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# **TECHNICAL MINIMUM REQUIREMENTS FOR DVB-T2 RECEIVERS FOR THE AUSTRIAN MARKET**

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# TABLE OF CONTENTS

|            |  |           |
|------------|--|-----------|
| <b>1</b>   | <b>INTRODUCTION</b>                      | <b>6</b>  |
| 1.1        | Scope                                    | 6         |
| 1.2        | Document History                         | 7         |
| 1.3        | Terminology                              | 7         |
| <b>2</b>   | <b>GENERAL REQUIREMENTS</b>              | <b>9</b>  |
| <b>3</b>   | <b>HARDWARE REQUIREMENTS</b>             | <b>9</b>  |
| <b>3.1</b> | <b>Audio, Video, and Data Interfaces</b> | <b>9</b>  |
| 3.1.1      | Analog Audio and Video Interfaces        | 9         |
| 3.1.2      | Digital Audio and Video Interfaces       | 10        |
| 3.1.3      | Data Interface                           | 11        |
| 3.1.4      | DVB Common Interface                     | 11        |
| <b>3.2</b> | <b>DVB-T2 Tuner and Demodulator</b>      | <b>11</b> |
| 3.2.1      | General                                  | 11        |
| 3.2.2      | Demodulation and Error Correction        | 11        |
| 3.2.3      | RF Tuner Interface                       | 12        |
| 3.2.4      | Tuner performance                        | 12        |
| <b>4</b>   | <b>TUNING AND SCANNING PROCEDURES</b>    | <b>14</b> |
| <b>4.1</b> | <b>General</b>                           | <b>14</b> |
| <b>4.2</b> | <b>Logical Channel Numbering (LCN)</b>   | <b>15</b> |
| 4.2.1      | Manual changes of the Channel List       | 15        |
| <b>4.3</b> | <b>MPEG-2 Demultiplexer</b>              | <b>16</b> |
| 4.3.1      | General                                  | 16        |
| 4.3.2      | DVB Descrambler                          | 16        |
| 4.3.3      | Dynamic PMT processing                   | 16        |
| 4.3.4      | Dynamic SDT processing                   | 17        |
| 4.3.5      | Update of service lists                  | 17        |
| <b>5</b>   | <b>DECODING CAPABILITIES</b>             | <b>17</b> |
| <b>5.1</b> | <b>Video Decoding</b>                    | <b>17</b> |
| 5.1.1      | SDTV                                     | 17        |
| 5.1.2      | HDTV                                     | 18        |
| <b>5.2</b> | <b>Audio Decoding</b>                    | <b>19</b> |
| 5.2.1      | Audio – Video Synchronization            | 19        |
| 5.2.2      | Multichannel Audio                       | 20        |
| 5.2.3      | Audio Description                        | 21        |

|           |  |           |
|-----------|--|-----------|
| 5.2.4     | Loudness Levels, Dynamic Range Control and Downmixing      | 21        |
| <b>6</b>  | <b>SERVICE INFORMATION</b>                                 | <b>21</b> |
| <b>7</b>  | <b>NAVIGATOR AND EPG</b>                                   | <b>22</b> |
| 7.1       | Standard EPG   | 22        |
| 7.2       | Navigator User Interface and Preference Settings           | 22        |
| <b>8</b>  | <b>REMOTE CONTROL</b>                                      | <b>23</b> |
| <b>9</b>  | <b>TELETEXT AND DVB SUBTITLING</b>                         | <b>23</b> |
| 9.1       | Teletext   | 23        |
| 9.1.1     | Teletext data in the VBI                                   | 23        |
| 9.2       | DVB Subtitling   | 23        |
| <b>10</b> | <b>CONDITIONAL ACCESS AND DIGITAL RIGHTS MANAGEMENT</b>    | <b>24</b> |
| 10.1      | Conditional Access System                                  | 24        |
| 10.2      | PRE Enablement   | 24        |
| 10.3      | CA-System Error&Status messages                            | 25        |
| 10.4      | Content Security for Content delivered via DVB             | 25        |
| 10.4.1    | Digital Copy Protection                                    | 25        |
| 10.4.2    | Analog Copy Protection                                     | 25        |
| 10.4.3    | Component Video Control                                    | 26        |
| 10.4.4    | Storage Rights for IRDs with embedded CA System            | 26        |
| 10.4.5    | Storage Rights for IRDs with non-embedded CA System        | 27        |
| 10.5      | Parental Control   | 27        |
| 10.6      | General Rules on Content Immutability                      | 27        |
| 10.6.1    | No modification to program signals                         | 27        |
| 10.6.2    | No graphical overlays over original signal                 | 27        |
| 10.6.3    | No concurrent display of program signals and other content | 28        |
| 10.6.4    | No rescaling of the program signal                         | 28        |
| 10.6.5    | No automatic Ad zapping                                    | 28        |
| <b>11</b> | <b>DIGITAL VIDEO RECORDER (DVR)</b>                        | <b>28</b> |
| 11.1      | DVR Performance  | 28        |
| 11.2      | Content Security   | 29        |
| 11.3      | DVR Scheduling   | 29        |

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|             |  |           |
|-------------|--|-----------|
| <b>11.4</b> | <b>Maturity Rating</b>                             | <b>29</b> |
| <b>12</b>   | <b>SYSTEM SOFTWARE UPDATE</b>                      | <b>29</b> |
| <b>12.1</b> | <b>SSU Over-The-Air (Broadcast Download)</b>       | <b>30</b> |
| <b>12.2</b> | <b>Local Download</b>                              | <b>30</b> |
| <b>12.3</b> | <b>Download of SSU via the Internet connection</b> | <b>30</b> |
| <b>13</b>   | <b>HBBTV AND INTERACTIVE APPLICATIONS</b>          | <b>30</b> |
| <b>13.1</b> | <b>General</b>                                     | <b>30</b> |
| <b>13.2</b> | <b>Signalling</b>                                  | <b>31</b> |
| <b>13.3</b> | <b>Cookies</b>                                     | <b>31</b> |
| <b>13.4</b> | <b>User agent header</b>                           | <b>31</b> |
| <b>13.5</b> | <b>Specific Application Support (SAS)</b>          | <b>31</b> |
| <b>14</b>   | <b>DEFINITIONS</b>                                 | <b>33</b> |
| <b>15</b>   | <b>REFERENCES</b>                                  | <b>35</b> |

# 1 INTRODUCTION

## 1.1 Scope

This Guideline applies to Standard DVB-T2 receiver devices for the Austrian market. This Guideline specifies the minimum requirements for Receiver Devices, which are designated for the reception of terrestrial signals provided by the ORS group. Compliance to this guideline ensures that the IRD is able to receive, decrypt, decode and deliver the content to a display in an accurate manner.

The specified Standard DVB-T2 receiver shall provide access to both SD and HD signals transmitted over DVB-T and DVB-T2 modulation.

It may include access to an internal or external storage mechanism such as a Hard Disk Drive, and should support an interactive EPG.

This document outlines a set of minimum requirements for IRDs (integrated receiver decoder), CAMs (Conditional Access Modules) and TV Sets with an integrated IRD used for receiving the DVB-T2 SD (standard definition) and HD (high definition) television programming distributed by the ORS group for the Austrian market.

All IRD requirements apply to TV Sets. Exceptions for TV Sets are written explicitly within the affected clause.

Requirements, which apply only to IRDs with PVR or PVR-ready functionality, are explicitly described.

This guideline defines only a minimum set of requirements and is not intended to be a complete specification for IRDs. It lists the minimum requirements to receive digital audio and/or video in either standard or high definition and/or data services distributed via Digital Terrestrial Television.

## 1.2 Document History

| Version | Date       | Comments   |
|---------|------------|--|
| 0.1     | 17.10.2011 | Initial version.   |
| 0.2     | 13.11.2011 | Review and expansion of interactive services   |
| 0.3     | 1.2.2012   | NorDig references added. Tuner Performance   |
| 0.4     | 1.3.2012   | E-AC-3 added   |
| 0.5     | 7.3.2012   | LTE signal immunity added, Interactivity revised   |
| 0.6     | 26.3.2012  | Cardless CA added  |
| 0.7     | 27.3.2012  | CTO approval   |
| 0.8     | 10.4.2012  | Dolby Digital Consideration added  |
| 0.9     | 31.5.2012  | Feedback from CE Industry added: CE, Ph (FEEI), FH, So, DG, Sa, DTL, Wi, Ka  |
| 0.91    | 1.7.2012   | CA System Irdeto CCA defined   |
| 0.95    | 11.1.2013  | Irdeto SSU mandatory, Storage control for non-embedded CA defined, Parental Control via EIT  |
| 1.0     | 29.3.2013  | Final Version  |
| 2.0     | 24.10.2016 | DRAFT <ul style="list-style-type: none"> <li>• CI+ specification changed to V1.3</li> <li>• HDMI version update</li> <li>• Antenna power supply short circuit handling procedure</li> <li>• Added support for AES CBC scrambled signals</li> <li>• Update of Dynamic PMT processing requirement</li> <li>• Update of multichannel audio paragraph</li> <li>• Added requirement to handle component descriptor in EIT</li> <li>• Update of CA paragraph (CCA version, support of Secure Core Mixed mode)</li> <li>• Update on HbbTV requirements</li> </ul> |
| 2.1     | 05.01.2017 | Release Version (Feedback from CE Industry added) <ul style="list-style-type: none"> <li>• Modified paragraph 4.1</li> <li>• Revised paragraph 4.3.3 (dynamic PMT processing)</li> <li>• Added paragraph 4.3.5 Update of service lists</li> <li>• Modified paragraph 6</li> <li>• Added paragraph 10.3 CA-System Error&amp;Status messages</li> </ul>  |

## 1.3 Terminology

Shall (mandatory)                      Denotes that the item is mandatory.

|                      |   |
|----------------------|---|
| Should (recommended) | Denotes that the item is not mandatory, but highly recommended. |
| May (allowed)        | Denotes that the item is allowed.                               |



## 2 GENERAL REQUIREMENTS

Compliance to general EBU requirements for HDTV receivers as described in EBU Tech 3333 [22] and in the E-Book [47] is recommended.

The compliance to the general requirements of the applicable European Community directives is mandatory (CE marking).

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

If the IRD is switched-on from standby mode, then the IRD shall tune to the last viewed service.

## 3 HARDWARE REQUIREMENTS

### 3.1 Audio, Video, and Data Interfaces

#### 3.1.1 Analog Audio and Video Interfaces

The IRD shall have one or more analog audio and video outputs. The physical interface shall be implemented as a SCART interface according to 3.1.1.1 or a coaxial interface according to 3.1.1.2.

*This clause is not valid for TV Sets.*

##### 3.1.1.1 SCART output interface

The SCART interface shall comply with ETSI EN 50049-1[9] and ETSI EN 50157-2 [10].

If a SCART interface is implemented, an analog stereo audio output interface in the SCART interface is mandatory.

##### 3.1.1.2 Coaxial audio and coaxial Composite video output interface

The composite interface shall be implemented as an RCA connector.

If coaxial video output interface is implemented, the IRD shall have an analog audio stereo output interface (left and right channel RCA connector)).

*This clause is also valid for TV Sets, in case a SCART or coaxial composite interface for video output is available.*

### **3.1.1.3 Component Analog Video Interface**

The IRD may have analog component video output implemented via RCA connectors. The analog component video output shall support High Definition resolution.

*The clause 3.1.1.3 is also valid for TV Sets, in case a Component interface for video output is available.*

## **3.1.2 Digital Audio and Video Interfaces**

### **3.1.2.1 Digital Audio Video Interface (HDMI)**

The IRD shall have at least one HDMI output as described in ETSI TS 102 201 [16], sub-clause 4.6. All digital Video Interfaces shall be compliant to the HDMI Specification Version 1.4b [27] or higher.

The IRD shall provide HDCP digital copy protection at all HDMI output interfaces as defined in the HDMI specification. The IRD shall provide an option for the user in the system menu to disable the HDCP authentication for unprotected content (see EBU Tech 3333 [22], §9.5). The HDMI source (IRD) shall attempt authentication if the content requires protection. A successful HDCP authentication shall always trigger encrypted delivery of the content.

If the content is signaled as digital copy protected content and the HDCP authentication handshake is successful, then the HDCP command ENC\_EN triggering the encrypted transmission of content shall be sent by the HDCP transmitter. If the content is signaled as digital copy protected content and the HDCP authentication handshake fails at any time of the transmission, then unencrypted (clear) content shall not be transmitted.

An HDMI output interface capable of carrying native audio bitstreams, transcoded audio bitstreams, and decoded stereo PCM audio shall be present.

In the case of TV Sets, an HDMI input interface with Audio Return Channel (ARC) shall be present, capable of carrying native audio bitstreams, transcoded audio bitstreams, and decoded stereo PCM audio.

*The clause 3.1.2.1 is also valid for TV Sets, in case an HDMI interface for audio and/or video output is available.*

### **3.1.2.2 Digital Audio S/PDIF Interfaces**

The IRD should have a digital audio S/PDIF output (electrical RCA or optical TOSLINK connector) capable of carrying transcoded audio bitstreams and decoded stereo PCM audio.

*The clause 3.1.2.2 is also valid for TV Sets, in case a Component interface for video output is available.*

### **3.1.3 Data Interface**

The IRD shall have a Universal Serial Bus Port, USB 2.0 or higher [17].

The IRD should have a LAN: Fast Ethernet IEEE 802.3u Port [45].

In cases where the IRD contains middleware as described in clause 13, a wired or wireless LAN connection shall be supported.

### **3.1.4 DVB Common Interface**

In case the IRD lacks an embedded CA system as required in 10.1, the IRD shall be equipped with at least one DVB Common Interface slot in compliance with the Common Interface specification ETSI EN 50221 [20] and the CI Plus Specification v1.3.1 [23].

The CA Module shall be capable of signaling and activating any Content Protection and DRM functionality to the IRD as required 10.4 via a secured and inevitable way.

## **3.2 DVB-T2 Tuner and Demodulator**

### **3.2.1 General**

The IRD shall include at least one tuner/demodulator unit for reception of signals from an indoor or external antenna (e.g. roof top antenna).

### **3.2.2 Demodulation and Error Correction**

Demodulation and error correction shall be performed for all code rates and guard intervals specified in ETSI EN 302 755 [2].

The DVB-T2 receiver shall support all modulation parameters as specified in ETSI EN 302 755 [2] .

### **3.2.3 RF Tuner Interface**

#### **3.2.3.1 General**

The IRD shall accept incoming DVB signals, which comply with DVB-T2, as specified in ETSI EN 302 755 V1.2.1.2009-09 [2],

#### **3.2.3.2 RF Input Connector**

The IRD shall have at least one tuner input connector, type: IEC female in accordance with IEC 60169-2, part 2 [4]. The input impedance shall be 75 ohm.

#### **3.2.3.3 Power Supply to antenna**

The IRD shall be able to provide power to an external antenna.

The provided power supply shall be

- Voltage: 5,0 V +/- 5%
- Current: at least 100mA

If the RF input supports DC power to an external antenna with amplifier, it shall not degrade to the performance of the RF input characteristics.

The DC power supply shall be protected against short circuit. Furthermore, there shall be an option in the user menu and during first time installation to active/deactivate the antenna DC power supply.

When the antenna power supply is switched “off” by the user the power shall remain off even after power cycle of the receiver.

When antenna power supply is activated and short circuit is detected then:

- Deactivate antenna power supply.
- Show on screen message to notify the user. User shall have the option to acknowledge this message.
- After power cycle or when receiver reboots the antenna power shall be activated in case no short circuit is detected. If short circuit is detected show on screen message again.

*The clause 3.2.3.3 is not valid for TV Sets.*

### **3.2.4 Tuner performance**

#### **3.2.4.1 General**

The IRD's Tuner shall fulfill all requirements defined in the NorDig Unified Requirements for Integrated Receiver Decoders [24] chapter 3.4.

This applies especially to the C/N performance and QEF reception performance for DVB-T and DVB-T2 signals.

### 3.2.4.2 Immunity to channel interference from LTE 800 signals

The IRD should provide a frequency filter to protect the tuner from distortions and interferences evoked by LTE 800 signals.

The subsequent text applies only to IRDs which have the optional LTE filter implemented.

The IRD shall apply a frequency filter to the incoming RF antenna signal for masking LTE 800 signals as shown in Table 1 and Diagram 1.

The application of this filter should be switchable via the IRD's set up menu. The initial manufacturer's setting shall come with deactivated LTE filter.

In case this option is turned off, no LTE filter shall be applied to the incoming RF antenna signal.

|            | <b>lower<br/>threshold</b> | <b>upper<br/>threshold</b> |
|------------|----------------------------|----------------------------|
| <b>MHz</b> | <b>dB</b>                  | <b>dB</b>                  |
| 470        | -0,5                       | 0                          |
| 766        | -0,5                       | 0                          |
| 790        | -3                         | 0                          |
| 798        | -20                        | -5                         |
| 822        | -80                        | -40                        |
| 830        | -80                        | -50                        |
| 862        | -80                        | -50                        |
| 900        | -80                        | -50                        |

*Table 1: Required LTE800 filter characteristics*

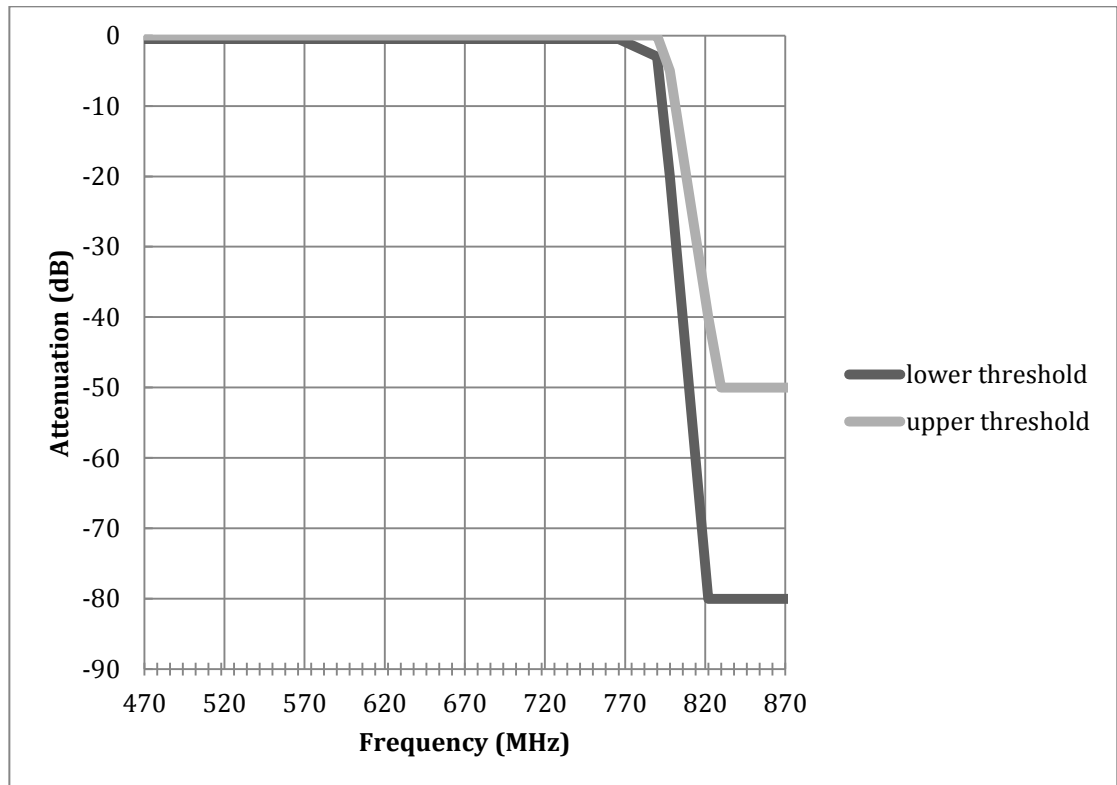


Diagram 1: Required LTE800 filter characteristics

## 4 TUNING AND SCANNING PROCEDURES

### 4.1 General

The IRD shall provide an initial set up routine, where the user shall be able to configure at minimum the menu language, in case multiple languages additionally to the mandatory German language are supported.

The first time installation routine shall be started immediately after the first activation of the IRD. If the first time installation routine is interrupted the IRD shall execute the first time installation routine after reboot of the IRD again.

Within the first time installation routine the IRD shall start an LCN channel scanning procedure as described in 4.2.

For manual channel list setup the IRD shall provide a scanning procedure over the whole frequency range as defined in the NorDig Unified Requirements for Integrated Receiver Decoders [24] chapter 3.4.

The IRD shall provide a manual scanning procedure for retrieving the services available on the network if LCN as described in 4.2 is not available over the DTT network.

For automatic channel list management the IRD shall use Logical Channel Numbering (LCN) as described in 4.2.

The IRD shall provide a signal strength indicator and reception quality indicator. These indicators shall be accessible in a submenu of the IRD's configuration menu.

Within the user menu there should be an option to display signal information of the currently tuned service:

- Channel/frequency, bandwidth, DVB-T/T2
- Service name
- TS\_ID
- ONID
- SID
- LCN position
- Video PID
- Audio PID
- PCR PID
- Signal quality bar (%)
- Signal strength bar (%)

## 4.2 Logical Channel Numbering (LCN)

The IRD shall support Logical Channel Numbering version 1.0 as described in the technical specification NorDig Unified Requirements [24], clause 12.

The Original Network ID for the ORS bouquet is 8232 (0x2028) as assigned by the DVB Services Organization (see [http://www.dvbservices.com/identifiers/original\\_network\\_id](http://www.dvbservices.com/identifiers/original_network_id)).

### 4.2.1 Manual changes of the Channel List

Within the Channel List View the user shall have the right to manually change the order of channels and insert, replace or delete channels at his own discretion and therefore change manually the mapping of channel numbers to channel names. In such case however, the IRD shall provide an option in the IRD setup menu to reset the mappings to the last stored or actively signaled Channel List.

In case the IRD provides user defined channel lists, these lists shall only be affected by the LCN functionality if the user confirms the changes before.

## **4.3 MPEG-2 Demultiplexer**

### **4.3.1 General**

The IRD demultiplexer shall be compliant to the MPEG-2 transport layer defined in ISO/IEC 13818-1 [6].

The IRD shall support ETSI TS 101 154 [5].

Additional requirements:

The IRD shall interpret the Conditional Access (CA) descriptor as defined in ETSI ETR 289 [15].

The IRD shall be able to decode an ISO/IEC13818-1 [6] stream with data rates up to 58 MBit/s.

The IRD shall be capable to utilize at least 32 elementary streams simultaneously, which requires 32 PID filters.

The IRD shall provide at least 32 section filters.

The IRD shall support variable bit rate elementary streams within a constant bit rate transport stream.

### **4.3.2 DVB Descrambler**

The descrambler unit shall be based on the Common Scrambling Algorithm (CSA) as specified by DVB described in DVB A 011 [1]. Additionally the descrambler unit shall be able to handle AES CBC scrambled signals.

The IRD shall be able to evaluate the CA descriptor regardless if it is inserted in the PMT at program level or program element level.

### **4.3.3 Dynamic PMT processing**

The IRD shall be able to handle dynamic changes in the Program Map Table (PMT).

A practical use case for dynamic PMT changes is for example the requirement to support switching on and off regional variants of programs by a broadcaster.

The IRD shall handle dynamic PMT changes in the correct manner:

- 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 the elementary streams are scrambled or not.

It is recommended, that the video stream should freeze (freeze frame), until the new video stream is displayed.



The IRD shall be able to handle a dynamic switchover from H.264/AVC HD elementary stream to H.264/AVC SD elementary stream. The maximum outage shall be below 3 seconds.

#### **4.3.4 Dynamic SDT processing**

The IRD shall be able to handle dynamic updates of the SDT.

#### **4.3.5 Update of service lists**

The IRD shall be able to detect changes in the service configuration of each broadcast transport stream. This is to ensure that changes in the service configuration are automatically detected (e.g over night) without the user need to perform a new channel scan.

The IRD shall update service lists and user defined channel lists in a way that services that have been moved are kept at the same position of the service lists. The IRD shall remove services from the service lists if services are removed from Multiplex. If service are added to the service configuration these service shall be added to the service list according to their LCN position.

## **5 DECODING CAPABILITIES**

### **5.1 Video Decoding**

The IRD video decoding subsystem shall comply with ETSI TS 101 154 [5] and shall comply with ETSI EN 302 307 V1.1.2 [3]. Still pictures shall be supported in all modes listed below.

#### **5.1.1 SDTV**

##### **5.1.1.1 MPEG-2**

The IRD shall comply with ETSI TS 101 154 [5], sub-clause 5.1, “25 Hz MPEG-2 SDTV IRDs and Bitstreams”.

The minimum requirements are:

- The IRD shall decode MPEG-2 Main Profile Main Level bit-streams (MPEG-2 MP@ML).
- The IRD shall decode and deliver video material with a frame rate of 25 Hz interlaced.
- The IRD shall decode SDTV video bit-streams with 4:3 and 16:9 aspect ratio without distortion.
- The IRD shall decode luminance resolutions of 352x576 to 720x576.

- The HDTV IRD decoder shall be able to decode at bit rates down to 1.0 Mbps for video resolutions up to full Standard Definition resolution video (720x576).

#### **5.1.1.2 H.264/AVC**

The IRD shall comply with ETSI TS 101 154 [5], sub-clause 5.6.2, “25 Hz H.264/AVC SDTV IRD and Bitstream”.

The minimum requirements are:

- The IRD shall decode H.264/AVC Main Profile, Level 3 bit streams.
- The IRD shall decode and video material with a frame rate of 25 Hz interlaced or progressive.
- The IRD shall decode bit streams with 4:3 and 16:9 aspect ratio without distortion.
- The HDTV IRD shall be able to decode H.264/AVC video at bitrates down to 250 kbps for all resolutions up to 352x576 to 720x576
- The HDTV IRD shall be able to decode AVC still picture at bitrates down to 100 kbps

#### **5.1.1.3 16:9 Letterbox Conversion**

It shall be possible for the user to switch the video output aspect ratio between 4:3 and 16:9 (adjustable preset in the user preferences submenu).  
*(Not required for TV Sets)*

In case a 4:3 aspect ratio is preset in the IRD user preferences settings and video with an aspect ratio of 16:9 is to be displayed, the IRD shall do an automatic 16:9 letterbox conversion. *(Not required for TV Sets)*

TV Sets shall display the video in the correct aspect ratio (without distortion) by adding pillar box or letterbox spacing.

### **5.1.2 HDTV**

#### **5.1.2.1 H.264/AVC**

The IRD shall comply with ETSI TS 101 154 [5], sub-clause 5.7.2, “25 Hz H.264/AVC IRD and Bitstream”.

The minimum requirements are:

- The IRD shall support HP@L4.0 Decoding profile
- The IRD shall decode and deliver video material with frame rates of 25 Hz interlaced or progressive, or 50 Hz progressive.

- The HDTV IRD shall support H.264/AVC video at bitrates down to 250 kbps for all resolutions up to 1920x1080.
- The HDTV IRD shall be able to decode AVC still picture at bitrates down to 100 kbps

The following HD video formats shall be supported:

- 1280x720p/50 frames
- 1920x1080i/25 frames

#### **5.1.2.2 Downscaling from HD to SD**

If the IRD is equipped with analog video interfaces as described in 3.1.1, the downscaled HD signal displayed on the analog output shall be at least the same quality and resolution as full PAL resolution SD signal. The aspect ratio conversion shall be handled as described in clause 5.1.1.2.

The Content Security System shall control the analog output as described in 10.4.

## **5.2 Audio Decoding**

The IRD's audio decoding subsystem shall comply with ETSI TS 101 154 [5], in particular with sub-clause 6 ("Audio") and its related annexes.

The audio decoder(s) shall decode the following input audio bit streams:

- MPEG-1 Audio Layer I and II
- E-AC-3 (Enhanced AC-3) [44]

The audio decoder should decode the following input audio bit streams:

- MPEG-4 HE AAC and MPEG-4 HE AAC V2 as defined in [32] and [5]

### **5.2.1 Audio – Video Synchronization**

The IRDs shall not introduce more than  $\pm 5$  ms of relative delay between the audio and video components on the primary output and not more than  $\pm 25$  ms between the primary video output and a secondary audio output.

The IRD should include a delay unit that allows user-defined adjustment of the audio/video delay. If implemented the adjustment shall be accessible in a submenu of the IRD's configuration menu.

## 5.2.2 Multichannel Audio

### 5.2.2.1 Digital Audio Interface

For the HDMI output, the IRD shall be capable of delivering the E-AC-3 audio bitstream of the selected audio component in its native incoming format and as a transcoded AC-3 bitstream on the digital audio output interfaces (ref. 3.1.4.2) in accordance with the requirements of 3.1.2.1. and 10.4 either of the formats is selected and delivered.

For the S/PDIF output, the IRD shall transcode E-AC-3 [29] or MPEG-4 HE AAC (if supported) input bit streams to AC-3 [29] output bit streams at a bitrate of 640kbps. During this transcoding process the metadata from the E-AC-3 [29] or MPEG-4 HE AAC (if supported) input bit stream shall be transferred to the AC-3 [29] output bit stream.

In the case of an E-AC-3 or MPEG-4 HE AAC (if supported) multi-channel audio stream, a stereo downmix with metadata applied according to [29] shall be also available for delivery to the digital audio output interfaces.

In case of a present HE AAC V2 multi-channel audio stream the audio format shall be optionally available as PCM bit stream on the digital audio interfaces, in case MPEG-4 HE AAC V2 is supported.

The user shall be able to choose if the receiver outputs a stereo signal (PCM) or a multichannel bitstream on the digital outputs.

*This clause is also valid for TV Sets, in case a digital multichannel audio output interface is available.*

### 5.2.2.2 Analog Audio Interface

If present, the E-AC-3 or MPEG-4 HE AAC multi-channel (if supported) audio bit stream shall be decoded and downmixed to stereo and shall be delivered to the analog output interfaces (ref. 3.1.1.2).

All E-AC-3 [29] metadata parameters shall be applied to the decoded audio according to [29].

*This clause is also valid for TV Sets, in case analog audio output interfaces are available.*

### 5.2.2.3 Dynamic Audio Component Switching

In case the selected E-AC-3 [44] or MPEG-4 HE AAC [32] component is switched off inside the selected service during playback, the IRD shall select

automatically one of the remaining audio components to be delivered to all audio outputs. During the switching period the interruption should be shorter than 3 seconds.

### 5.2.3 Audio Description

The IRD should:

- Decode a main E-AC-3 input bitstream and a supplementary E-AC-3 input bitstream simultaneously.

Additionally, the IRD shall:

- Mix the output of each decoder according to mixing metadata contained within the supplementary input bitstream as per [29]
- Include user control for the relative balance between main and supplementary audio levels
- Provide an option to deliver the mixed audio over one output interface simultaneously with the main audio over a separate output interface
- Deliver the mixed audio as a stereo downmix if the input channel configurations are multichannel

Optionally the IRD should:

- Deliver the mixed audio as a re-encoded AC-3 output bitstream at 640kbps in a multichannel format if the input is multichannel.

### 5.2.4 Loudness Levels, Dynamic Range Control and Downmixing

The IRD shall apply format dependent attenuation to decoded stereo PCM audio, in order to align stereo outputs (-23LUFS) at the same level as multichannel outputs (-31LUFS).

The IRD shall allow the user to select multichannel audio in order to provide encoded audio bitstreams on at least one audio output interface, which shall be achieved using a stereo / multichannel mode selector.

## 6 SERVICE INFORMATION

The IRD shall be able to process the incoming MPEG-2 TS PSI and DVB SI data (descriptors, tables) according ETSI EN 300 468 v1.10.1 [11] and ETSI TR 101 211 v1.7.1 [12].

The IRD shall be able to process the DVB-SI tables for 'actual' and 'other' transport streams.

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

The IRD shall process the following EIT tables:

- EIT actual (present/following/scheduled)
- EIT other (present/following/scheduled)

The following descriptors in the EIT shall be processed by the IRD:

content\_descriptor, short\_event\_descriptor, extended\_event\_descriptor. The IRD should be able to process the component\_descriptor in the EIT.

The IRD shall process the copy control descriptor as described in clause 10.4.

Descriptors or other data structures that are currently undefined or are unknown to the IRD shall be skipped and shall not cause any harm.

The IRD shall support an extended\_event\_descriptor of up to 1.000 characters per event. Per service a minimum of 200 events shall be handled and shall be displayed in the EPG schedule.

## **7 NAVIGATOR AND EPG**

### **7.1 Standard EPG**

The Navigator shall include a basic electronic program guide which displays information extracted from relevant DVB-SI tables as described in clause 6.

The IRD shall be able to read and use ISO 639-2 [7] language descriptors associated with the audio streams in the MPEG-2 transport stream ISO/IEC 13818-1 [6].

### **7.2 Navigator User Interface and Preference Settings**

The IRD shall implement a Navigator, which allows the user to control the operation of the IRD, and which provides user access to system information (user preferences settings, system settings, initiating system software updates etc.).

The Navigator is by definition part of the system software.

The Navigator shall support the German language in all menus and submenus. The initial standard language shall be set to German language or shall be selectable during first initialization process.

The user shall be able to set storable preferences for the default audio language. The IRD should provide the option to select "MIS" language code as defined in ISO 639-2 [7]. If an audio-stream for the default audio language

is available for the service the IRD shall automatically choose that audio stream. In addition the user shall be able to manually select between all audio streams available within the active service.

## **8 REMOTE CONTROL**

The IRD shall be controllable via a remote control.

The remote control shall have a “Teletext” key. *(Does not apply to TV sets)*

The remote control should be compliant to the Nordig Specification [24].  
*(Does not apply to TV sets)*

## **9 TELETEXT AND DVB SUBTITLING**

### **9.1 Teletext**

During normal operation (decoding of video/audio/data-streams), the IRD shall be able to demultiplex in parallel the Teletext service transmitted in a packetized format according ETSI EN 300 472 [14].

The IRD shall be able to display Teletext using the OSD. Teletext subtitles shall be displayed synchronous with video. The correct and dynamic display of Teletext subtitles is mandatory.

The Teletext function shall be easily available via remote control interaction.

#### **9.1.1 Teletext data in the VBI**

The insertion of the Teletext data in the VBI of the analog video output is recommended.

VBI Insertion shall conform to ITU-R BT.653-3 [18].

*The clause 9.1.1 is not valid for TV Sets.*

### **9.2 DVB Subtitling**

The IRD shall be capable of decoding and displaying DVB subtitle services which are transmitted in conformance with ETSI EN 300 743 [19].

The enabling and disabling of the subtitles shall be user controlled through the user interface and/or a dedicated key of the remote control.

If both DVB-Subtitling and Teletext subtitling are received simultaneously the IRD shall only display the DVB-Subtitling stream.

## **10 CONDITIONAL ACCESS AND DIGITAL RIGHTS MANAGEMENT**

### **10.1 Conditional Access System**

The IRD shall support Conditional Access (CA) in one of the following ways:

**Embedded CA system**

or

**Embedded CA system and one or more Common Interface slot(s) for CAMs**

or

**One or more Common Interface slot(s) for CAMs**

Each CI-slot of the IRD shall be in compliance with the DVB Common Interface specification ETSI EN 50221 [20] and the additional requirements as described in 3.1.4.

The embedded CA system has to be integrated according to the rules of the CA System vendor and product and shall be fully compliant to Irdeto Cloaked CA Agent for Secure Chipset based STBs Integration Overview[46]

All test procedures (e.g mandatory DVT test cases) and licensing terms as defined by CA vendor have to be observed.

The device shall integrate Irdeto Cloaked CA Agent 4.6.1 or higher embedded with Secure Core 5.1 Mixed Mode (T-DES/AES Mixed Deployment mode). This also applies to and is mandatory for any subsequent updates to the Irdeto CA system. Therefore the device manufacturer shall consolidate with Irdeto about the actual CCA Version.

The HDTV IRD and CAM vendor has to provide to ORS a written and certified proof that the device fulfils all requirements as stipulated in Irdeto Cloaked CA Agent for Secure Chipset based STBs Integration Overview [46].

The device shall be able to handle Irdeto Unique Announcements and Mail messages as well as Global Announcements and Mail messages.

### **10.2 PRE Enablement**

The embedded CA System shall support Secure pre-enablement (SPE) as specified in Irdeto Cloaked CA Agent [46].

After successful first HDTV IRD setup, an initial pre entitlement period is running. Period shall be started after switching first time to an encrypted channel and receiving default ECM. This period shall not reset when a factory reset or software update is performed on the device.



### **10.3 CA-System Error&Status messages**

Messages generated by the embedded CA-System shall be implemented according to document CA-MESSAGES\_ORIS\_T2\_IRD\_final [50]. This document defines the message text to be used by the IRD instead of the generic messages text defined by the CA-system vendor.

### **10.4 Content Security for Content delivered via DVB**

The IRD shall support all content security features as required by the cardless CA system [46] via an embedded CA system or via a CA system residing in a CA Module.

All signaling of copy protection and DRM information shall be done within ECMs of the CA system provider defined in clause 10.1.

In case of encrypted content the IRD shall apply the copy protection and DRM measures to the related service components as signaled in the ECMs accordingly.

In addition to the ECM contained metadata, DRM and copy protection information are also available entirely or partly in the copy control descriptor of the EIT. The IRD should decode and display this information inside the shown present / following program information the service list and the EPG schedule.

In case of unencrypted content the IRD should support the requirements listed in EBU TECH 3333 [22], §9.7.

#### **10.4.1 Digital Copy Protection**

The activation of digital copy protection is signaled in ECMs defined by the CA system provider listed in clause 10.1.

If digital copy protection is signaled as active, then copy protection shall be enabled on all relevant digital interfaces. Please refer also to clause 3.1.2.1.

#### **10.4.2 Analog Copy Protection**

The activation of analog copy protection is signaled in ECMs defined by the CA system provider listed in clause 10.1.

If analog copy protection is signaled as active, then all relevant analog interfaces (see clause 3.1.1) shall apply appropriate actions to prevent copying (e.g. activate Macrovision), except the analog video component interface, which is handled separately (see clause 10.4.3).

### 10.4.3 Component Video Control

Restrictions regarding the analog component video interface are signaled in ECMs defined by the CA system provider listed in clause 10.1.

### 10.4.4 Storage Rights for IRDs with embedded CA System

This clause 10.4.4 is only valid for PVR enabled IRDs which have an embedded CA System.

For IRDs where the CA System reside on an external CI Plus CA module please refer to 10.4.5 .

#### 10.4.4.1 Basic rules

In case the IRD has an internal or an external storage capability, the storage rights information shall be signaled in ECMs defined by the CA system provider listed in clause 10.1.

The IRD shall be able to handle and observe the following storage rights:

- No restrictions on storage of content
- Recording allowed but trick mode prohibited
- No recording allowed

These storage rights shall be stored together with the content and shall be observed during subsequent playback of the content (see [48]).

#### 10.4.4.2 Storage Encryption

In case the IRD has an internal or an external storage capability, activation of storage encryption shall be signaled in ECMs defined by the CA system provider listed in clause 10.1.

The IRD shall provide an encryption system for local encryption of content, which is stored on an internal or external storage device.

The IRD shall provide a decryption system for local decryption of content, which was previously stored encrypted on an internal or external storage device.

In case the ECM does not contain any storage encryption information the service shall be recorded scrambled on the storage (see [46]).

#### 10.4.4.3 Playback Trick Mode Control

In case the IRD has an internal or an external storage capability, the restrictions on playback trick modes shall be applied as signaled in ECMs defined by the CA system provider listed in clause 10.1.

## **10.4.5 Storage Rights for IRDs with non-embedded CA System**

In case the CA System resides on an attached CA Module, scrambled services shall be processed and recorded according to the Usage Rule Information signaled by the CA Module (see [23]).

The temporary stored content shall be scrambled and should be removed after expiry.

Non scrambled Services shall be recorder in clear and without any access restriction at all.

## **10.5 Parental Control**

Parental Rating Descriptor will be signaled within the EIT. This descriptor shall be processes per event.

In the case the Descriptor is set to a value equal or higher than the maturity threshold set in the IRD, the user shall be asked for entering a PIN code, before viewing any content.

The IRD shall provide a PIN-Control menu to perform at least following functions:

- 1) Setting age thresholds (at least for 14 and 18 years). Default shall be "18"
- 2) Changing the PIN value
- 3) Activating/deactivating PIN checking, Default shall be "active"

## **10.6 General Rules on Content Immutability**

The subsequent clauses are required for program providers having additional needs in securing the immutability of their program signals.

The IRD shall provide technical means to observe these requirements.

### **10.6.1 No modification to program signals**

The IRD shall not allow the modification of the original program signal by any other service provider than the original one. This is not limited to but includes for example insertion or replacement of advertisements.

### **10.6.2 No graphical overlays over original signal**

The IRD shall not allow any graphical overlays on top of the original TV signal by any other service provider than ORS comm, neither on the whole nor on parts of the TV screen. However user initiated overlays are still allowed.

The display of general (neutral) information like present/following event information and IRD related information displayed as part of the navigator (e.g. menus) is allowed.

This section does not apply to Applications which are directly related to the tuned broadcast signal like HbbTV applications or Teletext which are

transported or at least signalized inside the currently decoded and displayed DVB broadcast service.

### **10.6.3 No concurrent display of program signals and other content**

The IRD shall not allow the concurrent display of the program signal and any other content (video, images, text) by e.g. a split screen mechanism unless the original service provider issues an explicit permission for that or in case of Picture in Picture functionality, unless it is user initiated.

The display of general (neutral) information like present/following event information and IRD related information displayed as part of the navigator (e.g. menus) is allowed.

This section does not apply to Applications which are directly related to the tuned broadcast signal like HbbTV applications or Teletext which are transported or at least signalized inside the currently decoded and displayed DVB broadcast service.

### **10.6.4 No rescaling of the program signal**

The IRD shall not allow the rescaling of the program signal except in non-discriminatory EPGs and/or navigators or within Picture in Picture functionality.

This section does not apply to Applications which are directly related to the tuned broadcast signal like HbbTV applications or Teletext which are transported or at least signalized inside the currently decoded and displayed DVB broadcast service or user initiated applications.

### **10.6.5 No automatic Ad zapping**

The IRD shall not allow automatic Ad zapping, for example tuning to another service during commercial breaks.

This also applies during the playback of recorded content (see clause 11.)

## **11 DIGITAL VIDEO RECORDER (DVR)**

The IRD should be capable of recording content from DVB signals on an internal storage ("PVR") or an external storage ("PVR ready"). This storage may be used for scheduled recording, instant recording or time shift applications under the observance of the following obligations:

### **11.1 DVR Performance**

The DVR and the implemented content protection system shall be capable to record one or more services from one multiplex and playback one or more service to/from the storage at the same time, whereas each service bitrate may vary up to a maximum of 30 Mbps.

The IRD shall support time shift functionality for SD and HD video services. The recorded stream shall include video and audio component and the EIT present data, in case a video service is recorded. The recorded EIT data shall be used to control the Parental Control mechanism as described in 10.5 during playback of the Video Service.

The recorded stream should include EIT, all audio components, DVB subtitle.

## **11.2 Content Security**

The recorded content shall be accessible and decodable at any time. The access and decoding of the recorded content shall be in compliance to clause 10.4.

The DVR should display information about content security restrictions inside an EPG and in present/following event information based on EIT Schedule and EIT Present/Following based on the copy control descriptor as described in clause 10.4.

All content security restrictions valid at the time of recording shall be observed during playback of the content.

## **11.3 DVR Scheduling**

If the recording time is scheduled via an EPG, the recording process of the DVR should be triggered via the present-following event information (EIT present/following).

## **11.4 Maturity Rating**

The maturity rating information (see also 10.5) shall be stored together with the recorded content and shall be processed during subsequent playback of the content.

## **12 SYSTEM SOFTWARE UPDATE**

The IRD shall provide a software download mechanism for the download of software modules. The manufacturer is responsible of providing a secure and failure safe download mechanism.

The System Software Update mechanism shall comply with state of the art and approved Security Mechanisms.

The IRD software download mechanism shall provide the possibility to replace the existing system software with another.

User preferences settings and channel lists shall be preserved. In case that this cannot be guaranteed, the user has to be explicitly informed that user settings will be affected during the update process.

Updates mechanisms required by CA system vendor shall be supported.

The actual download process should be initiated by the user.

The progress of the update procedure shall be displayed on screen.

The update procedure shall be designed in a way that the user can interrupt the update procedure any time without corrupting the currently installed IRD system software.

## **12.1 SSU Over-The-Air (Broadcast Download)**

The IRD shall be capable of establishing a system software update (SSU) via broadcast download. This shall be according to the Irdeto SSU mechanism [46] [48]. This requirement applies only in case the CA System is embedded.

The IRD vendor has to provide the following data to ORS comm to enable the SSU service via DTT:

- a TS-File for cyclic broadcast and
- the necessary descriptors/parameters that are to be signaled.

All user dialogues shall be written in German or English language depending on the users language configuration.

*This chapter 12.1 does not apply to TV sets.*

## **12.2 Local Download**

Download shall be possible using a local data interface (see 3.1.3). The IRD manufacturer shall define the protocol mechanisms. The actual download shall be in the user's responsibility.

## **12.3 Download of SSU via the Internet connection**

The IRD should be able to download new system software via Internet from remote server provided by the IRD's manufacturer and/or vendor, in case the IRD has Internet connectivity and the IRD is connected to the Internet.

# **13 HBBTV AND INTERACTIVE APPLICATIONS**

## **13.1 General**

If the HDTV IRD is able to connect to internet services, the HDTV IRD shall be able to process Hybrid Broadcast Television Applications in compliance with ETSI TS 102 796 V1.2.1 [25] including any errata and in particular shall support all of the mandatory OIPF and DRM features listed in Table A.1 of [25]. From 01.07.2017 all new devices shall be able to process Hybrid Broadcast Television Applications in compliance with HbbTV 2.0.1 [40].

If the device is capable of processing HbbTV application it is mandatory to enable HbbTV application start-up by default. The IRD may have a user menu function to disable HbbTV for a specific service or in general.

The IRD shall support MPEG DASH according to [40] Annex E and especially the parameters (availabilityStartTime, availabilityEndTime and minimumUpdatePeriod).

The IRD shall provide an interface to read out the CAS related ClientID via HbbTV application by using the interface as described in chapter 13.5.

## 13.2 Signalling

The receiver's capabilities shall be returned by the application/oipfCapabilities object as detailed in [40].

The option string "+DRM" shall be returned in ui\_profile element's name property of the xmlCapabilities property of the application/oipfCapabilities embedded object.

## 13.3 Cookies

The STB shall store cookies in persistent memory as described in [40]. If the IRD has an option to disable or enable the storage of cookies, this should be enabled by default. The receiver shall provide the ability for a user to delete any stored cookies via a UI menu item.

## 13.4 User agent header

All out-going HTTP requests from an HbbTV application shall include a User-Agent header as per section 7.3.2.4 of [40]. Note that this does not apply to requests made from middleware components invoked as a result of the HbbTV application executing, e.g. DRM system or media player components (e.g. MPEG-DASH segment requests).

## 13.5 Specific Application Support (SAS)

For IRDs with non-embedded CA-System the device shall support Specific Application Support (SAS) resource as defined in CI Plus specification [23]. This resource offers a transparent pipe that allows an application on the Host to access functionality on the CICAM. The IRD shall support this resource as defined in CI+ Specification – chapter 11.4 [23] and Irdeto Cloaked CA Agent-Device Integration Overview [46].

For IRDs with embedded CA-System and which supports HbbTV the device shall provide an interface to read the IRD unique CA Client ID via HbbTV application as specified in [49]

Therefore IRDs with embedded CA-system and CAM platform provider needs to provide and implement the corresponding proxy component (according to HBBTV, OIPF, and HTML5), which will be interacting with the HBBTV Application from its northbound, as well as interacting with Irdeto Cloaked CA

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system from its southbound according to Irdeto Cloaked CA Agent-Device Integration Overview [46] and ORS API definition for HBBTV integration [49]



## 14 DEFINITIONS

|           |   |
|-----------|---|
| AAC-HE    | Advanced Audio Coding High Efficiency   |
| AC-3      | Audio Coding 3 (also known as Dolby Digital)  |
| AD        | Audio Description (scene description for visually impaired)   |
| AIT       | Application Information Table   |
| API       | Application Programming Interface   |
| AVC       | Advanced Video Coding   |
| BAT       | Bouquet Association Table   |
| CA        | Conditional Access  |
| CAM       | Conditional Access Module   |
| CAT       | Conditional Access Table  |
| CI        | Common Interface  |
| CI+       | Common Interface Plus   |
| CRC       | Cyclic Redundancy Check   |
| CSA       | Common Scrambling Algorithm   |
| CVBS      | Color, Video, Blank And Sync  |
| DRM       | Digital Rights Management   |
| DTS       | Digital Theatre Sound   |
| DTT       | Digital Terrestrial Television  |
| DVB       | Digital Video Broadcasting  |
| DVB SSU   | DVB System Software Update.   |
| DVB-T     | Digital Video Broadcasting - Terrestrial  |
| DVB-T2    | Digital Video Broadcasting – Second Generation Terrestrial  |
| DVR       | Digital Video Recorder. An IRD, which is capable of recording content of a DVB Transportstream on the IRD internal data storage or external data storage. |
| E-AC-3    | Enhanced AC-3 (also known as Dolby Digital Plus)  |
| EICTA     | European Information & Communications Technology Industry Association   |
| EIT       | Event Information Table   |
| EITp/f    | Event Information Table, present/following  |
| EITsch    | Event Information Table, schedule   |
| EPG       | Electronic Program Guide  |
| ETSI      | European Telecommunications Standards Institute   |
| H.264     | H.264 is a standard for video compression. It is also known as MPEG-4 Part 10, or MPEG-4 AVC (for Advanced Video Coding).                                 |
| HbbTV     | Hybrid broadcast broadband Tele Vision.   |
| HE AAC    | MPEG-4 High Efficiency Advanced Audio Coding  |
| HE-AAC V2 | MPEG-4 High Efficiency Advanced Audio Coding version 2 (also known as aacPlusv2 and eAAC+)  |
| HD        | High Definition   |
| HDCP      | High-bandwidth Digital Content Protection   |
| HDTV      | High Definition Television  |
| HDMI      | High Definition Multi-media Interface   |

|            |   |
|------------|---|
| iDTV       | Integrated Digital TV set   |
| IRD        | Integrated Receiver Decoder: herein terrestrial DVB-T2 receiver   |
| IRD vendor | The IRD vendor is understood as a contractor of the ORS comm, who is amended to offer and sell certified IRDs in the Austrian market, according to the defined trade arrangement. |
| LCN        | Logical Channel Number  |
| Mb         | Megabit   |
| MFN        | Multi-Frequency Network   |
| MPEG       | Motion Picture Experts Group  |
| NID        | Network ID  |
| NIT        | Network Information Table   |
| ONID       | Original Network ID   |
| ORF        | Österreichischer Rundfunk   |
| ORS        | Österreichische Rundfunksender  |
| ORS comm   | ORS comm GmbH & Co KG   |
| OSD        | On Screen Display   |
| PAT        | Programme Association Table   |
| PID        | Program Identifier  |
| PIN        | Personal Identification Number  |
| PiP        | Simultaneous display of the unchanged video content of two independent live video sources on one screen.  |
| PMT        | Program Map Table   |
| PVR        | Personal Video Recorder, see also DVR   |
| PSI        | Program Specific Information  |
| RCA        | Radio Corporation of America  |
| RF         | Radio Frequency   |
| SCART      | Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs / Radio and Television Receiver Manufacturers'  |
| SD         | Standard Definition   |
| SDT        | Service Description Table   |
| SDTV       | Standard Definition Television  |
| SFN        | Single Frequency Network  |
| SGT        | Service Guide Table   |
| SI         | Service Information   |
| SID        | Service ID  |
| SSU        | System Software Update...   |
| TS         | Transport Stream  |
| TV Set     | The term "TV Set" describes within this document the integrated combination of an IRD and a display. See also iDTV.   |
| UI         | User Interface  |
| USB        | Universal Serial Bus  |

## 15 REFERENCES

|      |                                |   |
|------|--------------------------------|---|
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| [2]  | ETSI EN 302 755 V1.2.1.2009-09 | Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)   |
| [3]  | ETSI EN 302 307 V1.2.1         | Digital Video Broadcasting (DVB): Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications. |
| [4]  | IEC 60169-2                    | Radio-frequency connectors, Part 2: Coaxial unmatched connector   |
| [5]  | ETSI TS 101 154 V2.2.1         | Digital Video Broadcasting (DVB); Implementation guidelines for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream   |
| [6]  | ISO/IEC 13818-1                | Information technology - Generic coding of moving pictures and associated audio information. Part 1: Systems.   |
| [7]  | ISO 639-2                      | Code for the representation of names of languages   |
| [8]  | ITU-T V.92                     | Enhancements to Recommendation V.90   |
| [9]  | ETSI EN 50049-1                | Domestic and similar electronic equipment interconnection requirements: Peritelevision connector  |
| [10] | ETSI EN 50157-2-1              | Domestic and similar equipment interconnection requirements: AV.link-Part 2-1: Signal quality matching and automatic selection of source devices  |
| [11] | ETSI EN 300 468 v1.11.1        | Digital Video Broadcasting; Specification for service information (SI) in DVB Systems   |
| [12] | ETSI TR 101 211 v1.9.1         | Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)  |
| [13] | ETSI TS 102 006                | Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems   |
| [14] | ETSI EN 300 472 v1.3.1         | Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams   |
| [15] | ETSI ETR 289                   | Digital Video Broadcasting (DVB); Support for use of scrambling and Conditional Access within digital broadcasting systems.   |
| [16] | ETSI TS 102 201 v1.2.1         | Interfaces for DVB Integrated Receiver and Decoder  |
| [17] | Universal Serial Bus           | Universal Serial Bus (USB) Specification, Revision 2.0, April 27, 2000.   |
| [18] | ITU-R BT.653-3                 | Teletext systems  |
| [19] | ETSI EN 300 743 v1.3.1         | Digital Video Broadcasting (DVB); Subtitling systems  |
| [20] | ETSI EN 50221                  | Common Interface Specification for Conditional Access and other Digital Video Broadcasting Decoder Applications   |
| [21] | ETSI TS 102 825                | Digital Video Broadcasting Content Protection & Copy Management (DVB-CPCM)  |
| [22] | EBU Tech 3333                  | EBU HDTV Receiver Requirements, March 2009  |

|      |   |   |
|------|---|---|
| [23] | CI Plus Specification   | CI Plus Specification Minimum Version v1.3.1 or higher available at <a href="http://www.ci-plus.com">http://www.ci-plus.com</a>   |
| [24] | NorDig Unified Requirements for Integrated Receiver Decoders, version 2.5.1 | NorDig Unified Requirements for Integrated Receiver Decoders for use in cable, satellite, terrestrial and IP-based networks, Version 2.5.1  |
| [25] | ETSI TS 102 796 V1.2.1  | Hybrid Broadcast Broadband TV (HbbTV)   |
| [26] | Irdeto CA Smartcard System Specification                                    | Irdeto, Softcell DVB Client, Integration Guide. Version 3.10 or higher. Actual version. Including any specific complementary guideline for CA system implementation for the Austrian market.          |
| [27] | HDMI Specification V1.3   | HDMI Licensing LLC, High-Definition Multimedia Interface Specification Version 1.3  |
| [28] | ETSI EN 300 744 v1.5.1  | DVB Framing structure, channel coding and modulation for digital terrestrial television. (ETSI)   |
| [29] | ETSI TS 102 366   | Digital Audio Compression (AC-3, Enhanced AC-3) Standard  |
| [30] | ISO/IEC 13818-2   | Information technology - Generic coding of moving pictures and associated audio information: Video  |
| [31] | ISO/IEC 13818-3   | Information technology - Generic coding of moving pictures and associated audio information - Part 3: Audio   |
| [32] | ISO/IEC 14496-3   | ISO/IEC 14496-3:2009, "Information technology - Generic coding of moving pictures and associated audio information - Part 3: Audio"   |
| [33] | HTML 5  | HTML5 - A vocabulary and associated APIs for HTML and XHTML<br>Editor's Draft 04 November 2011<br><a href="http://dev.w3.org/html5/spec/Overview.html">http://dev.w3.org/html5/spec/Overview.html</a> |
| [34] | Scalable Vector Graphics  | Scalable Vector Graphics (SVG) 1.1 (Second Edition)<br><a href="http://www.w3.org/TR/SVG11/">http://www.w3.org/TR/SVG11/</a>  |
| [35] | MPEG DASH   | MPEG DASH ISO/IEC 23001-6 Draft International Standard, Dynamic Adaptive Streaming over HTTP  |
| [36] | DLNA  | Digital Living Network Alliance, Home Networked Device Interoperability Guidelines V.1.5, October 2006  |
| [37] | UPnP  | Universal Plug and Play, as referenced by DLNA  |
| [38] | IEEE 802.11.a/b/g/n Wi-Fi   | IEEE Wireless Communications Protocols  |
| [39] | Windows Media DRM   | Windows Media DRM for Network Devices Specification   |
| [40] | HbbTV 2.0.1   | HbbTV 2.0.1 (2016-07-04)  |
| [41] | USB 2.0 and 3.0   | <a href="http://www.usb.org/developers/docs/">http://www.usb.org/developers/docs/</a>   |
| [42] | PowerLine Modem   | HomePlug AV 1.0, IEEE 1901.2010   |
| [43] | API ORS Media   | Application Programming Interface for ORS comm media services   |
| [44] | Dolby Digital+  | ETSI TS 102 366 Digital Audio Compression (AC-3, Enhanced AC-3) Standard  |
| [45] | Ethernet  | Fast Ethernet IEEE 802.3u   |
| [46] | Cardless Irdeto CA  | Irdeto Cloaked CA Agent - Device Integration Overview;  |

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|      | System                                   | recent version  |
|------|--|---|
| [47] | E-Book                                   | IEC 62216-1: Digital terrestrial television receivers for the DVB-T system                        |
| [48] | Irdeto complementary specification       | Complementary IRD specifications for the Austrian DVB-T2 market; External version, recent version |
| [49] | ORS API definition for HBBTV integration | API definition for HBBTV integration with Irdeto CCA v1.0   |
| [50] | CA-MESSAGES ORS T2 IRD                   | CA-MESSAGES_ORIS_T2_IRD_final   |