



REGIONAL RECEIVER SPECIFICATION – RECOMMENDATIONS

Project: South-East European Digital Television

Acronym: SEE Digi.TV

Version R-1.1; Date: 02.04.2013

DOCUMENT HISTORY

Version	Status	Date	Author	Comments	Approved by
R-1.1	Revised version	02.04.2013	Sintesio	Comment added on page 37	Project manager
A-1.0	Approved	29.02.2012	Sintesio	Document approved	Project manager

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1 INTRODUCTION

This document is being prepared within SEE Digi.TV project¹, co-financed by the South-East Europe programme which helps to promote better integration between the Member States, candidate and potential candidate countries and neighbouring countries.

The aim of SEE Digi.TV project is to speed-up digitalization of broadcasting services, and to contribute to a wider use of ICT broadband services. As different stakeholders, especially broadcasters and industry are addressed by the project; positive impacts of the project should be reflected also in a broader business and social environment. The project is tackling issues of digital divide and social inclusion and aiming at creation of the region of equal opportunities. Project comprehends from 14 partners from 10 countries to whom APEK is acting as lead partner. The project partners are predominantly national regulatory bodies from Italy, Austria, Hungary, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Former Yugoslav Republic of Macedonia, Albania and Slovenia.

While the process of analogue switch-off is carried out, available specifications for the receivers and compliance test specifications are necessary to avoid inconsistencies between new digital networks and receivers available on the market. The aim of this document is therefore to help national institutions in developing receiver specifications and conformity assessment procedures for receivers in the form of recommendations for the entire Digi.TV region, with a clear goal - to protect the market from use of non-compliant equipment.

The document is including short introduction, with second chapter presenting the methodology and scope of specifications. In the third chapter short analysis of current situation was prepared, where short description of current platform can be found, technical details and status regarding receiver specifications in project countries. Fourth chapter is listing standards and other relevant documents which were taken into consideration when preparing recommendations. Fifth chapter is about guidelines on how to implement these specifications on a national level, with some specific best practices. Technical specifications for all the relevant parts of receiver can be found in the last chapter.

¹ <http://www.see-digi.tv/>

1.1 List of Abbreviations

3DTV	3D television
AAC	Advanced Audio Coding
AC3	Digital audio compression standard, known as Dolby Digital
AGCOM	Italian Regulatory Authority for electronic communications and media Autorita per le Garanzie nelle Comunicazioni
APEK	Post and Electronic Communications Agency of the Republic of Slovenia
ASO	Analogue switch-off
AV	Audio Visual
AVC	Advanced Video Coding
BHRT	Radio and Television of Republic of Bosnia and Herzegovina
BiH	Bosnia and Herzegovina
CA	Conditional Access
CAT	Conditional Access Table
CBR	Constant Bit Rate
CI	Common Interface
COFDM	Coded Orthogonal Frequency Division Multiplexing
CVBS	Composite Video Baseband Signal
DTT	Digital terrestrial television
DVB-H	Digital video broadcasting - Handheld
DVB-T	Digital Video Broadcasting - Terrestrial
DVB-T2	Digital Video Broadcasting – Second Generation Terrestrial
E-AC3	Enhanced AC3, known as Dolby Digital Plus
EIT	Event Information Table
EN	European Norm
EPG	Electronic Programming Guide
ETSI	European Telecommunication Standards Institute
HAKOM	Croatian post and electronic communications agency
HDMI	High-Definition Multimedia Interface
HDTV	High Definition Television
HE-AAC	High Efficiency AAC
HRT	Croatian Radio and Television
iDTV	Integrated Digital TV set
ISO	International Organization for Standardization
ITU	International Telecommunication Union
MFN	Multi Frequency Network
MHP	Multimedia Home Platform
MKTV	Macedonian Radio and Television
MPEG	Moving Pictures Expert Group
MUX	Multiplex
NIT	Network Information Table

NF	Noise Figure
OiV	Odašiljači i veze d.o.o. – Transmitters and communications Ltd.
ORF	Österreichische Rundfunk
ORS	Österreichische Rundfunk-sender GmbH & Co KG
PAT	Program Association Table
PCM	Pulse Coded Modulation
PMT	Program Map Table
PSI	Program Specific Information
QAM	Quadrature Amplitude Modulation
QEF	Quasi Error Free
QPSK	Quaternary Phase Shift Keying
RAI	Rai Radiotelevisione Italiana S.p.A.
RAK	The Communications Regulatory Agency ob Bosnia and Herzegovina
RAS	Rundfunk Anstalt Südtirol
RDC	Broadcast center of Montenegro
RF	Radio Frequency
RGB	Red Green Blue
RTRS	Radio Television of Republic of Serbia
RTV FBiH	Radio Television of federation of Bosnia and Herzegovina
RTVSH	Radio Television Shqiptar
SDT	Service Description Table
SDTV	Standard Definition Television
SEE	South East Europe
SFN	Single Frequency Network
SI	Service Information
STB	Set-top Box
TDT	Time and Date Table
TOT	Time Offset Table
TS	Transport Stream
UHF	Ultra-High Frequency
VBI	Vertical Blanking Information
VBR	Variable Bit Rate
VHF	Very-High Frequency

1.2 Reference documents

[1]	EN 300 744	DVB Framing structure, channel coding and modulation for digital terrestrial television. (ETSI)
[2]	IEC 60169-2, part 2	Radio-frequency connectors. Part 2: Coaxial unmatched connector
[3]	ETSI TS 101 154	Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications
[4]	ISO/IEC 14496-10	Information technology - Coding of audio-visual objects - Part 10: Advanced Video Coding
[5]	ISO/IEC 13818-1	Information technology - Generic coding of moving pictures and associated audio information: Systems.
[6]	ISO 639.2	Code for the representation of names of languages
[7]	ITU-T V.92	Enhancements to Recommendation V.90
[8]	EN 50049-1	Domestic and similar electronic equipment interconnection requirements: Peritelevision connector
[9]	EN 50157-2-1	Domestic and similar equipment interconnection requirements: AV link-Part 2-1: Signal quality matching and automatic selection of source devices
[10]	EN 300 468	Digital Broadcasting Systems for television, sound and data services; Specification for service information (SI) in Digital Video Broadcasting (DVB) Systems
[11]	ETSI TR 101 211	Guidelines on Implementation and Usage of Service Information (SI)
[12]	ETSI TS 102 006	Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems
[13]	ETS 300 231	Television systems; Specification of the domestic video Programme Delivery Control system (PDC)
[14]	ETSI ES 202 130	Human Factors (HF); User Interfaces; Character repertoires, ordering rules and assignments to the 12-key telephone keypad
[15]	ETSI EN 300 472	Conveying ITU-R System B Teletext in DVB bitstreams
[16]	ETSI EN 301 775	Conveying VBI data bitstreams
[17]	ISO/IEC 13818-2	Information technology - Generic coding of moving pictures and associated audio information - Part 2: Video
[18]	ITU-R BT.653-3	Teletext systems
[19]	EN 50221	Common Interface Specification for Conditional Access and other Digital Video Broadcasting Decoder Applications
[20]	IEC 60958	Digital Audio Interface
[21]	IEC 61937	Digital audio – Interface for non-linear PCM encoded

		audio bitstreams applying IEC 60958
[22]	ETS 300 706	Enhanced Teletext Specification
[23]	ISO/IEC 8859-1	Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1
[24]	ETSI TS 102 114	DTS coherent acoustics; Core and extensions
[25]	IEC 62216-1	Digital terrestrial television receivers for the DVB-T system – Part 1: Baseline receiver specification
[26]	CEA 770.3	High Definition TV Analog Component Video Interface
[27]	EN 300 743	Subtitling systems
[28]	EN 50049-1	Domestic and similar electronic equipment interconnection requirement: Peritelevision Connector
[29]	HDMI	HDMI Licensing, LLC: HDMI , “High- Definition Multimedia Interface”, rev. 1.3A, October 10, 2006
[30]	CEA 861- D	Consumer Electronics Association (CEA): A DTV Profile for Uncompressed High Speed Digital Interfaces, July 18, 2006
[31]	EICTA HD extension to IEC 62216-1	“High Definition” extensions to the IEC 62216-1 “Digital Terrestrial Television Receivers for the DVB-T System”
[32]	IEC 60603-14	Connectors for frequencies below 3 MHz for use with printed boards – Part 14: Detail specification for circular connectors for low-frequency audio and video applications such as audio, video and audio-visual equipment.
[33]	ETSI TS 102 366	Digital Audio Compression (AC-3, Enhanced AC-3) Standard
[34]	ISO/IEC 14496-3	ISO/IEC: Information technology -- Coding of audio-visual objects -- Part 3: Audio
[35]	EN 302 755	Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2).
[36]	ISO/IEC 8859-16	Information technology — 8-bit single-byte coded graphic character sets — Part 16: Latin alphabet No. 10
[37]	IRD GUIDELINES FOR THE DVB-T (S) PLATFORM AUSTRIA – Interactive profile	The Interactive Profile defines requirements to receive digital broadcast with support for enhanced applications and for an interaction channel.
[38]	IRD GUIDELINES FOR THE DVB-T (S) PLATFORM AUSTRIA – Enhanced profile	The Enhanced Profile defines requirements to receive digital broadcast with support for enhanced applications.
[39]	IRD GUIDELINES FOR THE DVB-T (S) PLATFORM AUSTRIA – Zapping profile	The Zapping Profile defines requirements to receive digital broadcast. The requirements for this profile are based on the DVB Specification.
[40]	Recommendation on minimum receiver technical requirements	The Croatian Post and Electronic Communications Agency (HAKOM) has issued this document as a

	for the reception of DVB-T and DVB-T2 signal in the Republic of Croatia	recommendation regarding the minimum technical requirements to be met by DVB-T and DVB-T2 receivers in order to facilitate high-quality reception of basic digital terrestrial television services in the Republic of Croatia.
[41]	DGTVi D-Book 1.3 (rev.2)	Compatible DTV receivers for the Italian market: baseline requirements
[42]	DGTVi Z-Book 1.3 (rev.2)	Compatible DTV zapper receivers for the Italian market: baseline requirements
[43]	HD Book (final 1.0)	Compatible High Definition receivers for the Italian market: baseline requirements
[44]	Requirement specifications for DVB-T receivers used in Republic of Slovenia	The document represents minimum requirements for DVB-T receivers used in Republic of Slovenia.
[45]	Test specifications for DVB-T receivers used in Republic of Slovenia	Test specifications are established in order to ensure that decoders comply with the common minimum requirements for use in Republic of Slovenia.
[46]	NorDig unified requirements for integrated receiver decoders	document specifies a set of equipment requirements for reception of DVB-based and related services from cable, satellite and/or terrestrial broadcast networks
[47]	NorDig unified test specifications for integrated receiver decoders	Common test specifications are established in order to ensure that decoders comply with the common minimum requirements.
[48]	ISO/IEC 8859-2	Information technology — 8-bit single-byte coded graphic character sets — Part 2: Latin alphabet No. 2
[49]	ISO/IEC 8859-5	Information technology — 8-bit single-byte coded graphic character sets — Part 5: Latin/Cyrilic alphabet

2 METHODOLOGY FOR PREPARATION AND SCOPE OF SPECIFICATIONS

2.1 Analysis

As a background for this document a deep analysis of current situation in target region was conducted, whereas other countries, which already deployed digital terrestrial network and have finished with ASO, were taken into consideration as well. In this respect a comprehensive documentation regarding receiver requirements, test specifications and networks was analysed and taken into consideration, in order to transfer and utilize best practice approaches.

This document is initially applicable for stand-alone set-top boxes (STB) and integrated receivers (iDTV). The specification is covering both broadcasting standards, DVB-T and DVB-T2, and on the other hand, it is applicable for both, SDTV and HDTV level receivers. With minor modifications this document can be used also for other versions of receivers like PC expansion cards and USB receiving devices. Specifications contain wide aspect of technologies and standards for digital broadcasting due to different situations in SEE countries. It is a decision of each specific country to choose which technology and standards will be used and adopted and accordingly, modify specifications in a most beneficial manner.

More detailed information about status in each particular country is presented in following chapters, with special attention to technologies and audio/video coding standards used and adopted.

2.2 Scope of specifications

The goal of adopted national specifications is to protect end-users and network operators from functionality and compatibility related issues when using receivers and establishing broadcasting networks. These could be used as technical support for receiver producers and resellers on one hand and institutions developing and adopting receiver specifications on the other.

Technical specifications for receivers represent **minimum recommended requirements for DVB-T and DVB-T2 receivers** used in Digi.TV region. Since both DVB-T and DVB-T2 technologies are covered, it is specifically noted which functionality is required only for DVB-T2 receivers, whereas text in **BOLD** is used for DVB-T2 only requirements.

The specifications recommendations cover the following profile:

- **Basic profile** defines general requirements for reception of DVB-T and DVB-T2 broadcasted content in standard and high definition. Requirements are based on international standards and include regional features related to presentation of the characters of official languages in Digi.TV region. For future usage, revision of this document is possible. Additional functionality as MHP, interactivity and other are possible but are not defined and therefore not a part of this document.

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

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

3 CURRENT STATUS IN DIGI.TV PROJECT MEMBER STATES

This chapter presents short analysis of Digi.TV project region countries. It contains basic information about networks in each country, with future or potential new multiplexes and trials. Information about planned or actual ASO dates is included as well.

Broadcasting networks and receivers technical details are focused into video and audio coding standard and type which is being used in different countries (e.g. standard or high definition etc.) This input is important for preparation of overall regional recommendations which need to cover all specifics in the target area. Special requirements for receivers are mainly related to national language characteristics which should be defined in the receiver user interfaces and in addition to general broadcasting technology standards which the receiver shall support.

Status of national receiver requirements, respective certification procedures and responsibilities are presented in this section as well.

General overview table, status Q4 2011:

Country	Adopted broadcasting standard		Adopted coding standards		Receiver specifications adopted	ASO date/plan*	Free to Air or scrambled
	DVB-T	DVB-T2	Audio coding standards	Video coding standards			
Austria	In operation	In trial	MPEG-1L2, AC3	MPEG-2, in trial MPEG-4 is used	Yes	7 th June 2011	FTA only
Albania	In operation	/	MPEG-1L2	MPEG-2, MPEG-4	No	*2015	FTA, Pay TV
Bosnia and Herzegovina	Adopted	/	MPEG-1L2, AAC	MPEG-4	/	*2015	FTA
Croatia	In operation	In trial	MPEG-1L2, MPEG-4 HE-AAC	MPEG-2, MPEG-4	Yes	5 th October 2010	FTA, trial DVB-T2 scrambled with CAS
Republic of Macedonia	In operation	/	MPEG-1L2	MPEG-4	No	*2013	FTA, Pay TV MUX scrambled with Viaccess
Hungary	In operation	/	MPEG-1L2, AAC, AC3	MPEG-4	No	*2015	FTA, Pay TV MUX scrambled with Conax
Italy	In operation	In operation	MPEG-1L2, AAC, HE-AAC, AC3	MPEG-2, MPEG-4	Yes	12 th December 2012	FTA, Pay TV scrambled
Montenegro	/	Adopted	/	MPEG-4	No	31 st December 2012	FTA mandatory for public broadcasting services and existing holders of licenses, Pay TV possible
Serbia	/	Adopted	/	/	/	4 th April 2012	/
Slovenia	In operation	In trial	MPEG-1L2, AAC	MPEG-4	Yes	1 st December 2010	FTA

3.1 Albania

3.1.1 General description

Since July 2004, pay-DTT services have been available from DigitAlb which offers up to 35 pay television services across four multiplexes on UHF channels 62, 64, 67 and 69. All services are broadcasted using 8k mode in an 8MHz channel, with 64QAM, a guard interval of 1/8 and a code rate of 5/6 where SFN's are used to broadcast the services. DigitAlb claims over 100,000 subscribers in Albania.²

The legal framework allows for the launch of up to seven national DTT multiplexes, two of which are reserved for the public service broadcaster RTVSH. No single service operator can manage more than one national multiplex and at least 50% of its services must be offered free-to-air.

In 2008, the representatives of the National Council for Radio and TV presented that the Albanian public broadcaster RTVSH could end up with two DTT multiplexes each carrying 20 channels. Each multiplex would use MPEG-4, H.264 AVC compression and have the option to operate two national channels, eight free to air thematic channels, 11 regional services and six pay-tv channels.³ (It is under discussion the number of public purpose channels and pay-tv channels for public broadcaster)

3.1.2 Technical details of network and receivers

Following standards are used or planned to be adopted:

- **Video coding:**

MPEG-2 video coding is being used in all multiplexes. Experimental MPEG-4 in one Digitalb MUX.

- **Audio coding:**

MUX-A is using MPEG-1 Layer2 audio coding

- **Content type (SD, HD,...):**

SD (experimental HD)

² http://www.dvb.org/about_dvb/dvb_worldwide/albania/

³ <http://www.broadbandtvnews.com/2008/12/18/albania-considers-dtt-options/>

3.1.3 Status on national receiver requirements

By 2012 some standards will adopted.

- **Requirements for receivers:**
No requirements defined yet
- **Test specifications for receivers:**
Till now no test specifications defined
- **Responsible authority for preparing requirements and specifications:**
NCRT is responsible for preparing requirements and specifications
- **Certification process available:**
No certification process defined yet. (It is expected by half 2012)
- **Responsible for certification:**
Standardisation office

3.2 Austria

3.2.1 General description

At the end of 2011 there are 2 nationwide and 1 regional DVB-T multiplex in operation. Nationwide multiplexes are operated by ORS⁴. First multiplex A includes 3 programs (ORF1, ORF2 and ATV) while second multiplex B has 4 programs inside (3SAT, ORF sport plus, PULS 4 and ServusTV). Multiplex C is used for regional operators.

There are also two local multiplex with HD services from Austria run by Rundfunk Anstalt Südtirol (RAS) in Italy, which are retransmitting the two HD channels, from Austria's public broadcaster ORF, ORF 1 HD and ORF 2 HD.

On 7th June 2011 ASO was completed which made further room for new multiplexes. Additionally the licence for the DVB-H multiplex was terminated in December 2010. That is why by the end of July 2011 the Austrian Media Authority "KommAustria" has announced the creation of two nationwide DTT multiplexes (MUX-D and MUX-E) which will use the DVB-T2 standard.

Currently at the end of 2011 the Austrian broadcast network operator ORS is trialling the DVB-T2 transmission standard on its DTT platform in the area of Vienna. ORF1 HD, ORF2 HD, several radio programmes from the public broadcaster as well as commercial broadcasters are taking part in the trial which is being broadcast in HD on UHF channel 65 from the Kahlenberg transmitting station near Vienna and the Arsenal transmitting station in the center of Vienna. Furthermore on the Kahlenberg transmitting station on channel 60 a second trial is operating to evaluate the indoor coverage in comparison to the SFN network on channel 65. The trial which began on the 12th April and will continue for 12 months aims to discover the optimum choice of parameters to be used with the DVB-T2 standard.⁵

3.2.2 Technical details of network and receivers

Following standards are used or planned to be adopted:

- **Video coding:**
All multiplexes currently in operation (MUX-A, MUX-B and MUX-C) are using MPEG-2 video coding.
- **Audio coding:**
MUX-A is using MPEG-1 Layer2 and AC-3 audio coding, while MUX-B has only MPEG-1 Layer2 audio coding.
- **Content type (SD, HD,...):**
MUX-A and MUX-B is broadcasting only SD content type.

⁴ <http://www.ors.at/>

⁵ <http://www.dvb.org>

3.2.3 Status on national receiver requirements

The following receiver requirements are adopted since the introduction of DVB-T. The upcoming DVB-T2 transmission will require new receiver requirements.

- **Requirements for receivers:**

There are 3 types of minimum requirements:

- On 23th December 2005 **interactive profile** [37] for IRD's or iDTV's was released which featured set of an audio/video receiver by the ability to download applications via broadcast. Additional, it supports a return channel for use by applications running on the IRD or iDTV.
- On 7th March 2006 **enhanced profile** [38] was released which features audio/video receiver by the ability to download applications via broadcast.
- On 4th April 2006 **zapping profile** [39] was released which have a feature set as an audio/video receiver without the ability to download applications via broadcast.

- **Test specifications for receivers:**

Test specifications for receivers were released together with minimum requirements.

- **Responsible authority for preparing requirements and specifications:**

Requirements and test specifications were prepared by ORS.

- **Certification process available:**

Certification process is available and still in process.

- **Responsible for certification:**

Responsibility for certifications is in hands of TÜV Austria⁶.

⁶ <http://www.tuev.at>

3.3 Bosnia and Herzegovina

3.3.1 General description

In December 2009 RTRS was broadcasting DVB-T signal from single transmitter, which was shut down due to legal issues in 2010.

In April 2010 RAK announced that MUX-A should be shared by all three national TV companies (BHRT, RTV FBiH and RTRS). To help gathering the necessary equipment, RAK has launched a tender for the creation of its DTT infrastructure ahead of the country's analogue switch-off on February 2011. The tender had been seeking companies to help complete the first phase of the project that would set up digital connections between capital Sarajevo and other main cities including Banja Luka and Mostar.

On August 2011 news came that the introduction of DTT in Bosnia and Herzegovina is delayed until spring 2012, instead of an earlier plan for the first phase to be completed in October 2011. According to RAK the delay is because of an appeal against the result of the international tender for the DTT equipment.

3.3.2 Technical details of network and receivers

- **Video coding:**

MPEG-4 video coding is being planned for usage in three multiplexes that will be deployed during the transition period until switch-over (SO).

- **Audio coding:**

MPEG-1 layer II and MPEG-4 AAC for audio coding are planned to be in usage for three multiplexes during the transitional period until SO.

- **Content type (SD, HD,...):**

SD is planned to be in usage for three multiplexes during the transitional period until SO.

- **Other special demands for receivers:**

Receivers should support letters which are included inside ISO/IEC 8859-2 to be visible inside navigator, EPG and subtitles, while receivers should support languages used in Bosnia and Herzegovina (both Cyrillic and Latin letters).

3.3.3 Status on national receiver requirements

National receiver requirements are submitted to the Council of Ministers for adoption.

3.4 Croatia

3.4.1 General description

Pilot DVB-T transmissions started in 2002 from two transmitters on Sljeme and HRT dom which were followed by transmitters on Ucka and Osijek in 2005. In April 2009 OiV -Odašiljači i veze d.o.o. (Transmitters and Communications Ltd.) were granted a licence for 2 DVB-T multiplexes (MUX-A and MUX-B) and started to build their network, which ended the trial of DVB-T in Croatia. Another licence for multiplex (MUX-D) was granted to OiV in July 2010 which is a combined national/regional and local coverage multiplex. Analogue switch off for national broadcasters began in January 2010 and was completed on October 5th 2010.

At the end of 2011 Croatia now has 2 nationwide multiplexes and 1 local multiplex for each allotment, all run by OiV. MUX-A contains 4 programs (HRT1, HRT2, NOVA and RTL), MUX-B contains 2 programs (RTL2 and Doma TV) which will soon be added another 2 (HRT3 and HRT4). Multiplex MUX D contains 3 national coverage programs (KAPITAL NETWORK, CMC, SPORTSKA TELEVIZIJA) and several regional/local programmes depending on the region. In total 9 programs with national coverage (2 additional to be introduced), 19 programs with regional coverage and 2 with local (town) coverage.

From March 2007 to February 2011 a trial for HDTV was in operation in cities the Zagreb, Osijek, Rijeka and Split which followed with a one month trial for DVB-T2 in October 2011 from two transmitters near the capital city of Zagreb.

In October HAKOM issued a licence for two multiplexes (MUX C and MUX E) to to consortium of HP Produkcija Ltd, OIV Ltd and Hrvatska pošta Inc. These two multiplexes will be using the DVB-T2 system and they will be used for pay-TV services. Commercial start is scheduled in May 2012.

3.4.2 Technical details of network and receivers

Following standards are used or planned to be adopted:

- **Video coding:**
All the multiplexes are using MPEG-2 video coding, while there were also tests for MPEG-4 video coding.
- **Audio coding:**
All the multiplexes uses MPEG-1 layer II for audio coding.
- **Content type (SD, HD,...):**
All the multiplexes are broadcasting SD content. There was also one trial for HD content.
- **Other special demands for receivers:**

Receivers should support letters which are included inside ISO/IEC 8859-2 to be visible inside navigator, teletext, EPG and subtitles, while receivers should support Croatian language.

3.4.3 Status on national receiver requirements

- **Requirements for receivers:**

On 29.9.2010 first version of requirements was published, which contained DVB-T receiver requirements. On 13.9.2011 second version [40] of the same document was published where DVB-T2 receiver requirements were added.

- **Test specifications for receivers:**

There are no test specifications for receivers published.

- **Responsible authority for preparing requirements and specifications:**

HAKOM was responsible for preparing the requirements.

- **Certification process available:**

Certification process is in hand of each individual seller who is responsible to put the sticker with technical details on the all DVB-T receivers which are on Croatian market. HAKOM have released a document where it is described what should be written on the sticker so that customers wouldn't have many difficulties when buying a receiver.⁷

- **Responsible for certification:**

Document for certification was released by HAKOM, but responsibility for certification is in hands of seller.

⁷ <http://www.hakom.hr/UserDocsImages/dokumenti/Ozna%C4%8Divanju%20prijamnika%20za%20digitalnu%20televiziju.pdf>

3.5 Republic of Macedonia

3.5.1 General description

In 2007 company On.Net, a subsidiary of Telekom Slovenia began with DVB-T trial in capital city Skopje. In 2009 same operator has won the tender for 10 year license for the management of the DVB-T multiplexes.

Currently there are 3 multiplexes from which two are free to air and are taken by Macedonian national TV (MKTV) and others consists from pay TV channels.

3.5.2 Technical details of network and receivers

Following standards are used or planned to be adopted:

- **Video coding:**
MPEG-4 video coding is used.
- **Audio coding:**
MPEG-1 layer 2 audio coding is being used.
- **Content type (SD, HD,...):**
There are both SD and HD content available in multiplexes.

3.5.3 Status on national receiver requirements

Process of adaptations not initiated yet.

- **Requirements for receivers:**
Not adopted yet.
- **Test specifications for receivers:**
Not adopted yet.
- **Responsible authority for preparing requirements and specifications:**
Ministry of information society and administration, Agency for electronic communications.
- **Certification process available:**
Certification throughout the Standardization Institute of Republic of Macedonia.
- **Responsible for certification:**
Ministry of information society and administration throughout the Standardization Institute of Republic of Macedonia.

3.6 Hungary

3.6.1 General description

In 1999 Antenna Hungária started its terrestrial digital television experiments with the MPEG-2 video coding. Trial was ongoing until year 2008 when they were given 12 year license to operate 5 TV multiplexes and 1 radio multiplex on VHF. Three multiplexes had the chance to be operational from the beginning with additional two to be added after ASO.

Currently at the end of 2011 there are 3 multiplexes operational. MUX-A is free to air and offers 7 TV channels from which 3 of them are in HD standard and 4 radio channels. MUX-B offers 13 pay tv channels while MUX-C offers 4 free to air channels and 11 pay tv channels.

Antenna Hungária and Nokia launched DVB-H service in Budapest on December 2008. DVB-H was broadcasted inside MUX-B with 6 programs until September 2011 when DVB-H content was replaced by DVB-T programs.

In 2010 Antenna Hungária also broadcasted 3DTV test transmissions over its digital terrestrial platform. The test in conjunction with iPONT transmitted 3DTV through its transmission system and displayed it on special screens which could be viewed without glasses. The transmission was executed in Full HD (1920x1080), 50i format and with a data rate of 8 megabit/s.⁸

3.6.2 Technical details of network and receivers

Following standards are used or planned to be adopted:

- **Video coding:**
MPEG-4 video coding is used.
- **Audio coding:**
There are 3 audio coding standards used: MPEG-1 layer II, HE AAC v1 and Dolby AC-3.
- **Content type (SD, HD,...):**
Both SD and HD contents are broadcasted inside multiplexes.

⁸ http://www.dvb.org/about_dvb/dvb_worldwide/hungary/

3.6.3 Status on national receiver requirements

- **Requirements for receivers:**

Requirements for receivers weren't published in public, but there were some requirements given to producer Technisat which is producing receivers for Hungarian market.⁹

- **Test specifications for receivers:**

No test specifications published.

- **Responsible authority for preparing requirements and specifications:**

Antenna Hungaria were responsible to prepare requirements, which were given to producer of receivers Technisat.

- **Certification process available:**

All the receivers which come from Technisat have a sticker on it with logo of MinDigTV.

- **Responsible for certification:**

Antenna Hungaria is responsible authority for receiver certifications.

⁹ <http://www.ahrt.hu/Sajtoszoba/Sajtokozlomenyek/AH%20-%20Technisat%20Digital.aspx>

3.7 Italy

3.7.1 General description

Italy has 16 national multiplexes. In September 2011 additional 6 multiplexes was made available from AgCom as ASO was about to be completed by the end of 2012.

From December 2008 to March 2009 RAI was broadcasting trial for DVB-T2 in Turin, which helped to validate the DVB-T2 specification through the interoperability of independent hardware implementations. First DVB-T2 channel was launched on May 2010 from commercial broadcaster Europa 7 which used the DVB-T2 standard on VHF Band III to allow viewers to access 8 pay HD television services.

There are also 3DTV channels available on DTT network in Italy. First 3DTV channel was released on December 2010 from partnership between public and private bodies operating in the area, including Sisvel, Quartarete TV and CSP Innovazione nelle ICT. Motive Television has launched a 3D on-demand service over Mediaset's DTT network using its Bestv software on January 2011 and Telecom Italia Media Broadcast (TIMB) started to broadcast first live 3D content on June 2011, where service was carried through the LA7 channel and used Thomson Video Networks ViBE EM3000 equipment. Città Digitali became Italy's last TV channel to broadcast in 3D on the occasion of the European Digital Television Forum held recently in Lucca in July 2011.

3.7.2 Technical details of network and receivers

Following standards are used or planned to be adopted:

- **Video coding:**
There are both MPEG-2 and MPEG-4 coding standards available.
- **Audio coding:**
There are all types of audio coding available. MPEG-1 layer I and II, HE-AAC, Dolby AC3.
- **Content type (SD, HD,...):**
There are mainly SD services but HD and also 3DTV services are available.
- **Other special demands for receivers:**
After first installation the default language shall be Italian.

3.7.3 Status on national receiver requirements

- **Requirements for receivers:**

AGCOM has issued Resolution 216/00/CONS (and all subsequent amendments) which defines the technical requirements for digital receivers (SAT, DTT, etc.).

There are also 3 types of specs. Released by DGTVi for DTT receivers in order to be allowed to get the DGTVi “sticker” (bollino) for the Italian market:

- On September 2004 with latest update on July 2009 **D-BOOK** [41] was released which featured SD requirements for receivers with MPEG-2 video coding and MPEG-1 audio coding
- On July 2007 **Z-BOOK** [42] was released which is a subset devoted to zappers of latest D-BOOK version.
- On October 2008 **HD-BOOK** [43] was released which features HD and SD specifications for receivers with MPEG-2 and MPEG-4 video standard and MPEG-1, HE-AAC, AC-3 and Enhanced AC-3 audio coding.

- **Test specifications for receivers:**

No test specifications published.

- **Responsible authority for preparing requirements and specifications:**

AGCOM is responsible for defining the receiver requirements. DGTVi has released the DTT specs. For receivers to get the DGTVi “sticker” (bollino).

- **Certification process available:**

Certification process is available as all the compliant receivers get stickers and are put on the list which can be found on web page from DGTVi.¹⁰

- **Responsible for certification:**

DGTVi is responsible for testing and certification of receivers.

¹⁰ <http://www.dgtvi.it/bollino.php>

3.8 Montenegro

3.8.1 General description

In order to further support digital switch-over of the Public Broadcasting Service of Montenegro, under IPA 2009 programme, The European Union, represented by Delegation of the European Union to Montenegro on behalf of and for the account of the beneficiary country – Montenegro (hereinafter Contracting Authority) intends to provide broadcasting equipment to the Montenegrin Broadcasting Centre (RDC). Procurement will encompass digital transmitting equipment necessary to cover with broadcasting the majority of population of Montenegro. In accordance with this project, Contracting Authority published invitation to tender for "Support to the Digitalisation of the Montenegrin Public Broadcasting" in September 2010 (under Publication reference: EuropeAid/129435/C/SUP/ME). The subject of the contract was the supply, delivery, installation, commissioning, training and maintenance during the warranty by the Contractor of the following goods: transmitters, gap fillers, TV duplexers, IP to ASI Adapters, MPEG TS multiplexer, MPEG-4 encoders and antennae parts. Eurotel Company from Italy has been selected.

Implementation of digital terrestrial broadcasting network, state co-financed within this project has not started yet, but it is envisaged for putting into operation depends on equipment procurement. Bearing in mind a significant delay and climate conditions in the context of network deployment, it may be anticipated target dates to be postponed.

Ministry for Information Society and Telecommunications decided to adopt DVB-T2 over DVB-T, as envisaged by Strategy for Development of Information Society for the period 2012 – 2016 - Montenegro Digital Society, endorsed in December 2011 (hereinafter Strategy).

Taking into account that DVB-T2 standard will be deployed one national multiplex is planned for the starting phase. For the final phase, the number of national coverage networks will depend on market demands, also taking into account frequencies released after analogue switch-off, to be used as digital dividend for the broadcasting services (for example in the bands below 790 MHz). Frequency band 790 – 862 MHz is still used for analogue broadcasting services, since digital broadcasting stations have not been put into operation so far. Current regulatory provisions are included in the national Allocation Plan, as given in footnotes 5.316B and 5.317A of Radio Regulations. In Section 2, Subsection 2.1.2 under Radio-frequency Spectrum Framework, the Strategy envisaged the following: „After digital switchover finalization, planned for the end of the year 2012, in part of UHF band, 72 MHz sub-band (790-862 MHz), having very good propagation characteristics, will be released ("digital dividend"). By the actual national Allocation Plan this sub-band is allocated to fixed, mobile and broadcasting services, on primary basis“.

3.8.2 Technical details of network and receivers

There are no multiplexes in operation that is why technical details are unknown.

3.8.3 Status on national receiver requirements

Because there are no multiplexes in operation also national receiver requirements are not adopted.

The Agency for Electronic Media (AEM) and the Agency for Electronic Communications and Postal Services (EKIP) have been partner organizations from Montenegro within the SEE Digi.TV project in order to actively participate in eliminating disparities in the field of analogue to A/DSO in the SEE region by ensuring harmonized technical framework, in order to avoid technical fragmentation of the digital broadcasting in the region, as a specific objectives of the project, among others.

In relation to regional receiver specification, AEM and EKIP have intention to use this document as a recommendation to authorities in Montenegro, relevant for endorsement of by-laws in the terms of technical specification, respecting implemented technologies, as much as possible aligned within the region and assuring that the receivers on the market are set according to the specification, guaranteed through conformance test procedures, for which guidelines will be prepared also within the this project.

3.9 Serbia

3.9.1 General description

The Public service broadcaster RTS officially launched pilot trial using the DVB-T on May 2005, which became first digital terrestrial pilot in Serbia. Standard pilot provided coverage of the capital city Belgrade from a single transmitter. The transmitted multiplex was simulcasting the three existing TV programmes RTS1, RTS2 and RTS3 together with four radio programmes.

Because there were some difficulties surrounding digital switchover, Serbia has become one of the first countries to commit to the DVB-T2 standard in May 2009. They decided to use the new DVB-T2 transmission standard for digital terrestrial broadcasting together with MPEG-4 (H.264, AVC) for its forthcoming transition to digital broadcasting. Trial broadcasting of DVB-T2 signals in Serbia should have started by the end of 2011, while ASO should be completed in April 2012.¹¹

3.9.2 Technical details of network and receivers

There are no multiplexes in operation that is why technical details are unknown.

3.9.3 Status on national receiver requirements

Because there are no multiplexes in operation also national receiver requirements are not adopted.

¹¹ http://www.dvb.org/about_dvb/dvb_worldwide/serbia/

3.10 Slovenia

3.10.1 General description

There are 2 national multiplexes (MUX-A and MUX-B) in operation at the moment. MUX-A is operated by national television (RTV Slovenia) and MUX-B is in hands of Norkring d.o.o. which is a subsidiary company from Norkring Norway. Currently at the end of 2011 MUX-A contains 9 programs and MUX-B has 2 programs. In addition to 2 national multiplexes there are also 6 local multiplexes which are covering small area around bigger cities each containing only 1 program.

ASO has been completed on December 2010, when all of the major analogue transmitters were switched off and only some small analogue transmitters was still in operation until they were all shut down in 2011. There has been a trial for HDTV in capital city of Ljubljana from start of MUX-A until April 2011. DVB-T2 trial transmission is operational on the western part of Slovenia.

3.10.2 Technical details of network and receivers

Following standards are used or planned to be adopted:

- **Video coding:**
MPEG-4 video coding is being used in all multiplexes.
- **Audio coding:**
MUX-A uses MPEG-1 layer II while MUX-B uses MPEG-4 AAC for audio coding.
- **Content type (SD, HD,...):**
There has been a trial for HD content but at the end of 2011 all of the programs are broadcasted in SD.
- **Other special demands for receivers:**
Receivers should support letters which are included inside ISO/IEC 8859-2 to be visible inside navigator, EPG and subtitles, while receivers should support Slovenian language.

3.10.3 Status on national receiver requirements

- **Requirements for receivers:**

Requirements for DVB-T receivers [44] were adopted in 2008 and they contain requirements for SD and HD content.

- **Test specifications for receivers:**

Test specifications [45] for DVB-T were adopted in year 2009 and they contain test procedures which must be taken into consideration when testing receivers for Slovenian market.

- **Responsible authority for preparing requirements and specifications:**

Requirements and specifications were prepared by Sintesio and released by APEK.

- **Certification process available:**

Certification process was prepared by Ministry of Economics which gave all the authorities to Sintesio who has been in charge for testing of receivers. All the compliant receivers were given a DIGI sticker so that consumers can find it easily in stores.

- **Responsible for certification:**

Sintesio was responsible authority for certification of receivers.

4 RELEVANT STANDARDS AND BACKGROUND DOCUMENTATION

Specific documents and standards published by ETSI, ISO, ITU and other organizations which are related to DVB-T and DVB-T2 were taken into considerations while preparing this document. Most important broadcasting standards are EN 300 744 [1], which describes framing structure, channel coding and modulation for digital terrestrial television and EN 302 755 [35], which describes frame structure, channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2).

Since this document is describing requirements and specifications for receivers it was important also to include documents and standards from receiving aspect, not only broadcasting. Taking this into consideration, standards defining subtitles, connectors, teletext and other parts of receiving side were considered, with a goal to define the receiver providing satisfactory user experience.

For preparing the specifications other published documentation has been considered. Special attention was given to already adopted minimum requirements from Digi.TV project countries such as Austria, Croatia, Italy and Slovenia, which all adopted specifications for DVB-T or DVB-T2 receivers with both SD and HD content were supported, with Croatia announcing DVB-T2 specifications [40]. In addition to requirements from Digi region, NORDIG requirements [46] and test specifications [47] were one of the main sources for DVB-T and DVB-T2 receiver specifications.

Complete list of reference documents can be found in Reference documents chapter, where full name of the document and its short description can be found.

5 IMPLEMENTATION GUIDELINES AND RECOMMENDATIONS

This chapter is presenting guidelines about how to implement specifications on a national level. It is highly important for each respective country to acknowledge the fact that good specifications are basis for establishing a quality digital terrestrial networks and services, and to prevent non-conformances between new digital networks and receivers.

The specifications are covering multiple audio standards (MPEG-1L2, AAC, HE-AAC, AC3,...), video coding standards (MPEG-2, MPEG-4), as well as both broadcasting standards, DVB-T and DVB-T2.

In case of adapting specifications in a specific country, it is highly recommended to consider and decide upon which standards to be adopted and develop specifications accordingly. Neighbouring countries should also be taken into consideration in order to enable viewers in border regions to receive cross-border programs.

In order to implement national specifics to the national version of specifications it is important for the authority who will be adopting the specification, to have a clear strategy related to following questions:

1. Shall the receivers support only DVB-T or DVB-T2 as well?

- a. In case of new networks in most cases DVB-T2 is recommended, due to higher efficiency, but backward compatibility is in most cases a prerequisite. On the other hand, countries may decide for specifying also DVB-T2 receiver, although only DVB-T network will be built in the beginning. In any case, one needs to take into consideration the national strategy, usage of technologies in neighbouring countries, receiver price and some other specific factors.

2. Which type of content will be broadcasted - SD or HD?

- a. Technology trend is to produce and broadcast more and more content in HD but still some services will be broadcasted in SD for a long time. In case of decision to have both, SD and HD content, it is advisable that the specification define both types of content, SD as well as HD.

3. Audio and video coding standards to be supported (MPEG-2, MPEG-4, AAC, etc.)?

- a. Video coding standards covered by this document are commonly used and it is advisable to specify MPEG-2 video coding alongside with MPEG-4 video coding, commonly used in many networks.
- b. MPEG-1 L2 audio coding was initially used in MPEG-2 networks and this was also the case in many networks where MPEG-4 video coding was already adopted. AAC audio coding shall predominantly be specified in DVB-T networks with MPEG-4 video coding.
- c. For HDTV receivers, specifications are determining both E-AC3 and HE-AAC support for multichannel audio. In case there is no clear strategy about using one

of these standards, it is advisable to specify both, whereas if use of particular standard is being agreed, specification can specify only one.

4. Shall the receivers support de-scrambling?

- a. In general it would be recommended to request the option to use descrambling cards or expansion slots but since this is impacting the price of receiver more detailed consideration is recommended. In general, if Pay-TV services are being planned in particular country, the operator would normally be responsible also for specifying the receivers; however coordination with institution issuing the specifications is highly recommended. It is advisable to have aligned set of specification covering both, Free-to-air and Pay-TV services. Technically, it would be useful for end-users to have option for using decoding card to their iDTV or STB and would avoid requiring additional receiver for Pay-TV services.

5. Which language and specific letters should be supported in the navigator, subtitling, EPG?

- a. It is important to define all languages and related code-pages, which shall be present in user interface, subtitling and EPG. This decision shall be taken by the authority publishing the specifications and specified accordingly.

6. Will extended functions be used (like MHP, etc...)?

- a. Since this document is not covering all possible extensions or special requirements the responsible authority shall evaluate and implement all extended functionalities on the basis of national strategy and technical specifics introduced in the digital networks.

In the overall process of developing national specifications, it is highly recommended to involve all relevant stakeholders, such as:

- Network operators,
- Content providers,
- Regulatory authorities,
- Independent technical experts.

The specifications should be a basis for network operators since they will have to broadcast according to the specification. Moreover, content providers have important role as well, since content produced by them shall be broadcasted having in mind their technological plans.

Other stakeholders like equipment providers, installers, user rights protection associations should be included at least in the phase of presentation of specifications.

It is highly recommended that national specifications include all required standards and functionalities from the first official publishing of specifications. Any amendments to

published specifications can lead to disturbances on the market and non-compliances of receivers already in use or in the retail stores.

It is not advisable to request some future functionalities which are stepping into force after a certain date in the future in order to avoid market fragmentation. The set of published specifications shall preferably define all current and future requirements stepping in force with a date of publishing.

6 RECEIVER SPECIFICATIONS

Terminology which will be used within this document:

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

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

QEF - Quasi-Error-Free means less than one uncorrected error event per hour, corresponding to (MPEG TS Packet Error Rate) PER= 10⁻⁷ or BER = 10⁻¹⁰ to 10⁻¹¹ at the input of the MPEG-2 demultiplexer.

In this chapter universal term “RECEIVER” refers to all devices capable to receive and decode DVB-T and DVB-T2 signals in order to present AUDIO and VIDEO content (iDTV, STB, other devices).

6.1 General requirements

The receivers shall satisfy all mandatory legal requirements, as specified for the European Union and by the relevant national authority.

The receivers should be energy efficient and minimise its power consumption during all modes of the operation. Manufacturers are recommended to follow voluntary agreement(s) on energy consumption for complex set-top-boxes under the EU regulation and/or the European Commission's regulation (EC) No 1275/2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to Ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment for their receivers.

6.2 Hardware requirements

6.2.1 RF part

Comment for implementation:

The receiver RF part/Radio Frequency part/Tuner is important in order to allow the receiver to receive broadcasted signal from the air. The requirements are written for both DVB-T and DVB-T2 standard.

6.2.1.1 General

Comment for implementation:

In this section, most important characteristics for DVB-T and DVB-T2 are listed. In case only DVB-T standard will be adopted, DVB-T2 options marked with BOLD can be excluded. In addition, some of DVB-T2 demodulation options could be excluded in case the country would in advance decide for used transmitting parameters. In case of excluding some demodulation options parameters are used by neighbouring countries should be taken into account in order to allow reception of that signal.

The receiver shall allow reception and demodulation of the DVB-T signal transmitted in accordance with EN 300 744 [1] and DVB-T2 receiver shall allow in addition reception of signal transmitted in accordance with EN 302 755 [2]

The receiver shall allow reception of the DVB-T and DVB-T2 signals in Single Frequency Networks (SFN) or Multi Frequency Networks (MFN).

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

The receiver shall allow reception of the DVB-T and DVB-T2 signal with all allowed combinations of following parameters according to EN 302 755 [35] (**DVB-T2 ONLY options are in bold**):

- Transmission mode: **1k**, 2k, 4k, 8k **normal and extended**, **16k normal and extended**, **32k normal and extended**
- Modulation: QPSK, 16 QAM, 64QAM, **256QAM both rotated and non-rotated**
- Code rate: 1/2, **3/5**, 2/3, 3/4, **4/5**, 5/6, 7/8
- Guard interval: 1/4, **19/256**, 1/8, **19/128**, 1/16, 1/32, **1/128**
- **Pilot pattern: PP1, PP2, PP3, PP4, PP5, PP6, PP7, PP8**
- **SISO/MISO**
- **FEC Frame length: 64800, 16200**
- **Input Mode A (single PLP) or Input Mode B (Multiple PLPs – Common PLP, Type 1 and 2 up to the maximum allowed figure 255)**
- **Single RF frequency or Time Frequency Slicing (TFS)**
- **Normal Mode or High Efficiency Mode**
- **FEF parts¹²**
- **Auxiliary streams¹³**

¹² The receivers are not required to demodulate or decode the content of FEF parts and auxiliary streams, but existence of FEFs and/or auxiliary streams shall not cause issues to receiver.

¹³ The receivers are not required to demodulate or decode the content of FEF parts and auxiliary streams, but existence of FEFs and/or auxiliary streams shall not cause issues to receiver.

The receiver shall allow reception of the DVB-T and DVB-T2 signals in environment with echoes according to EN 300 744 [1].

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

6.2.1.2 Receiver Signal Input Levels

Comment for implementation:

Values in this section related to minimum receiver input level shall be adopted accordingly in case of using other bandwidths and modes than specified. More information related to C/N values can be found in EN 300 744 and EN 302 755 standards.

For 8 MHz Normal Bandwidth DVB-T and DVB-T2 signal the receiver shall support for QEF operation:

- $P(\min) = -105,2\text{dBm} + \text{NF}(\text{dB}) + \text{C/N}(\text{dB})$ input signal level without degradation of decoded picture and audio (QEF reception).

In VHF III, UHF IV and UHF V band maximum Noise Figure (NF) of DVB-T receivers shall not exceed 7dB and shall not exceed 10dB in S Band I, S Band II and S Band III.

In VHF III, UHF IV and UHF V band maximum Noise Figure of DVB-T2 receivers shall not exceed 6dB and shall not exceed 10dB in S Band I, S Band II and S Band III.

Minimum calculated input level of DVB-T receivers for QEF reception on 8MHz and Gaussian profile for VHF S Band I&II and UHF S Band III shall therefore be in range from:

- -90,1dBm for QPSK CR 1/2 GI 1/4 and
- -72,7dBm for 64-QAM CR 7/8 GI 1/4

For 8MHZ UHF band IV&V the values shall correspond in range from:

- -93,1dBm for QPSK CR 1/2 GI 1/4 and
- -75,7dBm for 64-QAM CR 7/8 GI 1/4

Minimum calculated input level of DVB-T2 receivers for QEF reception on 8MHz and Gaussian profile for VHF S Band I&II and UHF S Band III shall therefore be in range from:

- -91,6dBm for QPSK CR 1/2 GI 1/4 and
- -70,0dBm for 256-QAM CR 5/6 GI 1/8

For 8MHZ UHF band IV&V the values shall correspond in range from:

- -95,6dBm for QPSK CR 1/2 GI 1/4 and
- -74,0dBm for 256-QAM CR 5/6 GI 1/8

Maximum STB input signal level for DVB-T and DVB-T2 is -23dBm.

6.2.1.3 RF input connector

Comment for implementation:

This section contains receiver recommendation for additional loop RF connector in order to enable users connecting additional equipment using same antenna source. It is possible to change this requirement to "shall" in case most users would need this option.

Requirement related to providing DC power to external antenna is important in case many users will use active antennas. In case use of these antenna types is not common it could be an option.

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

The receiver should have also a looped RF input connector to provide additional connection to the antenna installation.

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

The receiver shall support a DC power to an external antenna with amplifier. It shall not degrade the RF input characteristic. The DC power supply should be protected against short circuit. In the menu system of the receiver shall be an option to turn the DC power supply on/off. The factory default value shall be off.

6.2.1.4 Tuning/Scanning procedures

Comment for implementation:

Tuning/scanning procedure described in this section is allowing the receiver listing both programs in case same Id is found on different frequencies. Stricter requirement would be to request automatic selection of better signal but in reality some receivers could have issue to comply with this requirement. Decision shall be taken based on country situation.

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

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

In addition to the automatic search, the receiver shall allow a manual search where Channel Id (or frequency) is entered by the end user. The receiver shall tune to this channel, search all available DVB-T and DVB-T2 modes, add new services and replace existing services in the service list (without considering any quality criteria).

6.2.1.5 *Dynamic channel management*

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

6.2.1.6 *Dynamic PMT*

Comment for implementation:

Requirements related to dynamic PMT are most important for countries using time division or other changes of program inside transport stream. In case of specific country requirements it is useful to define the requirement more detailed based on national cases.

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

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

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

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

6.2.2 Interfaces

Comment for implementation:

This chapter is describing interfaces of receiver. It is to be considered that interfaces in most cases have impact to the price of receiver. Some low-price receivers not supporting HDTV in most cases don't need all connection interfaces like HDMI or similar. It is to be evaluated by each country which interfaces to request as mandatory and others can be recommended.

6.2.2.1 SCART interface

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

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

Table 6-1: SCART requirements

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

* Not relevant for iDTV

** OPTIONAL

(1): Control signal on PIN 8:

Nom. 0 Volt/DC: internal source of TV set
 Nom. 6 Volt: external source, 16:9 format
 Nom. 12 Volt: external source, 4:3 format

(2): Control signal on PIN 16:

Nom.0 Volt/DC: CVBS active
 1-3 Volt/DC: RGB active

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

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

6.2.2.2 RCA analogue video output

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

The receiver should have at least one analogue CVBS video interface based on RCA connector, female type IEC 60603-14 [32].

6.2.2.3 Interfaces for Conditional Access

Comment for implementation:

This chapter is defining DVB Common interface. For countries with plans to use scrambled signal it is advisable to re-write this requirement in a way exact coding method will be listed and the receivers should comply with requirements.

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

6.2.2.4 Digital Audio Output

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

6.2.2.5 RCA analogue audio output

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

6.2.2.6 HDMI interface

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

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

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

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

It shall also be possible to manually set default output format from the HDTV Level STB to a fixed format. Fixed format shall include the following formats:

- 1920x1080i@25Hz,
- 1280x720p@50Hz,
- 720x576p@25Hz

and optionally

- 1920x1080p@25Hz,
- 1920x1080p@50Hz.

The preferred default output shall be stored in the STB.

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

6.2.3 Processor

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

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

6.2.4 MPEG Demultiplexer

Comment for implementation:

This section is currently considering both DVB-T and DVB-T2. In case the decision would be to select only DVB-T the DVB-T2 requirements written with BOLD could be deleted

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

- Shall be able to decode an ISO/IEC 13818-1 [5] stream with data rates up to 32 Mbit/s for DVB-T **and up to 50,34 Mbit/s for DVB-T2.**
- Shall support variable bitrate elementary streams within a constant bitrate transport stream.

6.2.5 MPEG VIDEO Decoder

Comment for implementation:

The requirements in this section are written in a way to enable decoding of MPEG-2 and MPEG-4 coded picture for standard definition (SDTV). In addition also variable bitrate (VBR) shall be supported. It is advisable to specify in requirements also HDTV requirements also in case there is currently no plan to broadcast services in HDTV. Receivers shall support and comply with HDTV requirements if they are labelled with HD or HDTV; otherwise this can lead to issues in future when HDTV services will be broadcasted.

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

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

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

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

Table A – Broadcast overscan flags

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

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

Table B – Receiver overscan behaviour

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

For receivers with HDMI output, the receiver shall pass the video without overscan related reformatting to its output, setting the bits in the AVI Infoframe [30].

Table C – Overscan signalling on HDMI

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

6.2.5.1 Decoding of SDTV services

Comment for implementation:

Decoding of SDTV services is mandatory also for HDTV level receivers since it is expected that some content will never be broadcasted in HD format.

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

The decoder of receiver shall decode video in resolution of 720x576 pixels with minimum data rate of 600 kbit/s.

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

6.2.5.2 Decoding of HDTV services

Comment for implementation:

This chapter is important for HDTV receivers. In case of receivers are not capable to decode HDTV and not labelled as HD this requirements are not mandatory.

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

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

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

6.2.6 Audio Decoder

6.2.6.1 Requirements for Audio Decoder in SDTV Level RECEIVER

The receiver shall provide at least one stereo audio decoder that is able to meet minimum decoding requirements based on MPEG 1 Layer II ("Musicam" ISO/IEC 11172-3) and decoder for AC3. Audio decoder shall support also MPEG-4 AAC decoding according to ISO/IEC 14496-4 sub part 4. [34], MPEG-4 HE-AAC v1 (ISO/IEC 14496-3:2001/Amd.1:2003) and MPEG-4 HE-AAC v2 (ISO/IEC14496-3:2005/Amd.2:2006) [34].

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

6.2.6.2 Additional Audio Decoder requirements for HDTV Level RECEIVER

Comment for implementation:

This chapter is important only for HDTV receivers. In case of receivers are not capable to decode HDTV and not labelled as HD this requirements are not mandatory.

6.2.6.2.1 General

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

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

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

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

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

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

HDTV services with multi-channel audio

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

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

The HD level receiver shall adjust the output level of all audio decoders to match the internal reference level so that perceived programme loudness is consistent for all audio coding schemes. For receivers featuring E-AC3, this should be consistent with Dolby Technical Bulletin 11: Requirement Updates for AC3 and E-AC3 in DVB Products [34]. Receivers featuring AC3 or E-AC3 decoding shall include the PCM Level Control feature described therein. For example, for

MPEG-1 Layer 2 audio streams that have an average loudness of about -20 dBLeq, the receiver shall apply an attenuation of 11 dB for the digital output to match the internal reference level.

6.2.6.2.2 Audio formats

Comment for implementation:

Currently two systems on the market are used for multichannel audio. In these specifications both E-AC3 and HE-AAC are listed as mandatory and this is also done in most other specifications. In case there is no clear strategy about using one of these standards, it is advisable to specify both, whereas if use of particular standard is being agreed, specification can specify only one.

The HDTV Level receiver shall in addition to the audio requirements for SDTV Level receiver support the formats specified in chapters 7.2.2.1 and 7.2.2.2 of this document.

6.2.6.2.2.1 System with E-AC3 bitstream

The HDTV Level receiver shall have capabilities for processing AC3 and E-AC3 streams.

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

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

The following formats are optional for the HDMI output connector:

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

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

- E-AC3 bitstream transcoded to AC3
- PCM stereo from the decoded or down-mixed bitstream
- Pass-through of AC3 bitstream
- Pass-through of DTS bitstream to the S/PDIF connector is optional.

The receiver shall:

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

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

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

6.2.6.2.2.2 System with HE AAC bitstream

The HDTV Level shall have capabilities for processing HE AAC streams

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

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

The following formats are optional for the HDMI output connector:

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

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

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

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

The receiver shall:

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

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

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

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

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

6.2.7 Radio mode

Comment for implementation:

Most receivers have the possibility to play RADIO programs broadcasted along TV programs in multiplex. It is advisable to keep the feature from this section as mandatory. In case of national plan for broadcasting RADIO services using DVB-T or DVB-T2 platform more detailed requirement should be considered.

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

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

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

6.2.8 System software upgrade

Comment for implementation:

It shall be mandatory for every receiver to have an upgrade option. This chapter is not requesting any particular method for upgrade of SDTV level receivers but there has to be a possibility to upgrade the receiver by end user. For HDTV level receivers it is mandatory to have OTA System Software Update; receivers can in addition also support other methods for performing upgrade. In case the country would decide to request OTA upgrade method also for SDTV level receiver's this section has to be changed accordingly.

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

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

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

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

6.2.9 Middleware

Comment for implementation:

Middleware is software part of receiver connecting hardware capabilities and system software to enable end users interaction. This chapter covers only basic requirements and shall be elaborated more precisely in case the country and operators would decide to use more advanced approach of delivering user information by using EPG.

6.2.9.1 Service information

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

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

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

The receiver shall offer basic functionality of EPG in order to present following:

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

6.2.9.2 Navigator (USER INTERFACE)

Comment for implementation:

This chapter is to be supplemented with exact information regarding required languages for each specific country.

The navigator shall be presented in official languages of DIGI.TV region country and shall support characters/letters from code tables defined in group of standards ISO/IEC 8859-x.

Individual standards where DIGI.TV region countries are supported:

- **ISO/IEC 8859-1 [23]** (Latin-1 Western European) where German, Italian and Albanian languages are supported
- **ISO/IEC 8859-2 [48]** (Latin-2 Central European) where Bosnian, Croatian, Slovenian, Serbian and Hungarian languages are supported
- **ISO/IEC 8859-5 [49]** (Latin/Cyrillic) where Macedonian and Serbian languages are supported
- **ISO/IEC 8859-16 [36]** (Latin-10 South-Eastern-European) where Albanian, Croatian, German, Hungarian, Italian and Slovenian languages are supported

All official languages used in specific country shall be supported so the user can select and store his preference.

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

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

6.2.9.3 Teletext

Comment for implementation:

The specification for delivering Teletext for SDTV receivers is requesting at least one of the listed options for presenting Teletext. In case national decision would be to request either both options or request one of listed options the specification shall be changed accordingly.

Due different specifications of teletext in some countries it shall be evaluated if the standard used in this section is the same as used in the country.

The SDTV Level receiver shall offer at least one of following options for presentation of Teletext:

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

6.2.9.3.1 Teletext for HDTV Level RECEIVER

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

6.2.9.4 Subtitling

The receiver shall be capable of decoding and displaying DVB subtitle services which are transmitted in conformance with ETSI EN 300 743 [27] including characters from code table presented for each specific country in chapter 6.2.9.2.

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

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

6.2.9.5 User settings

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

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

6.2.10 Remote control

Comment for implementation:

In case of special requirements for user remote control this section shall be modified. Current version of specification is written so that the manufacturer can define functionality and also other characteristics of remote control like type of batteries, size etc.

The receiver shall have an easy to use remote control. The functionality of the remote control can be defined by manufacturer.

6.2.11 Factory presets

Comment for implementation:

It is advisable to request pre-settings for receivers in order to make the first steps for end-users simple as possible. It should be evaluated by each country if this requirement shall be valid for both SDTV and HDTV level receivers and exact presets requirements shall be defined. Optionally special note where it is clearly written how to access most important settings from the list could be included.

For SDTV and HDTV Level receivers following pre-settings shall be enabled (or optional special note should be included on how to set these parameters):

- Default language for User interface and subtitling set to one of official languages of DIGI.TV country as defined in chapter 6.2.9.2
- Default codepage for language set to one of official languages of DIGI.TV country as defined in chapter 6.2.9.2
- Antenna DC power supply off.
- Subtitling: ON (enabled)
- Analog video output format: 4:3
- "16:9 letterbox" conversion: ON
- OTA System Software Upgrade: ON (enabled)
- Default digital audio output set to PCM Stereo according to IEC 60958 [20]