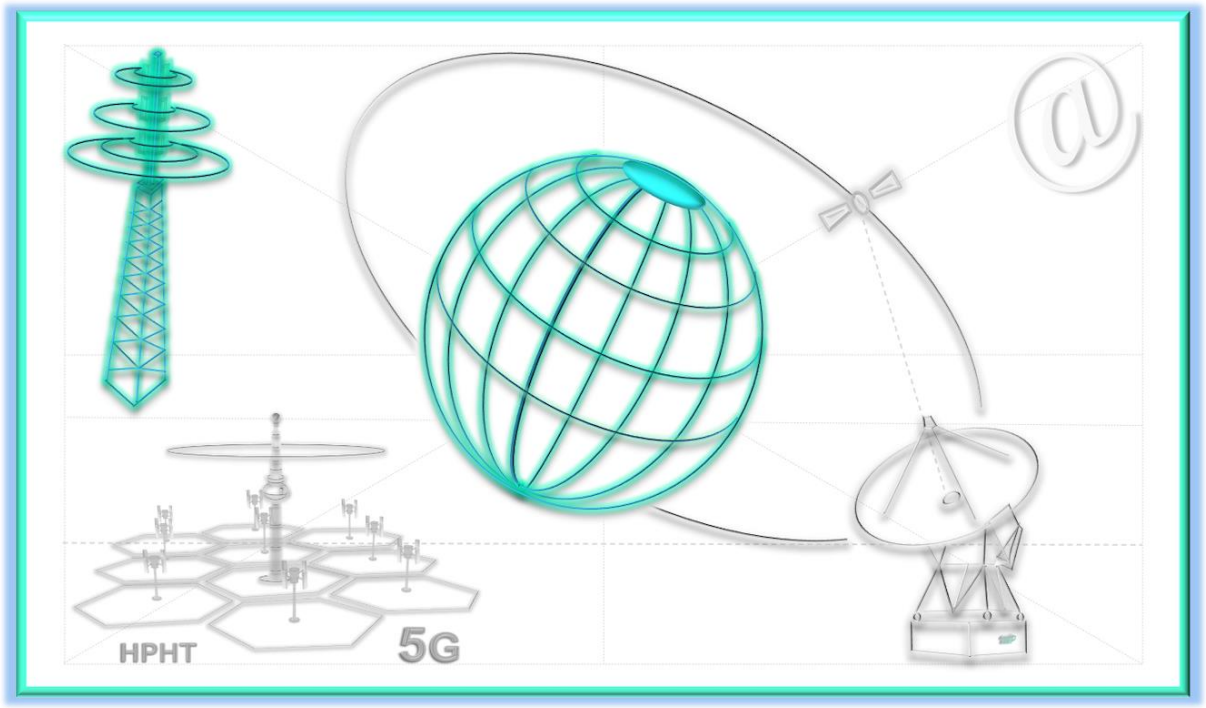
HD Z-Book
DTT platform

(Digital Terrestrial Television)

Compatible High Definition basic receivers for the Italian market: minimum requirements



Final 1.0

ULTRAHD FORUM ITALIA
Beyond Definition

tivù

Digital Television Collection

Table of Contents[1]

[1] Void chapters and clauses are omitted

Tables

1. Introduction

The HD Z-Book is a co-publishing initiative supported by Tivù and HDFI.

HD Forum Italia (HDFI) is an association constituted on September 19th. 2006, to represent the general interests of the industry and consumers towards high definition. HDFI's aim is to promote, support, illustrate and disseminate the utilization of multimedia contents and audiovisual programmes, productions and technology in high-definition format (HD) and beyond (3DTV, UHDTV).

Tivù S.r.l. is a company created by the main Italian terrestrial broadcasters: Mediaset, RAI and Telecom Italia Media, aimed at providing advanced services for digital television, like the platform for free-to-air satellite digital television in areas not covered by terrestrial networks known under the "tivùsat" brand. One of Tivù's missions is to promote the diffusion of digital terrestrial television in Italy.

This co-published document is an extraction taken from the UHD Book 2.0 [1], published by HDFI, containing only the minimum requirements for HD DTT basic receivers, the so-called "zapper set-top boxes" or simply "zappers", while maintaining the same numbering of chapters and clauses of the parent document to make comparison easier. As already happened with the ASO in 2012, it is expected that zappers will play a crucial role for the forthcoming switch-off to retrofit existing non-compatible TV sets.

The new switch-off, from DVB-T to DVB-T2, is defined in Italy in its form by the "Decreto Ministeriale 19 giugno 2019" issued by Ministero dello Sviluppo Economico (MISE). The first phase will start in September 2021, with the transition of all DTT transmissions to MPEG-4 (i.e. H.264/AVC) coding and will end by the end of May 2022 - early June 2022; the second phase, transitioning all DTT transmissions from DVB-T to DVB-T2, will start from mid-June 2022 and will end by June 2022 the 30th.

DVB-T2 services will still be encoded in H.264/AVC but a gradual migration to H.265/HEVC encoding is expected over a not too long period of time to achieve even greater spectrum efficiency.

Key aspect of this transition is that new receivers bought by consumers shall be compatible with all the envisaged coding/transmission combinations and related signalling: H.264/AVC over DVB-T first, then H.264/AVC over DVB-T2 and finally H.265/HEVC over DVB-T2.

The HD Z-Book aims specifically to cover the minimum requirements for HD DTT zappers. Other devices such as iDTVs and UHD set-top boxes are out of the scope. For any other device than HD DTT zappers or for any other feature of HD DTT zappers exceeding the minimum requirements set out in this volume, please refer to the UHD Book 2.0 published by HDFI.

The ultimate goal of these minimum requirements is that HD DTT zappers will guarantee the service continuity, by the means of:

- The compatibility with DVB-T and DVB-T2 transmissions
- The compatibility with H.264/AVC and H.265/HEVC Main 10 profile compressions used for HD services
- The proper use of the LCN descriptors aired by broadcasters to uniform the user experience in all the national territory
- The resistance to the interference from LTE in 800MHz and 700MHz spectrum slices

1.1. Void

1.2. Void

1.3. DTT migration in Italy

1.3.1. Introduction

If on one side the technological innovation pushes towards a significant increase in quality, resolution and definition of images and sounds, on the other side broadcasters in Europe will face a drastic 30% reduction of the UHF frequency spectrum available for digital terrestrial transmission in the coming years due to the refarming of the 700 MHz Band in favour of 5th generation mobile services.

In Italy, to cope with such spectrum reduction for TV broadcasting, the transition to DVB-T2 has been planned by the Government starting from July 1st 2022, when the 700MHz Band is going to be finally released.

The high-impact event, 10 years after the previous switchover ended in 2012, induces operators to re-evaluate their broadcasting strategy to face the dual need to maintain the current number of channels/services offered, while increasing quality with much less transmission resources.

In the following, 2 particular aspects related to this transition are discussed:

- Management of LCN conflicts for simulcasted services
- Possible variations of format for the same service

1.3.2. LCN or HD_Simulcast_LCN conflicts in the transition period

SD/HD simulcasting solutions still used today, with codecs now technologically obsolete such as MPEG-2, can no longer be considered as plausible solutions.

In Italy, services on DTT currently operate with DVB-T/MPEG2 (SD), DVB-T/AVC (SD and HD) and DVB-T2/AVC (SD and HD), plus some premium events occasionally transmitted in UHD with DVB-T/HEVC. In the next few years (2020-2022) it is expected a growing penetration of DVB-T2/HEVC/UHD-HDR services, with resolutions ranging from 1080p up to 2160p, in view of the 700 MHz band refarming, thanks also to a law mandating the presence of DVB-T2 and HEVC in all the receivers sold as of January 1st, 2017.

Service lists are managed by LCN and HD_simulcast_LCNs. At a receiving point, there may be several services signalled with the same LCN or HD_simulcast_LCN. In this case, as specified in the present document and previous versions of the HD Book, the user is given the choice to select the service which will be placed according to its LCN or HD_simulcast_LCNs. The other services conflicting for the same LCN or HD_simulcast_LCN will be placed in the Main Overflow range (850+).

Several instances of the same service may be received at one location. In this case, the receiver only places the best received service in the service list.

As a consequence of the planned 700 MHz Band release, the Italian Digital Terrestrial platform is going to migrate from a mixed DVB-T/T2 MPEG-2/AVC service offer to a DVB-T/T2 AVC/HEVC service offer. This migration may be progressive, i.e. region by region, potentially transmitter per transmitter.

Given the very limited spectrum available and in order to maintain coverage quality and service continuity to the maximum possible extent, various partial migration scenarios (e.g. service per service) may be envisaged. The following examples may illustrate some partial approaches of these migrations with their possible intermediate steps:

- DVB-T/ MPEG 2/SD -> T or T2/AVC/SD -> T2/HEVC/SD -> T2/HEVC/HD
- DVB-T/AVC/HD-> T2/AVC/HD -> T2/HEVC/HD
- DVB-T/AVC/HD -> T2/HEVC/UHD

Such partial migration could take place per individual service or per complete multiplex with or without some simulcast (1 day up to 1 year). Also, temporary transmitter sites with different coverage may be operated for the migration.

During DTT migration, as described above, at a given location and at a given time, for the same LCN or HD_Simulcast_LCN, a receiver may receive:

- several variants of the same service,
- several instances of a same service
- several regional variants of a service
- several regional services
- a combination of all or part of the above

1.3.2.1. Service Variants

A selection of the following parameter combinations[1] could form the set of service variants conflicting for the same LCN or HD_Simulcast_LCN which may be present at the same time at one place, potentially with different reception quality[2]:

- DVB-T MPEG2 SD 720x576i50
- DVB-T AVC SD 720x576i50
- DVB-T AVC HD 1920x1080i50
- DVB-T2 AVC SD 720x576i50
- DVB T2 AVC HD 1920x1080i50
- DVB-T2 HEVC SD 960x540p50
- DVB T2 HEVC HD 1920x1080p50
- DVB T2 HEVC HD 1920x1080p50 HDR
- DVB T2 HEVC UHD 3840x2160p50
- DVB T2 HEVC UHD 3840x2160p50 HDR

1.3.2.2. Several Instances of a Service

Several instances of a service (i.e. instances of a service with exactly the same content and video format using the same DVB triplet ONID, TSID, SID) may be received at one place due to overlap of transmitters or common use of transmitter sites.

1.3.2.3. Regional variants of a service

Several instances of a regionalized service, i.e. regional variants of a same service carrying most of the time the same content but varying partly or completely during the day, conflicting for the same LCN or HD_Simulcast_LCN may be received at one place due to overlap of transmitters or common use of transmitter site.

[1] The full set of video conformance points is specified in Table 2

[2] Though possibly on-air during the transition, as reported above, DVB-T HEVC services are not considered in the following as they will be of transient nature (e.g. UHD early trials and/or HD HEVC test signals). As such, operators will be very cautious in avoiding LCN conflicts with this kind of services

1.3.2.4. Regional Services

Several fully regionalized services, i.e. services available only in some part of Italy, conflicting for the same LCN or HD_Simulcast_LCN may be received at one place due to overlap of transmitters or common use of transmitter sites.

1.3.2.5. HDFI's approach

HDFI's overall objective is to limit the number of unnecessary LCN/HD_simulcast_LCN conflicts presented to the user during the transition phase whilst delivering the best quality experience and driving consumers away from legacy services to their most up-to-date variants. More concretely, in case of LCN/HD_simulcast_LCN conflicts for the same position preference should be automatically given to the best receivable service variant, i.e. the one offering the best image quality and/or the most up-to-date coding or transmission technology. In addition, users should only be offered the choice amongst receivable regional services and regional service variants of a service.

HDFI is currently studying a comprehensive technical solution to allow a user-friendly automatic resolution of LCN/HD_simulcast_LCN conflicts which may be included into future version of this specification.

In order to reduce the unnecessary options to the user, a further automatic selection of services or service variants is proposed as an interim solution to resolve LCN/HD_simulcast_LCN conflicts (see §7.2.2.5.3), based on SDT's service_type, stream_content and component_type. In any case, the services variants or services not automatically selected will still be available to the viewer in the Main Overflow range.

1.4. Compliance notation

A word on the vocabulary: the use of shall, must, should, may is often baffling for non-native English speakers. We have chosen to follow the IETF (Internet Engineering Task Force) which in its RFC 2119 states:

- MUST: This word, or the terms "REQUIRED" or "SHALL", means that the definition is an absolute requirement of the specification.
- MUST NOT: This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective "RECOMMENDED", means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.
- MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. "

N.B. Throughout this document "MANDATORY" is also often used as a "REQUIRED" synonym.

1.5. Acknowledgments

The persons that have contributed to the Digital Television Collection, including the D-Books and Z-Books (from DGTVi), the HD-Books DTT and SAT (from HDFI in partnership with DGTVi or CRTV or Tivù) the UHD-Books (from HDFI in partnership with CRTV) and the

present HD Z-Book (from HDFI in partnership with Tivù), are so numerous we would shortly run out of space if we tried to thank them individually. HDFI and Tivù can only extend their gratitude to all of them and repeat that without them, this work could not have been completed. Of course, all errors and omissions are the sole responsibility of the editors and of the HD Forum Italia.

Manufacturers, through their constructive remarks and questions have played a major role in helping us to clarify and improve many points of the specification. Let them be thanked here.

January 2021

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2. Document History

Document	Revision	Changes	Date
HD Z-Book 1.0	0	First edition	

Credits:

D-Book:

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For the purposes of this document the following references apply:

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[2] ITU-R Recommendation BT.2020-1: "Parameter values for ultra-high definition television systems for production and international programme exchange"

[3] ITU-R Recommendation BT.709-5: “Parameter values for the HDTV standards for production and international programme exchange”

[4] CENELEC EN 50049-1: “Domestic and similar electronic equipment interconnection requirements: Peritelevision connector”

[5] NorDig “Unified Test Plan for Integrated Receiver Decoders for use in cable, satellite, terrestrial and IP-based networks”, version 3.1.1, September 2019, https://nordig.org/wp-content/uploads/2019/09/NorDig-Unified-Testplan-ver.-3.1.1.pdf

[6] NorDig: “Unified Requirements for IRDs for use in cable, satellite, terrestrial and IP based network”, version 3.1.1, September 2019, https://nordig.org/wp-content/uploads/2019/09/NorDig-Unified-Requirements-ver.-3.1.1.pdf

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[18] ETSI ETS 300 743 V1.5.1 (2014-01): “ Digital Video Broadcasting (DVB): Subtitling systems”

[19] ETSI TS 101 162 V1.7.1 (2014-02): “Digital Video Broadcasting (DVB); Allocation of Service Information (SI) codes for DVB systems”

[20] ETSI TS 101 211 V1.12.1 (2013-12): “Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)”

[21] ETSI TS 102 992 v1.1.1 (2010-09): "Digital Video Broadcasting (DVB); Structure and modulation of optional transmitter signatures (T2-TX-SIG) for use with the DVB-T2 second generation digital terrestrial television broadcasting system"

[22] ETSI EN 302 755 V1.4.1 (2015-07): "Framing structure, channel coding and modulation for a second-generation digital terrestrial television broadcasting system"

[23] ETSI TS 102 831 V1.2.1 (2012-01): "Implementation guidelines for a second-generation digital terrestrial television broadcasting system (DVB-T2)"

[24] DGTVi D-Book, "Compatible DTTV receivers for the Italian market, September 2004

[25] IEC 61169-2:2007 "Radio-frequency connectors - Part 2: Sectional specification. Radio frequency coaxial connectors of type 9,52"

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[31] EICTA, "Digital Terrestrial TV Receivers for the DVB-T System", Draft Specification 2.0 (June, 2008)

4. Definitions and abbreviations

4.1. Definitions

Cross carriage: Carrying the data (typically EIT data) pertaining to one multiplex on a different multiplex. Cross carriage agreements usually imply reciprocity.

HD Receiver: either a TV set with HD resolution capable of decoding HD signals specified in this document and used as receiver or a STB capable of decoding HD signals specified in this document and of driving a display with HD resolution.

Locator: The unique identifier of a DVB service/event.

Out of Box Experience: the first contact of the user with the product, as experienced when taking it out of the packaging box and plugging it into the wall socket and antenna cable (without having to read tons of manuals…).

Receiver: a piece of equipment designed to receive (and decode) DTTV signal. It can be provided as a separate box – in this case it is often called Set Top Box (STB), and sometimes Integrated Receiver Decoder (IRD) – or can be incorporated into a TV set, which is then called an Integrated Digital TV set (iDTV).

Service: For TV and Radio, a sequence of programmes under the control of a broadcaster which can be broadcast as part of a schedule [10]. For Applications and Data, refers to a data stream that can be used directly or be presented to an output interface, without having to tune into a TV or Radio service.

Service List: List of all autonomously accessible services (television, radio, application, and data) identified through a service number

TV Viewing Mode or Viewing Mode: normal TV viewing condition, when less than 5% of the screen area is covered by any HbbTV, or receiver proprietary, GUI.

4.2. Abbreviations

3DTV	Plano-stereoscopic 3D TV
AAC	Advanced Audio Coding
AAC-LC	AAC Low Complexity
AC-3	Audio Coding 3
AC-4	Audio Coding 4
ACE	Active Constellation Extension
ADSL	Asymmetric Digital Subscriber Line
ADTS	Audio Data Transport Stream
AES	Advanced Encryption Standard
AFD	Active Format Descriptor
AGCOM	Autorità per le Garanzie nelle Comunicazioni
AIT	Application Information Table
API	Application Programming Interface
AVC	Advanced Video Coding
BAT	Bouquet Association Table
BER	Bit Error Rate
BW	Band Width
CA	Certification Authority
CA	Conditional Access
CAD	Content Access Descriptor
CAM	Conditional Access Module
CEC	Consumer Electronics Control
CENC	Common Encryption
CHAP	Challenge Handshake Authentication Protocol
CI	DVB Common Interface
CICAM	Common Interface Conditional Access Module
CoD	Content on Demand

COFDM	Coded Orthogonal Frequency Division Multiplexing
CRL	Certificate Revocation List
CRTV	Confindustria Radio TV
CS	Companion Screen
CSA	Common Scrambling Algorithm
CVBS	Component Video Baseband Signal
DAB	Digital Audio Broadcasting
DAE	Declarative Application Environment
DAI	Dynamic Advert Insertion
DAS	Dynamic Advert Substitution
DASH	Dynamic Adaptive Streaming over HTTP
dCSS	digital Channel Stacking Switch
DHCP	Dynamic Host Configuration Protocol
DiSEqC	Digital Satellite Equipment Control
DRM	Digital Rights Management
DTS	Digital Theater Systems
DTT(V)	Digital Terrestrial Television
DTV	Digital Television
DVB	Digital Video Broadcasting
DVB-H	DVB Handheld
DVB-I	DVB Internet
DVB-T	DVB Terrestrial
EACEM	European Association of Consumer Electronics Manufacturer
ECP	Enhanced Content Protection
EDID	Extended Display Identification Data
EHDF	European HD Forum
EICTA	European Information and Communication Technology Association
EIT	Event Information Table
EPG	Electronic Program Guide
ETSI	European Telecommunications Standards Institute
EU	European Union
FEF	Future Extension Frame
FIFO	First In First Out
FFT	Fast Fourier Transform
FTTH	Fiber To The Home
GPRS	General Packet Radio System
GS	Generic Stream
GUI	Graphic User Interface
HbbTV	Hybrid broadcast broadband TV
HD	High Definition
HDCP	High bandwidth Digital Copy Protection
HDFI	HD Forum Italia
HDMI	High Definition Multimedia Interface
HDR	High Dynamic Range
HDSPA	High-Speed Downlink Packet Access
HDTV	High Definition TV
HE-AAC	High Efficiency AAC
HEVC	High Efficiency Video Coding
HFR	High Frame Rate
HTTP	Hyper-Text Transfer Protocol
HTTPS	Hyper-Text Transfer Protocol Secure
iDTV	Integrated Digital TV Set
IP	Internet Protocol
IPTV	IP Television
IRD	Integrated Receiver Decoder

ISO	International Organization for Standardization
ISOBMFF	ISO Base Media File Format
ISP	Internet Service Provider
i-TV	Interactive Television
LAN	Local Access Network
LL-DASH	Low Latency DASH
LTE	Long Term Evolution
MFN	Multi Frequency Network
MHP	Multimedia Home Platform
MIME	Multipurpose Internet Mail Extensions
MPD	Media Presentation Description
MPEG	Moving Picture Experts Group
NGA	Next Generation Audio
NID	Network ID
NIT	Network Information Table
NTS	Network Time-Shift
OFDM	Orthogonal Frequency Division Multiplexing
OIPF	Open IPTV Forum
OMA	Open Mobile Alliance
ONID	Original Network ID
OSD	On-Screen Display
OSDT	Online SDT
OTA	Over The Air
OTT-TV	Over The Top TV
PAE	Procedural Application Environment
PAL	Phase Alternate Lock
PAP	PPP Authentication Protocol
PAPR	Peak-to-Average Power Ratio
PAT	Program Association Table
PCMCIA	Personal Computer Memory Card International Association
PDC	Program Delivery Control
PID	Packet IDentifier
PKI	Public Key Infrastructure
PLP	Physical Layer Pipe
PMT	Program Map Table
POP	Point Of Presence
PPP	Point-to-Point Protocol
PPPoE	PPP over Ethernet
PSI	Program Specific Information
PSTN	Public Switched Telephone Network
QAM	Quadrature Amplitude Modulation
QEF	Quasi Error-Free
QPSK	Quadrature Phase Shift Keying
RRC	Regional Radio Conference
RSA	Rivest, Shamir, Adleman
SCART	Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs
SCR	Satellite Channel Router
SD	Standard Definition
SDR	Standard Dynamic Range
SDT	Service Description Table
SEI	Supplemental Enhancement Information
SFN	Single Frequency Network
SI	Service Information
SID	Service ID
SIM	Security Identity Module

SSU	System Software Update
STB	Set Top Box
T-DMB	Terrestrial Digital Media Broadcasting
T2-IRD	DVB-T2 Integrated Receiver Decoder
TA	Targeted Advertisement
TEE	Trusted Execution Environment
TLS	Transport Layer Security
TM	DVB Technical Module
TFS	Time Frequency Slicing
TR	Tone Reservation
TS	Transport Stream
TSID	Transport Stream ID
UHD(TV)	Ultra High Definition (TV)
UHF	Ultra High Frequency
UI	User Interface
UNT	Update Notification Table
URL	Uniform Resource Locator
USB	Universal Serial Bus
VHF	Very High Frequency
WAN	Wide-area Access Network
WLAN	Wireless LAN
WCG	Wide Colour Gamut
WSS	Wide-Screen Signalling

5. The Digital Television Collection

5.1. Introduction

The Digital Television Collection is made up of technical specifications aimed to manufacturers of television receivers (STB and TV). It sets out the baseline requirements for the Italian digital television platform: open, horizontal, interoperable.

Through years, such technical specifications have been jointly produced by different organizations: DGTVi, HDFI, CRTV and Tivù.

DGTVi has been the association which has represented the general interests of the Italian DTT industry until ASO completion on June 2012. Since June 2013 DGTVi role has been taken over and widened in scope by Confindustria Radio Televisioni (CRTV) which now represents the general interests of the whole Italian broadcasting industry (TV, Radio, DTT, SAT).

HD Forum Italia (HDFI) is an association constituted on September 19th. 2006, to represent the general interests of the industry and consumers towards high definition. HDFI is aimed to promote, support, illustrate and disseminate the utilization of multimedia contents and audiovisual programmes, productions and technology in high definition format (HD) and beyond (3DTV, UHDTV).

The HDFI association members represent the major institution & companies in the audiovisual & telecommunication Industry in Italy. They cover most segments of the entire production chain, from content creation to end users: Dolby, EI Towers, Eurofins, Eutelsat, Fastweb, Fincons Group, Fondazione Ugo Bordoni, Fraunhofer IIS, Gruppo Industriale Vesit, Kineton, LG Electronics, Lutech, MainStreaming, Mediaset, Nagra, Panasonic, RAI, Samsung, Sisvel Technology, Sky, Sony Europe, TIM, Tivù and TP Vision.

HDFI adheres, as Italian member organization, to FAME (Forum on Advanced Media in Europe, formerly known as EHDF, European HD Forum), promoted and jointly chaired by the international organizations EBU (European Broadcasting Union) and DIF (Digital Interoperability Forum.

Tivù is a company created by the principal Italian Broadcasters: RAI, Mediaset, and Telecom Italia Media. Tivù has established a satellite platform, i.e. a collection of services sharing the same conditional access system and Electronic Programme Guide, named “tivùsat”.

5.2. From D-Book to UHD Book and HD Z-Book

The first baseline specification was finalized by DGTVi in September 2004 under the name of “D-Book, Compatible DTTV receivers for the Italian market” (v1.0). This specification was later updated with different stand-alone addenda. The “D-Book 1.2” merged all these addenda in a single clean document which considered the comments received by the industry.

The D-Book 1.2 has been the basis on which HD Book DTT 1.0 was jointly developed in 2008 by HDFI and DGTVi, by introducing all HD-specific features (formats, codecs, connectors, signalling, simulcasting). At the same time, latest developments in the areas of supplementary audio and of automatic channel ordering (LCN) to cope with cross-border conflicts were considered. Such developments were then incorporated in D-Book 1.3.

Approaching the 2012 ASO, DGTVi felt useful releasing in 2009 the Z-Book, a technical specification targeting basic DTT SD receivers without any interactive feature, the so-called “zappers”. Under several respects, the present HD Z-Book could be considered the HD upgrade of Z-Book.

HD Book DTT has developed up to version 4.0 which was published in 2016. All major HD Book DTT releases have had a SAT counterpart, usually published a few months later by HDFI in partnership with Tivù, differing only for the front-end and few other aspects (e.g. LCN signalling and handling policy).

Published in 2017, UHD Book 1.0 for the first time has provided specifications for interoperable DTT and SAT UHDTV receivers in a single volume.

In October 2020, UHD Book 2.0 was published, which the present document is drawn from.

Special attention has always been paid to the needs of impaired people through some ancillary requirements specifically devoted to them. The following symbols are used by European broadcasters to mark transmissions offering audio description or video subtitling services.

Some optional features are also described that allow compatibility with the innovative services being introduced on the digital TV networks.

5.3. Terminology and notation

The features are divided into two main categories: “mandatory” and “optional”.

When a feature is “mandatory”, its inclusion is mandatory and it must conform to the defined specification.
When a feature is “optional”, its inclusion is left at the choice of the manufacturer, but whenever implemented, it shall be implemented in conformance with the specification.
Within the optional category, the document presents some features, which would be of a great advantage to the user, as “recommended”.

The different TV formats are represented in the document according to the following notation [17]:

<active lines> <scanning> <frames/s>

For instance:
576i25 (aka 576@50i) represents the 720x576 interlaced format in 50Hz systems
720p50 (aka 720@50p) represents the 1280x720 progressive format in 50Hz systems
1080i25 (aka 1080@50i) represents the 1920x1080 interlaced format in 50Hz systems

5.4. Linkage with other organizations

Where available and compatible with the Italian situation, the specification contained in this document refers to standards developed by standards setting organisations (DVB, ETSI,

DIGITALEUROPE, NorDig, MPEG, OIPF, ISO, CEI, CEN). Furthermore, it follows the Italian legislation in force concerning DTT and reception equipment for Digital Terrestrial Television.

For the aspects of the receiver where nothing is indicated, the expectation is that manufacturers will follow the EICTA E-book. The version 2.0 is taken as a reference (with the exception of obvious editorial errors).

5.5. Graceful Degradation

A receiver compliant with this specification shall implement a “graceful degradation” mechanism for specific unsupported (optional) features and shall not hang up in any circumstance.

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6. Basic requirements

6.1. Front-End & Signal Decoding

6.1.1. Terrestrial Front-End

The Italian DTT network is still evolving. Receivers must support a range of transmission parameters and modes to allow for changes in the use of the allocated spectrum.

Receivers MUST meet minimum performance criteria to maximise both network coverage and the reliability of receivers acquired by consumers in the retail market.

The receiver SHALL support the signal characteristics specified in the following.

A receiver capable of receiving DVB-T2 broadcasts [22] SHALL also be capable of receiving DVB-T broadcasts [13]. Such a receiver is in the following referred to as “T2-IRD”, when there is a need to differentiate such a receiver from a receiver supporting DVB-T only. The T2-IRD shall automatically detect whether DVB-T or DVB-T2 signal is being used in the specific channel.

Feature	Specification	Comment
DVB-T		
Channel Bandwidth	- 7 MHz in Band III (European VHF channel allocation) - 8 MHz in Band IV-V (UHF)	Ref.: [13] Since July 2009, according to resolutions taken at Regional Radio Conference GE06, Italy has adopted 7MHz bandwidth in Band III with European channel allocation.
Digital demodulation	COFDM DVB-T (EN 300 744)	Ref.: [13]
Transmission mode	2k and 8k	Ref.: [13]
Constellation Combinations	QPSK, 16-QAM, 64-QAM, hierarchical 16-QAM, hierarchical 64-QAM)	Ref.: [13]
Code rates	1/2, 2/3,3/4, 5/6 or 7/8	Ref.: [13]
Guard Interval	1/4, 1/8, 1/16 or 1/32	Ref.: [13]
Hierarchical Modulation	Alpha=1, 2 or 4 (where applicable)	Ref.: [13] The receiver is required to demodulate and present all and only the services that it is able to handle among those possibly available in both high (HP) and low priority (LP) streams.
Noise Figure (NF)	Better than 7 dB Note: for dual or multiple internal tuners a NF better than 8 dB is highly recommended for implementation.	Ref.: [15] [27] Same as §12.7.3 in E-Book [8].
Implementation Margin	Better than 3 dB.	Ref.: [13]

Feature	Specification	Comment
Minimum signal level	The demodulator operates on Gaussian channel at QEF performance (i.e. BER less than $2x10^{-4}$ after convolutional decoding and before Reed-Solomon decoding) with a minimum input signal of -78.2dBm across the whole UHF range (8k, 64 QAM mode, 2/3 code rate, Tg/Tu ¼, 8dB NF and 7.61MHz bandwidth).	Ref.:[13], [5], [6]. See Annex B.
Maximum Signal Level	Greater than -28 dBm (80 dBµV on 75 Ohm) without degrading the signal (Implementation Margin).	Ref.: [13] Even with a strong reduction in the power transmitted, in the hypothesis of an antenna gain of 12 dB and a cable loss of 4 dB there could be levels reaching the receiver of -35dBm (73 dBµV on 75 ohm) and of the order of -25, -30 dBm.
Resistance to interference (analogue and digital) co-channel, on adjacent channel and from LTE signals in 800 MHz and 700 MHz Bands.	1.The maximum co-channel protection ratios for PAL / VSB signal interference (including Teletext and analog audio (mono or stereo) conform to the values given in the ITU-R Recommendation BT.1368-10. 2. In the case of interference from DVB-T (co-channel) the value of C / N on the Gaussian channel is expressed by EN 300 744 specification increased by the implementation margin. 3. The protection ratio from adjacent interfering upper and lower PAL, and for all others channels comply with the values given in the ITU-R BT.1368-10 and / or ETSI (DVB) Recommendation TR 101190. 4 The protection ratio values (from adjacent lower / upper DVB-T channels and picture channels) comply with the relative values provided in the ITU-R BT.1368-10 and ETSI TR 101 190. Reference on resistance to interference from LTE signals in 800 MHz and 700 MHz Bands is the NorDig Unified Specification [6].	It's expected that the DVB-T receiver permits an interfering DVB-T/T2 signal with (minimum) interference to signal level ratio (I/C) of 38 dB when the interference is on +/-2 channels (Band IV and V UHF, 8MHz BW), while maintaining QEF reception for DVB-T modes 64QAM, GI 1/4, code 2/3 and 3/4. See also [6], paragraph 3.4.10.6.1 and Table 3.16.
Behaviour in the presence of two static (distant) echoes	The receiver correctly operates in the presence of two static echoes (i.e. 2 paths) with a relative delay in a range of 0,2 µs. and 0,9 times the duration of the guard interval, independently of the value of the amplitude and of the relative phases. This requirement applies to all possible modes.	This is the minimum requirement if one wants the receiver to also operate in a Single Frequency Network as well. The minimum performance and test profile are those presented in E-Book [8], §12.7.8.1

Feature	Specification	Comment
Behaviour in the presence of short echoes	In the presence of echoes of matching levels, the demodulator operates with an implementation margin of 3.5 dB when the channel profile corresponds to that reported in EN 300 744 [13] (Rice and Rayleigh profiles using the six strongest rays). In the presence of an echo at 0 dB, in the absence of noise, to the limit of the guard interval, and for any guard interval, the demodulator operates with QEF performance in the 64 QAM mode and with 2/3 code rate.	Ref: [13] The minimum performance and test profile are those presented in E-Book [8], §12.7.8.2
Change of modulation parameters	At least code rate, time guard and constellation changes shall be automatically detected	Network(s) evolution shouldn't impact existing services
Demultiplexing	MPEG-2 System Transport Stream	Ref.: [9]
DVB-T2		
Channel Bandwidth	- 1.7 MHz (OPTIONAL) - 7 MHz (European VHF channel allocation) in Band III - 8 MHz in Band IV-V (UHF)	Since July 2009, according to resolutions taken at Regional Radio Conference GE06, Italy has adopted 7MHz bandwidth in Band III with European channel allocation.
Digital demodulation	COFDM DVB-T2	Ref.: [22]
Transmission mode	1K, 2K, 4K, 8K normal and extended, 16K normal and extended, 32K normal and extended	Ref.: [22] - For 8 MHz DVB-T2 signal, a normal carrier mode corresponds to a signal bandwidth of 7.61 MHz and an extended carrier mode corresponds to a signal bandwidth of 7.71 MHz for FFT size of 8K and 7.77 MHz for FFT size of 16K and 32K. - For 7MHz DVB-T2 signal, a normal carrier mode corresponds to a signal bandwidth of 6.66 MHz and an extended carrier mode corresponds to a signal bandwidth of 6.80 MHz - For 1.7 MHz DVB-T2 signal, a normal carrier mode corresponds to a signal bandwidth 1.54 MHz and an extended carrier mode corresponds to a signal bandwidth of 1.57 MHz
Constellation Combinations	QPSK, 16-QAM, 64-QAM, 256-QAM, both rotated and non-rotated	Ref.: [22]
FEC Frame length	64800, 16200	Ref.: [22]
Code rates	1/2, 3/5, 2/3, 3/4, 4/5, 5/6	Ref.: [22]
Pilot pattern	PP1, PP2, PP3, PP4, PP5, PP6, PP7	Ref.: [22]
Guard Interval	1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4	Ref.: [22]

Feature	Specification	Comment
Single/Multiple PLP	Both	Ref.: [22] The receiver is required to demodulate and present all and only the services that it is able to handle among those possibly available. Input Mode A (single PLP) or Input Mode B (Multiple PLPs – Common PLP, Type 1 and 2 up to the maximum allowed figure 255)
Time interleaving	$2^{19}+2^{15}$ OFDM cells for a data PLP and its common PLP together	Ref.: [22]
PAPR	All possible configurations: - No PAPR - ACE-PAPR only - TR-PAPR only - both ACE and TR	Ref.: [22]
SISO/MISO	Both	Ref.: [22]
Time Frequency Slicing (TFS)	Not required	Ref.: [22]
FEF parts and Auxiliary streams	The receivers are not required to demodulate or decode the content of FEF parts and auxiliary streams, but the existence of FEFs and/or auxiliary streams shall not cause receiver to malfunction. Receivers are required to ignore the possible presence of a T2-TX-SIG signal.	Ref.: [22] See Annex A. Note: The 'auxiliary-stream" and the 'FEF' methods described in [21] are complementary and may, if desired, be used in combination.
T2-Lite	The receivers are not required to demodulate or decode the content of T2-Lite signals, but the existence of T2-Lite signals shall not cause the receiver to malfunction. Receivers are required to ignore the possible contemporary presence of a T2-Lite and a T2-TX-SIG signal. Optionally, the receiver can also demodulate and present the list of available T2-Lite services. For this feature: ▪ The characteristic of the T2-Lite signals shall comply with [22] and [23], including all the limitations in terms of Modulation, Mode, PLP data rate and T2-Lite receiver buffer model. ▪ Only the T2-Lite signals that use one of the T2-Base code-rates (1/2, 3/5, 2/3, 3/4, 4/5, 5/6) are considered. The case of T2-Lite signals that use the T2-Lite additional code-rate "1/3" or "2/5" is out of scope.	Ref.: [22][23] [21] See Annex A Note: • T2-Lite signals can be transmitted as "stand alone" signals i.e. in a multiplex dedicated to T2-Lite. • For the combination of T2-Lite and T2-Base in the same multiplex, T2-Lite is transmitted in the FEF of T2-Base and vice versa. • Alternatively, the content of the above "T2-Lite services" can be transmitted in a separate PLP to the above "T2-Base services" but this PLP is subject to the range and limitations of the range of modcod parameters available to the T2-base transmission. The same FFT size and guard interval must be used for both PLPs and the "1/3" and "2/5" T2-lite code rates cannot be used. In this case no FEF mechanism is required.

Feature	Specification	Comment
Resistance to interference (analogue and digital) co-channel, on adjacent channel and from LTE signals in 800 MHz and 700MHz Bands.	See Annex A. Reference on resistance to interference from LTE signals in 800 MHz and 700 MHz Bands is the NorDig Unified Specification [6].	Ref.: [15][6]
Noise Figure (NF)	Better than 6dB Note: for dual or multiple internal tuners a NF better than 7 dB is highly recommended for implementation	Ref.:[27] [6]
C/N Performance	See Annex A	
Minimum signal level	The receiver SHALL provide QEF reception for the following minimum signal levels (P_{min}): For 7MHz Normal/Extended Bandwidth: P_{min} = -105.7dBm + NF [dB] + C/N [dB] For 8MHz Normal Bandwidth: P_{min} = -105.2dBm + NF [dB] + C/N [dB] For 8MHz Extended Bandwidth: P_{min} = -105.1dBm + NF [dB] + C/N [dB]	[6] with C/N values given in Annex A
Demultiplexing	MPEG-2 System Transport Stream	Ref.: [9]

Table 1: Terrestrial front-end features table

6.1.2. Signal Decoding

Feature	Specification	Comment
Audio Decoder	The following standards SHALL be supported: - MPEG-1 Audio Layer I & II[4] - HE-AACv1 up to level 2 for stereo and level 4 for multichannel (5.1) - AC-3 (aka Dolby Digital) - Enhanced AC-3 (aka Dolby Digital Plus) up to 5.1 channels[5] Receivers SHALL support audio description in the following formats as per [10]: - MPEG-1 L2 broadcaster mix - MPEG-1 L2 receiver mix - HE-AACv1 and Enhanced AC3 receiver mix	Ref.: [9] Full decoding of stereo transmissions is MANDATORY for any of the standards listed aside. PCM Stereo downmix of 5.1HE-AACv1, AC-3 or Enhanced AC-3 transmissions is *MANDATORY*. Presentation of the downmixed analog signal on SCART and RCA outputs (if present) is MANDATORY. Transcoding of 5:1 HE-AACv1 transmissions to AC-3 or DTS and of Enhanced AC-3 transmissions to 5:1 AC-3 signal is MANDATORY unless the receiver provides a minimum 5 channel audio reproduction system capable of driving at least 5 speakers. Presentation of the transcoded or native AC-3 signal on SPDIF output (if present) is MANDATORY.
Audio Multi-Language	Language shall be selectable.	Behaviour as specified in §7.5.2

[4] It is expected that this old and inefficient audio codec will remain confined to legacy SD services on DVB-T and it will not be used on DVB-T2 alongside advanced video codecs like H.264/AVC and HEVC.

Feature	Specification	Comment
Video Decoder (SD mode)	MPEG-2 Video Main Profile @ Main Level and H.264/AVC High Profile @ Level 3 (576i25) SHALL be supported. Colour space: according to BT.601 Video Format: 720x576i25 Chroma subsampling: 4:2:0 Video Aspect Ratio: 4:3; 16:9.	Ref.: [9] The support of a picture aspect-ratio conversion function to transform programmes broadcast in the format 16:9 to 4:3 (and vice-versa) is mandatory. The receiver shall follow indications given by the Active Format Descriptor, if present (see §6.3.4)
Video Decoder (HD mode)	H.264/AVC High Profile @ up to Level 4 support is MANDATORY for the following conformance points: - 1080i25 - 1080p25[6] - 720p50 - 720p25 - 576p50[7] Colour space: according to BT.709 [3] Chroma subsampling: 4:2:0 Video aspect ratio: 16/9 HEVC Main 10 Profile @ up to Level 4.1 support is MANDATORY[8] for the following conformance points (16:9 aspect ratio): - 1080p50 - 720p50 - 540p50[9]. Colour space: according to BT.709 [3] Chroma subsampling: 4:2:0 Video aspect ratio: 16/9	Ref.: [8], [9] In presence of HEVC encoded HD transmissions using BT.2020 colorimetry [2], in order to allow their meaningful presentation on attached displays, receivers SHALL be able to downconvert them, through a proprietary conversion function, to: - BT.709 colorimetry [3] on HDMI ouput - BT.601 colorimetry on SCART output.

Table 2: Signal decoding features table

6.2. Void

6.3. I/O Connectors

6.3.1. Mandatory Connectors

The following connectors shall be present in any applicable receiver (see comments).

Connector	Specification	Comment
Input RF connector.	Input: Female, 75 Ohm [25]	Tuner input.

[5] It is expected that the Enhanced AC-3 codec should be used for DVB-T2 services, alongside advanced video codecs like H.264/AVC and HEVC. Older and less efficient codecs such as AC-3 are not recommended for DVB-T2 services. It must be noted that any Enhanced AC-3 receiver is also, by design, an AC-3 receiver
[6] Broadcasters might be interested into this format for certain applications
[7] Broadcasters might consider this format (Enhanced Definition TV) for new H.264/AVC SD services.
[8] Support for HEVC Tiles and WPP (Wavefront Parallel Processing) is OPTIONAL
[9] 720p50 and 540p50 (16:9 aspect ratio) are two formats which broadcasters might consider for new HEVC near-SD services.

Connector	Specification	Comment
SCART Connector (Primary)	Peritelevision standard [4] • RGB • CVBS: PAL Out • Audio Output A/V Control Pin 8	For connection to old TV sets. Only applicable to STBs. As an option, the user menu may offer the possibility to output a Y/C signal instead of the RGB signal. In case of HD or UHD signal, the downsampled SD version has to be presented on this output, both in composite and component mode, with the same user settings defined in the menu page for connection to 4:3 or 16:9 TV sets. Teletext reinsertion on VBI is required (see §8.1.2). The stereo output pins will carry one of the following: • a mono or stereo signal, in the case of the received audio component being mono or stereo; • a two channel downmixed signal, in the case of the received audio component being multi-channel.
Output HDMI Connector with HDCP content protection	Type A (Female) [28] Automatic audio/video sync is required. Support of HDMI-CEC is MANDATORY. HDCP [29] must be ON by default. 1080p50 is the recommended default output format. NOTE: When HDCP2.2. is supported by the HDMI sink, it is highly recommended to keep HDCP 2.2 protection constant for all the services to avoid delays when switching channel.	For digital connection of STBs to HD Ready or HD Ready 1080p or UHD displays. According to DIGITALEUROPE HD TV and HD TV 1080p logos' requirements, a "dynamic" output (unscaled) mode shall be available where the HD output format (720p50 or 1080i25) will match the HD transmission format (720p50 or 1080i25 respectively) based on EDID. By avoiding possible (even multiple) format conversions, such mode would in theory provide the best video quality. But due to limitations in early HDMI/HDCP implementations it would likely cause some substantial extra delay, with respect to a fixed 720p50 or 1080i25 output setting, when moving between services or events with different HD or SD transmission formats. For these reasons, the dynamic output mode SHALL be available in user menus but not necessarily as the default value. In order to possibly minimize the number of cascaded conversions, when dynamic output mode is selected SD output towards HD Ready or HD Ready 1080p displays SHALL be set to 576p50.

Connector	Specification	Comment
USB Port (Host)	USB Type A Connector	Compliant with USB 2.0 or later specification [16]. For user-managed software upgrade and/or for attaching external storage media

Table 3: Mandatory connectors table

6.3.2. Void

6.3.3. Audio outputs matrix

The following matrix specifies which audio shall be presented on which output (if present) of a compliant receiver, based on the received signal, both for broadcast and broadband:

	HDMI (including ARC)	SCART	RCA	SPDIF
Mono/stereo audio (any codec)	Decoded PCM mono/stereo audio	Decoded analog mono/stereo audio	Decoded analog mono/stereo audio	Decoded PCM mono/stereo audio
AC-3 5.1 audio	AC-3 5.1 audio or decoded PCM multichannel audio or stereo downmix of multichannel audio, in the given preference order, based on sink's capabilities (as per EDID)	Analog stereo downmix of multichannel audio	Analog stereo downmix of multichannel audio	AC-3 stream
Enhanced AC-3 5.1 audio	Enhanced AC-3 5.1 audio or AC-3 5.1 transcoded stream or decoded PCM multichannel audio or stereo downmix of multichannel audio, in the given preference order, based on sink's capabilities (as per EDID)	Analog stereo downmix of multichannel audio	Analog stereo downmix of multichannel audio	AC-3 5.1 transcoded stream
HE-AAC v1 5.1 audio	AC-3 or DTS 5.1 transcoded stream or decoded PCM multichannel audio or stereo downmix of multichannel audio, in the given preference order, based on sink's capabilities (as per EDID)	Analog stereo downmix of multichannel audio	Analog stereo downmix of multichannel audio	AC-3 or DTS 5.1 transcoded stream

Table 4: Audio channel mapping

It SHALL be possible to change via system menus the default output on HDMI, amongst those notified by the sink via EDID.

6.3.4. Active Format Descriptor

Transmission of this description by the broadcaster is OPTIONAL, but, when present, use of this description by the receiver is MANDATORY.

As explained in Annex B of ETSI TS 101 154 [9] “The Active Format Description (AFD) describes the portion of the coded video frame that is "of interest". It is intended for use in networks that deliver mixed formats to a heterogeneous receiver population. The format descriptions are informative in nature and are provided to assist receiver systems to optimize their presentation of video.

“[…] The AFD is intended for use where there are compatibility problems between the source format of a programme, the format used for the transmission of that programme, and the format of the target receiver population. For example, a wide-screen production may be transmitted as a 14:9 letter-box within a 4:3 coded frame, thus optimized for the viewer of a 4:3 TV, but causing problems to the viewer of a wide screen TV.
The appropriate AFD may be transmitted with the video to indicate to the receiver the "area of interest" of the image, thereby enabling a receiver to present the image in an optimum fashion (which will depend on the format and functionality of the receiving equipment combined with the viewer's preferences).
The AFD itself does not describe the aspect ratio of the coded frame (as this is described elsewhere in the MPEG-2 video syntax).”

The use, by the broadcaster, of this description allows it to optimize the presentation of its program for both 4:3 and 16:9 displays. Therefore, by default, the receiver shall make use of this descriptor. However, the manufacturer may implement a manual override and/or a manual disable.

6.3.4.1. Syntax and Semantics

For standard definition programs, the receiver SHALL recognize AFD transmitted according to [9] Annex B.2.2.

In case of HDTV compatible receiver, the receiver SHALL recognize AFD transmitted according to [9] Annex B.3.2.

6.3.4.2. Valid Values for Descriptor

All values referenced in [9] Annex B “Table B.2 active_format” are valid in the broadcast signal.

6.3.4.3. Behaviour of receiver in the presence of AFD

The receiver SHALL behave in accordance with “The DTG Receiver Implementation Guidelines” [26].

NB: AFDs supplement and qualify - but do not replace - the aspect ratio flag carried in the MPEG sequence header of digital broadcasts. Receivers must interpret both the aspect ratio flag and the AFD in order to present the image in the correct manner.

6.3.4.4. Analogue output of the receiver

The receiver should reinsert WSS data in analogue standard definition outputs according to what is specified in [26].

6.3.4.5. AFD and HDMI

Receivers are recommended to provide at least one of the following methods to process aspect ratio and AFD information for video output on HDMI:

- Provide a reformatting function for the video to match the aspect ratio of the display based on AFD, aspect ratio and user preference as per section 6.4.3.5 in [26] (for 16:9 displays). Support for scaling to 4:3 aspect ratio for HDMI is optional (since consumer HD displays are 16:9). Aspect ratio signaling in the HDMI AVI Infoframe bits R0..R3, M0, M1 (see CEA-861) shall be set in accordance with the properties of

the video on the output.

- Pass the video to the HDMI output unprocessed with respect to AFD and aspect ratio scaling, and pass AFD and aspect-ratio signaling in the video to the HDMI output as part of the AVI Infoframe bits R0..R3, M0, M1 (see CEA-861)

7. Service Information & Channel Selection

7.1. Introduction

On installation, receivers must offer the viewer all services that may be received at the current location via DTT.

The services being received at a given location will change over time. To ensure that the viewer is always able to access every service currently active, the receiver must detect and reflect to the viewer any such changes with minimal viewer involvement.

Services may have an associated Logical Channel Number (LCN). Broadcasters may use this as a marketing tool for service promotion to the viewer. Consequently, when possible, receivers SHOULD present the channels so that a numeric entry will always select the service with the corresponding Channel Number. However, viewers SHALL also be free to re-order and/or filter the channel list as they require.

Access to, and use of, accurate service information is essential if the viewer is to enjoy all of the content being delivered. Receivers must offer a complete list of available services and information, if available, about the current and following programmes.

7.1.1. Terrestrial delivery

Due to the distributed nature of DTT transmissions, a receiver may be able to receive more than one instance of a particular service, which may include regional variants of a service, and must handle such an occurrence sensibly from a viewer perspective.

7.2. Broadcast services

7.2.1. DVB Locator

The DVB locator is the unique identifier of a DVB service. It is composed of three elements:

- Original_Network_ID
- Transport_Stream_ID
- Service_ID

Its format is dvb://<onID>.<tsID>.<sID>[.<ctag>[&<ctag>]][;<evID>][<path>]. (The optional parameter [;<evID>] allows to identify a single event within a service.)

To ensure a harmonious use of the relevant codes, a coordinated allocation of codes and code ranges is recommended for the Italian Digital Terrestrial Television environment. The details of the scheme adopted by Italian DTT broadcasters is given in Annex D.

7.2.2. SI and PSI Information

A receiver specification should not put any constraints on the broadcast signal as the receiver must be robust against erroneous or incomplete signalling and present all services whenever they are present. Of course, receiver behaviour, in many cases will be dependent on the presence, in the signal, of supplementary signalling.

7.2.2.1. Notation

The same symbols as in the E-book (§9.1.4 in [8]) are adopted for specifying the expected implementation for Broadcast or Receiver.

Meaning	Specification applies to:	
	Broadcast	Receiver
Mandatory to broadcast – this shall be present in all broadcasts	M	
Mandatory to understand – receivers are required to understand and act on this item		m
Conditional to broadcast – this shall be present if certain criteria are met (for example, certain signalling is required for CA controlled services)	C	
Recommended to broadcast – inclusion of this item improves the usefulness of broadcasts to receivers and allows them to provide better facilities to users. It is preferable for broadcasts to include this. However, receivers shall be able to work correctly without this information	R	
Optional to broadcast – this item is allowed in broadcasts and has a defined meaning. However, receivers shall be able to work correctly without it	O	
Undefined to broadcast – this item is allowed in broadcasts but has no defined use within this specification. Receivers should ignore this information unless they are designed with information from other specifications that define its use	U	
Forbidden to broadcast – this item is not allowed in broadcasts as it may cause confusion to receivers that conform to this specification	F	

Table 5: Symbols notation as per E-Book

7.2.2.2. Program Map Table (PMT)

The descriptors possibly carried by this table at Program level are the following:

Descriptor	Tag	Status
Conditional access descriptor	0x09	C
Private data specifier descriptor	0x5F	C

Table 6: Program descriptors (PMT)

The descriptors possibly carried by this table at Elementary Stream level are listed hereafter.

Component	Descriptor	Tag	Status
Any	Stream identifier descriptor	0x52	C m
	Conditional access descriptor	0x09	C
	Private data specifier descriptor	0x5F	O
Audio	ISO 639 language descriptor	0x0A	C m
	Audio preselection descriptor	*0x7F*[10] *0x19*	*O*
Private data (AC-3)	AC-3 descriptor	0x6A	C m
Private data (EAC-3)	Enhanced AC-3 descriptor	0x7A	C m
Void			
Private data (AAC)	AAC descriptor	0x7C	C m
DVB Subtitles	Subtitling descriptor	0x59	C m
Teletext	Teletext descriptor	0x56	C m

[10] Indicating use of the extension descriptor in conjunction with the relevant descriptor_tag_extension [10]

Component	Descriptor	Tag	Status
SSU stream	Databroadcast_id descriptor	0x66	O m

Table 7: Elementary stream descriptors (PMT)

7.2.2.2.1 Multiple components of the same type

The PMT may contain multiple instances of components with identical signalling. For example, multiple audio components with the same stream type, language and audio_type, or multiple video components in services providing multi-angle viewing (and single audio).

In this case the receiver SHALL select as default component the one with the lowest PID among those of the same type.

However, all the components SHALL be presented for manual selection when requested by the user.

7.2.2.2.2 HD-specific elementary stream types

Further to the stream types

- 0x02 for MPEG-2 or MPEG-1 constrained parameter video streams
- 0x03 for MPEG-1 audio streams
- 0x05 for MPEG-2 TS private_sections
- 0x06 for PES packets containing private data

whose support was already required for SD receivers by DGTVI's D-Book [24], the following stream_type values SHALL also be supported in the scope of this document:

- 0x11 for MPEG-4 AAC and MPEG-4 HE AAC packetized elementary streams
- 0x1B for H.264/AVC video streams
- 0x24 for HEVC video streams

The value of stream_type for an Enhanced AC-3 elementary stream will be 0x06 (indicating PES packets containing private data), same as for AC-3.

7.2.2.2.3 Supplementary Audio

For TV-broadcasting applications, noticeably public service broadcasting, there is often a requirement for commentary or narration audio services to provide for different languages or Visually Impaired or Hearing Impaired audiences.

7.2.2.2.3.1 DVB solution

DVB solution encompasses both receiver-mixed and broadcast-mixed Supplementary Audio. Relevant signalling specifications are contained in new Annex to latest [9] revisions.

7.2.2.2.3.2 Enhanced AC-3 solution

Compliance with the behaviour specified in [9] §6.2.1.2 and §6.2.2.2 is required.

7.2.2.3. Network Information Table (NIT)

The descriptors possibly carried by this table in first loop are the following:

Descriptor	Tag	Status	
		Actual	Other
Network_name_descriptor	0x40	M	O m
Multilingual_network_name_descriptor	0x5B	O m	O m
Linkage_descriptor	0x4A	C	C

Descriptor	Tag	Status	
		Actual	Other
Private_data_specifier_descriptor	0x5F	C	C
Void			

Table 8: Network descriptors (NIT first loop)

If a change occurs in the “network_id” in the NIT, during transmission, the receiver SHALL ignore it and continue to present the services already in the list and not delete them.

If a change occurs in the “network_name_descriptor” the receiver SHALL ignore it and continue to present the services already in the list and not delete them.

7.2.2.3.1 Void

7.2.2.3.2 Terrestrial delivery

The descriptors possibly carried by this table in second loop are the following (DTT case):

Descriptor	Tag	Status	
		Actual	Other
Terrestrial_delivery_system_descriptor	0x5A	M m*	O
Frequency_list descriptor	0x62	R	R
Service_list_descriptor	0x41	R	R
Private_data_specifier_descriptor	0x5F	C	C
Logical_channel_descriptor	0x83	O m	O
HD simulcast descriptor	0x88	O m	O m
T2_delivery_system_descriptor	ext(0x04)	M m	O

Table 9: Transport stream descriptors (NIT second loop for DTT)

7.2.2.3.2.1 Terrestrial delivery system descriptor

Receivers may use the modulation parameters in the terrestrial_delivery_system_descriptor as a recommendation when trying to tune to a multiplex but the receiver shall always be able to detect the modulation from the transmission itself (e.g. assisted by TPS bits).

MFN network may include repeaters (or channel translations can be performed in MATV systems): the receiver shall ignore the “centre_frequency” specified in the terrestrial delivery system descriptor. In other words, the receiver shall select the service in a DVB-T channel according to the frequency used during the tuning procedure, ignoring the value contained in the NIT.
The receiver SHOULD consider the
- other_frequency_flag (inside the terrestrial_delivery_system_descriptor)

Receiver SHALL ignore the “bandwidth”, “priority”, “constellation”, “hierarchy_information”, “code_rate”, “guard_interval” and “transmission_mode” values in the terrestrial_delivery_system_descriptor of the NIT.

7.2.2.3.2.2 T2 Delivery System descriptor

T2_delivery_system_descriptor is signalled in the extension_descriptor (Tag extension value 0x04).

The T2-IRD SHALL uses the system parameters in the T2_delivery_system_descriptor to determine the mapping between original_network_id/network_id/transport_stream_id and T2_system_id/plp_id.

The T2-IRD SHOULD uses the other system parameters in the T2_delivery_system_descriptor as a recommendation when trying to tune to a multiplex. The T2-IRD SHOULD, however, always be able to detect these system parameters from the transmission itself (i.e. assisted by L1 signalling).

Operators can broadcast the same transport stream in the same network using different system parameter settings, reflected in a different T2_system_id. This allows for optimization of the network coverage in frequency planning involving SFN and MFN combination networks.

7.2.2.3.2.3 Other_frequency_flag

The terrestrial_delivery_system_descriptor may signal the use of possible alternative frequencies through the other_frequency_flag. This flag may be used (inter alia) to advise the receiver that an identical multiplex may be receivable on other centre frequencies. The receiver must always be able to receive all the available services in the RF channels.

If the same service is available on two different RF channels, both were tuned (with the automatic or manual scan procedure), and both are available to the user.

Support by receivers of this flag is OPTIONAL. It is expected that broadcasters in Italy will not use this flag.

7.2.2.3.3 Void

7.2.2.3.4 Logical Channel Descriptor

The logical channel descriptor provides a default channel number label for services. This information is quasi-static. The logical channel descriptor may be inserted once in the second descriptor loop of the NIT (actual or other) or of the BAT.

The logical channel number does not consider the service type, i.e. all service types share the same number space.

Syntax	No. of bits	Type
logical_channel_descriptor{		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0; i<N; i++){		
service_id	16	uimsbf
visible_service_flag	1	bslbf
reserved	5	bslbf
logical_channel_number	10	uimsbf
}		
}		

Table 10: Syntax of the logical channel descriptor

Descriptor_tag: This shall be assigned to be 0x83.

Service_id: This is a 16 -bit field which serves as a label to identify this service from any other service within the network. The service_id is the same as the program_number in the corresponding program_map_section. Services shall be included irrespective of their running status.

Visible_service_flag: When set to '1', this 1-bit field indicates that the service is normally visible and selectable (subject to the service type being suitable, etc.) via the receiver service list. When set to '0' this indicates that the receiver is not expected to offer the service to the user in normal navigation modes. However, the receiver should provide a mechanism to access these services (for example, by direct entry of the logical channel number).

See also Receiver rules. Support by receivers of the visible_service_flag is MANDATORY.

Reserved: All "reserved" bits shall be set to '1'.

Logical_channel_number: This is a 10 -bit field which indicates the broadcaster preference for ordering services. Its use is defined in the following table:

logical_channel_number	Description
0	Service not suitable for selection by the user a)
1 - 999	logical_channel_number
1000 - 1023	rfu – not usable
a) For example, the value zero may be used for data services only intended for selection from interactive applications or for firmware download services, etc.	

Table 11: Logical channel number

Any service with LCN=0 shall be ignored.

See also Receiver rules.

7.2.2.3.5 HD Simulcast Logical Channel Descriptor

The HD Simulcast Logical Channel Descriptor provides a means to override the default channel number label of services for an HD receiver. This information is quasi-static.
The HD simulcast logical channel descriptor may be inserted in the second descriptor loop of the NIT. The descriptor may appear more than once in this location.

The constraints on uniqueness are the same as those for the logical channel descriptor.

Syntax	No. of bits	Type
HD_simulcast_LCN descriptor{		
descriptor_tag	*8*	*uimsbf*
descriptor_length	*8*	*uimsbf*
for (i=0; i<N; i++){		
service_id	*16*	*uimsbf*
visible_service_flag	*1*	*bslbf*
reserved	*5*	*bslbf*
logical_channel_number	*10*	*uimsbf*
}		

Syntax	No. of bits	Type
}		

Table 12: Syntax of the HD simulcast logical channel descriptor

Descriptor_tag: This shall be assigned to be 0x88.

Service_id: This is a 16 -bit field which serves as a label to identify this service from any other service within the network. The service_id is the same as the program_number in the corresponding program_map_section. Services shall be included irrespective of their running status.

Visible_service_flag: When set to '1', this 1-bit field indicates that the service is normally visible and selectable (subject to the service type being suitable, etc.) via the receiver service list. When set to '0' this indicates that the receiver is not expected to offer the service to the user in normal navigation modes. However, the receiver should provide a mechanism to access these services (for example, by direct entry of the logical channel number).

See also Receiver rules. Support by receivers of the visible_service_flag is mandatory.

Reserved: All "reserved" bits shall be set to '1'.

Logical_channel_number: This is a 10-bit field which indicates the broadcaster preference for the ordering of services. This descriptor shall only be interpreted by receivers that are able to decode an advanced codec HD digital television service. The channel number label assignment defined by this descriptor overrides the channel number label assignment defined by the Logical Channel Descriptor that is located in the same network_id. The rules for the set of channel number labels used by this descriptor is the same as the rules for the set of channel number labels
used by the Logical Channel Descriptor.
In the case where this descriptor assigns to a service (service A) a channel number label which is already assigned to another service (service B) (perhaps by the Logical Channel Descriptor), the receiver shall treat the original service (service B) as having no assigned channel number label and assign one automatically in the normal manner.
This descriptor is intended to be used for HD services broadcast in simulcast with the same service in SD so that the HD service appears at the primary channel number label on HD capable receivers while the SD service appears at that label for SD-only capable receivers.

Expected receiver behaviour in the presence of HD_simulcast_LCN_descriptor is outlined in the following flow chart.

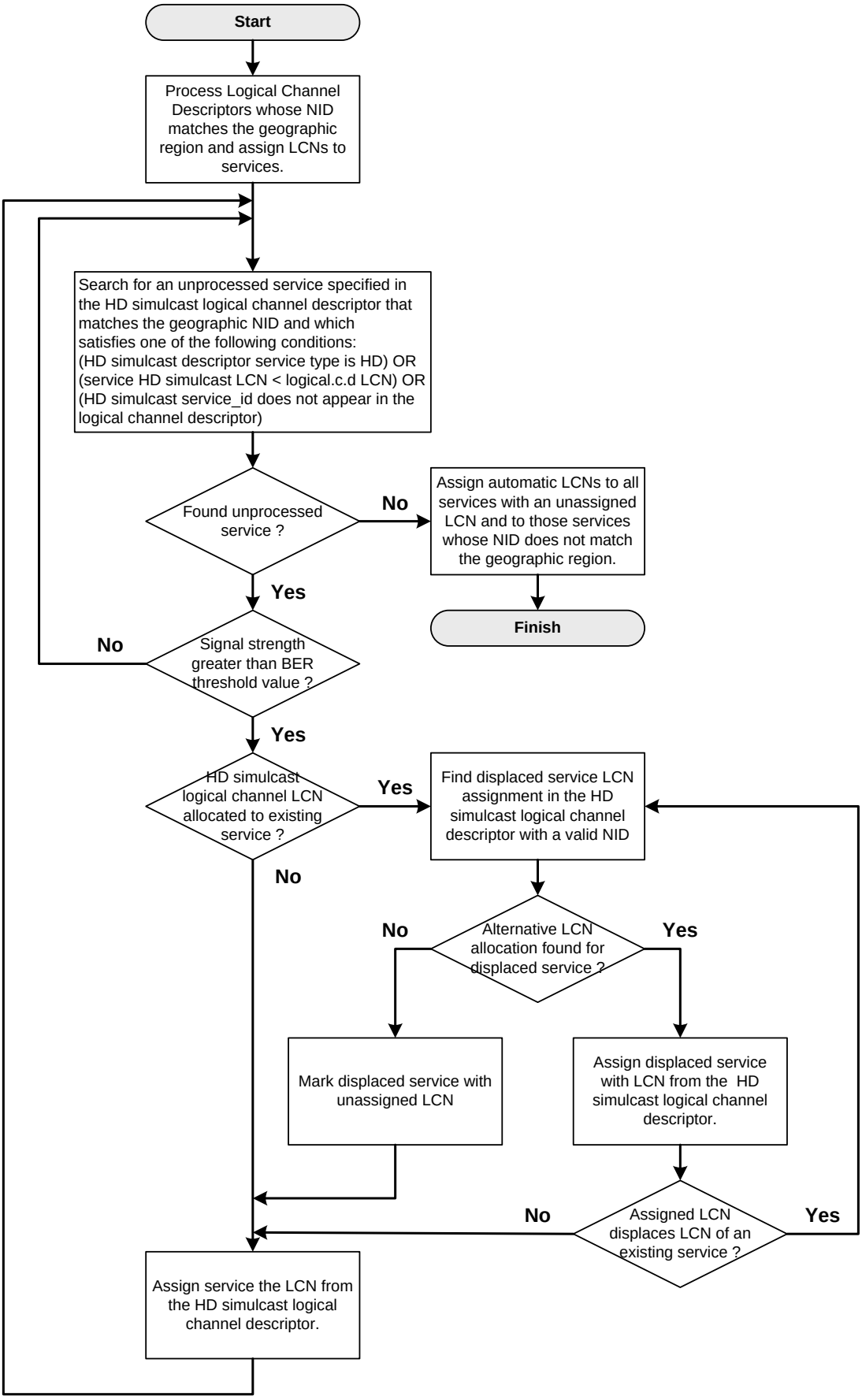

Figure 1: HD_simulcast_LCN operation

7.2.2.3.6 Terrestrial LCNs

In DTT context the logical channel number is not necessarily unique within the same original_network_id (except when its value is zero) but may be re-used for regional variants of a service or for local services with strictly not overlapping coverage. Hence the number is not unique within the original network.

The logical channel number does not consider the service type, i.e. all service types share the same number space.

The logical channel number does not consider the transmission standard, i.e. services transmitted on DVB-T and DVB-T2 share the same numbering space.

7.2.2.4. Bouquet Association Table (BAT)

In some platforms BAT may be used for conveying Logical Channel Numbers. Receivers addressing such platforms SHALL support BAT.

The descriptors possibly carried by this table are listed hereafter.

Descriptor	Tag	Status
		Actual
Bouquet_name_descriptor	0x47	C m
Multilingual_bouquet_name_descriptor	0x5C	O m
Linkage_descriptor	0x4A	C
Private_data_specifier_descriptor	0x5F	C
Eacem_stream_identifier_descriptor	0x86	O

Table 13: Network descriptors (BAT first loop)

Descriptor	Tag	Status
		Actual
Service_list_descriptor	0x41	R
Private_data_specifier_descriptor	0x5F	C
Logical_channel_descriptor	0x83	O m
HD simulcast descriptor	0x88	O m

Table 14: Transport stream descriptors (BAT second loop)

7.2.2.5. Service Description Table (SDT)

The descriptors possibly carried by this table are the following:

Descriptor	Tag	Status	
		Actual	Other
Service_descriptor	0x48	M m	O m
Component_descriptor	0x50	C m	C m
CA_identifier_descriptor	0x53	C m	C m
Private_data_specifier_descriptor	0x5F	C	C
Preferred_name_list_descriptor	0x84	O	O

Descriptor	Tag	Status	
Linkage_descriptor	0x4A	O m	O m

Table 15: Service descriptors

In the presence of a CA_identifier_descriptor, the receiver shall always try to present the service to the end user. In case the service is effectively scrambled, and the relevant CA system is not present, the receiver shall present an error message (see 7.5.1.2).

The preferred_name_list_descriptor, as defined in [8], provides a list of alternative names, and name identifiers, for the service. This information is quasi-static.

7.2.2.5.1 Service descriptor

When tuning a service, receivers SHOULD detect a “service_name” change since the last (re)install or manual/automatic service list update and update it unless it was manually edited by the end user.

Receivers SHALL only list a service in their service selection interfaces where the service is of a type, as declared in the “service_type” value, which the receiver is able to present to the user or to a receiver interface.

NB: Users may be confused or frustrated if the receiver presents for selection services that are not decodable by the receiver (such HD services on an SD receiver) or are not intended for user selection (such as receiver firmware update broadcasts).

Receivers are required to support at least the following service types:

service_type = 0x01, digital television service
service_type = 0x02, digital radio sound service (MPEG-1 Layer 1 or 2 audio)
service_type = 0x0A, advanced codec digital radio sound service
service_type = 0x16, advanced codec SD digital television service
service_type = 0x19, advanced codec HD digital television service

The following signalling SHALL be present for HEVC HD or sub-HD services in accordance with [10]:

service_type = 0x1F
stream_content = 0x9
stream_content_ext = 0x0
component_type = 0x00 (HEVC Main Profile HD, 50 Hz) or
0x01 (HEVC Main 10 Profile HD, 50 Hz)

The following signalling SHALL be present for HEVC UHD and sub-UHD services with SDR in accordance with [10]:

service_type = 0x1F
stream_content = 0x9
stream_content_ext = 0x0
component_type = 0x04 (HEVC Ultra High Definition Video)

Receivers compliant with this specification SHALL keep in the service list services signalled like that as they might include HD services with BT.2020 colorimetry that receivers are expected to handle through the conversion function introduced in Table 2.

Receivers supporting HEVC SHALL interpret and correctly react to the above signalling (service_type, stream_content, stream_content_ext, component_type).

> NOTE: In the future, the same service_type may be used for formats which may not be supported by the HEVC receiver described in this version of specification. For this reason, it is essential that receivers interpret the four fields described above.

According to DVB SI [10], service_type=0x01 should be used for MPEG-2 SD digital television service. However, it may also be used for services using other encodings, including encodings that have a specific entry, e.g. advanced codec HD digital television service. That doesn't apply to services using HEVC video coding which SHALL be explicitly and unambiguously signalled as stated above.

A service, as identified by its DVB triplet, will exclusively be either SD or HD.

Support for other service types (for example service_type = 0x06, mosaic service) is optional.

7.2.2.5.2 Running status

Receivers are required to support at least the following values and behaviours for the running_status in SDT:

running_status = 4, running -> normal behaviour
running_status = 1, not running -> display banner with the following exception

If a linkage descriptor with linkage type 0x05 (service replacement service) is present in SDT for a given service, the receiver SHALL automatically select the replacement service, if selectable, instead. The receiver SHALL listen to updates of the running_status value (from running to not running or from not running to running) of the given service in SDT, automatically selecting the replacement service or the service itself, if selectable.

7.2.2.5.3 Priorities amongst services and service variants

For the purpose depicted in the following section §7.4, DTT receivers SHALL apply the following priorities to service variants and services:

Priority (9 is highest)	service_ type	stream_ content	stream_ content_ext	component_ type	Service	Delivery System	See notes
1	0x01	any	any	any	MPEG-2 SD	DVB-T	1 & 3
2	0x16	any	any	any	AVC SD	DVB-T	1 & 3
3	0x16	any	any	any	AVC SD	DVB-T2	1 & 3
4	0x19	any	any	any	AVC HD	DVB-T	1 & 3
5	0x19	any	any	any	AVC HD	DVB-T2	1 & 3
6	0x1F	0x09	0x00	0x00	HEVC Main HD	DVB-T2	3 &4
7	0x1F	0x09	0x00	0x01	HEVC Main10 HD	DVB-T2	3& 4

Table 16: Service priorities

NOTES:

1 Service_type 0x01 could be (and actually is) legitimately used to signal AVC HD and AVC SD services. Broadcasters should be aware of that in case of self-caused LCN conflicts.

2 As HEVC services with HD resolution and lower have to use the same DVB SI signalling, HEVC services with 960x540p50 resolution will have higher priority than AVC HD (1920*1080i) services.

*3 Services with a resolution of 1920*1080 or less with BT.2020 and HLG or PQ10 will be signalled as UHD services according to EN 300 468 [10]*

7.2.2.6. Event Information Table (EIT)

7.2.2.6.1 Event Information Descriptors

The EIT can carry the following descriptors to meet the requirements of EN 300 468 [10] and TR 101 211 [20]:

Descriptor	Tag	Status			
		Present/Following		Schedule	
		Actual	Other	Actual	Other
Linkage descriptor	0x4A	O m	O m	C	C
Short event descriptor	0x4D	M m	M m	O m*	O m*
Extended event descriptor	0x4E	C m	C m	O	O
Component descriptor	0x50	M	M	O	O
CA identifier descriptor	0x53	C	C	C	C
Content descriptor	0x54	R	R	R	R
Multi lingual component descriptor	0x5E	O	O	O	O
Parental rating descriptor	0x55	O m	O	O	O
Time shifted event descriptor	0x4F	F	F	F	F
Private data specifier descriptor	0x5F	C	C	C	C
PDC descriptor	0x69	C	C	C	C
Preferred name identifier descriptor	0x85	O	O	O	O
* Mandatory only if no other EPG than the one based on SI data is available on the receiver					

Table 17: Event Information Descriptors

The preferred_name_identifier_descriptor, as defined in [8], may be used in the EIT to identify the preferred service name at the time of an event and so allows a schedule of service names.

7.2.2.7. Summary of mandatory tables

Table	Actual	Other
Program association table	M m	N/A
Program map table	M m	N/A
Conditional access table	C	N/A
Network information table	M m	O m
Bouquet association table	U	N/A
Service description table	M m	M m
Event information table present/following	M m	M m
Event information table schedule	O m*	O m*
Time and date table	M m	N/A
Time offset table	R m	N/A

Table	Actual	Other
Running status table	U	N/A
* Mandatory only if no other EPG than the one based on SI data is available on the receiver		

Table 18: List of mandatory tables

7.2.2.8. Private Data

When private descriptors are present in a broadcast, a private data specifier descriptor SHOULD be used (cf. EN 300 468) to identify the definer of the private descriptor.

For the Logical Channel Descriptor, the private data specifier value used in the E-Book, as registered in ETSI TR 101 162, SHALL be used; it is the one registered for EACEM (then EICTA, DIGITALEUROPE today).

The following table lists this value and the other private SI items that are defined within its scope.

Organisation/ specification	PDSD	Private SI information	Value	Type
EACEM	0x00000028	Eacem stream identifier descriptor	0x86	Descriptor tag
EACEM	0x00000028	Logical channel descriptor	0x83	Descriptor tag
EACEM	0x00000028	Preferred name list descriptor	0x84	Descriptor tag
EACEM	0x00000028	Preferred name identifier descriptor	0x85	Descriptor tag
EACEM	0x00000028	HD simulcast descriptor	0x88	Descriptor tag

Table 19: Private SI recognised in the E-Book

7.3. Void

7.4. LCN operation

The role of the LCN is to enable user presentation of service numbers in a convenient and familiar form.

Logical channel numbers allocated should be usable directly as service numbers in a receiver.

7.4.1. Network operator rules

7.4.1.1. Terrestrial delivery

To avoid conflicting allocation of LCNs:

- The logical_channel_number should be unique across all the networks that cover the same geographical region.
- The same logical channel number should be reused only in non-adjacent regions,
- Regional variants of a service may nevertheless use the same logical channel number.

Receivers need to have a mechanism for handling conflicting LCN allocations either within the same country or on the borders of confining countries (see below).

This specification defines the logical channel number concept for conveying such service numbering information to receivers. Network operators should obey the following specification rules in order for receivers to be able to properly operate.

Services with the same triplet (original_network_id/transport_stream_id/service_id) shall have the same logical_channel_number. Within the scope of one network (as defined by the network_id), logical channel numbers shall be allocated uniquely.

When defining regional variants of a service, the same logical_channel_number may be used (for example in neighbouring networks). This facilitates defining a consistent and compact national/regional/local channel numbering scheme, as well as indicating to the receiver that services with the same logical_channel_number are similar (regional variants).

Proper usage for their networks by Italian and confining broadcasters of NIT network_id values in the ranges officially assigned by DVB to the respective DTT networks (see Annex D) allows receivers to understand which LCNs belong to which country and then to give priority in case of conflicts to those from the country selected at first installation time.

7.4.1.2. Void

7.4.1.3. Void

7.4.1.4. Invisible services

It is recommended to allocate high service numbers to services marked as invisible to avoid accidental collision of service numbers with those of visible services when they are being automatically or manually reallocated.

7.4.2. Receiver rules

Receivers SHALL provide an automatic service numbering facility on the basis of logical channel numbers with the rules set out below.

It SHOULD be possible for the user to select, in the set-up menu, the possibility to switch off and on this automatic ordering possibility. Default setting SHALL be ON.

7.4.2.1. General rules

The receiver SHALL be able to associate with one service (i.e. with a unique triplet) at least the first logical channel number set by the broadcaster in the LC descriptor associated with that service. Support of other possible LCNs (up to 4) associated to the same service is OPTIONAL.

When a viewer uses the channel up-down arrows, the receiver SHALL skip all service numbers which are not allocated or are allocated to “invisible” services.

7.4.2.2. Logical channel number zero

Services associated to logical channel number “0” should be disregarded as part of the process below (irrespective of the value of the visible_service_flag). These services are not intended to be presented as part of the viewer’s service list. These services are not intended to be selectable by viewers.

7.4.2.3. Invisible services

Receivers complying with this specification:

- SHALL support a “default” mode in which they will not show services marked “invisible” in their user service list or selectable in normal P+/P - browsing.

- SHALL ignore the presence of “invisible” services when (re-) allocating services to service numbers requested by “invisible” services.
- SHOULD support a mode (for example as a service mode or as an installation option) in which it will allow direct selection of all services (irrespective of being marked invisible) by the user.

7.4.2.4. Terrestrial delivery

As a consequence of the decided 700MHz bandwidth release by year 2022, DTT in Italy is preparing its migration to T2/ HEVC. This may lead during the transition period to the reception of many service variants with the same LCN or HD_simulcast_LCN (see §1.3.2).

7.4.2.4.1 First initialisation

When a receiver is first initialised or reinitialised (e.g. because the user applied for a factory reset), it is expected that user will be present in front of the receiver.

The receiver SHALL perform in accordance with the following rules:

a) It should give the user the possibility to choose between automatic (LCN-driven) and manual (based on discovery) service numbering (see above).

b) If automatic service numbering has been selected the receiver shall attempt to allocate in the Service List each service with associated LCN(s) to the service number(s) equal to the LCN(s) requested for that service. This rule implies that if there is only one service with a particular logical_channel_number request, it shall be allocated to that service number.

c) In the case of the presence of the same service (identical DVB triplet - ON_id, TS_id & S_id) on two different frequencies, the conflict shall be resolved as described in §7.6.1.5.

d) In the presence of a conflict between different services that request the same logical channel number the receiver shall first check if the conflict would arise between a service from a network from the country selected at first installation time, i.e. from a network whose network_id comes from the range assigned to that country by DVB, and a service from another country. In that case the requested service number will be allocated to the former and the latter will be moved in the so called “Main Overflow”[11].

Secondly, if an LCN conflict still exists, the receiver SHALL categorize the services, regional variants of a service or service variants according to their priority (see Table 16). The conflicting LCN SHALL be allocated to the service with the highest priority whilst services, regional variants of a service or service variants with lower priority SHALL be placed in the “Main Overflow”.

In case of multiple services, regional variants of a service or service variants with the same highest priority the receiver SHALL:

- present the viewer with a menu allowing to select which service to maintain at the requested position; automatic resolution of the conflict, either based on signal power or first/last found during scan, will be performed after expiration of a suitably long timeout
- allocate the other service(s) to the next unallocated number(s) in the Main Overflow.[12]

[11] The Main Overflow occupies service numbers 850 to 999. In case Main Overflow space would get filled up, free positions from 849 backwards SHALL be used)

[12] When an existing service is moved to another multiplex, e.g. because of a network operator reorganizing the services carried across more multiplexes, in order to ease customers’ migration both previous and new service variants may be simulcast for a period of time, which can trigger an LCN conflict. In such a case, if the requested LCN is allocated to the previous service variant, when that service is finally removed, the receiver SHALL re-allocate the new service variant to that LCN, even if the new service variant is placed in the Main Overflow or at a different LCN (see §7.6.1.4 and §7.4.2.4.3)

e) If a service does not have an associated logical_channel_number, it SHALL be allocated an available number in the Main Overflow.

The detailed expected behaviour for cross-border LCN conflicts resolution is the following:

- if a particular LCN position is claimed by only 1 service, it will be granted that position regardless of its network_id (NID) and of the position claimed (i.e. including LCNs in Main Overflow range)
- if more services are competing for the same LCN position
    - if only 1 service has its NID within the range 0x3001 - 0x3100, it will automatically get the requested position
    - if more services have their NIDs within the range 0x3001 - 0x3100, the conflict resolution amongst such services is left up to the customer. Possible competing services whose NIDs is outside the range 0x3001 - 0x3100 will be automatically moved to Main Overflow range (850-999)
    - if all competing services have their NIDs outside the range 0x3001 - 0x3100 the conflict resolution is left up to the customer
    - whatever the above case, all the other services which haven't got the requested position will be moved to Main Overflow range (850-999)

7.4.2.4.2 Adding new services

When adding services to the Service List as a result of an update scan (whether manual or automatically, in stand-by or in operate mode), the receiver shall first try to allocate each new service to the number(s) indicated in the LC descriptor, if any. That applies also to each service which is already in the Service List but at a position different than the LCN itself. Should such position be actually free, the receiver will move the subject service there in the Service List, to cope with services which didn’t have an LCN at the time when they were first tuned.

In case of conflict (i.e. the number is already occupied by a “non-invisible” service or is requested by several services), the receiver shall proceed with the same rules given above for first initialisation (§7.4.2.4.1).

In particular, after signalling to the user that new services are available (as in the procedure described in §7.6.1), the receiver SHALL display a pop-up menu for each case of conflict, to allow the viewer to select which service to allocate to the requested service number. If there is already a service at the requested number, that service SHALL be the first in the list and the one selected by default (e.g. in case of timeout). If the update scan is performed while in stand-by, pop-up menus for conflict resolution SHALL be displayed as soon TV viewing is started after leaving stand-by mode.

7.4.2.4.3 Removing a service

If, during an automatic or a manual update scan, the receiver decides that a service can be removed from the Service List, it will exclude the service and its service number from the Service List and the Master User List.

A service will be considered as removed in case it’s no longer present in the NIT actual and the SDT actual.

After the removal of a service, if its LCN is still requested by another service, the receiver SHALL allocate it to that service. If the LCN is still requested by multiple other services, regional variants of a service or service variants, the receiver SHALL allocate the LCN as described in §7.4.2.4.1 step d).

7.4.3. Service variation options

7.4.3.1. Network re-configuration

For major network reconfigurations, it is recommended that the user proceed with a re-installation, even at the risk of losing his/her custom numbering, if any.

When the receiver detects a service offer change, which includes the addition and deletion of multiple services and/or networks it shall first remove all services which it can determine positively (see Removing a service) to be removed permanently from the service list, and then add the new services.

7.4.3.2. Change of LCN numbering scheme

Any re-arrangement by the broadcasters of LCN numbering of services will be treated as above under network re-configuration. This implies that user changes and non-default allocation of services to service numbers by the receiver should be preserved as much as possible unless a re-installation is done.

7.5. Receiver functions

7.5.1. Service Change

When changing service, parameters need to be set to deal with video formats, languages and unexpected failures in service selection. The minimum requirements for receiver behaviour during service change are outlined in the following paragraphs.

7.5.2. Audio language

It is assumed that the user has entered one or more language preferences during the receiver installation process. If the selected service has audio tracks in more than one language, the language is selected according to the user preferences.

The receiver SHALL behave as follows:

- If preferred languages do not match any of the available languages, then the receiver SHALL automatically select the “undefined” (“und” code of the ISO_639_Language_descriptor) audio stream.
- If “undefined” stream is absent, the stream with the lowest PID (lowest numerical value - unsigned integer) in the specified program SHALL be selected.
- In case no language descriptor is specified the audio stream with the lowest PID SHALL be selected.

In addition to this automatic soundtrack selection, it shall always possible for the user to manually select any of the available languages.

7.5.3. Void

7.5.4. CA controlled services

Where a component cannot be presented due to the presence of scrambling, an error message shall be displayed. Otherwise the receiver shall present the component, even in the presence of a CA descriptor.

7.5.5. Service Not Available

If the video component within a video service, the audio component in a radio service or the data component in a data service cannot be presented because it is no longer accessible on the registered parameters (PID, etc.), an error message is shown to the user indicating that

the service cannot currently be accessed. In case secondary components are missing, the receiver shall present the main component of the service: e.g. a video service with no audio component shall be presented anyway with no error message.

“Service not available” error message SHALL NOT be shown if an HbbTV auto-start application is associated to the service.

The receiver SHALL present all the components of a service it can present.

7.6. Service List initialization and maintenance

A general principle is that any scanning procedure shall make accessible to the user all the services available at a given location.

As new multiplexes or new services inside already existing multiplexes will be started over the time, it is important to make it very easy for the user to enjoy all the new services as soon as they are active, without any need for a manual rescan. Receivers should then be able to automatically and regularly update the service list without the need of direct intervention by the viewer.

Obviously, the viewer has to be able to perform a complete scan at any moment, either manually or automatically. Furthermore, the viewer SHOULD have the possibility to disable the automatic service list update procedure.

7.6.1. Terrestrial delivery

In order to make receivers capable of managing the situations previously described, the following functions SHALL be implemented:

- **manual full scan**: the procedure, initiated by the user, performs a full (automatic) scan of the; it can be used to **update** the channel and service lists or to **re-install** everything from scratch;
- **manual scan (single channel)**: a manual tuning procedure allowing the user to manually select and tune a single VHF/UHF channel (giving for example the channel number);
- **automatic full scan**: the procedure is initiated automatically by the receiver; it performs a full (automatic) scan of the; its only purpose is to update the service list(s);

Receivers SHALL provide a single list containing both DVB-T and DVB-T2 services.

For the terrestrial part of all the described tuning procedures, receivers SHALL scan the following spectrum bands:

- III-VHF (BW=7MHz with European channel raster),
- IV-UHF and V-UHF (BW=8 MHz).

7.6.1.1. First Installation Procedure

- At first installation the receiver SHALL perform an automatic scan over the entire spectrum bands, searching for all the digital services available.
- At the end of the scan, all the services found (audio/video) are stored in the service list
- If automatic ordering of services mechanism is active (based on a logical channel numbering scheme) the resulting lists will be organised according to the criteria described in §7.4.2.4. Otherwise the list will be organised according to frequency scan order.
- The receiver SHALL provide an interface allowing the user to access the list and move or discard services from the list.

7.6.1.2. Manual Full Scan Procedure

7.6.1.2.1 Update

The receiver SHALL:

- update (where necessary) in the list those services which were already existing; for example:
  - the receiver shall detect a service name ("service_name" in SDT) change of a given service and update it unless it was manually edited by the end user;
  - if automatic ordering is active, the receiver shall move, if possible based on the rules given in §7.4.2.4 for allocation and conflict resolution, an existing service to the new position indicated by the LCN;
- insert newly available channels or services (audio/video/data) in the relevant position:
  - if they carry an LCN and automatic ordering is active, the rules given in §7.4.2.4 for allocation and conflict resolution apply;
  - if they don't carry any LCN, if automatic ordering is not active, they will be appended at the end of the list.

7.6.1.2.2 Re-install

Same as §7.6.1.1.

7.6.1.3. Manual Scan Procedure (Single Channel)

Same as §7.6.1.2.1 on single channel.

7.6.1.4. Automatic full scan (Automatic service list update)

To maintain an up to date service list, the receivers SHALL implement an automatic service list update procedure, in accordance with the following requirements:

- The receiver SHALL perform an automatic scan at regular intervals (at a specified hour and with a specified frequency) to search for new services.
- The automatic scan can be performed both in standby mode (recommended) and in operate mode (optional). Refer to the following table for automatic channel scan default settings.
- The automatic scan in either mode can be disabled – separately - by the user, but, as a default setting, it should be active only in stand-by mode. In case user would decide to disable automatic search for new channels in standby mode he/she should be warned that this way the capability of automatically tracking evolution of networks and services will be hindered. For this purpose, a message like "Warning! After disabling this feature the receiver won't be any more able to keep your channel list automatically updated with respect to services on-air" (Italian translation: "Attenzione! Disabilitando questa funzione il ricevitore non sarà più in grado di aggiornare automaticamente la lista canali in base a quelli effettivamente trasmessi") should be presented.
- When the receiver performs the scan, looking for new channels, it compares any single service found with the list of services already registered. This comparison will be based on frequency, Ts_id, On_id and Service_id of the broadcast services. The comparison SHALL consider all services including those that were discarded by the user from the channel/service list and are listed in the "discarded channel list".
- For those services already registered in the service list, the receiver SHALL:
  - detect a "service_name" change and update it unless it was manually edited by the end user;
  - if automatic ordering is active, move an existing service, if possible based on the rules given in §7.4.2.4 for LCN allocation and conflict resolution, to the new position indicated by the LCN;

- If any service is found with frequency, Ts_id, On_id or Service_id different from those of the channels already registered, it will be added to the channel list (in its own category group) according to the following rules:
    - if new service carries an LCN and automatic ordering is active, the rules given in §7.4.2.4 for allocation and conflict resolution apply
    - if a new service doesn't carry any LCN, if automatic ordering is not active, it will be appended at the end of the list.
- If any new service is found a message will be shown on screen when the receiver is switched on (if it was in standby mode) and will be left on screen until the user presses the OK key. The message will be something like: "New channels were found and added to the channel list" (Italian Translation: "Sono stati trovati nuovi canali in onda. I nuovi canali sono stati aggiunti alla lista canali").
- In case both the "search for new channels in standby mode" and the "search for new channels in operate mode" options are set on "YES", then the receiver must start the automatic scan at the time indicated for performing the channel search in operate mode.
- In case the "search for new channels in operate mode" is available and set on "YES", at the time specified for starting the procedure, a 30 seconds countdown will appear on screen with a message like the following: "The receiver will start looking for new channels in … seconds". Italian translation: "Il Box Interattivo comincerà la ricerca di nuovi canali entro … secondi" (mutatis mutandis for IDTV sets). The user will be able to press "OK" for letting the procedure start immediately or "exit" for aborting the procedure. In case the user will choose "exit", the procedure will be aborted and will not be performed again until the next scheduled time.
- In case the "search for new channels in standby mode" option is set on "YES", but the "search for new channels in operate mode" option is available and set on "NO" (or was aborted – refer to previous point), the receiver shall start the scanning procedure some time, implementation dependent, after being put in standby mode (in case the receiver is put in standby mode more than once a day, this procedure has to be performed only once daily).

7.6.1.5. Handling of duplicate services

In the presence of the same service available on different frequencies/Transport Streams, the Receiver shall behave as follows.

When identical services (i.e. with the same original_network_id, transport_stream_id and service_id triplet) are received on different frequencies (obtained from different transmitters or generated by the MATV system), the receiver SHOULD present to the user all of the instances of the service (i.e. including duplicates). In the channel list, the position associated with the lowest ordinal number should be given to the service with the best QoS. Extra instances of services should be regrouped at the end of the list.

The minimum requirement is that only the instance with best C/N out of the services with the same DVB triplet found during scan shall be kept, provided that the situation is revisited at each automatic or manual rescan.

In the context of interactive applications (e.g. an EPG) the (unique) DVB Locator of duplicate services shall refer to the one with the best QoS. (In case of equivalent QoS, it shall refer to the service first discovered).

7.6.2. Void

7.6.3. Default settings for automatic scan

N.	Settings / Italian Translation	Default settings
1	"Automatic search for new channels in standby mode" / "Ricerca automatica di nuovi canali in standby"	YES / SI' (MANDATORY)
2	"Automatic search for new channels in operate mode" / "Ricerca automatica di nuovi canali a decoder acceso"	NO / NO (if available)
3	"Time" / "Ora"	04:30 AM
4	"Repetition" / "Frequenza"	"Daily" / "Quotidiana" = default ("Weekly" / "Settimanale" – other options possible)

Table 20: Default settings for automatic scan

7.6.4. Automatic Ordering of Channels and Services in the absence of LC descriptor acquisition

If the off-the-air LC descriptor acquisition mechanism is not activated in the receiver, the services shall appear in the order they have been detected (considering the procedure described in §7.6.2) and grouped into three categories in the following order:

- TV channels
- Radio channels

Interactive services linked to TV or Radio services shall not be shown.

7.6.5. Network evolution

As specified in Table 20 on default settings for automatic scan, the receiver SHALL implement, by default, an automatic scanning procedure, to adapt the receiver to the evolution of the network.

As specified in §6.1.1.1, changes in modulation parameters of existing services SHALL be automatically detected.

7.6.6. Default channel numbering of services

No default service numbering shall be implemented by manufacturers.

7.7. User interface to SI carried data

This clause describes the minimum set of views of the SI information that receivers SHALL (M), SHOULD (R) or MAY (O) be able to present to the user.

The minimum lengths for text fields (if present) that shall be displayed by receivers are defined in the following table. Note that the figures given are for the number of displayable characters (including spaces) required to represent the text field. The number of bytes required will depend on the use of control codes and whether one- or two-byte character representation is used.

Field name	Field length in displayable characters	M/R/O	Comments and examples
Network Name	247	O	"Operator X"
Service Provider Name	20	O	"Media Company Y"

Field name	Field length in displayable characters	M/R/O	Comments and examples
Service Name or Preferred Name	32	M	“Italia International” Full name for display on set-up menus
Short Name of Service	8	O	“It.Int” A short version for display on browse and listing display. Possibly shortened by broadcasters from full name by use of escape characters as defined in TR 101 211. Otherwise the full length Service Name should be displayed.
Event Name	40	M	“La Grande Zia” Individual broadcasters are free to add an episode title to the title within the space, for example “Lo Zio: la Storia Segreta”
Short Event description	200	M	“Un giorno, Zio esce per cercare sigarette. Torna venti anni dopo.” Broadcasters must ensure that the text does not overflow the maximum descriptor size.
Extended Event Text	3984	O	The extended event text complements the short event description.
Component description	32	O	“In alta definizione”

Table 21: Text Field Lengths

7.7.1. Timer

Must be locked to the Time & Date Table (TDT) and adjusted by the Time Offset Table (TOT), if broadcast.

7.7.2. Access to the Service List

Access to the Service List SHALL be provided through a dedicated key (recommended) or by a resident menu. This list SHALL present TV Channels, Radio Channels, and Independent Interactive services (i.e. when they are not bound to a TV or a Radio service, or another Interactive Service) following the indication of the associated LC descriptor.

If the LCN acquisition mechanism is not active, the Service List SHALL be grouped by:

- TV services,
- Radio services

8. Void

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9. Resident Software

9.1. Services

9.1.1. Teletext

Teletext [12] is an important medium in Italy. Not all analogue Teletext services will immediately be converted to interactive applications. Thus, there is a need to maintain compatibility with DVB Teletext [11].

The DVB Teletext signal shall be decoded and presented within the receiver and displayed using graphical functions (so-called Teletext Mode 2). That's particularly true for STBs as (analogue) VBI Teletext signal cannot be carried across (digital) HDMI interface. At least level 1.5 Teletext, as defined in ETS 300 706 [12], shall be supported.

One single remote control is then sufficient to view audiovisual services and Teletext using the "Text" key.

In order to preserve customers' investments in TV sets with advanced Teletext features, Teletext signal shall be anyway reinserted on the TV SCART and RCA (if present) VBI lines. Insertion shall conform to ITU-R BT.653-2 [31]. Teletext data will be inserted from lines 6 to 22 and 320 to 335.

It is recommended that VBI data, including Teletext, be reinserted on the VCR SCART (including the Y/C signals) when present (see 6.1.4.2), even if many VCRs will not be able to replay this data. Insertion shall conform to ITU-R BT.653-2 [31]. Teletext data will be inserted from lines 6 to 22 and 320 to 335.

9.1.2. Subtitling

Concerning subtitling it is expected that broadcasters will follow the EBU recommendation on subtitling in digital services [7]. However, compatibility must also be maintained with subtitling through Teletext.

As a consequence, the receiver SHALL implement DVB Subtitling and Teletext subtitling.

9.1.2.1. DVB Subtitling

DVB Subtitling SHALL be implemented in conformance with [18].

HD Subtitling SHALL be implemented according to [31].

A Display Definition Segment SHALL only be included in the subtitle stream when the video is HD. The maximum display_width SHALL be 1919 and the maximum display_height SHALL be 1079. It is RECOMMENDED that receivers support Display Definition Segments.

9.1.2.2. Teletext Subtitling

Teletext subtitling is part of both Teletext modes described above. Information about the presence of Teletext subtitles shall be obtained from the teletext descriptor and this information shall be made available to the user, at his request (e.g. when pressing the "Sub" key, or through a banner).

It is acceptable to make the user select the relevant teletext page for viewing subtitles, as long as a clear message on the availability and modality of access to the subtitles is presented to the user (e.g. a channel banner).

Where possible, receivers should be able to display both subtitles and interactive graphics simultaneously. However, not all receivers may be able to do this: in that case, when an application is activated, it shall be able to suspend the rendering of Teletext.

9.2. Resident Software

9.2.1. Resident Manufacturer Specific Applications

9.2.1.1. Navigator

It SHALL be present. It is defined by the manufacturer.

9.2.1.1.1 Handling of input events by the Navigator

When the receiver is in TV Viewing Mode (see definition in §4.1), it is expected that any running application shall release input keys VK_0 to VK_9. The Navigator shall always be able to handle those input events.

The Navigator must also handle all the other keys used for TV viewing (e.g. channel list, volume, and program up/down).

9.2.2. Parental Control

The receiver shall provide a PIN-controlled Parental Control menu to perform the following functions:

1) setting age thresholds (at least for 14 and 18 years) for viewing single events
2) changing the PIN value
3) activating/deactivating PIN checking on 1), 2), 3) above and on the menu itself

The PIN value SHALL be explicitly set by the user during installation procedure. In conformance with National Authority AGCOM requirements, manufacturers SHALL NOT provide a default value for such a PIN. Reset of the PIN, e.g. in case it was forgotten, can only be achieved through an overall receiver reset to the out-of-the-box status. User SHOULD be duly warned about this drawback during installation procedure.

From the receiver Parental Control menu, it shall be possible setting an age threshold to be matched against the value set by broadcasters, on a per event/content basis, in the Parental_rating_descriptor of the EIT.

If this value is equal or greater than the age threshold set, the current event can be viewed only entering a PIN. Such PIN is the same as the receiver's Parental Control PIN (if any). The PIN protection can be enabled/disabled by means of an appropriate receiver menu. At least the 14- and 18-years thresholds must be present.

The parental rating is associated to one or more countries through the country_code in EIT's Parental_rating_descriptor.

That could either be a code assigned to a single country (e.g. "ITA" for Italy) or to an ETSI defined group of countries (e.g. "902" for all countries, "905" for Europe). A given parental rating will be applicable if the associated country code would match or include the country set in the receiver at installation time.

By default, the receiver shall be set to block all events and/or channels flagged with an 18 years threshold.

Locking/unlocking single services could be also optionally offered by manufacturers. In this case from the Parental Control menu it will be possible to lock one or more specific services so that they can be viewed only entering a PIN. Such PIN is the same as the receiver's Parental Control PIN (if any). The PIN protection can be enabled/disabled by means of an appropriate receiver menu.

9.3. Void

9.4. Maintenance and Upgrade

In order to protect consumers from bugs in receivers' firmware and possible unexpected mismatches with services on air, manufactures SHALL provide some proprietary means to allow customers to update the software installed on their receivers.

As a minimum requirement, software update manually performed via USB SHALL be supported.

Should the receiver have broadband connectivity, Ethernet and/or WiFi, automatic software update over the network from manufacturer's repository would provide a better service to customers.

After a software update has been performed, user settings like services listings (preferred, etc,) SHOULD be preserved, whenever feasible.

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10. Accessories and Setup

Receivers must be both easy to install and use. An existing viewer of analogue services needs to be able to complete a basic digital installation, i.e. just for viewing, using only what has been supplied with the receiver. In addition, on-screen information must be provided in a clear and consistent manner both to aid installation and (if required) to enable an easy dialogue with any support staff, e.g. call-centre

10.1. Receiver Accessories

The manual should contain at least the following information:

- Advice on the verification and eventual adaptation of reception equipment
- The modes of connection of other peripheral appliances (TV, VCR, DVD, other STB)
- Set up and tuning of the receiver
- Description of the functions of the remote control keys
- Options and accessories (e.g. Infra-red Keyboard, etc…)
- Troubleshooting

Accessory	Presence
1 Power Cable	Mandatory
Handbook in Italian language	Mandatory

Table 22: Accessories

10.2. Power Supply / Voltage

220V AC + 15%; 50 + 2 Hz (Low Voltage recommendation 73/23/CEE e 93/68/CEE. Law n° 971/1977).

10.3. Low-power mode

In order for receivers supporting a low-power standby feature, based on mandatory or voluntary EU ecodesign requirements, to meet operators' needs (e.g. rights refresh for Pay TV services, spot software upgrade campaigns), the following recommendations/constraints apply:

1. It SHOULD be possible disabling/enabling low-power standby mode through a dedicated menu option
2. before entering low-power standby mode receivers SHALL perform, if currently enabled, automatic channel list update and software upgrade
3. transition from normal to low-power stand-by mode SHOULD take at least 1 hour
4. low-power standby mode SHOULD NOT last longer than 23 consecutive hours before normal stand-by is entered; after housekeeping (point 2) is performed and proper transition time waited (point 3), low-power standby mode will be entered again.

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11. Default settings

The following is a list of the overall default settings of the receiver. These requirements are intended to provide to all receivers on the market a very similar behaviour when they are installed or restored to factory defaults.

Those strictly related to broadcasters' services and applications (Parental Control, Automatic OTA Update, Automatic Channel Update, LCN) SHALL be compliant with the table below. The rest should be considered by manufacturers just as a suggestion.

Feature	Specification	Status	Note
Present and Next banner			
• Duration	Less or equal to 4 sec.	Mandatory	
• Current Time	Active	Optional	
• Channel number	Active	Mandatory	
• Service name	Active	Mandatory	Long "channel name" label
• Volume indicator	Active	Optional	If the receiver allows to locally control volume, the volume bar SHALL be present
Country	As per after the first installation	Mandatory	After first installation the default country SHALL be Italy
Language options			
• Language	As per after the first installation	Mandatory	After first installation the default language SHALL be Italian
• Primary Audio	As per after the first installation	Mandatory	
• Subtitles	Not Active	Mandatory	
• Primary Subtitles language	As per after the first installation	Mandatory	
Automatic Channel Numbering	Active	Mandatory	This is a toggle active/inactive
TV settings			
• Screen Format	16:9	Mandatory	
• HDMI output format	As per after the first installation	Mandatory	
• TV SCART output	RGB	Mandatory	
• VCR SCART output	CVBS	Mandatory	when available

Feature	Specification	Status	Note
Parental Control settings			
PIN protected events	PIN SHALL be asked for any event with rating value equal or greater than 18 years	Mandatory	
Automatic channel list update			
..in Standby mode	Active	Mandatory	
..in Operate mode	Not Active	Optional	
Time	4:30 am	Mandatory	
Repetition	Daily	Mandatory	

Table 23: Default settings summary table

Annexes

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A DVB-T2 Performance Tables[13]

A.1 FEF and Auxiliary streams

To test that FEFs do not cause malfunctions the following T2+FEF test signal shall be generated and input to the receiver, with FEF power same as T2 signal and no added noise. The receiver should be able to receive this signal with no errors in the displayed video for PLP#0.

Property	*Value*
Overall	
FFTSIZE	32k
GI	1/16
Lf	62
SISO/MISO	SISO
PAPR	TR-PAPR
Frames per superframe (N_{T2})	6
Bandwidth	8MHz
Extended Bandwidth Mode	Yes
Pilot Pattern	PP4
L1 Modulation	64QAM
FEF Type	0
FEF Length (samples)	588000
FEF Interval	6
FEF P1: S1 Value	2
FEF P1: S2 Value	1
L1 Repetition	0
PLP #0	
Type	1
Modulation	256QAM
Rate	3/5
FEC Type	64800
Rotated QAM	Yes
FEC blocks per interleaving frame	200
TI blocks per frame (N_TI)	3
T2 frames per Interleaving Frame (P_I)	1
Frame Interval (I_JUMP)	1
Type of time-interleaving	0
Time Interleaving length	3

Table 24: FEF test signal

To test that the presence of Auxiliary streams does not cause malfunctions the following test signal shall be generated and input to the receiver, with no added noise. The receiver, with Auxiliary streams enabled, should be able to receive this signal with no errors in the displayed video for PLP#0.

[13] All data specified in this Annex are preliminary because DVB-T2 experience in real operations is very limited, especially in case of SFN

Property	Value
Overall	
FFTSIZE	32k
GI	1/16
Lf	62
SISO/MISO	SISO
PAPR	TR-PAPR
Frames per superframe (N_{T2})	6
Bandwidth	8MHz
Extended Bandwidth Mode	Yes
Pilot Pattern	PP4
L1 Modulation	64QAM
FEFs	Not used
L1 Repetition	0
PLP #0	
Type	1
Modulation	256QAM
Rate	3/5
FEC Type	64800
Rotated QAM	Yes
FEC blocks per interleaving frame	200
TI blocks per frame (N_TI)	3
T2 frames per Interleaving Frame (P_I)	1
Frame Interval (I_JUMP)	1
Type of time-interleaving	0
Time Interleaving length	3

Table 25: Auxiliary streams test signal

A.2 C/N Performance

Examples of C/N values and sensitivity are given in the following tables.

AWGN and “0dB echo” C/N calculations are based on NorDig [6] and EBU [14] assumptions for implementation losses.

Ricean and Rayleigh C/N calculations are based on EBU assumptions [14].

Modulation	Code rate	C/N performance (dB)							
		32KE PP2 C/N (dB)				32KE PP2 Sensitivity 8MHz, NF=6, 290K (dBm), Px=-33dBc			
		Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)	Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)
QPSK	1/2	3.5	3.7	4.5	5.2	-95.6	-95.4	-94.6	-93.9
QPSK	3/5	4.7	4.9	6.0	6.8	-94.4	-94.2	-93.1	-92.3
QPSK	2/3	5.6	5.9	7.4	8.4	-93.5	-93.2	-91.7	-90.7
QPSK	3/4	6.6	6.9	8.7	9.8	-92.5	-92.2	-90.4	-89.3
QPSK	4/5	7.2	7.6	9.6	10.9	-91.9	-91.5	-89.5	-88.2
QPSK	5/6	7.7	8.1	10.4	12.0	-91.4	-91.0	-88.7	-87.1
16 QAM	1/2	8.7	8.9	10.2	10.9	-90.4	-90.2	-88.9	-88.2
16 QAM	3/5	10.1	10.3	11.8	12.7	-89.0	-88.8	-87.3	-86.4
16 QAM	2/3	11.4	11.6	13.3	14.3	-87.7	-87.5	-85.8	-84.7
16 QAM	3/4	12.5	12.9	14.9	16.3	-86.6	-86.2	-84.1	-82.8

Modulation	Code rate	C/N performance (dB)							
		32KE PP2 C/N (dB)				32KE PP2 Sensitivity 8MHz, NF=6, 290K (dBm), Px=-33dBc			
		Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)	Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)
16 QAM	4/5	13.3	13.7	16.2	17.8	-85.8	-85.4	-82.9	-81.3
16 QAM	5/6	13.8	14.2	17.0	18.9	-85.3	-84.8	-82.1	-80.1
64QAM	1/2	13.0	13.3	15.0	16.0	-86.1	-85.8	-84.0	-83.1
64QAM	3/5	14.8	15.1	16.9	18.0	-84.2	-83.9	-82.2	-81.1
64QAM	2/3	16.2	16.5	18.3	19.7	-82.9	-82.6	-80.8	-79.4
64QAM	3/4	17.7	18.0	20.4	22.0	-81.4	-81.1	-78.7	-77.1
64QAM	4/5	18.7	19.2	22.0	24.0	-80.3	-79.8	-77.1	-75.1
64QAM	5/6	19.4	19.8	23.0	25.5	-79.7	-79.3	-76.1	-73.6
256 QAM	1/2	17.0	17.4	19.5	20.6	-82.1	-81.7	-79.6	-78.5
256 QAM	3/5	19.4	19.6	21.7	23.1	-79.7	-79.5	-77.4	-76.0
256 QAM	2/3	20.8	21.1	23.3	25.1	-78.2	-77.9	-75.8	-73.9
256 QAM	3/4	22.9	23.2	25.8	28.0	-76.2	-75.9	-73.2	-71.1
256 QAM	4/5	24.3	24.8	28.0	30.8	-74.8	-74.3	-71.1	-68.2
256 QAM	5/6	25.1	25.6	29.5	33.6	-73.9	-73.5	-69.6	-65.5

Table 26: Example of maximum required C/N and sensitivity for QEF reception at TS output (PP2 and FFT size 32KE)

Modulation	Code rate	C/N performance (dB)							
		32KE PP4 C/N (dB)				32KE PP4 Sensitivity 8MHz, NF=6, 290K (dBm), Px=-33dBc			
		Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)	Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)
QPSK	1/2	3.1	3.3	4.1	4.8	-96.0	-95.8	-95.0	-94.3
QPSK	3/5	4.3	4.5	5.6	6.4	-94.8	-94.6	-93.5	-92.7
QPSK	2/3	5.2	5.5	7.0	8.0	-93.9	-93.6	-92.1	-91.1
QPSK	3/4	6.2	6.5	8.3	9.4	-92.9	-92.6	-90.8	-89.7
QPSK	4/5	6.8	7.2	9.2	10.5	-92.3	-91.9	-89.9	-88.6
QPSK	5/6	7.3	7.7	10.0	11.6	-91.8	-91.4	-89.1	-87.5
16 QAM	1/2	8.3	8.5	9.8	10.5	-90.8	-90.6	-89.3	-88.6
16 QAM	3/5	9.7	9.9	11.4	12.3	-89.4	-89.2	-87.7	-86.8
16 QAM	2/3	11.0	11.2	12.9	13.9	-88.1	-87.9	-86.2	-85.2
16 QAM	3/4	12.1	12.5	14.5	15.8	-87.0	-86.6	-84.6	-83.2
16 QAM	4/5	12.9	13.3	15.7	17.4	-86.2	-85.8	-83.3	-81.7
16 QAM	5/6	13.4	13.8	16.5	18.5	-85.7	-85.3	-82.5	-80.6
64QAM	1/2	12.6	12.9	14.6	15.5	-86.5	-86.2	-84.5	-83.5
64QAM	3/5	14.4	14.7	16.4	17.6	-84.7	-84.4	-82.6	-81.5
64QAM	2/3	15.7	16.0	17.9	19.2	-83.3	-83.0	-81.2	-79.8
64QAM	3/4	17.3	17.6	20.0	21.6	-81.8	-81.5	-79.1	-77.5
64QAM	4/5	18.3	18.8	21.6	23.5	-80.8	-80.3	-77.5	-75.6
64QAM	5/6	18.9	19.3	22.5	25.0	-80.2	-79.7	-76.6	-74.1
256 QAM	1/2	16.5	17.0	19.0	20.2	-82.5	-82.1	-80.1	-78.9
256 QAM	3/5	18.9	19.1	21.2	22.6	-80.2	-79.9	-77.8	-76.4
256 QAM	2/3	20.4	20.7	22.9	24.6	-78.7	-78.4	-76.2	-74.4
256 QAM	3/4	22.4	22.7	25.3	27.4	-76.7	-76.3	-73.7	-71.7
256 QAM	4/5	23.8	24.3	27.4	30.2	-75.2	-74.8	-71.7	-68.9
256 QAM	5/6	24.6	25.1	28.9	32.7	-74.4	-74.0	-70.2	-66.3

Table 27: Example of maximum required C/N and sensitivity for QEF reception at TS output (PP4 and FFT size 32KE)

Modulation	Code rate	C/N performance (dB)							
		32KE PP4 C/N (dB)				32KE PP4 Sensitivity 8MHz, NF=6, 290K (dBm), Px=-33dBc			
		Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)	Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)
QPSK	1/2	2.4	2.6	3.4	4.1	-96.6	-96.4	-95.6	-94.9
QPSK	3/5	3.6	3.8	4.9	5.7	-95.4	-95.2	-94.1	-93.3

Modulation	Code rate	C/N performance (dB)							
		32KE PP4 C/N (dB)				32KE PP4 Sensitivity 8MHz, NF=6, 290K (dBm), Px=-33dBc			
		Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)	Profile1 Gaussian (AWGN)	Profile2 (Ricean) F1	Profile3 (Rayleigh) P1	Profile4 (0dB echo)
QPSK	2/3	4.5	4.8	6.3	7.3	-94.5	-94.2	-92.7	-91.7
QPSK	3/4	5.5	5.8	7.6	8.7	-93.5	-93.2	-91.4	-90.3
QPSK	4/5	6.1	6.5	8.5	9.9	-92.9	-92.5	-90.5	-89.2
QPSK	5/6	6.6	7.0	9.3	11.0	-92.4	-92.0	-89.7	-88.1
16 QAM	1/2	7.6	7.8	9.1	9.9	-91.4	-91.2	-89.9	-89.2
16 QAM	3/5	9.0	9.2	10.8	11.7	-90.0	-89.8	-88.3	-87.4
16 QAM	2/3	10.4	10.6	12.3	13.3	-88.7	-88.5	-86.8	-85.8
16 QAM	3/4	11.5	11.9	13.9	15.2	-87.6	-87.2	-85.2	-83.9
16 QAM	4/5	12.3	12.7	15.1	16.7	-86.8	-86.4	-84.0	-82.3
16 QAM	5/6	12.8	13.2	15.9	17.9	-86.3	-85.9	-83.2	-81.2
64QAM	1/2	12.0	12.3	14.0	14.9	-87.1	-86.8	-85.1	-84.2
64QAM	3/5	13.8	14.1	15.8	16.9	-85.3	-85.0	-83.3	-82.1
64QAM	2/3	15.1	15.4	17.2	18.6	-84.0	-83.7	-81.8	-80.5
64QAM	3/4	16.6	16.9	19.3	20.9	-82.4	-82.1	-79.8	-78.2
64QAM	4/5	17.7	18.2	20.9	22.8	-81.4	-80.9	-78.2	-76.2
64QAM	5/6	18.3	18.7	21.9	24.3	-80.8	-80.4	-77.2	-74.8
256 QAM	1/2	15.9	16.3	18.4	19.5	-83.2	-82.8	-80.7	-79.6
256 QAM	3/5	18.3	18.5	20.6	22.0	-80.8	-80.6	-78.5	-77.1
256 QAM	2/3	19.7	20.0	22.2	23.9	-79.3	-79.0	-76.9	-75.1
256 QAM	3/4	21.7	22.1	24.6	26.6	-77.3	-77.0	-74.5	-72.4
256 QAM	4/5	23.2	23.6	26.6	29.3	-75.9	-75.5	-72.4	-69.8
256 QAM	5/6	23.9	24.4	28.0	31.6	-75.1	-74.7	-71.0	-67.5

Table 28: Example of maximum required C/N and sensitivity for QEF reception at TS output (PP7 and FFT size 32KE)

Note 1: Values do not include any possible additional Implementation Loss for Ricean (e.g. 0.5dB) and Rayleigh (e.g. 0.75dB) that can be adopted as “safety margin” for receiver conformance purposes only. It’s expected that this possible additional margin shall be included into the typical (e.g. 1 dB) “measurement error margin” that is always admitted for receiver conformance purposes.

Note 2: Values of Sensitivity are calculated under the assumption NF= 6dB

Note 3: Values of sensitivity for 32KN (8MHz BW) can be obtained considering the difference of the signal BW between the two cases (7.77 MHz vs. 7.61 MHz), giving for 32KN a reduction of approximately 0.1 dB with respect to the case of 32KE. Values of sensitivity in case of 7MHz BW can be obtained accordingly to the previous rule (6.80 MHz for 32KE and 6.66 MHz for 32KN) giving a value of approx. 0.6 dB less than the case of 8MHz BW.

Note 4: Receivers shall be capable of QEF reception for all the DVB-T2 possible modes (as from the list of “Mandatory requirement”) listed in this version of HD Book. Additional values for the C/N Performance (e.g. valid for PP1) can be obtained using similar assumptions to those in [14] and [6].

Note 5: C/N values in the Tables can be used for 32KN FFT size and also for other FFT sizes e.g. 16K. Guard Interval does not influence C/N and, therefore, sensitivity.

Profile 1: Gaussian noise (N) is applied together with the wanted carrier (C) in a signal bandwidth of a DVB-T2 signal. No echo is applied.

Profile 2: The Ricean channel is defined according to the following table (derived from Table B.1 of [13]). Path #14 is omitted.

Profile 3: The Rayleigh channel definition is derived from the following table as well by removing path #0 and re-normalising amplitude values.

#	normalised ρi [dB]	τi(μs)	θi(deg)
0	-0.4	0.000	0
1	-24.0	0.074	122
2	-27.5	0.144	226
3	-36.8	0.154	63
4	-27.5	0.194	198
5	-26.4	0.204	63
6	-21.6	0.430	340
7	-18.8	0.519	336
8	-22.8	0.603	215
9	-24.1	0.641	191
10	-22.6	0.849	36
11	-23.4	0.924	210
12	-35.8	1.003	278
13	-35.2	1.017	311
14	-22.7	1.369	23
15	-29.7	1.381	162
16	-19.0	1.936	9
17	-21.4	2.752	127
18	-20.1	3.229	175
19	-25.7	3.325	331
20	-26.1	5.422	196

Table 29: Ricean channel definition

Profile 4: The “0 dB echo” is the combination of two paths at the same level. The 0 degree channel center shall be used in fading simulator and attenuation 0dB for the second path with delay 1.95μs. In this context it means that the carriers from the direct and echo signal are cumulative and the output power of the simulator is the power sum of the two paths.

A.2.1 Behaviour in the presence of echoes inside the guard interval

The receiver SHALL provide the reference BER (QEF) when the DVB-T2 channel contains two (or more) static paths with relative delay from 1 μs up to 95% of the guard interval length, independently of the relative amplitude and phases of the paths. No noise is added.

A.2.2 Behaviour in the presence of echoes outside the guard interval

QEF reception SHALL be possible for 32k FFT modes with echo levels up to the values defined in the following tables (Echo attenuation in dB relative reference).

Delay -/+ μs (8MHz channels)	120	150	200	230	260
Delay -/+ μs (7MHz channels)	135	165	215	266	298
256QAM, PP4, GI 1/16, code 3/5	-	-	-	2.0	4.0
256QAM, PP4, GI 1/16, code 2/3	-	-	-	3.0	6.0
256QAM, PP4, GI 1/16, code 3/4	-	-	-	4.0	8.0
256QAM, PP4, GI 1/32, code 3/5	2.0	4.0	7.0	9.0	10.0
256QAM, PP4, GI 1/32, code 2/3	3.0	6.0	10.0	11.0	12.0
256QAM, PP4, GI 1/32, code 3/4	4.0	8.0	12.0	13.0	14.0

Table 30: QEF reception for echoes outside the guard interval for PP4

Delay -/+ µs (7MHz channels)	266	298	400	512	608
256QAM, PP2, GI 1/16, code 3/5	2.0	4.0	9.0	11.0	12.0
256QAM, PP2, GI 1/16, code 2/3	3.0	6.0	11.0	14.0	15.0
256QAM, PP2, GI 1/16, code 3/4	4.0	8.0	14.0	16.0	18.0

Table 31: QEF reception for echoes outside the guard interval for PP2, GI 1/16, 7MHz

Delay -/+ µs (8MHz channels)	120	150	200	230	260
Delay -/+ µs (7MHz channels)	135	165	215	266	298
256QAM, PP2, GI 1/8, code 3/5	3.5	5.5	7.0	8.0	8.5
256QAM, PP2, GI 1/8, code 2/3	5.0	7.0	8.5	9.5	10.0
256QAM, PP2, GI 1/8, code 3/4	7.0	9.0	10.5	11.5	12.0

Table 32: QEF reception for echoes outside the guard interval for PP2, GI 1/8

As a non-mandatory indication of typical receiver performance, QEF reception in case of three SFN static paths inside the guard interval and one SFN static path outside the guard interval should be possible for the T2 modes and echo profiles below:

- 8MHz, FFT 32K, 256QAM, CR 2/3, PP4, GI 1/16

Path (tap)	Delay (µs)	Relative attenuation (dB)
1 (useful)	0	6
2 (useful)	50	0 (reference -60 dBm)
3 (useful)	180	10
4 (interference)	270	20.7

Table 33: Test set-up (PP4) for pre-echoes and echoes outside the guard interval (informative)

- 8MHz, FFT 32K, 256QAM, CR 2/3, PP2, GI 1/8

Path (tap)	Delay (µs)	Relative attenuation (dB)
1 (useful)	0	6
2 (useful)	50	0 (reference -60 dBm)
3 (useful)	180	10
4 (interference)	550	21.1

Table 34: Test set-up (PP2) for pre-echoes and echoes outside the guard interval (informative)

A.2.3 Behaviour in the presence of co-channel interference

QEF reception shall be possible in the presence of a DVB-T/T2 co-channel interferer with a C/I level according to column “C/N Ricean” (profile 2) in Table 26, Table 27 and Table 28 when the interference is uncorrelated with the wanted signal.

As a non-mandatory indication of typical receiver performance, in the case of a co-channel interference where the interferer may be correlated with the wanted DVB-T2 signal symbol timing and pilot pattern (e.g. inside an SFN), an additional margin of 1dB should be added.

A.2.4 Behaviour in the presence of digital signal in other channels

Reference is the NorDig Unified specification [6], chapter 3.4.10.6.1 “Immunity to DVB-T/T2 signals in other channels”.

A.2.5 Behaviour in the presence of co-channel analogue signals

Reference is the NorDig Unified ver. 2.4 [15], chapter 3.4.10.8 “Immunity to Co-Channel Interference from Analogue TV signals”.

The receiver shall perform better than specified in Table 35 when an 8MHz DVB-T2 signal is exposed to interference from a co-channel G/PAL signal including video with teletext, an FM sound and a NICAM sub carrier. The level of the FM sound relative to the vision carrier is -13 dB. The level of the NICAM signal relative to the vision carrier is -20 dB.

Constellation	***256 QAM***		
Code rate	3/5	2/3	3/4
C/I	3 dB	5 dB	7 dB

Table 35: Carrier to Interference, C/I (dB) for QEF reception, when DVB-T2 signal is interfered with by an analogue TV carrier.

A.3 List of some DVB-T2 modes for different types of networks and receiving conditions

Table 36 shows a list of suitable T2 modes for a number of different network configurations and receiving conditions. It represents only a small sample of all the T2 modes that are possible. The intent is to give some examples, without limiting the possibility to adopt different T2 modes.

Being the exact Bit-Rate of these modes subject to the choice of other parameters like, e.g., Lf and L1mod (and the combination of the PLPs in case of multiple PLP), all the values in the table are rounded and given only as an indicative value.

Type	***Very Large SFN***	***Very Large SFN***	***Large SFN-MISO***	***Large SFN***	***Local SFN***	***MFN***	***Portable***	***Mobile***	***Fixed/ Portable***	***Fixed/Mobile***	
	Single PLP								**Multiple PLP**	**T2 Base/Lite**	
Examples	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	
FFT	32K	32K	32K	32K	32K	32K	16k	16k	32K	32K	8K
BW Extension (E/N)	E	N	E	E	E	N	E	E	E	E	N
GI	1/8	1/8	19/256	1/16	1/32	1/128	1/4	1/4	1/8	1/16	1/4
GI duration (µs)	448	448	266	224	112	28	448	448	448	224	224
PP	PP2	PP2	PP2	PP4	PP4	PP7	PP1	PP1	PP2	PP4	PP1
PLP1 Modulation	256QAM	256QAM	256QAM	256QAM	256QAM	256QAM	64QAM	16QAM	256QAM	256QAM	QPSK
Rotation (R/NR)	R	NR	R	R	R	R	NR	R	R	R	R
PLP1 Code rate	2/3	¾	2/3	2/3	2/3	3/5	3/4	1/2	3/4	3/4	2/3
PLP2 Modulation	-	-	-	-	-	-	-	-	16QAM	-	-
Rotation (R/NR)	-	-	-	-	-	-	-	-	R		
PLP2 Code rate	-	-	-	-	-	-	-	-	3/4	-	-
SISO/MISO	SISO	SISO	MISO	SISO	SISO	SISO	SISO	SISO	SISO	SISO	SISO
T2-Base/Lite	T2-Base	T2-Base	T2-Base	T2-Base	T2-Base	T2-Base	T2-Base	T2-Base	T2-Base	T2-Base	T2-Lite
Bit-Rate (Mbit/s)	33	36	34	36	38	35	25	11	33	28	1,9

Table 36: List of some DVB-T2 Modes

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B DVB-T Minimum input level

QEF reception (BER 2E-4 after Viterbi) shall be possible with the minimum input levels in the table below for UHF Channels (8MHz BW), FFT 8k and GI 1/4.

Below table is based on the values in [6] (Table 3.14) and in [5] (Table 2.2). Values for “60s Error free video” are given as a suitable reference for measurement purposes. The description of the “60s Error free video” method is included in [5] at paragraph 2.3.2 (QEF Quality Measurement Methods).

The value for 64QAM 5/6 and the profile 4 (0 dB echo) for “60s Error free video”, is indicative only. It is an expected value for a typical DVB-T receiver.

Reference values for VHF channels (7 MHz BW) are those in [6] (Table 3.14) and [5] (Table 2.2).

		Minimum input level (dBm)			
		Profile 1 Gaussian		Profile 4 0 dB echo	
		UHF Band IV & V 8 MHz signal		UHF Band IV & V 8 MHz signal	
Modulation	Code rate	"60 s Error free video"	BER 2E-4 after Viterbi	"60 s Error Free video"	BER 2E-4 after Viterbi
QPSK	1/2	-94.4	-93.1	-90.6	-89.4
QPSK	2/3	-92.6	-91.3	-86.3	-84.5
QPSK	3/4	-91.6	-90.3	-84.1	-80.8
QPSK	5/6	-90.6	-89.3	-	-
QPSK	7/8	-89.8	-88.5	-	-
16 QAM	1/2	-88.7	-87.4	-86.1	-84.9
16 QAM	2/3	-86.4	-85.1	-81.9	-80.3
16 QAM	3/4	-84.9	-83.6	-79.2	-76.1
16 QAM	5/6	-83.9	-82.6	-	-
16 QAM	7/8	-83.5	-82.2	-	-
64 QAM	1/2	-83.0	-81.7	-80.4	-79.2
64 QAM	2/3	-80.8	-79.5	-76.4	-75.0
64 QAM	3/4	-79.3	-78.0	-73.4	-70.6
64 QAM	5/6	-77.9	-76.6	-69.0	-
64 QAM	7/8	-77.0	-75.7	-	-

Table 37: DVB-T minimum input levels (dBm)

Note: Values in above table are calculated under the assumption NF= 7dB.

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D Allocation and usage of SI codes in Italy

D.1 Allocation of SI codes

As explained the Italian DTT environment is "*multi-network*" and "*multi-operator*". According to DVB SI Specification [10] and SI Guidelines [20]:

- a **network** is a collection of MPEG-2 Transport Stream (TS) multiplexes transmitted on a single delivery system (e.g. all digital channels on a specific cable or **terrestrial** system)
- a **service** is uniquely identified by the following parameters (the DVB locator):
  - **original_network_id (ON_ID):** unique identifier of a network
  - **transport_stream_id (TS_ID):** unique identifier of a TS within an original network.
  - **service_id (S_ID):** unique identifier of a service within a TS

The network_id (N_ID) is not part of this path.

The following figure shows the service delivery model for digital broadcasting:

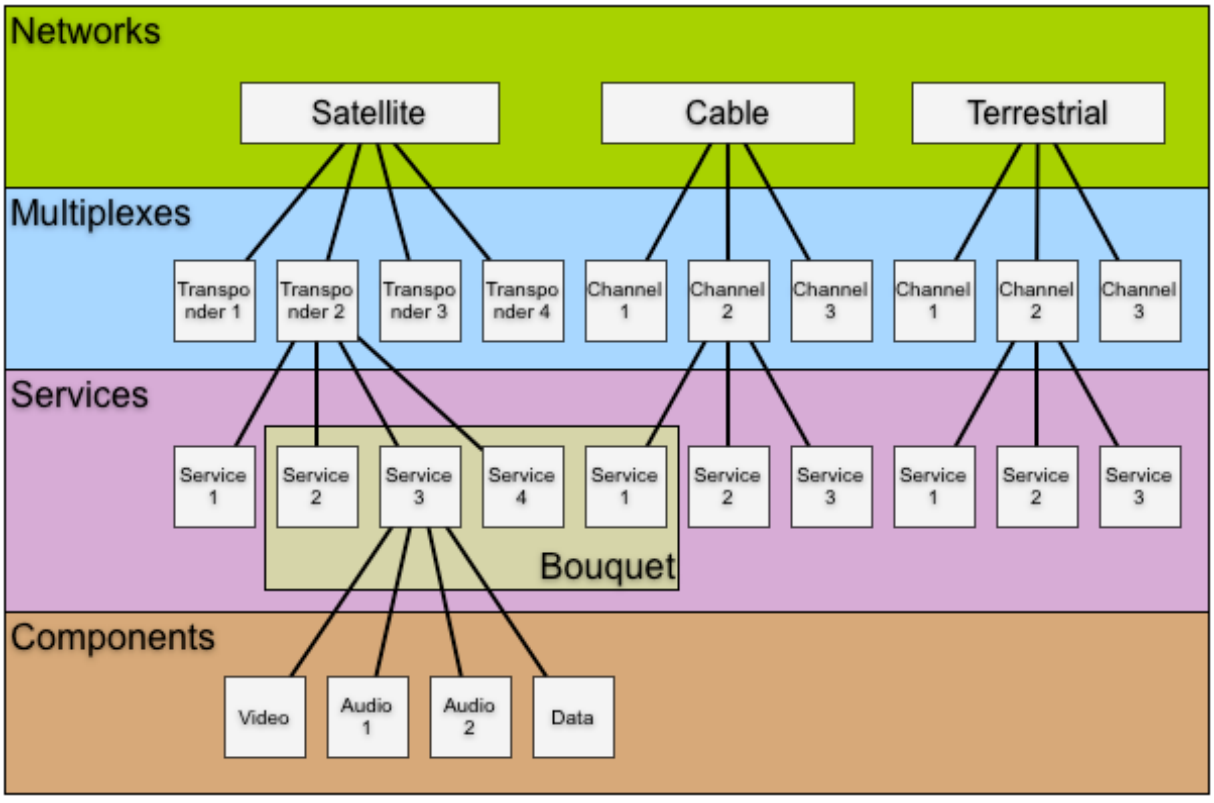

Figure 2: Service delivery model

The unique identification of a service cannot be guaranteed if each operator allocates these codes on arbitrary basis. A policy needs to be defined in order to avoid potential situations of conflict

D.2 Original_network_id

Allocation of original_network_ids is presently handled by the DVB Project Office, on behalf of the ETSI.

The value of already pre-assigned ON_ID codes for terrestrial services is 0x2000 + 3-digit country code. Then for Italy the original_network_id value that should be allocated is: 0x217C (380dec - 0x17Chex is the country code for Italy).

The registration of this value shall be formally requested, by the competent authority to the DVB Project Office, in order to obtain afterwards the formal registration by ETSI in the Register of Service Information (SI) Codes.

It is recommended that all terrestrial operators in Italy use this value for ON_ID to avoid potential conflicts with other networks in the same area or in neighbouring countries.

Operators that have been allocated, by the DVB, a value for ON_ID and operators with services that originate from a satellite network may keep their allocated ON_ID or the ON_ID used on the satellite network.

D.3 Transport_stream_id

The ON_ID value is not meant to be used to distinguish multiplexes of different operators.

Therefore, TS_ID and S_ID are the two parameters that are used to distinguish terrestrial multiplexes and services.

The Transport_Stream_ID has 65535 possible values (for each ON_ID): a unique value can be assigned to each and every national, regional or local multiplex. Every network operator shall be granted one or more values, as he requests and depending on the configuration of his network (number of transmitters).

D.3.1 Recommended allocation of codes

DGTVi recommended the following allocation of codes:

transport_stream_id	Use
0x0000	Reserved
0x0001 – 0x03FF	Range usable for national networks (1023 values)
0x0400 – 0x0FFF	Reserved for extension of national codes (3072 values)
0x1000 – 0xB7FF	Range usable for regional/local networks (43008 values)
0x1000 – 0x17FF	Region 1 (Piemonte) – 2048 values
0x1800 – 0x1FFF	Region 2 (Valle d'Aosta) – 2048 values
0x2000 – 0x27FF	Region 3 (Lombardia) – 2048 values
0x2800 – 0x2FFF	Region 4 (Trentino) – 2048 values
0x3000 – 0x37FF	Region 5 (Veneto) – 2048 values
0x3800 – 0x3FFF	Region 6 (Friuli Venezia Giulia) – 2048 values
0x4000 – 0x47FF	Region 7 (Liguria) – 2048 values
0x4800 – 0x4FFF	Region 8 (Emilia Romagna) – 2048 values
0x5000 – 0x57FF	Region 9 (Toscana) – 2048 values
0x5800 – 0x5FFF	Region 10 (Umbria) – 2048 values
0x6000 – 0x67FF	Region 11 (Marche) – 2048 values
0x6800 – 0x6FFF	Region 12 (Lazio) – 2048 values

transport_stream_id	Use
0x7000 – 0x77FF	Region 13 (Abruzzo) – 2048 values
0x7800 – 0x7FFF	Region 14 (Molise) – 2048 values
0x8000 – 0x87FF	Region 15 (Campania) – 2048 values
0x8800 – 0x8FFF	Region 16 (Puglia) – 2048 values
0x9000 – 0x97FF	Region 17 (Basilicata) – 2048 values
0x9800 – 0x9FFF	Region 18 (Calabria) – 2048 values
0xA000 – 0xA7FF	Region 19 (Sicilia) – 2048 values
0xA800 – 0xAFFF	Region 20 (Sardegna) – 2048 values
0xB000 – 0xB7FF	Reserved for future use

Table 38: Allocation of TS_IDs in Italy

D.3.2 National Codes already in use

Following codes are compatible with the recommended allocation.

transport_stream_id	Operator
0x0001	Rai
0x0002	Rai
0x0003	Rai
0x0004	Rai
0x0005	Rai
0x0006	Rai
0x0009	Rai
0x0107	Cairo Network
0x0200	Persidera
0x0201	Persidera
0x0202	Persidera
0x0204	Persidera
0x032A	H3G
0x0384	D-Free
0x0385	Mediaset
0x0389	Mediaset
0x03A2	Mediaset
0x03AC	Mediaset
0x03B6	Mediaset

Table 39: National TS_IDs in use

D.4 Service_id

Because of the uniqueness of TS_ID assigned to every multiplex, the allocation of Service_IDs (65535 possible values) can be left to each multiplex operator. Receivers shall distinguish services with the same service_id (and ON_ID) but different TS_ID.

D.5 Network_id

The DVB *network_id* is defined by ETSI TR 101 162 [19] which allocates the identifiers on a geographical basis to ensure that no conflict in adjacent network identities occurs in different geographic regions. The allocation is typically referred to as the DVB color map as shown in the following figure.

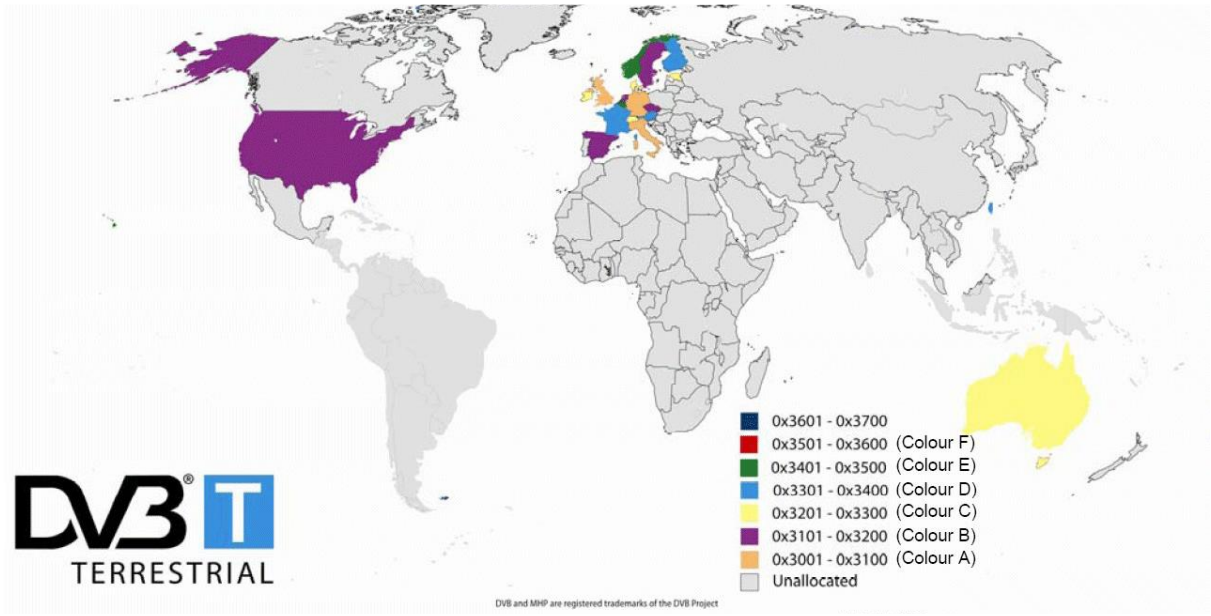

Figure 3: Colour map for allocating network_ids in terrestrial networks

The allocation of the network_id for countries in the European region comprising Italy is shown in the following table:

Country	network_id
Austrian Digital Terrestrial Television	0x3301 ÷ 0x3400
French Digital Terrestrial Television	0x3301 ÷ 0x3400[14]
Italian Digital Terrestrial Television	0x3001 ÷ 0x3100
Slovenia Digital Terrestrial Television	0x3201 ÷ 0x3300
Spanish Digital Terrestrial Television	0x3101 ÷ 0x3200
Swiss Digital Terrestrial Television	0x3201 ÷ 0x3300

Table 40: Network_ids of interest

Network_ids shall not be used to uniquely identify a service.

Network_ids shall instead be used to identify the country which a network belongs to for the purpose of LCN conflicts (see §7.4.2.4). In particular, if Italy has been selected as “Country” at first installation time, all networks whose network_id fits in the 0x3001÷0x3100 range shall be considered as belonging to Italy.

D.6 Network Name

No assumption is or shall be made for this parameter.

[14] France will likely go on using as single network_id for the whole country the same value assigned by DVB to French DTT as original_network_id (0x20FA)

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