subject to conditional access data in the smart card.

The audio and video streams are output to the Video/Audio decoder units; the teletext, subtitling and EIT data are output to the appropriate processing units; while some private data streams can be directly managed by Controller/Bootloader unit (e.g. System Software Update data carousel).

See also Chapter 4.

2.2.4. Video Decoder

The Video Decoder unit shall be able to decode at least MPEG-2 SD, and H.264/AVC SD and HD video streams.

The receiver shall be able to support Active Format Description (AFD), which may require further processing on the decoded video frames, and it shall be able to render the result for the video output unit(s) at least with such aspect ratio and signalling that result correct geometric presentation on the surface of the targeted display, in accordance with the viewer preferences.

For further details, see Chapter 6.

2.2.5. Audio Decoder

The Audio Decoder unit shall be able to decode at least MPEG-1 and MPEG-2 backward compatible audio, and MPEG-4 AAC audio streams, while the decoding of AC-3 and Enhanced AC-2 audio is recommended.

According to the type of the incoming audio stream, the capabilities of the device and the selected viewer preferences, the receiver may be required to transcode and/or down-mix audio streams. The receiver shall support the presentation audio only (Radio) services, and services including multiple audio tracks as well.

For further details, see Chapter 7.

2.2.6. Common Interface and Embedded Smart Card Reader (options)

The receiver shall be able to handle free-to-air services, and it should have at least one Common Interface (CI) and/or embedded smart card reader in order to be able to handle encrypted services as well.

Receivers equipped with CI and/or embedded smart card reader shall support the reception and decoding of encrypted services, CA based maturity rating and content protection.

For further details, see Chapter 10.
2.2.7. Teletext

The receiver shall be able to display the received Teletext data, conforming to ETSI EN 300 706 [4], by using an embedded Teletext browser and OSD, and/or it shall be able to insert the received teletext data into the VBI of the analogue video output. Receivers equipped with HDMI output shall always have embedded Teletext browser.

If the receiver has embedded Teletext browser, then it shall support the displaying of all the Hungarian characters, as it is enabled at Teletext level 1.5, and it shall support teletext subtitling as well.

For further details, see Chapter 8.

2.2.8. DVB Subtitling

The receiver shall be able to decode and display DVB subtitles, conforming to ETSI EN 743 [5], as it is defined in Chapter 8.

2.2.9. Applications related to event information

The receiver shall support 7-day Electronic Program Guide (EPG) by using data provided in the Event Information Table (EIT), as it is defined in ETSI EN 300 468 [2]. Furthermore, the receiver shall support the displaying of present/following information banner, by which the viewer shall be enabled for browsing at least the event information of the actual and succeeding events of the actually selected service (from EIT p/f actual), without blocking the audiovisual content presented in the background.

The present/following information banner (and/or the EPG) shall enable the viewer for browsing the event information of the actual and succeeding events of all the services of the actually selected service list (from EIT p/f actual and other), without blocking or changing the audiovisual content actually presented in the background.

The EPG and the present/following information banner shall support the displaying of the EIT text information in accordance with the Latin-2 character set, including all special Hungarian characters.

The receiver shall support the EIT based maturity rating.

For further details, see Chapter 9.

2.2.10. Bootloader

The receiver shall support over-the-air software download mechanism in accordance with the ETSI TS 102 006 [13] simple profile. Furthermore, the receiver should have an appropriate data input interface (USB, SD card, etc.) that enables local software update of the whole software environment, including the Bootloader component.

For further details, see Chapter 11.

2.2.11. System Software

The receiver shall provide an easily usable system menu at least in Hungarian and English that allow the viewer to access all the functionalities provided by the device. Via the system software, the viewer shall be allowed to adjust storable preferences for the functions described above.

The receiver shall provide a “Factory reset” function, which restores all parameters of the software to the default values and deletes the service list(s).

For further details, see Chapter 12.
2.3. **Interface Specification**

2.3.1. **RF Connector(s)**

A coaxial unmatched RF input connector is mandatory for the receiver. It shall be an IEC 61169-2 [27] 75 Ω female antenna socket.

In case of STBs the RF input connector shall support at least 5V 50mA power source for antenna power amplifier. This function shall be switched on/off from menu by the user.

Loop-through output is recommended, either active or passive mode. It shall be an IEC 61169-2 [27] 75 Ω male connector. Active mode loop-through means that it shall work when the receiver is in operating mode. Passive mode loop-through means that it shall work when the receiver is in standby or switched off.

RF modulator output is optional. It shall be an IEC 61169-2 [27] 75 Ω male connector.

2.3.2. **Conditional Access Interfaces**

In case of non-FTA STBs with one tuner at least one embedded Conax CAS 7.0 - without chip-pairing - capable interface is mandatory. Common Interface is optional for one tuner STBs.

In case if IDTVs at least one Common Interface is mandatory. CI+ capability is optional.

The Common Interface implementation shall comply with EN 50221 [30].

2.3.3. **Analogue Video**

In case of STBs at least one analogue video output connector is mandatory. It could be in SCART, but if there is no SCART connector, other analogue output shall be implemented.

2.3.3.1. **SCART**

In case of STBs at least one 21 pin SCART connector is highly recommended. It shall use the composite and RGB pins as well and the user shall be able to set which one to use. In case of composite signal at least PAL 576i50 mode shall be supported.

In case of IDTVs the use of SCART connector for analogue video output is not relevant.

2.3.3.2. **CVBS**

In case of STBs an additional RCA connector for composite video output is optional. If present at least PAL 576i50 mode shall be supported.

In case of IDTVs the use of CVBS output is not relevant.

2.3.3.3. **Y-Pb-Pr**

In case of STBs the analogue component video output is optional. If present shall be implemented with three RCA connectors and video modes up to 1080i50 shall be supported.

In case of IDTVs the use of component video output is not relevant.

2.3.4. **Digital Video**

2.3.4.1. **HDMI**

In case of STBs at least one HDMI type A female connector is highly recommended. If present at least HDMI 1.3a standard shall be implemented. At least 720p25 and 1080i50 resolutions shall be supported and other common resolutions are highly recommended.
In case of CA STBs the HDMI output shall use HDCP in case of scrambled programs.

In case of IDTVs on HDMI input is highly recommended.

Usage of YUV color space is mandatory, and RGB is highly recommended.

### 2.3.5. Analogue Audio

In case of STBs at least one analogue audio output is mandatory. If SCART connector is not present stereo RCA connectors are mandatory for analogue audio output. If SCART connector is present it shall use the stereo analogue output pins, even if stereo RCA audio outputs are present.

In case of IDTVs for analogue audio output 3.5 stereo audio jack or stereo RCA connectors are highly recommended.

### 2.3.6. Digital Audio

#### 2.3.6.1. S/PDIF

Using S/PDIF digital audio outputs are highly recommended. The interface can be implemented with RCA connector or TOSLINK optical fibre connector. The RCA connector shall serve the 75 Ω unbalanced coaxial cable.

#### 2.3.6.2. HDMI

In case of digital video output the HDMI type A connector shall support the transmission of stereo audio as well synchronized to the video content.

### 2.3.7. Data Interface

#### 2.3.7.1. USB

The receiver shall implement at least one USB 2.0 standard-A socket for local system software update.

If PVR ready function is implemented, it shall support recording on USB Mass Storage devices or external hard drives.

#### 2.3.7.2. Ethernet

In case of hybrid receivers an RJ45 type8P8C Ethernet socket is mandatory. It shall support at least 100BASE-TX connections.

#### 2.3.7.3. Wi-Fi

In case of hybrid receivers support of Wi-Fi interface is optional. If present it shall support at least IEEE 802.11b/g standard using the 2.4 GHz band. Capability for 5 GHz band is optional. It shall be capable to use the WPA2 encryption.
3. Front-end

3.1. General

The MinDig TV compliant receiver shall include at least one tuner/demodulator unit (front-end) for reception of DVB signals from terrestrial broadcasting in accordance with EN 300 744 [6]. The receiver may contain further front-end units, even in order to receive inputs from other platforms (e.g. satellite, IP, etc.), however, in the present document, the wording “front-end” always refers to the primary terrestrial tuner/demodulator unit.

The front-end shall be capable of tuning and demodulating all the available DVB-T signals broadcast in the supported frequency ranges.

By monitoring the TPS, the front-end shall be able to automatically detect the applied modulation parameters from the transmission itself.

The front-end shall be able to work in both the MFN and SFN network environments. It shall be able to tolerate the disturbing effects of other broadcast digital and analogue signals, as described in section 3.5, based on RRC06 [38].

The front-end shall be able to retrieve the MPEG-2 transport stream, conforming to ISO/IEC 13818-1 [20], carried by the actually tuned DVB signal and pass it towards the demultiplexer unit.

3.2. Frequencies and Bandwidths

The receiver shall be able to receive DVB-T signals at least in the VHF band III (174-230 MHz) with 7 MHz raster and in the UHF bands IV-V (470-862 MHz) with 8 MHz raster. 8 MHz raster is optional for VHF band III.

The front-end shall be capable tuning to the centre frequency $f_c$ for the supported frequency ranges, as follows:

VHF Band III:

\[ f_c = 177.5 \text{ MHz} + (k - 5) \times 7 \text{ MHz} \]

where $k$ is the channel id, an integer, running from 5 to 12

UHF Band IV-V:

\[ f_c = 474 \text{ MHz} + (k - 21) \times 8 \text{ MHz} \]

where $k$ is the channel id, an integer, running from 21 to 69

The front-end shall be able to receive signals with a continuous fine frequency offset range up to +/- 50 kHz from the nominal frequency.
3.3. Transmission Parameters

The terrestrial tuning process shall be fully automated; the receiver shall be able to automatically detect the transmission parameters from the transmission itself, by the TPS bits, in order to reduce the tuning time. The only inputs of this process shall be the frequency (and bandwidth) values.

The front-end shall detect a change of transmission parameters signalled by the TPS as well, in order to reduce the recovery time and output QEF bitstream as soon as possible. This shall take less than one second for any change. The transmission parameters should be continually saved and used in case of service switching.

The TPS shall always have priority over the transmission parameters indicated by the terrestrial_delivery_system_descriptor of the Network Information Table (NIT), defined in ETSI EN 300 468 [2]. The latter shall be handled as a recommendation e.g. in case of first-time tuning of a DVB-T signal.

The receiver shall be able to demodulate all the possible combinations of the following parameters:

- modulation: QPSK, 16-QAM, 64-QAM,
- non-hierarchical: \( a = 0 \),
- code rate: 1/2, 2/3, 3/4, 5/6, 7/8,
- guard interval: TU/4, TU/8, TU/16, TU/32,
- IFFT mode: 2K, 8K.

The handling of the hierarchical mode is recommended for the receiver.

3.4. Input Signal Levels

3.4.1. Minimum Level

The front-end shall have a noise figure (NF) equal to or better than 7 dB.

The front-end shall provide QEF reception for the minimum signal levels \( P_{\text{min}} \) as stated below (at 293K):

\[
P_{\text{min}} = -105.7 \text{ dBm} + \text{NF [dB]} + \text{C/N [dB]}, \text{ [for 7 MHz]}
\]

\[
P_{\text{min}} = -105.2 \text{ dBm} + \text{NF [dB]} + \text{C/N [dB]}, \text{ [for 8 MHz]}
\]

where C/N values are listed in Table 3.1, and \( P_{\text{min}} \) values are listed in Table 3.2.

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code rate</th>
<th>C/N (dB), Rice FX</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK</td>
<td>½</td>
<td>5.9</td>
</tr>
<tr>
<td>QPSK</td>
<td>2/3</td>
<td>7.9</td>
</tr>
<tr>
<td>QPSK</td>
<td>¾</td>
<td>9.1</td>
</tr>
<tr>
<td>QPSK</td>
<td>5/6</td>
<td>10.3</td>
</tr>
<tr>
<td>QPSK</td>
<td>7/8</td>
<td>11.3</td>
</tr>
<tr>
<td>16-QAM</td>
<td>½</td>
<td>11.6</td>
</tr>
<tr>
<td>16-QAM</td>
<td>2/3</td>
<td>14.1</td>
</tr>
<tr>
<td>16-QAM</td>
<td>¾</td>
<td>15.7</td>
</tr>
<tr>
<td>16-QAM</td>
<td>5/6</td>
<td>16.9</td>
</tr>
<tr>
<td>16-QAM</td>
<td>7/8</td>
<td>17.5</td>
</tr>
<tr>
<td>64-QAM</td>
<td>½</td>
<td>17.2</td>
</tr>
<tr>
<td>64-QAM</td>
<td>2/3</td>
<td>19.5</td>
</tr>
<tr>
<td>64-QAM</td>
<td>¾</td>
<td>21.2</td>
</tr>
<tr>
<td>64-QAM</td>
<td>5/6</td>
<td>22.7</td>
</tr>
<tr>
<td>64-QAM</td>
<td>7/8</td>
<td>23.7</td>
</tr>
</tbody>
</table>

Table 3.1 - Minimum required C/N for QEF reception

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code rate</th>
<th>Minimum input level (dBm),</th>
</tr>
</thead>
</table>
3.4.2. Maximum Level

The receiver shall be able to handle DVB-T signals up to a level of -20 dBm while providing QEF reception.

3.5. Protection Ratios for Disturbing Signals

While maintaining QEF reception, the receiver shall tolerate disturbing signals equal to or lower than as it can be calculated from the protection ratios defined in this section.

3.5.1. Digital Disturbing Signal

3.5.1.1. Co-channel protection

A co-channel protection ratio for a DVB-T signal interfered by another DVB-T signal broadcast in the same channel, required for a QEF reception, is specified as the signal level to interference ratio, C/I.

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code rate</th>
<th>C/I (dB), Rice FX</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK</td>
<td>1/2</td>
<td>6</td>
</tr>
<tr>
<td>QPSK</td>
<td>2/3</td>
<td>8</td>
</tr>
<tr>
<td>QPSK</td>
<td>3/4</td>
<td>9.3</td>
</tr>
<tr>
<td>QPSK</td>
<td>5/6</td>
<td>10.5</td>
</tr>
<tr>
<td>QPSK</td>
<td>7/8</td>
<td>11.5</td>
</tr>
<tr>
<td>16-QAM</td>
<td>1/2</td>
<td>11</td>
</tr>
<tr>
<td>16-QAM</td>
<td>2/3</td>
<td>14</td>
</tr>
<tr>
<td>16-QAM</td>
<td>3/4</td>
<td>15</td>
</tr>
<tr>
<td>16-QAM</td>
<td>5/6</td>
<td>16</td>
</tr>
<tr>
<td>16-QAM</td>
<td>7/8</td>
<td>17.5</td>
</tr>
<tr>
<td>64-QAM</td>
<td>1/2</td>
<td>17</td>
</tr>
<tr>
<td>64-QAM</td>
<td>2/3</td>
<td>20</td>
</tr>
<tr>
<td>64-QAM</td>
<td>3/4</td>
<td>21</td>
</tr>
<tr>
<td>64-QAM</td>
<td>5/6</td>
<td>23.3</td>
</tr>
<tr>
<td>64-QAM</td>
<td>7/8</td>
<td>24.3</td>
</tr>
</tbody>
</table>

Table 3.3 – Digital co-channel protection ratios
3.5.1.2. **Adjacent channel protection**

The protection ratio for a DVB-T signal interfered by a DVB-T signal broadcast in the lower (N – 1) and upper (N + 1) adjacent channels, required for a QEF reception, are specified as the minimum interference to signal level ratio, I/C.

<table>
<thead>
<tr>
<th>Channel</th>
<th>N-1 (dB)</th>
<th>N+1 (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/C</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 3.4 – Digital adjacent channel protection ratio

3.5.1.3. **Echo in a Single Frequency Network**

The front-end shall be able to obtain QEF bitstream in case the channel contains two static paths with a relative delay from 0.25 up to 0.95 times guard interval length, independently of the relative attenuation and the relative phases.

3.5.2. **Analogue Disturbing Signal**

3.5.2.1. **Co-channel protection**

A co-channel protection ratio for a DVB-T signal interfered by an analogue signal broadcast in the same channel, required for a QEF reception, is specified as the minimum carrier to interference ratio, C/I. The receiver shall perform better than specified in the table below when an 8 MHz DVB-T signal is exposed to interference from a co-channel G/PAL signal.

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code rate</th>
<th>C/I (dB), Rice FX</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK</td>
<td>1/2</td>
<td>-12.0</td>
</tr>
<tr>
<td>QPSK</td>
<td>2/3</td>
<td>-8.0</td>
</tr>
<tr>
<td>QPSK</td>
<td>3/4</td>
<td>-2.8</td>
</tr>
<tr>
<td>QPSK</td>
<td>5/6</td>
<td>4.3</td>
</tr>
<tr>
<td>QPSK</td>
<td>7/8</td>
<td>10.4</td>
</tr>
<tr>
<td>16-QAM</td>
<td>1/2</td>
<td>-8.0</td>
</tr>
<tr>
<td>16-QAM</td>
<td>2/3</td>
<td>0.0</td>
</tr>
<tr>
<td>16-QAM</td>
<td>3/4</td>
<td>2.5</td>
</tr>
<tr>
<td>16-QAM</td>
<td>5/6</td>
<td>10.3</td>
</tr>
<tr>
<td>16-QAM</td>
<td>7/8</td>
<td>17.4</td>
</tr>
<tr>
<td>64-QAM</td>
<td>1/2</td>
<td>0.0</td>
</tr>
<tr>
<td>64-QAM</td>
<td>2/3</td>
<td>4.5</td>
</tr>
<tr>
<td>64-QAM</td>
<td>3/4</td>
<td>12.0</td>
</tr>
<tr>
<td>64-QAM</td>
<td>5/6</td>
<td>16.3</td>
</tr>
<tr>
<td>64-QAM</td>
<td>7/8</td>
<td>21.4</td>
</tr>
</tbody>
</table>

Table 3.5 – Analogue co-channel protection ratio
3.5.2.2. Adjacent channel protection

The protection ratio for a DVB-T signal interfered by an analogue signal broadcast in the lower and upper adjacent channels, required for a QEF reception, are specified as the minimum interference to signal level ratio, I/C.

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code rate</th>
<th>I/C (dB), Rice FX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Interference at N-1</td>
</tr>
<tr>
<td>QPSK</td>
<td>1/2</td>
<td>48.9</td>
</tr>
<tr>
<td>QPSK</td>
<td>2/3</td>
<td>47</td>
</tr>
<tr>
<td>QPSK</td>
<td>3/4</td>
<td>45.9</td>
</tr>
<tr>
<td>QPSK</td>
<td>5/6</td>
<td>44.8</td>
</tr>
<tr>
<td>QPSK</td>
<td>7/8</td>
<td>43.9</td>
</tr>
<tr>
<td>16-QAM</td>
<td>1/2</td>
<td>45.4</td>
</tr>
<tr>
<td>16-QAM</td>
<td>2/3</td>
<td>43</td>
</tr>
<tr>
<td>16-QAM</td>
<td>3/4</td>
<td>41.5</td>
</tr>
<tr>
<td>16-QAM</td>
<td>5/6</td>
<td>40.4</td>
</tr>
<tr>
<td>16-QAM</td>
<td>7/8</td>
<td>39.9</td>
</tr>
<tr>
<td>64-QAM</td>
<td>1/2</td>
<td>40.2</td>
</tr>
<tr>
<td>64-QAM</td>
<td>2/3</td>
<td>38</td>
</tr>
<tr>
<td>64-QAM</td>
<td>3/4</td>
<td>36.4</td>
</tr>
<tr>
<td>64-QAM</td>
<td>5/6</td>
<td>35</td>
</tr>
<tr>
<td>64-QAM</td>
<td>7/8</td>
<td>34.1</td>
</tr>
</tbody>
</table>

Table 3.6 – Analogue adjacent protection ratio

3.6. Signal Quality Indicator

The receiver shall be able to display the DVB-T signal quality, subject to the channel id (and/or frequency) selected by viewer. The viewer should be enabled to select any channel from the VHF band III (174-230 MHz) with 7 MHz raster and from the UHF bands IV-V (470-862 MHz).

The displayed DVB-T signal quality shall provide detailed (possibly numeric) information on the quality at which the bitstream described according to the ISO/IEC 13818-1 [20] can be obtained from the radio frequency signal described according to ETSI EN 300 744 [6]. In addition, the receiver should also provide information about the signal strength.

Displaying of signal quality shall be consistent; each identical receiver model shall provide the same value in case the same conditions. By knowing the result provided by the DVB-T signal quality, DTT call-centre shall be able to decide whether the reception conditions at the viewer side is appropriate, or not. The method of the DVB-T signal quality definition is not specified here; it is defined at the discretion of the manufacturer of the receiver.
4. MPEG-2 Demultiplexer

4.1. General

The Demultiplexer shall be compliant with the MPEG-2 transport layer defined in ISO/IEC 13818-1 [20].:

- the receiver shall utilize the MPEG-PSI data as specified in ISO/IEC 13818-1 [20], Annex C,
- the receiver shall be capable of dynamically tracking changes of PAT and PMT sections (PID/PIDs changes, number of services and/or service components, etc.),
- the receiver shall interpret the CA_descriptor as defined in ETR 289 [16],
- the receiver shall be able to decode an ISO/IEC 13818-1 [20] stream with data rates up to 54 Mbit/s,
- the receiver shall be capable to utilise at least 32 elementary streams simultaneously, which requires 32 PID filters,
- the receiver shall provide at least 32 section filters,
- the receiver shall support variable bit rate elementary streams within a constant bit rate transport stream (excluding audio),
- the receiver shall support a mixture of service types within the same ISO/IEC 13818-1[20] MPEG-2 transport stream (i.e. MPEG-2 SDTV service, MPEG-4 AVC SDTV and HDTV and Radio services may be multiplexed into the same transport stream),
- if the receiver equipped with CI and/or embedded smart card reader, then it shall support the common descrambling algorithm, as specified by DVB A 011 [31] (see also section Chapter 10).

4.2. System Clock Recovery

During the system time clock (STC) acquisition audio and video shall be muted. (The transition shall be smooth and seamless when the customer changes the channel). The decoder shall be able to:

- recover the STC using PCR with maximum jitter of +/- 10 µs,
- track long-term variations in the frequency of the encoder’s STC

For each service, the demultiplexer shall recover the source clock by extracting the associated PCR values received within the incoming multiplex and insert them into the appropriate Phase Locked Loop.

5. Service Management

The Service Management related requirements, which shall be satisfied by the MinDig TV compliant receiver, are specified in the “MinDig TV Service Management Guidelines, v1.0.1” document.

6. Video Decoding

The Video Decoding related requirements, which shall be satisfied by the MinDig TV compliant receiver, are specified in the “MinDig TV Video Decoding Guidelines, v1.0.1” document.
7. Audio Decoding

7.1. Broadcast Environment

7.1.1. MPEG-1 Layer II Audio

MPEG-1 and MPEG-2 backward compatible audio (ISO/IEC 11172-3 [19], ISO/IEC 13818-3 [22]) broadcasts, if any, will be in accordance with ETSI EN 300 468 [2] and ETSI TS 101 154 [8]. These audio components will be signalled in the PMT using stream type 0x03 or 0x04.

7.1.2. ISO/IEC 14496-3 Audio

MPEG-4 AAC and MPEG-4 HE AAC audio (ISO/IEC 14496-3 [24]) broadcasts, if any, will be in accordance with ETSI EN 300 468 [2] and ETSI TS 101 154 [8] (up to HE-AAC level 2 for stereo). These audio components will be signalled in the PMT using stream type 0x11. The AAC descriptor defined in the DVB SI specification EN 300 468, Annex H will be placed in the component loop of the PMT.

7.1.3. AC-3 and Enhanced AC-3 Audio

AC-3 or Enhanced AC-3 broadcasts, if any, will be in accordance with ETSI TS 102 366 [15], ETSI EN 300 468 [2] and ETSI TS 101 154 [8]. These audio components will be signalled in the PMT using stream type 0x06 indicating PES packet private data. The AC-3 descriptor or Enhanced AC-3 descriptor defined in the DVB SI specification EN 300 468, Annex D will be placed in the component loop of the PMT.

If a broadcast radio or television service has AC-3 or Enhanced AC-3 audio, then it will contain at least one Layer II or AAC audio as well.

7.1.4. Multiple Audio Tracks

A broadcast radio or television service may contain more than one audio component.

Inside a broadcast radio or television service, more than one audio component may be indicated with the same language code, e.g. because of different audio coding or supplementary audio streams.

7.1.4.1. Normal Programme Sound

The ISO_639_language_code descriptor, indicating the language of the given audio component, will be placed in the component loop of the PMT. In the ISO_639_language_descriptor for normal programme sound, the value of the audio_type field will be set to 0x00 (undefined).

7.1.4.2. Supplementary Audio

In the ISO_639_language_descriptor, for receiver mix Audio Description or Clean Audio components, the value of the audio_type field will be set to 0x03 (visually impaired commentary) or 0x02 (hearing impaired).

The broadcast mix supplementary audio component will be signalled by a supplementary_audio_descriptor placed in the component loop of the PMT. Inside this descriptor, the mix_type field will be set to 0x01, while its ISO_639_language_code field overrides the value in the ISO_639_language_descriptor in the same ES loop. In this case, the value of the audio_type field in the ISO_639_language_descriptor will be set to 0x00. (See ETSI EN 300 468 [2] and ETSI TS 101 154 [8])

Additional SI signalling in the NIT (component_descriptor) may be applied, see EN 300 468 and IEC 62216 [35].
7.2. Audio Decoder Requirements

The MinDig TV compliant receiver shall provide at least one audio decoder that is able to meet the decoding requirements set out in this clause. Preferably the receiver 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 service.

7.2.1. Supported Audio Stream Types

7.2.1.1. MPEG-1 Layer II Audio

The receiver shall be able to decode MPEG-1 and MPEG-2 backward compatible audio (ISO/IEC 11172-3 [19], ISO/IEC 13818-3 [22]), according to the minimum decoding requirements set out in the “MPEG-1 and MPEG-2 backward compatible audio” clause of the ETSI TS 101 154 [8].

7.2.1.2. ISO/IEC 14496-3 Audio

The receiver shall be able to decode MPEG-4 AAC and MPEG-4 HE AAC audio (ISO/IEC 14496-3 [24]) (up to HE-AAC level 2 for stereo), according to the minimum decoding requirements set out in the “MPEG-4 AAC, MPEG-4 HE-AAC and MPEG-4 HE-AACv2 audio” clause, excluding MPEG-4 HE-AACv2, of the ETSI TS 101 154 [8].

7.2.1.3. AC-3 and Enhanced AC-3 Audio

It is strongly recommended that the receiver is able to decode AC-3 and Enhanced AC-3 elementary streams (ETSI TS 102 366 [15]), up to 5.1 multichannel, according to the minimum decoding requirements set out in the “AC-3 and Enhanced AC-3 audio” clause of the ETSI TS 101 154 [8].

If AC-3 decoding is supported then the receiver shall be capable of down-mixing AC-3 to PCM stereo, while it should also be able to decode Enhanced AC-3 and/or transcode Enhanced AC-3 to AC-3.

7.2.2. Audio Metadata

The receiver shall support the use of the following metadata embedded in the audio stream when decoding AAC audio, according to ISO/IEC 14496-3 [24]:

- Dynamic Range Control,
- Program Reference Level

If AC-3 decoding is supported then the receiver shall support the use of a complete set of AC-3 metadata embedded in the audio stream when decoding AC-3 or Enhanced AC-3 bitstreams, transcoding Enhanced AC-3 bitstreams to AC-3, or creating a PCM stereo downmix from a decoded AC-3 or Enhanced AC-3 bitstream.

7.2.3. Synchronisation

The receiver shall not introduce more than +/- 5 ms relative delay between the video and audio components.

If the receiver, as a part of an integrated digital TV set (IDTV) has a direct audio output (RCA or embedded speaker), the audio shall be in sync with the video display.

If the receiver output the audio in an encoded form (such as in IEC 61937 [29]), the receiver shall compensate for the decoding latency of the selected audio format, as specified for the relevant reference decoder for the selected format (e.g. AC3), so that the output of the reference decoder would be +/- 5 ms with respect to the decoded video. However, this delay should be manually adjustable up to 250 ms in 10 ms steps.

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), the receiver shall not introduce more than +/- 5 ms of relative delay between the audio components.
7.3. **Audio Output Interfaces**

7.3.1. **Analogue Output**

The receiver shall always have an audio signal presented on the analogue output(s) (SCART and/or stereo RCA out) whenever any of the supported formats is received. See clause 7.4.2.

7.3.2. **Digital Output**

7.3.2.1. **S/PDIF**

The receiver shall always have either a PCM audio or a non-PCM native bitstream on its S/PDIF output, according to the viewer preferences and the available audio sources. See clause 7.4.2.

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

- pass-through of native AC-3 bitstream, according to IEC 61937 [29];
- PCM stereo, decoded and down-mixed from any supported audio stream types, according to IEC 60958 [28].

If AC-3 decoding is supported, then the receiver should also be capable of providing Enhanced AC-3 bitstream transcoded to AC3 on the S/PDIF connector.

7.3.2.2. **HDMI**

The receiver shall always have either a PCM audio or a non-PCM native bitstream on its HDMI output, if any, according to the viewer preferences and available audio sources. See clause 7.4.2.

If the receiver has HDMI output, it shall be capable of providing the following formats on the HDMI output connector:

- pass-through of native AC-3, Enhanced AC-3 and AAC bitstreams on the HDMI output connector (if the connected device indicated that it is able to receive native formats, see clause 7.4.2),
- PCM stereo, decoded and down-mixed from any supported audio stream type, on the HDMI output connector.

If AC-3 decoding is supported and the receiver has HDMI output, then it should also be capable of providing Enhanced AC-3 bitstream transcoded to AC3 on the HDMI output connector.

If AC-3 decoding is supported and the receiver has HDMI output, then it should be capable of providing PCM multi-channel, decoded and down-mixed from AC-3 or Enhanced AC-3 bitstream, on the HDMI output connector.

7.4. **System Software**

7.4.1. **Viewer Preferences**

The receiver shall allow the viewer to select storable preferences for primary audio language and secondary audio language.

After the first start-up and after each factory reset, the default value of the primary audio language shall automatically follow the OSD language selection of the viewer, unless there is an appropriate interface presented during the installation process that enables the viewer to manually select primary audio language.
The receiver shall allow the viewer to select storable preferences for the digital audio output mode. It shall offer at least the following options:
- PCM,
- native bitstream.

After the first start-up and after each factory reset, the digital audio output mode shall be set to PCM by default, unless there is an appropriate interface presented during the installation process that enables the viewer to manually set the digital audio output mode.

7.4.1.1. Applying Viewer Preferences

If more than one audio component is available for a service, the receiver shall be able to automatically select audio source according to the viewer preferences, see clause 7.4.2.

In addition, the receiver shall allow the viewer to manually select between all audio components that are associated with the actually selected service in an easy way. This manually viewer selection can be storable viewer preference individually for each service. Otherwise, after each service changing, the receiver shall automatically select audio source according to the viewer preferences again.

In the manual audio selection interface, the receiver shall display the language of the available audio components, while the AC-3 and Enhanced AC-3 audios shall be indicated with an additional sign. Furthermore, if the receiver does not support supplementary audio services, then it shall not allow the viewer to access any supplementary audio stream, unless it is a complete and independent stream, indicated by its audio_type which is set to 0x00, see clause 7.1.4.2.

7.4.2. Audio Prioritising

Table 10.1 shows the priorities of properties. If the viewer selections are not matching the available audio sources, the receiver shall always select one of the available audio sources which closest suites with the viewer preferences.

<table>
<thead>
<tr>
<th>Property</th>
<th>Priority of property</th>
<th>Priorities inside the property (1 is the highest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>language</td>
<td>1</td>
<td>1 primary&lt;br&gt;2 secondary (1)&lt;br&gt;3 based on the implementation</td>
</tr>
<tr>
<td>audio type</td>
<td>2</td>
<td>1 normal&lt;br&gt;2 hard of hearing (1)</td>
</tr>
<tr>
<td>stream type</td>
<td>3</td>
<td>1 Enhanced AC-3 (1)&lt;br&gt;2 AC-3 (1)&lt;br&gt;3 AAC&lt;br&gt;4 MPEG-1 Layer II</td>
</tr>
<tr>
<td>audio format</td>
<td>4</td>
<td>1 multichannel&lt;br&gt;2 stereo&lt;br&gt;3 mono</td>
</tr>
</tbody>
</table>

Note 1: if supported

Table 7.1 – Audio Prioritising

For the language selection, the receiver shall be able to read and use the ISO 639 language descriptors associated with the audio streams in the ISO/IEC 13818-1 [20] MPEG2 transport stream.

If the decoding of the audio source, selected according to the rules defined in Table 7.1, is not supported (e.g. AC-3), then the receiver shall select one of the available audio sources, which closest suits the viewer preferences, for the analogue output(s).
If the decoding of the audio source, selected according to the rules defined in Table 7.1, is not supported (e.g. AC-3), and the digital audio output mode is set to PCM, then the receiver shall select one of the available audio sources, which closest suits the viewer preferences, for the S/PDIF output. Otherwise, if native bitstream mode is set, then the receiver shall pass-through the best matching audio, independently from the audio stream selection for the analogue or HDMI outputs.

Where the receiver has HDMI output, it shall be able to use the (E-)EDID information returned by the connected display device:

- If the connected device indicates 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 shall always provide Basic Audio.
- If the connected device indicates that AC-3 decoding is supported, but Enhanced AC-3 decoding is not supported, the receiver, if capable, should transcode Enhanced AC-3 streams to AC-3 prior to HDMI transmission.

Similarly to the analogue and S/PDIF outputs, if the decoding or transcoding of the audio source, selected according to the rules defined in Table 7.1, is not supported by the receiver, then it shall select one of the available audio sources, which closest suits the viewer preferences, for the HDMI audio output.

7.4.2.1. Original and Local Audio components

For automatic audio prioritising the “Original” and “Local” language shall be listed in the “First audio language” and “Secondary audio language” settings as a selectable option like other living languages.

During the automatic audio language selection the receiver shall interpret the “mul” signalling as “Original” language and “qaa” signalling as “Local” language concerning to ISO 639 standard.

In the Hungarian OSD menu the “Original” shall appear as “Eredeti” and “Local” as “Helyi”. On other OSD languages similar mappings shall be applied at least when installation country is set for Hungary.

7.4.3. Dynamic Changing

The receiver shall be able to handle dynamic changes of audio component(s) (PID/PIDs) in a service. The receiver shall automatically identify if an audio component is added to or removed from a service. The receiver should have minimum disturbance for such changes of audio format.

The receiver shall be able to handle the following dynamic changes without user interaction and start decoding within one second after reception of a change (like PMT update, elementary stream header signalling):

- change of number of audio channels (e.g. from mono to stereo, from stereo to mono),
- change of bitrate for an audio component,
- change of audio PID value,
- addition of one audio component with higher preferred user settings (in this case, the receiver shall change to the new component in accordance with the pre-defined preferences),
- removal of the actually presented audio component/PID (in this case, the receiver shall use the next preferred audio component/PID).

The receiver shall handle the dynamic changes after change of selected service (“zapping”) (i.e. shall not require to re-install services) and shall be able to handle the following dynamic changes without user interaction and start decoding within one second after reception of change:

- change of number of audio codec,
- change of ISO 639 language for an audio component.
7.4.4. Reference Level

The receiver 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 receiver shall adjust the output level of all audio decoders to match the internal reference level so that the 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 AC-3 and Enhanced AC-3 in DVB Products. Receivers featuring AC-3 or Enhanced AC-3 decoding shall include the PCM Level Control feature described therein.

7.5. Audio Description

(Definition) The supporting of audio description is optional. If it is not supported, the receiver shall not enable the viewer to access any supplementary audio stream, unless it is a complete and independent stream. (hearing impaired, supplementary audio ETSI TS 101 154)

7.6. Clean Audio

(Definition) The supporting of audio description is optional. If it is not supported, the receiver shall not enable the viewer to access any supplementary audio stream, unless it is a complete and independent stream. (hearing impaired, supplementary audio, ETSI TS 101 154)

8. Teletext and Subtitling

8.1. Common

The MinDig TV compliant receiver shall support the Teletext and DVB Subtitling as stated in the following sections.

The receiver shall allow the viewer to select storable preferences for subtitling language(s), and for “normal” or “hard of hearing” subtitles. By default, the subtitling function shall be enabled; however, the viewer shall be allowed to disable it. The receiver should implement at least 5 levels of transparency between 0 % and 100 %.

In case of “hard of hearing” subtitling mode is selected and if no “hard of hearing”/“hearing impaired” pages are received (signalised in subtitling_descriptor and/or teletext_descriptor), then the receiver shall as a default use “normal” subtitling pages; otherwise, the receiver shall prefer the “hard of hearing”/“hearing impaired” subtitling, if it is matching with the preferred language.

If there is available subtitle for the actually selected service, the receiver shall be able to automatically select according to the viewer preferences.

In addition, the receiver shall allow the viewer to manually select among the available subtitles that are associated with the actually selected service in an easy way. In this manual subtitle selection interface, the receiver shall display the language of the available subtitles, while the “hard of hearing” subtitles shall be indicated with an additional sign. The manual viewer selections can be storable viewer preference, service by service. Otherwise, after each service changing, the receiver shall automatically select subtitle source according to the viewer preferences again.

The viewer preference settings and the control interface for subtitling should be common for Teletext Subtitling and DVB Subtitling.

If the receiver handles the DVB and Teletext subtitling in the same way (identified by subtitling_descriptor and/or teletext_desriptor), and both DVB and Teletext subtitles are received simultaneously with the same language code, the receiver shall only display the DVB subtitle.
8.2. Teletext

8.2.1. Broadcast Environment

The Teletext data will be transmitted as it is defined in the ETSI EN 300 472 [3].

Teletext data is conveyed in PES packets which are carried by TS packets as defined in ISO/IEC 13818-1 [20].

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

The Teletext data stream is signalled in the PMT using stream_type 0x06 indicating PES packet private data.

The appropriate ES_info field of the PMT describing Teletext data streams will contain a teletextDescriptor as defined in ETSI EN 300 468 [2].

A service may include more than one Teletext data stream, that streams are distinguishable by their respective teletextDescriptors in the PSI (language, type).

The Teletext data stream may be scrambled at component or service level.

8.2.2. General Receiver Requirements

During normal operation (decoding of video/audio/data-streams), the receiver shall be able to demultiplex in parallel the Teletext service transmitted in a packetized format according to ETSI EN 300 472 [3].

If the teletext component(s) of a service are scrambled at component or service level, and embedded smart-card reader and/or CI is present, then the receiver shall be capable of descrambling of the teletext component(s).

The receiver shall be able to display Teletext using an embedded Teletext browser and OSD, and/or by the insertion of the teletext data in the VBI of the analogue video output. Receivers equipped with HDMI output shall always have embedded Teletext browser.

If the VBI insertion is supported, then it shall be compliant with ITU-R BT.653-3, and the Teletext data shall be inserted in the lines 6 to 22 and 320 to 335.

The receiver shall be able to handle the case when a service includes more than one Teletext data stream.

8.2.3. Embedded Teletext Browser

The embedded Teletext browser, if present, shall be able to decode “normal” Teletext pages meeting the “Enhanced Teletext Specification” (ETSI EN 300 706 [4]) level 1.5 requirements, and it shall use the OSD to present the decoded pages.

The receiver should be able to use teletextDescriptor (ETSI EN 300 468 [2]). If the initial page is indicated in the teletextDescriptor, then the embedded Teletext browser shall use it for the initialization. Otherwise, the embedded Teletext browser shall start with the page number of 100.

While the viewer is using the embedded Teletext browser, the sound of the actually selected service shall not be muted, and it is recommended to offer a solution for managing the transparency of the displayed teletext pages.

The embedded Teletext browser shall allow the viewer for the basic navigation within the teletext service (e.g. direct page number selection, page linking, etc.).

The embedded Teletext browser should be able to cache decoded Teletext pages, including sub pages, in order to improve the access time for frequent used pages. When displaying a particular page the decoder should cache a certain number of pages requested by the viewer before that page and decode a certain number of pages that are most likely to be requested by the viewer later.
8.2.3.1. Latin G2 Supplementary Character Set

The embedded Teletext browser shall support the presentation of all the Hungarian characters, by interpreting packet X/26 at level 1.5, which is addressing a character location and overwriting the existing character defined on the Level 1 page. The special Hungarian characters shall be composed from a G0 basic character plus a diacritical from the Latin G0 supplementary set, as it is defined in ETSI EN 300 706 [4].

8.2.3.2. Subtitling

The embedded Teletext browser shall be able to display Teletext subtitles, both “normal” Teletext subtitling pages of type 0x02 and Teletext subtitling pages for hearing impaired people of type 0x05, meeting the requirements for level 1.5 in ETSI EN 300 706 [4].

By using the content of the teletext_descriptor, the receiver should integrate the Teletext subtitling service of the embedded Teletext browser with the DVB subtitle handling of the receiver, in order to offer a common way to the viewer to use both DVB and Teletext subtitling.

8.3. DVB Subtitling

8.3.1. Broadcast Environment

The DVB subtitle services will be transmitted as it is defined in the ETSI EN 300 743 [5].

DVB subtitles are conveyed in PES packets, signalled in the PMT using stream_type 0x06 indicating PES packet private data.

The appropriate ES_info field of the program map section describing DVB subtitling streams will contain a subtitling_descriptor as defined in ETSI EN 300 468 [2]:

- The subtitling_descriptor enables different subtitling streams to be distinguished by their ISO-639_language_code, subtitling_type, composition_page_id and ancillary_page_id.
- Any subtitling_type referring to EBU teletext or VBI data (i.e. 0x01 to 0x03) will not be used in the subtitling descriptor. Signalling of teletext subtitling will be done using the teletext_descriptor.
- If no ancillary page is transmitted, the values of ancillary_page_id and composition_page_id in the subtitling descriptor will be the same.
- The subtitling_type “normal” or “normal for display on a high definition monitor” will be used for subtitles intended primarily to provide translation. The latter value will be used when the subtitle stream includes a DDS.
- A type “normal” subtitle stream may be substantially empty, only having brief periods of subtitling where the audio channel is carrying a foreign language. In this scenario the main programme audio stream (type undefined) will normally be signalled with the natural language of the TV service, even if it periodically carries foreign speech.

The Subtitling data stream may be scrambled at component or service level.

The “End of display set” (EDS) segment will always be broadcast. The Display Definition Segment (DDS) may be broadcast in case of subtitles for HD video services.

8.3.2. General Receiver Requirements

The receiver shall be capable of decoding DVB subtitles as specified below, transmitted in conformance with clause 8.3.1; and it shall be displayed by using the OSD, whilst decoding the full television service (video and audio) to which it is associated.

- Support for ancillary pages is optional for the receiver. The enabling or disabling of the subtitle ancillary pages, if available, should be user controlled, with subtitle ancillary pages enabled as default option. The selection of subtitle ancillary pages shall be independent of enabling of subtitle composition pages.
The receiver shall support the DDS (ETSI EN 300 743 [5], Annex B). Absence of a DDS implies that the display segment width shall be assumed as 720 pixels and the height as 576 lines.

- The handling of the object type (0x00) “basic object, bitmap” shall be supported.
- The receiver shall be able to handle at least 128 objects.
- The receiver shall be able to handle at least one colour look-up table (CLUT) with a minimum of 16 entries per region and the possibility to have one colour scheme applied in each of the regions.
- The receiver shall support at least one DVB-subtitling stream i.e. at least support decoding of one subtitling composition page while support of one simultaneously available ancillary page is optional.

The receiver shall be able to handle dynamic changes of subtitle component(s) (PID/PIDs) in a service. The receiver shall automatically identify if a subtitle component is added to or removed from a service.
9. Applications Related to Event Information

9.1. Broadcast Event Information

The MinDig TV compliant receiver shall be able to present information, if any, about the broadcast events, as it is defined in clause 9.2. This feature shall be based on the broadcast EIT tables, defined in ETSI EN 300 468 [2], carried in ISO/IEC 13818-1 [20] MPEG-2 transport stream. The receiver shall be capable of extracting and interpreting EIT sections, as it is defined in Table 9.1.

<table>
<thead>
<tr>
<th>EIT section</th>
<th>table_id</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>actual, p/f</td>
<td>0x4E</td>
<td>mandatory</td>
</tr>
<tr>
<td>other, p/f</td>
<td>0x4F</td>
<td>mandatory</td>
</tr>
<tr>
<td>actual, schedule</td>
<td>0x50, 0x51</td>
<td>mandatory</td>
</tr>
<tr>
<td>(0-3 and 4-7 days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>other, schedule</td>
<td>0x60, 0x61</td>
<td>optional</td>
</tr>
<tr>
<td>(0-3 and 4-7 days)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9.1 – EIT sections required to interpret

The receiver shall be capable of extracting and interpreting the descriptors contained by the broadcast EIT tables (ETSI EN 300 468 [2]), as it is defined in Table 9.2.

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>short_event_descriptor</td>
<td>mandatory</td>
</tr>
<tr>
<td>extended_event_descriptor</td>
<td>mandatory</td>
</tr>
<tr>
<td>parental_rating_descriptor</td>
<td>mandatory</td>
</tr>
<tr>
<td>content_descriptor</td>
<td>optional</td>
</tr>
<tr>
<td>component_descriptor</td>
<td>optional</td>
</tr>
<tr>
<td>CA_identifier_descriptor</td>
<td>optional</td>
</tr>
<tr>
<td>content_identifier_descriptor</td>
<td>optional</td>
</tr>
</tbody>
</table>

Table 9.2 – EIT descriptors

The text fields of the short_event_descriptor and extended_event_descriptor may contain control byte(s), marking the character set required for the correct presentation of the text, as defined in ETSI EN 300 468 [2], Annex A.

The EIT data is dynamic information which means that it is often updated by the broadcaster several times during a day, for example:

- the description of events may be changed/updated from when the event was first “published”/broadcast,
- some events may be re-scheduled,
- past events from current day may be removed from broadcast etc.
9.2. Managing EIT Data

As factory default, the receiver shall continuously monitor, save and dynamically update the incoming EPG data without viewer request for update (e.g. by monitoring the version ids of the tables). It shall not affect the basic service decoding and navigation functions.

If the memory, allocated for the EIT data, is exceeded, then the receiver shall prioritize the event information nearest in time and first reduce the data most far ahead in time for all service, e.g. by using EIT table filtering. If the viewer has made personalized favorite service list consisting of a subset of available services, then the receiver should first prioritize favorite services and then events most nearest in time.

The receiver shall be able to handle situations when EIT is not present.

9.3. Presentation of EIT information of an Event

When displaying EIT information of an event, the receiver shall present:
- programme title (event_name field from short_event_descriptor),
- start time (start_time field from EIT),
- end time (start_time field + duration field from EIT),
- event description (combination of the text fields of the short_event and extended_event descriptors)

It is recommended to present:
- minimum age required for viewing (from parental_rating_descriptor),
- content type (content_descriptor),
- component information (based on the component_descriptor, if any)

By default, if Hungarian is selected as viewer language preference, the receiver should display the EIT text information in accordance with the Latin-2 character set, including all special Hungarian characters. If present, the receiver shall be capable of interpreting the control bytes, marking the character set required for the correct presentation of the text, as defined in ETSI EN 300 468 [2], Annex A; it is, however, sufficient to support the displaying of the Latin-1 and Latin-2 character tables.

If EIT information of an event is available in multiple languages then the receiver shall be able to display the EIT data from chosen language, according to viewer preferences.

The receiver shall display correct event times as conveyed by the TDT, adjusted by the offset signalled in the TOT and using the country name matching the viewer preferences.

The presentation of the event description shall be scrollable or shall be fragmentized on multiple pages among those the viewer can navigate.

If any information is missing (i.e. not included in the transmission) the receiver shall not display any error message, instead the text information field should stay empty.

The component_descriptor, if any, shall not have any effect outside the EIT data presentation function.

9.4. EIT Related Functions

9.4.1. Present/following Information Banner

The receiver shall support the displaying of p/f information banner, by which the viewer shall be enabled to browse at least the event information of the actual and succeeding events of the actually selected service (from EIT p/f actual), without blocking the audiovisual content presented in the background.
It is strongly recommended that the p/f information banner enables the viewer for browsing the event information of the actual and succeeding events of all the services of the actually selected service list (from EIT p/f actual and other), without blocking or changing the audiovisual content actually presented in the background.

### 9.4.2. Electronic Programme Guide

The receiver shall support the displaying of at least a 7-day (the actual and the forthcoming 6 days) EPG, by which the viewer shall be enabled for browsing event information of all the available services.

The layout of the EPG should contain a reduced size video window or background video so that during the EPG browsing the video and audio content of the actually selected service is presented continuously in the background.

The EPG should provide a function which allows the viewer to filter events with the same content type (by content_descriptor), events belonging to the same series (by content_identifier_descriptor), recommended events referred to by an event and to search events using keywords (by description).

### 9.4.3. EIT Based Parental Rating

The receiver shall support a parental event lock function based on the EIT. Among the protected parental lock settings, the receiver shall offer to the viewer at least the following rating categories: ‘6’, ‘12’, ‘16’, ‘18’, ‘any age’ (0).

The receiver shall be capable of interpreting the parental_rating_descriptor included in the EIT, specifying the minimum age (broadcast rating value + 4) required for viewing events.

As a minimum mandatory requirement, if the value of the minimum age specified for the actual event of a service is higher than or equal to the value of the parental rating category set by the viewer, then the receiver shall block the service (both the audio and video information); such blocking can be released by entering the appropriate PIN code.

Table 9.1 shows the minimum EIT based parental rating requirements that the receiver shall satisfy.

<table>
<thead>
<tr>
<th>Parental rating category set by the viewer</th>
<th>Minimum age required for viewing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4-5</td>
</tr>
<tr>
<td>6</td>
<td>x</td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

Fields with ‘x’ indicate the cases where the receiver shall block the content.

However, as the relating media law could change as time goes by, it is much more recommended to offer continual rating where the viewer is able to set the limit value from ‘4’ to ‘18’ (in addition to the ‘any age’), instead the five categories introduced above. In this case, the receiver shall block the service if the broadcast minimum age is higher than the limit value set by the viewer, while it is also allowed to block the service if the broadcast minimum age is equal to the limit as well.
10. Conditional Access

10.1. General

The receiver should be prepared to receive existing and future pay-TV services. This requires that the receiver should accommodate conditional access (CA) systems as stated in clause 10.1.1. Therefore, the receiver should support at least one DVB Common Interface (CI for CA module) and/or one embedded smart card reader for conditional access, CA based maturity rating, content protection and maybe for other purposes, see clause 10.4 and 10.5.

The CI, if any, with associated managing functions shall support the use of CA-Module (CAM) as it is defined in clause 10.2.

The embedded smart card reader, if any, with associated embedded functions shall support the use of external smart card(s) at least as it is defined in clause 10.1.1 and 10.3.

To enable receivers with a built-in CA system to receive additional services via simulcrypt techniques the DVB common scrambling algorithm, as specified by DVB (see DVB A 011 [31]), shall be implemented according to ETR 289 [16]. It is recommended that CA modules support simulcrypt on the same basis.

10.1.1. Applied Conditional Access System

For the Hungarian DTT, Conax CAS7 is selected for Conditional Access system. At the time of releasing this specification no memory or chip pairing is applied. Therefore, receivers equipped with CI and/or embedded smart card reader shall support of descrambling Conax CAS7, as defined in clause 10.4, and releasing CA based maturity rating as defined in clause 10.5.

10.2. Use of DVB-CI

The DVB Common Interface can be used for conditional access, CA based maturity rating, content protection and other purposes. A conditional access (CA) module may be connected to the Common Interface of the receiver in order to provide access control of the incoming services.

CI profile 2 as defined in TS 101 699 [12] shall be implemented as minimum.

Each CI-slot of the receiver shall be in compliance with the Common Interface specification EN 50221 [30] and be prepared for modules of type 2 defined therein.

10.2.1. Minimum requirements for the Applicable CA-Module

10.2.1.1. General – the CA-modules

The CA-module may contain the CA security device (“CA-module with fully embedded CA-system”) or a smart card interface for connection to an external smart card (“CA-module with partly embedded CA system”).

10.2.1.2. CA-module with Fully Embedded CA-system

The CA-module will be CA-system specific and contain all CA-functions, including the security device. For this case the relevant specifications have to be obtained from the relevant CA-system vendor, see clause 10.1.1.

10.2.1.3. CA-module with Partly Embedded CA-system

The CAM will be connected to a security device (smart card). The CAM shall provide the CI-functions specified in EN 50221 [30] and the additional functions specified by the relevant CA-system vendor for the smart card interface, see clause 10.1.1.
10.3. **Use of Embedded Smart-Card Reader**

The embedded smart card reader, if any, with associated embedded functions shall support the use of external smart card(s) at least as in accordance with Conditional Access system defined in clause 1.1.1.

The embedded smart card reader shall support an interface as partially specified in clause 1.3.1 below and hardware/firmware for descrambling as specified in clause 10.4.

The receiver shall be capable of replacing the CA-system software by download of new system and CA-system software via the bootloader, over the air.

10.3.1. **Smart-Card Interface**

The embedded smart card reader interface, if any, shall comply with ISO/IEC 7816 Part 1-3 [26]. The receiver does not need to support synchronous cards. The receiver shall implement all aspects related to asynchronous cards with the following exceptions:

- support for Vpp is not required,
- support for AFNOR pin-out is not required,
- Vcc range is 5V+-5%,
- Icc max is 65 mA,
- the clock frequency shall be at least 5 MHz

The possibility of using the data exchange protocol T=0 shall be supported. It shall be possible to include support for the data exchange protocol T=1 through an IRD software upgrade.

10.4. **Descrambling of Selected Service**

The receivers equipped with CI and/or embedded smart card reader shall be able to descramble on transport level and on PES format. The descrambler unit shall be based on the common scrambling algorithm as specified by DVB, see DVB A 011 [31]. Common Scrambling Algorithms versions 2 and 3 shall be implemented in the receiver. The receiver shall be able to process in parallel up to at least 6 different streams (either PES or transport level) with different access conditions. Data streams without access control shall be bypassed by the descrambling unit.

The receiver shall work correctly when using more than one ECM and EMM streams from the same CA provider. If different CAID is used from the same provider, the receiver shall select the correct one for every program, based on CAT descriptors. The receiver shall not be disturbed, if the TS include other CA provider’s ECM and EMM streams as well.

10.4.1. **ECM and EMM Filtering**

The receivers equipped with embedded smart card reader shall implement ECM and EMM acquisition in accordance with ETR 289 [16].

The receiver shall be able to simultaneously acquire at least two ECM streams. The ECMs shall be filtered based on PID, TID and toggle bit.

The receiver shall be able to acquire EMMs from at least one EMM stream (one PID). The EMMs shall be filtered based on PID, TID and section address field. The section address field is CA system specific, and described as part of the smart card application interface. The receiver shall be able to filter on three TID and address field combinations simultaneously.
10.5. Further CA Related Functions

10.5.1. CA Based Maturity Rating

The receivers, equipped with CI and/or embedded smart card reader, shall support CA based maturity rating.

The receiver shall support the displaying of the related CA menu in Hungarian language. The option, that enables the displaying of all the descrambled services without any effect of the broadcast maturity level, shall be translated and displayed as “all free”.

As default, the viewer shall be allowed to view each service, independently of the value of the broadcast maturity level, until the viewer changes this setting.

If the broadcast maturity level specifying the conditions required for viewing is equal to or less than the category set by the viewer, then the receiver shall enable the viewing of the service, otherwise it shall block the viewing (both the audio and video information); such blocking can be released by entering the appropriate PIN code.

Table 10.1 shows the rules how the content shall be managed subject to the CA maturity rating conditions.

<table>
<thead>
<tr>
<th>Maturity rating rules set by the viewer</th>
<th>Broadcast maturity level</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>x</td>
</tr>
<tr>
<td>PG</td>
<td>x</td>
</tr>
<tr>
<td>A</td>
<td>x</td>
</tr>
<tr>
<td>X</td>
<td>x</td>
</tr>
</tbody>
</table>

Fields with ‘x’ indicate the cases where the receiver shall block the content.

Association of categories: G: 12, PG: 16, A: 18, X: “any age”

Table 10.1

10.5.2. CA Based Content Protection

The HDMI output interface, if present, shall support the High-bandwidth Digital Content Protection (HDCP) [33].

The receivers, equipped with CI and/or embedded smart card reader and with HDMI output, shall support HDCP managed by CA based content protection, as defined in TS 101 699 [12].

The received service may be flagged with a need for content protection or not (CP “ON” or “OFF”) via the CA-system, as specified by the relevant CA-system vendor, see clause 10.1.1. Signals that the receiver is entitled to receive shall be sent to the HDMI-sink (display) in accordance with the following conditions:

- In case the received service is flagged with no need for content protection, the signal may be sent to the sink with HDCP disabled.
- In case the received service is flagged with content protection required, the signal shall only be sent to the sink with the HDCP enabled, e.g. when the HDMI sink satisfies the HDCP requirements and HDCP protection is established on the HDMI link.

The HDCP mode of the HDMI interface shall be set to disabled as default. However, the receiver should provide storable viewer preference for setting the preferred HDCP mode to either enabled or disabled. HDCP disabled viewer preference shall always be overridden to enabled when the received service is flagged with a need for content protection, “CP ON”, as stated above. The HDMI output signal shall always be managed in accordance with the actual HDCP mode for all the receivable services, even if the given service is not flagged via the CA-system.
11. System Software Update

The System Software Update related requirements, which shall be satisfied by the MinDig TV compliant receiver, are specified in the “MinDig TV System Software Update Guidelines, v1.0.1” document, where SSU means the System Software Update over the air or OAD – Over the Air Download. So this type of software update when the software is transmitted via broadcast is called SSU/OTA or SSU/OAD which have equivalent meanings.

Another type of System Software Updates include “local update”, when the system software is located on USB Mass Storage drive or on external hard drive, and it is connected via USB to the receiver.

If the receiver has RJ45 Ethernet and/or Wi-Fi interface a Network Software Update (NSU) is allowed as well.

In case of IDTVs with Ethernet and/or Wi-Fi interface if the software size is too big and handling in live environment is cumbersome, then SSU/OTA test is not compulsory. This decision will be made by technical people in testing laboratory if they require the test or not. If not, an NSU test can be required instead.

The SSU/OTA test is deployed simulating a real live environment, so the TS from the manufacturer shall contain at least the correct PAT, PMT, NIT, SDT tables and the DSM-CC carousel containing the software for update. Looking for dedicated software PIDs in the receiver’s software logic are not allowed since the input TS will be inserted into multiplexer and altering PID numbers can occur.

12. System Software

12.1. System Time

The receiver shall be capable of interpreting the transmitted TDT and TOT.

By default, the receiver shall automatically calculate the system time from the TDT and TOT tables. Furthermore, the receiver shall be capable of offering the manual setting of time offset.

If the receiver – mostly IDTVs - has enough resource to store a calendar and follow the daylight saving changes in the selected countries or regions, it is allowed to set the time offset from the operating system instead of TOT. In this case using TOT from broadcast is not compulsory.

Since in TDT the UTC time is broadcast in case of automatic time handling there could be a problem handling correct time when watching tuned programs of neighbouring countries which are in different time zone. In this case displaying the correct geographical time shall be based on installation country setting or offering semi-automatic mode to set time offset.

12.2. Viewer Preferences

12.2.1. Language

The menu of the receiver shall be available at least in both Hungarian and English.

The receiver shall allow the viewer to store preferences for the audio and subtitling languages. At least the primary language setting shall be supported, while it is recommended to offer the possibility to store secondary language as well.
12.2.1. Country

The receiver should allow the viewer to select his/her country at least during the “Auto Installation” process. The menu, audio and subtitling language settings should follow this selection, as well as the other country specific functions (e.g. the default character-set of the EIT presentation).

12.2.2. Video

The receiver shall support at least the following video displaying modes (combinations of the aspect ratio of the targeted display and the presentation modes, as it is defined in Chapter 6):

- 16:9 pillar-box or widescreen,
- 4:3 letterbox,
- 4:3 centre-cut-out (or pan&scan)

In case of IDTVs only supporting 16:9 pillar-box mode is mandatory.

If HDMI output is present, by default, the receiver shall continually output the best quality video format that matches with the capabilities of the connected display, based on the (E)-EDID information. In addition, the viewer shall be allowed to override this automatic selection to a fixed output format.

The viewer shall be able to select HDCP mode (on/off), that selection may be override in accordance with the CA content protection, as it is define in clause 10.5.2.

12.2.3. Audio

In addition to the language preferences, the receiver should allow the viewer to select between the “normal” (default) and “hard of hearing” audio modes, and store this selection.

The receiver shall allow the viewer to store the digital audio output mode (PCM and native non-PCM), as it is defined in clause 7.4.1.

The receiver shall allow the viewer to store audio delay for the digital audio output, as it is defined in clause 7.2.3.

12.2.4. Subtitling

In addition to the language preferences, the receiver shall allow the viewer to select between the “normal” (default) and “hard of hearing” subtitling modes, and store this selection.

12.2.5. Parental Rating

The receiver shall offer to the viewer the appropriate interfaces to manage EIT based and CA based parental rating functions, as it is defined in the clause 9.4.3 and 10.5.1.

By default, the parental rating functions shall be set to the mode that enables the viewer to access all the available services.

When the previously set parental rating trigger activates, a PIN code is needed to resolve the parental blocking, and allows watching the program. The receiver shall offer the parental PIN to be different from the system PIN.

12.2.6. Time

The receiver shall allow the viewer to select at least between two system time managing modes:

- fully automatic calculation, as default (based on TDT/TOT),
- manual time offset (based on the TDT and the viewer selected offset)
12.2.7. Service List

The receiver shall be able to provide the service list(s) and favourite list(s), as it is defined in Chapter 5.

The receiver shall allow the viewer for the deletion of all the service lists, without any effect on other stored parameters. It is accepted if this function is integrated part of the manually initiated full-band scan function (Automatic search).

12.3. Auto Installation

The receiver shall support the “Factory reset” function, which restores all the parameters of the system software to the default values and deletes all the service lists.

After each factory reset, and after the first start-up of the device, the same “Auto Installation” process shall be performed by the receiver.

During the “Auto Installation”, on its first view, the receiver shall allow the viewer to select the (menu) language and/or the country. All the language preferences (audio/subtitling/default EIT character-set/etc.) shall follow this selection, unless there is an appropriate interface that enables the viewer to override the default options.

The “Auto Installation” process shall enable the viewer at least to select the displaying mode as well:

- Aspect ratio of the targeted display: 4:3 or 16:9,
- presentation mode: letterbox, centre-cut-out (or pan-scan) and pillar-box/widescreen

As an integrated part of the “Auto Installation” process, the receiver shall offer the execution of a full-band (service initialization) scanning. By default, the found services shall be placed into the service list(s) in accordance with their broadcast LCN.

Before selecting full band scan the receiver shall offer “Digital Only” scanning for the terrestrial tuner, if the receiver is prepared to scan analogue channels as well, or by default it shall scan only the digital channels.

It is strongly recommended before “Auto” and “Manual” scanning to ask for system PIN code if EPG based maturity rating is set, because re-scan usually deletes the settings of maturity ratings.

13. PVR – Personal Video Recorder

If personal video recording function is implemented it can be PVR Ready when there is no internal data storage capability inside the receiver or Full-PVR if there is.

In case of scrambled programs, the manufacturer shall provide a solution to prevent the recording to be playable on computer or other type of devices, but shall enable to play it with the receiver which the recording was made. This is especially important in case of PVR Ready receivers when the external storage can be easily disconnected from the receiver.

This limitation shall be implemented based on MPEG container or header encryption by an algorithm, or based on Conditional Access System. In case of CAS implementation the receiver shall enable the user to replay the recorded content even if the Smart Card is not entitled for receiving scrambled broadcast content.

14. HbbTV

If the receiver supports HbbTV it shall support HbbTV 1.1 and MPEG-DASH from HbbTV 1.5.

In case of supporting HbbTV the functionality shall be ON by default in the system menu.

Further and more detailed specifications can be found in “HbbTV Receiver Specification” v0.1, which shall be used as an extension of current document.