

Requirements to NorDig compliant IRDs for reception of HDTV

Addendum to the

NorDig Unified Requirements (ver 1.0.3)

for

Integrated Receiver Decoders

for use in

cable, satellite, terrestrial and IP-based networks

Background to this Addendum

This document specifies the requirements for NorDig compliant **HDTV Level IRDs** for reception of HDTV and SDTV, based on new compression standards.

This document refers to the NorDig Unified Requirements version 1.0.3 (“NorDig-Unified”) with additional requirements and comments, in order to provide the performance requirements for NorDig HDTV Level IRDs.

If there are complete chapters or sections in NorDig Unified that remain unchanged, without any additions, the text is skipped in this document and replaced by the word **Unchanged** (black print on shaded background). If only parts of a chapter or section remain valid for IRDs for HDTV reception, these parts are kept in this document, and the required additions are **highlighted with red print on yellow background**, while deletions are marked as ~~xxxxxx~~.

This addendum will be kept as a separate document for some time, but the text will be merged into a NorDig Unified document in the future.

In this document explanatory notes are marked by parentheses like this: **{ text }**. This text will not be merged into the NorDig Unified document.

It should be noted that the NorDig specifications use the term “IRDs”, which includes both separate receiver units (Set Top Boxes = STBs) and relevant parts of Integrated Digital TV-sets (IDTVs).

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1 Introduction

1.1 Scope

This document specifies a set of equipment requirements for reception of DVB-based and related services from cable, satellite and/or terrestrial broadcast networks, in addition it includes requirements for reception via IP-based networks. The specifications cover IRDs, both as separate units (set-top-boxes) and as relevant parts of integrated digital TV-sets.

The NorDig IRD technical specifications are established with the aim to ensure that IRDs in the Nordic market satisfy a common set of minimum requirements, independent of operator/service provider and transmission media.

The NorDig I specification was first issued in 1998 when the common DVB API solution had not taken specific direction and based on the technical status of that time. The NorDig II specification was first issued in 2000 and added some hardware and software requirements mainly to include a standard API, as specified for the DVB MHP Interactive Broadcast profile.

The NorDig Unified Requirements were first issued in 2002 and included the profiles; **Basic TV**, **Enhanced**, **Interactive** and **Internet Access**, in addition to the initial **NorDig I** profile. The NorDig Unified specification includes the NorDig I and NorDig II specifications, plus new requirements for the Basic TV, Enhanced Broadcast and Internet Access profiles.

The **NorDig Basic TV profile** corresponds to basic requirements for digital broadcasting, services that do not depend on enhancements by applications or interaction. This profile is a subset of the Enhanced Profile.

The **NorDig Enhanced profile** covers the NorDig requirements for enhanced services that do not depend on an interaction channel, but depend on a standardized API, based on the DVB-MHP 1.1 Enhanced Broadcast Profile. The Enhanced profile is a subset of the Interactive profile.

The **NorDig Interactive profile** (NorDig II) covers the NorDig requirements for interactive services, including a standardized API, based on the DVB-MHP 1.1 Interactive Broadcast Profile.

The **NorDig Internet Access profile** covers the NorDig requirements for interactive services that depend on a standardized Internet access, based on the DVB-MHP1.1 Internet Access profile. The Internet Access profile includes the NorDig Interactive profile as a subset.

The **NorDig I profile** is now replaced by the NorDig Basic and NorDig Interactive profiles.

The various profiles refer both to the **SDTV Level**, which includes SDTV based on MPEG 2 video compression and **HDTV Level**, which also includes HDTV and SDTV, based on MPEG 4 AVC video compression. The NorDig profiles at HDTV Level are furthermore specified with some additional requirements, reflecting necessary enhancements for the provision of HDTV, and improvements in front-end performance. The NorDig HDTV Level IRD is specified to include the NorDig SDTV Level; i.e. backward compatibility with existing SDTV transmissions will be provided by NorDig compliant HDTV IRDs.

The NorDig Unified specification text relates to all profiles. All requirements specified in this document are mandatory unless otherwise specified.

Figure 1.1 indicates the relationships between the NorDig profiles at **SDTV Level**, and the various building blocks.

Figure 1.2 indicates the relationship between the NorDig profiles at **HDTV Level** and the various building blocks; note that e.g. NorDig Basic profile at HDTV Level also includes the NorDig Basic Profile at SDTV Level.

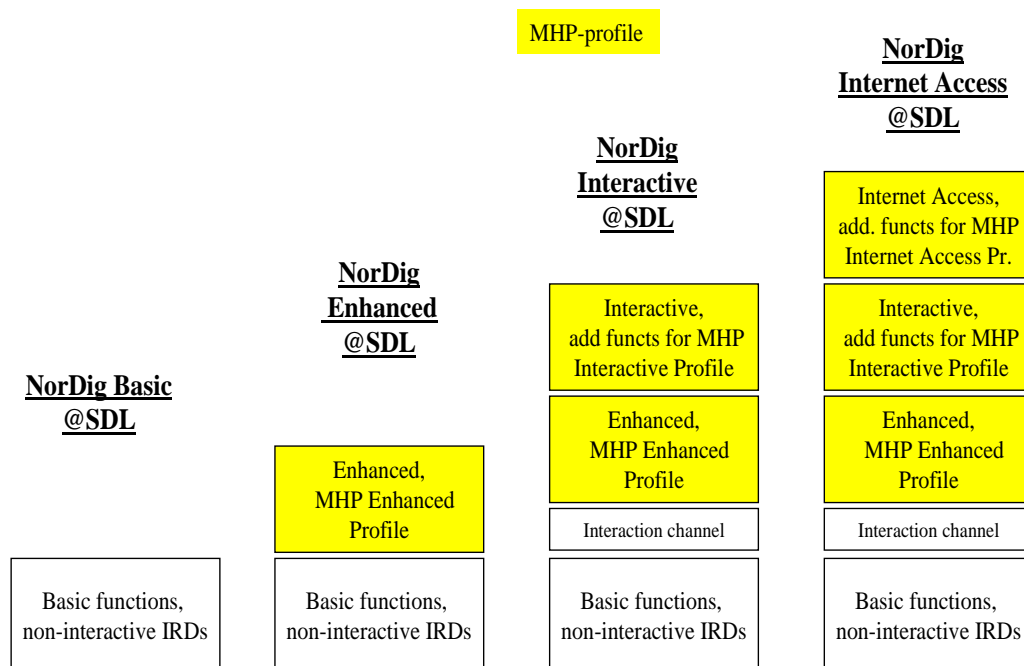


Figure 1.1 The NorDig profiles and the building blocks **at SDTV Level IRDs**

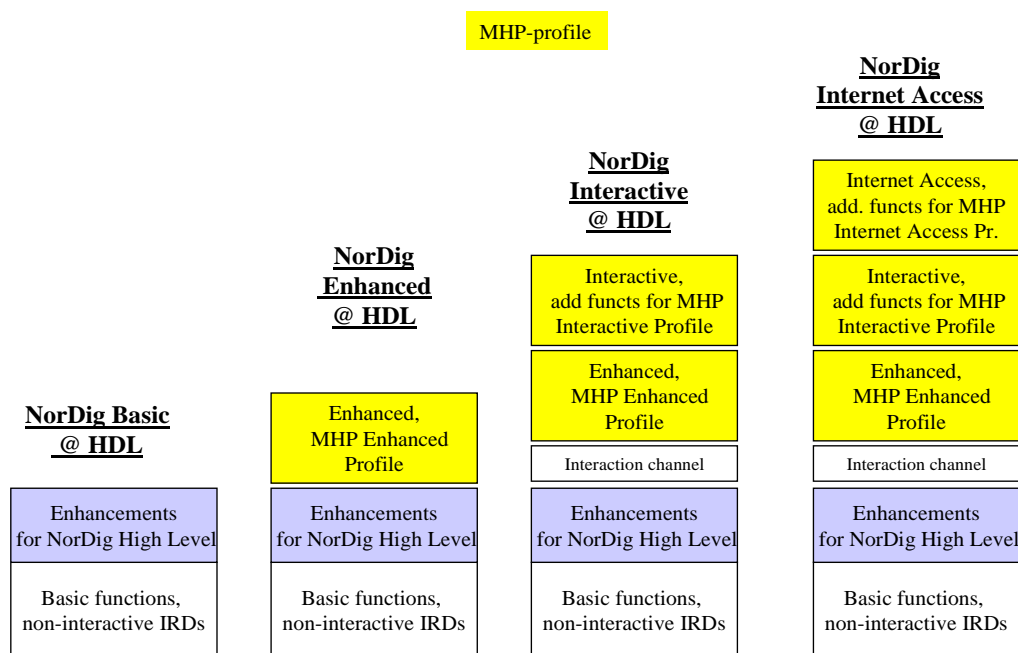


Figure 1.2 The NorDig profiles at HDTV Level IRDs. The HDTV Level includes enhancements to provide HDTV (and SDTV) based on MPEG 4AVC compression.

The NorDig Unified Requirements were updated in 2003 and in 2004/2005 (Version 1.0.2); when some new requirements were introduced as options or as mandatory requirements after a specified grace period. This version 1.0.3 includes some new requirements that will become mandatory after June 2007, as indicated in the specification text. In addition this version includes requirements for IP TV that were previously provided as a separate addendum. **These requirements were all based on the SDTV Level only.**

This Addendum to the NorDig Unified version 1.0.3 includes new requirements for the *NorDig HDTV Level*.

NorDig has also specified NorDig Rules of Operation for NorDig compliant networks [49], and the Unified NorDig Test Specifications [51], in order to verify compliance with the NorDig Unified Requirements for new IRDs. These Rules of Operation and Test Specifications cover all NorDig profiles. **It should be noted that compliance with the NorDig requirements will require full compliance with at least one of the remaining profiles (Basic, Enhanced, Interactive or Internet Access)**

The specifications of the NorDig IRDs are divided into two parts.

Part A: Hardware and firmware

Part B: The Software system and Application Programming Interfaces (API) as relevant.

The specification parts A and B outline the desired hardware and software architectures. Based on this framework the mandatory interfaces, functionality and performance requirements of the IRD are specified. Part B deals also with requirements to the operating system. Optional requirements are specified for recommended, but not mandatory functions.

The NorDig group represents broadcasters, operators and service providers in the Nordic countries, see Annex A.

The various members of NorDig are independent of each other but intend to transmit to IRDs that satisfy the specified common requirements. In order to ensure compliance with the NorDig requirements, the NorDig IRDs will be subject to a set of verification tests, based on NorDig Test Specifications [51].

1.2 Document History

Unchanged

Document history of this addendum:

Version	Date	Comments
{1.0}	{080410}	{This is the first version of the approved NorDig HDTV Addendum to the NorDig Unified Requirements for Integrated Receiver Decoders}

1.3 Terminology

Unchanged

1.4 Definitions

Unchanged

1.5 References

- [14] ETSI EN 300 744 v1.5.1 Digital Video Broadcasting (DVB); DVB Framing structure, channel coding and modulation for digital terrestrial television. European Telecommunications Standards Institute, ETSI.
- [35] NorDig Unified NorDig Unified Requirements for Digital Integrated Receiver Decoders, ver 1.0.3.

- [36] NorDig RoO NorDig Rules of Operation, ver 1.0.
- [37] ETSI TS 101 154 v. 1.7.1 Digital Video Broadcasting (DVB); Implementation guidelines for the use of Video and Audio Coding in satellite, cable and terrestrial Broadcasting Applications
- [38] NorDig RoO - HDTV Addendum to NorDig Rules of Operation, for NorDig compliant broadcasts carrying HDTV-signals. **{To be established based on this document, ref. [53], ref. [54] and ref. [55]}.**
- [39] ETSI EN 302 307 v1.1.2 Digital Video Broadcasting (DVB): Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (2005-06).
- [40] EICTA HD Ready EICTA, European Information & Communications Technology Industry Association, "HD ready" Minimum Requirements, www.eicta.org
- [41] CEA-770.3 Consumer Electronics Association (CEA): Standard Definition TV Analog Component Video Interface, CEA -770.2C, November 2001. www.ce.org/Standards.
- [42] HDMI HDMI Licensing, LLC: **HDMI**, "High- Definition Multimedia Interface", rev. 1.3A, October 10, 2006
- [43] HDCP Consumer Electronics Association (CEA): Intel: **HDCP**, "High-Bandwidth Digital Content Protection System", rev. 1.3, December 21, 2006. (Note: on DVI HDCP rev. 1.0 or rev. 1.1 will apply.)
- [44] ISO/IEC 60958-3 Ed.3.0 ISO/IEC: Digital audio interface - Part 3: Consumer applications, May 25, 2006
- [45] ISO/IEC 14496-10 ISO/IEC: Information technology — Coding of audio visual objects — Part 10:Advanced Video Coding, December 15, 2005
- [46] ETSI TS 102 114 ETSI Technical Specification (TS) : DTS Coherent Acoustics; Core and Extensions V. 1.1.1, August, 2002,
- [47] ISO/IEC 14496-3 ISO/IEC: Information technology -- Coding of audio-visual objects -- Part 3: Audio, 2005
- [48] ETSI TS 102 366 V.1.1.1 ETSI TS: Digital Audio Compression (AC-3, Enhanced AC-3) Standard, February 2005
- [49] Dolby Technical Bulletin 11 Dolby Technical Bulletin 11: Requirement Updates for Dolby Digital and Dolby Digital Plus in DVB Products
- [50] CEA 861-D Consumer Electronics Association (CEA): A DTV Profile for Uncompressed High Speed Digital Interfaces, July 18, 2006
- [51] ISO/IEC 11172-3 ISO/IEC: Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s - - Part 3: Audio
- [52] ETSI TS 102 114 v.1.2.1 DTS coherent acoustics; Core and extensions; 2002-12

1.6 *List of Abbreviations*

Unchanged

{Addition to the list of abbreviations}

CEA	Consumer Electronics Association (North American Association)
dBFS	dB Full Scale
DDS	Display definition segment
DDWG	Digital Display Working Group
EDID	Extended display identification data
EICTA	European Information & Communications Technology Industry Association
HDCP	High-bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDTV	High Definition Television
SDTV	Standard Definition Television



2 General Features of the NorDig IRD

Unchanged



PART A: Hardware and firmware

3 The Frontend of the NorDig IRD

3.1 Common Features

Unchanged

3.2 Satellite Tuner and Demodulator

3.2.1 General

Unchanged

The NorDig IRD shall include one tuner/demodulator unit for reception of signals from a satellite RF-outdoor unit.

The NorDig IRD should have an RF-bypass (1) (RF_{in} - RF_{out}). An RF-bypass is recommended to allow other IRDs to be connected to the same RF unit.

Note 1: In this specification RF_{in} means the input to the IRD, unless otherwise specified.

3.2.2 RF/IF Characteristics

The available transponder bandwidths and transponder powers vary with the different satellites. Consequently, a range of symbol rates and forward error correction rates may be employed.

The incoming digital DVB signals will comply with EN 300 421 [8]. The NorDig IRD shall ~~accept~~ support symbol rates on the incoming carrier in the range 7.5 Mbaud to 30 Mbaud.

Additional requirement for NorDig HDTV Level IRDs:

The incoming DVB signals will comply with comply with ETSI EN 302 307 (DVB-S2) [57], including QPSK and 8PSK waveforms. All specified error correction rates may be used.

The NorDig HDTV Level IRDs shall support the following symbol rates on the incoming carriers:

- QPSK-carrier: From 7.5 Mbaud to 45Mbaud (1) (2)
- 8PSK-carrier: From 5 Mbaud to 30 Mbaud (1)

Note 1: The Common Interface, see section 15.1, is specified for maximum 72 Mbps. The incoming carriers will not carry signals with higher bit rates than 72 Mbps when IRDs with CI are targeted.

Note 2: From 7.5 Mbaud to 30 Mbaud for IRDs that are launched before July 2010

3.2.3 Input Frequency Range/Tuning Range

Unchanged.

3.2.4 Tuning/ Scanning Procedures

Unchanged.

3.2.5 Control Signals

Unchanged.

3.2.6 Demodulation

Unchanged.

Demodulation, descrambling and error correction shall be performed for all symbol rates given above and for all error correction rates specified in EN 300 421 [8] (DVB-S).

Additional requirement for NorDig HDTV Level IRDs:

The NorDig HDTV Level IRD shall perform demodulation, descrambling and error correction for all symbol rates given above and for all corresponding error corrections rates specified in ETSI EN 302 307 (DVB-S2) [57].

3.2.7 Satellite Tuner Interface and Signal Levels

Unchanged.

3.2.8 Performance

Unchanged.

3.3 Cable Tuner and Demodulator

Unchanged.

{Note: DVB-C2 is being specified by DVB, but an ETSI standard is not assumed to be ready before 2009. DVB-C2 will be considered when completed by DVB}

3.4 Terrestrial Tuner and Demodulator

Unchanged.

{Note: DVB-T2 is being specified by DVB, but an ETSI standard is not assumed to be ready before 2009. DVB-T2 will be considered when completed by DVB}

3.5 IP Based Front-End

Unchanged.

{Note: DVB-IP is being updated by DVB; the update will be considered when completed by DVB}

4 MPEG-2 Demultiplexer

4.1 General

The Demultiplexer shall be compliant to the MPEG-2 transport layer defined in ISO/IEC 13818-1[42]. The NorDig IRD shall support ETSI TS 101 154 [23] and the additional requirements stated below:

- The NorDig IRD shall utilize the MPEG-2 Service Information as specified in Part B.
- The NorDig IRD shall interpret the CA descriptor as defined in ETSI ETR 289 [19].
- The NorDig SDTV Level IRD shall be able to decode an ISO/IEC 13818-1 [42] stream with data rates **that include all rates up to 58 Mbit/s that the front-end may deliver as defined in chapter 3.**
Note: The satellite front-end may deliver up to 80.4 Mbps after error correction
- It should be possible to select one or many section-based data streams and output them as data on RS232 or USB (if present).
- The NorDig IRD shall be capable to utilise at least 32 elementary streams simultaneously, which requires 32 PID filters.
- The NorDig IRD shall provide at least 32 section filters.

Note: This feature enables the NorDig IRD to utilise several components as video, audio, teletext, SI, subtitling and data for additional services.

- The NorDig IRD shall use the video stream descriptor to recognise still picture data.
- The NorDig IRD shall support variable bit rate elementary streams within a constant bit rate transport stream (excluding audio).

Additional requirement for HDTV level IRDs:

The NorDig HDTV IRD shall support a mixture of service types within the same ISO/IEC 13818-1[42] MPEG-2 transport stream (i.e. MPEG-2 SDTV service, MPEG-4 AVC SDTV and HDTV and Radio services may be multiplexed into the same transport stream).

4.2 DVB Descrambler Performance

Unchanged.

4.3 System Clock Recovery

Unchanged.

5 Video Decoder

5.1 Requirements for Video Decoder in NorDig SDTV Level IRDs

5.1.1 General

The NorDig IRD's video decoder shall fully comply with the DVB Implementation Guidelines for the use of MPEG-2 systems, Video and Audio in satellite, cable and terrestrial broadcasting applications, ETSI TS 101 154 (video sub clause 5.1; 25Hz MPEG-2 SDTV IRDs and Bitstreams) [23].

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

Note 1: This requirement is optional for IRDs that are launched before 1 July 2007

5.1.2 Constraints and Extensions

This section sets out the requirements to the NorDig IRD in addition to the DVB requirements expressed by ETSI TS 101 154 [23].

5.1.2.1 Display Mode for 16:9 Material on 4:3 Monitors

The viewer shall be able to choose at least one of the following storable display mode preferences:

1. display 16:9 material as full width 16:9 active picture aspect ratio in a 4:3 raster (letterbox).
2. display full height 4:3 aspect ratio picture as a centre cut-out of the transmitted 16:9 aspect ratio picture.

5.1.2.2 Displaying 4:3 Material on 16:9 Monitors

The NorDig IRD shall signal 4:3 material as specified in section 9.6 for SCART signalling and equivalent for iDTV.

5.1.2.3 16:9-Letterbox Conversion

16:9 letterbox conversion (i.e. 16:9 broadcast, which the IRD converts into 16:9 letterbox inside a 4:3 frame raster edge) shall be implemented for the display of video using the 16:9 aspect ratio on 4:3 monitors. This conversion shall be implemented by vertical filtering. Signal degradation due to the filtering should be subjectively imperceptible. Line 23 and line 623 should be masked before the letterbox conversion to avoid the irritating half lines.

5.1.2.4 Full video screen Luminance resolution

The incoming encoded video signal to the NorDig IRD can have full-screen luminance resolutions (Horizontal x Vertical) of one of the following values: 720x576, (704x576), 544x576, 480x576, 352x576 and 352x288 (SIF), as specified in ETSI TS 101 154 [55], section 5.1.4 for MPEG2 SDTV resolutions.

The incoming full-screen luminance resolutions shall (1) be up-converted into the full video raster in the decoded outgoing video signal of the IRD, as specified in ETSI TS 101 154 [55], i.e. received sub-sampled luminance resolutions shall be up-converted into the full video raster in the decoded outgoing video signal of the IRD. Observe that there shall be no up-sampling between 704x576 and 720x576.

(These full screen luminance resolutions are normally up-converted into the full video raster in the decoded outgoing video signal of the IRD, see section 5.2.5 Up-conversion). The outgoing signal's video raster shall at all time be a full video with 720(pixel)x576(pixel)x25(Hz) active video signal.

The outgoing SDTV signal from the NorDig IRD shall at all time have a full-screen active video signal, with a full-screen video raster of 720(pixel) x 576(pixel) and a frame rate of 25(Hz).

Note 1: For a NorDig IRD with an API, the incoming signal may in some cases be converted down or up to other valid resolutions, see sections 5.2.4 (Down-conversion) and 5.2.5 (Up-conversion).

5.1.2.5 Down-conversion

Down-conversion of pictures shall (1) be implemented, from any of the incoming encoded full screen luminance resolution values (720x576, (704x576), 544x576, 480x576, 352x576 and 352x288) into a video window of 352x288 (1/4, SIF), respectively 176x144 (1/16, QSIF) in the decoded outgoing video signal (full screen video raster) . It shall be possible for the API (2) to locate the down-converted video window anywhere on the screen.

Note 1: Not relevant for NorDig Basic.

Note 2: The control of down-conversion (size and position) is handled by DVB-MHP APIs, see chapter 11.

5.1.2.6 Up-conversion (1)

Up-sampling of video shall (1) be supported from any valid incoming encoded full screen luminance resolution (720x576, 544x576, 480x576, 352x576 or 352x288 (SIF) pixels) to any valid resolution (2). There shall be no conversion between 704x576 and 720x576. ~~Up-sampling of video from 176x144 (QSIF) to any valid resolution, shall be implemented (2).~~

It shall be possible for the API (2) to locate the up-converted video anywhere on the screen.

Note 1: **Not relevant for NorDig Basic.** Up-conversion to other values than full 720x576 is optional for NorDig Basic.

Note 2: **The control of up-conversion (size and position) is performed via the API, see chapter 11.** ~~Up conversion from 176x144 (QSIF) is optional for NorDig Basic~~

5.1.2.6.1 Default Location Mode

If no application requests a specific location of the up converted video the following default mode shall apply:

An input video with the resolution 704x576 shall not be up-sampled, thus it shall be located as indicated below.

If the result of the up-sampling process is *less* than 720 pixels wide then the output of the video decoder shall be centered within the region of 720 active digital video pixels. The offset from the start of the active digital video pixel area to the first (left most) pixel of video decoder output is the difference in their widths divided by 2 and truncated towards zero. Equivalent centering should be used to position the video decoder vertically within the 576 active lines of the analogue display.

If the result of the up-sampling process is *greater* than 720 pixels wide then the output of the video decoder shall be cropped symmetrically to fit within the region of 720 active video pixels. The number of pixels cropped from the left-hand side of the video decoder output shall be the difference between its width and 720 divided by 2 and truncated towards zero. The remaining difference shall be cropped from the right hand side of the video decoder output.

5.1.2.7 Still Picture Support

The NorDig IRD (1) shall support the decoding and displaying of still pictures (frame). A still picture is a video sequence containing exactly one intra-coded picture. Such a video bit stream will cause the buffer to under flow. In this situation, while the decoding process shall continue to examine the buffer, the display process associated with the decoder shall repeat the previously decoded picture until the normal operation of the buffer can resume.

Note 1: Recommended for NorDig Basic.

5.2 Additional requirements for Video Decoder in NorDig HDTV Level IRDs

5.2.1 General

The NorDig HDTV IRD video decoder shall, in addition to the MPEG-2 MP@ML video decoding, comply with AVC HDTV and SDTV video decoding – i.e. HP@L4.

The following clauses of ETSI TS 101 154 [23] specification are relevant to this specification:

- video sub clause 5.5; Specifications Common to all H.264/AVC IRDs and Bitstreams
- sub clause 5.6; H.264/AVC SDTV IRDs and Bitstreams
- sub clause 5.7; H.264/AVC HDTV IRDs and Bitstreams

Note: The minimum profile requirement in this specification is High Profile not Main Profile for Level 3.0 as in the sub clause 5.6 (5.6.1.2) in ETSI TS 101 154 [23].

5.2.2 Constraints and Extensions

This section sets out the requirements to the NorDig HDTV IRD in addition to the DVB requirements specified by ETSI TS 101 154 [23].

5.2.2.1 Reference Model for Video Decoder

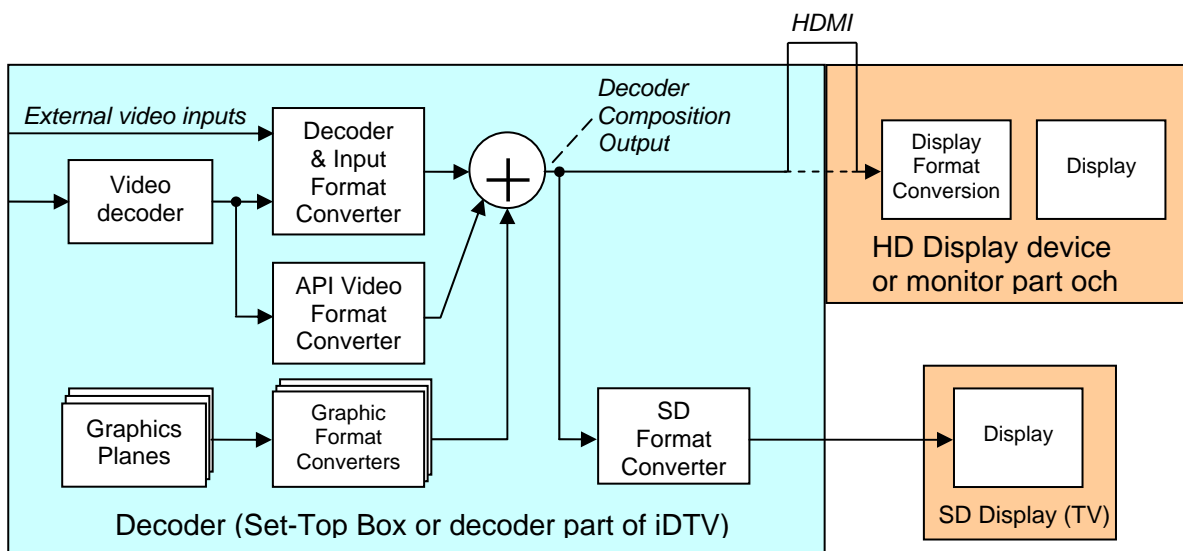


Figure 5.1 Reference Model for Video Decoder for NorDig HDTV IRDs

The Reference Model for Video Decoder for NorDig HDTV IRD's is illustrated in Figure 5.1. It is a logical reference model and does not imply any specific implementation of an actual STB or iDTV.

5.2.2.2 Video Decoder - resolutions and frame rates

The Video Decoder shall (1) be able to receive and decode the video formats specified in Table 5.1.

Video Luminance Resolutions <small>Horizontal x Vertical, (Sub-sampled formats included)</small>	Frame rate [Hz]	Interlace / Progressive	Frame Aspect Ratio (Horizontal : Vertical)	Bit Stream (Profile@Level)	Status
720x576	25	I	4:3, 16:9	MPEG-2 MP@ML	Mandatory
720x576	25	I	4:3, 16:9	AVC HP@L3	Mandatory
720x576	25	P	16:9	AVC HP@L3	[Mandatory] Note 3-A
720x576	50	P	16:9	AVC HP@L3.1	[Mandatory] Note 3-A
1280x720	50	P	16:9	AVC HP@L4	Mandatory (1)
1280x720	59.94 (60/1.001)	P	16:9	AVC HP@L4	[Mandatory] Note 3-C
1280x720	25	P	16:9	AVC HP@L4	[Mandatory] Note 3-A
1280x720	23.98 (24/1.001)	P	16:9	AVC HP@L4	[Mandatory] Note 3-B
1920x1080	25	I	16:9	AVC HP@L4	Mandatory
1920x1080	29.97 (30/1.001)	I	16:9	AVC HP@L4	[Mandatory] Note 3-C
1920x1080	23.98 (24/1.001)	P	16:9	AVC HP@L4	[Mandatory] Notes 3-B
1920x1080	25	P	16:9	AVC HP@L4	Mandatory (2)

Note 1: Most Nordic public broadcasters intend to broadcast HDTV on 1280x720p/50Hz format and consider using 1920x1080p/50Hz when equipment for such format becomes available.

Note 2: This requirement is optional for IRDs that are launched before 2009.

Note 3: [Mandatory] These formats are being considered to be made mandatory for NorDig IRDs, subject to comments from industry:

- A: These formats may be used for bandwidth constrained channels*
- B&C: These formats may be used in order to avoid recoding of 24 Hz film material or broadcast material from original 30Hz/60Hz productions.*

Conversion to 25Hz or 50Hz frame rate shall be as specified in section 5.2.2.12

Table 5.1 Video Formats to receive and decode

5.2.2.3 Luminance resolution

The NorDig IRD shall support luminance resolutions including all sub-sampled luminance resolutions as specified in ETSI TS 101 154 [55], section 5.6.2.3 for SDTV resolutions and section 5.7.1.5 for HDTV resolutions. Up-sampling of sub-sampled resolutions shall also be made in accordance with ETSI TS 101 154 [55], i.e. sub-sampled luminance resolutions shall be up-converted by the Decoder Format Converter into the full video raster of the Decoder Composition Output, see Reference Model Figure 5.1

Note: On the Decoder Composition Output the outgoing signal's video raster shall at all time be a full video with a raster of 1920x1080, 1280x720 or 720x576 according to selected settings. For an iDTV all resolutions shall be converted to the native resolution of the screen.

When up-converting the 720 x576 line resolution to any 1:1 pixel aspect ratio format (i.e. 1280x720 or 1920x1080) only the centred 702 pixels of the horizontal 720 shall be used. Those 702 pixels correspond to the 52 microseconds of an active line, hence preserves correct geometry in the up-conversion process.

When up-converting other valid input line resolution format to any 1:1 pixel aspect (output) format (i.e. 1280x720 or 1920x1080), only the centred horizontal pixels shall be used ; e.g. when up-converting (received) 544x576 line resolution format to any 1:1 pixel aspect ratio (output) format, only the centered 530 pixels of the horizontal 544 shall be used.

5.2.2.4 Colorimetry

The Decoder Format Converter shall use the VUI parameters (ISO/IEC 14496-10)[63]) *colour_primaries*, *transfer_characteristics* and *matrix_coefficients* in received AVC encoded bitstreams and the Sequence Display Extension parameters (ISO/IEC 13818-2) [43] in MPEG-2 encoded bitstreams.

The “Decoder Composition Output” shall output video with colour parameters targeting an ideal display, optimised for each video format.

Table 5.2 below gives the documentation where to find appropriate chromaticity co-ordinates, opto-electronic transfer characteristics and matrix coefficients to be used when deriving luminance and chrominance signals from the red, green and blue primaries (or vice versa, i.e. YCbCr to RGB):

Active composition resolution in the “Decoder Composition Output” (Horizontal x Vertical)	Documentation for appropriate Colour Processing	Comments
720x576	ITU-R BT.1700 (replaces ITU-R BT.470 System B, G)	Note that 576 lines in both interlaced scan (576i) and progressive scan (576p) shall be processed and output with equal colour parameters.
1280x720	SMPTE 296M	The colour parameters in SMPTE 296M are the same as in ITU-R BT.709.
1920x1080	ITU-R BT.709 (SMPTE 274M)	The colour parameters in SMPTE 274M are the same as in ITU-R BT.709.

Table 5.2 Documentation for appropriate Colour Processing

5.2.2.5 Dynamic changes in the video stream

The NorDig HDTV IRD shall be able to handle dynamic changes in transmission between different video modes (like from 720p to 1080i/1080p) or different frame rates within one seconds after receiving Random Access Point.

5.2.2.6 AVC still picture

The NorDig HDTV IRD shall support still picture for all AVC profiles.

For the signalling of the AVC still picture the AVC descriptor will be used (in PMT) as specified in MPEG-2 Systems (ISO/IEC 13818-1 [42]/ITU-T H.222.0 – Amendment 3), (the flag `AVC_still_present` will be set).

By still picture means broadcast of only intra coded frames at very low frame rate (typical 1 frame per second). The NorDig HDTV IRD shall decode this still picture frame and repeat displaying this until next (still picture) frame is available to display.

5.2.2.7 AVC video minimum bandwidth

The NorDig HDTV IRD shall provide support for very low bandwidth video. The NorDig HDTV IRD shall be able to decode AVC video down to 250 kbps. For AVC still picture the NorDig HDTV IRD shall be able to decode down to 100 kbps.

5.2.2.8 Format conversion for API use

{To be completed in a future version of this specification}.

5.2.2.9 Frame Cropping

The NorDig HDTV IRD shall support frame cropping. Frame cropping signalling is used to indicate which area of the encoded video that should be displayed.

For 1080 line formats, the video is encoded with 1088 lines. To indicate which area of the encoded video that should be displayed, frame cropping signalling may be used. If frame cropping information is included in the encoded video, this shall be used to decide which 8 lines should be hidden in the Decoder Composition Output. If no frame cropping signalling is available, the IRD shall crop the bottom 8 lines.

5.2.2.10 Overscan

For services carrying ISO/IEC 14496-10 [63] video, the broadcaster may use the `overscan_info_present` and `overscan_appropriate` flags to indicate whether the receiver should apply this typical overscan or should display the complete broadcast video image. The flags will be encoded according to Table 5.3.

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

Table 5.3 Broadcast overscan flag

Unless the user requests otherwise, NorDig HDTV level IRDs shall interpret and follow the overscan flags according to Table 5.4.

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

Table 5.4 Receiver overscan behaviour

The NorDig HDTV level IRDs shall pass the video without overscan related reformatting to its output, setting the bits in the AVI Infoframe (see CEA 861 [68]) in accordance with Table 5.5.

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

Table 5.5 Overscan signalling on HDMI

5.2.2.11 High Definition Video Output and Display

The NorDig HDTV Level STBs shall be able to use the EDID information provided by the display to determine automatically the STB output and to accept a manual setting of the STB output, as specified in section 9.11.2 (Video Output and Display).

For NorDig HDTV iDTVs the output video shall always be converted to the display's native resolution.

5.2.2.12 Down-conversion of High Definition Video for Standard Definition output

If SCART, or any other analogue video output (Y, P_b, P_r, RF-PAL or CVBS) is available, the decoded High Definition video shall be down-converted by the SD Format Converter to Standard Definition resolution for output via these interfaces.

Down-conversion of pictures shall be implemented, from any of the incoming encoded HD full screen luminance resolution values (1920x1080, 1440x1080, 1280x1080, 960x1080, 1280x720, 960x720 and 640x720) to SD resolution (720x576).

When down-converting any 1:1 pixel aspect ratio format (i.e. 1280x720 or 1920x1080) in the Decoder Composition Output to 720x576 resolution, the target shall be 702x576 pixels to be centred in the 720x576 grid with nine black pixels inserted as the start of the 720 pixel active line and nine pixels inserted as the end of the 720 pixel active line.

Down-converted HD video shall be displayed as 16:9 letterbox on 4:3 displays. (Allowing centre cut would limit the safe area to 4:3 for HD production, hence *not* an allowed display option).

The SD Format Converter should apply appropriate re-interlacing (field mode integration re-interlacing). It shall process and output 720x576i25 in 4:3 frame aspect ratio or 16:9 frame aspect ratio video with colours according to 5.2.2.4 Colorimetry.

Conversion of received video with other frame rates than 25 or 50 Hz is not required for the SCART or any other analogue Standard Definition output, implying that received 23.98, 29.97 and 59.94 Hz video content will not be available on the SCART output.

6 Audio Decoder

6.1 Requirements for Audio Decoder in NorDig SDTV Level IRD

6.1.1 General

The NorDig IRD shall provide at least one stereo audio decoder that is able to meet the minimum decoding requirements based on MPEG 1 level II ("Musicam" ISO/IEC 11172-3) [69].

The Audio decoders shall fully comply with the DVB Implementation Guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial Broadcasting Applications ETSI TS 101 154 [23].

6.1.2 Constraints and Extensions

6.1.2.1 Audio Video Synchronisation

The NorDig IRD shall provide at least one audio decoder that is able to meet the minimum decoding requirements, which is set out in ETSI TS 101 154 [23]. Additionally, The NorDig IRDs shall not introduce more than ± 5 ms of relative delay between the audio and video components on the primary output and not more than ± 25 ms on an up or down converted secondary output.

If the NorDig IRD as a part of an integrated digital TV set (IDTV) has an analogue stereo audio output on a cinch connector the audio shall be in sync with the video display.

Where audio leaves the IRD in an encoded form (such as in IEC61937 [33] outputs), the IRD should compensate for the decoding latency of a reference decoder for the system under test (e.g HE AAC, Dolby Digital or Dolby Digital Plus), such that the output of the reference decoder would be ± 5 ms with respect to the decoded video

6.1.2.2 Set-up Levels

Unchanged.

The level for reference tones for transmission shall be 18 dB below clipping level, in accordance with EBU Recommendation R.68 "Alignment level in digital audio production equipment and in digital recorders" as recommended by ETSI TS 101 154 [23].

6.1.2.3 Multichannel Audio (option)

The NorDig IRD should be able to output an audio stream as non-PCM encoded audio to the digital audio interface (see section 9.7) according to IEC 61937 [33] if there is a Dolby Digital (AC-3), DTS or HE AAC MPEG2 BC (ISO/IEC 13818-3 [43]) stream present for the chosen service in the incoming transport stream.

The AC3 Dolby Digital or Dolby Digital Plus multi-channel audio decoding shall should, when present, be decoded to a stereo down-mix under the control of the format indicated in the Dolby Digital metadata, e.g. to a Dolby Surround ProLogic compatible stereo down-mix (Lt/Rt signal) or to a normal stereo down-mix (Lo/Ro signal) and shall should be fed to the (stereo) analogue output connectors (SCART and cinch).

The HE AAC multi-channel decoding shall, when present, be decoded to a stereo down-mix of the format indicated by the HE AAC metadata and shall be fed to the (stereo) analogue output connectors (SCART and cinch).

The choice and priority between MPEG-1 Layer II audio, HE AAC, and Dolby Digital and Dolby Digital Plus (AC-3) for the analogue outputs shall then be as specified in section 6.2.3 (Audio

prioritising) 6.2.4 point 1 and 2 (defined for digital output). When Dolby Digital, Dolby Digital Plus; DTS or HE AAC multi-channel (AC-3) audio is present, it is recommended to show a visual indication.

6.1.2.4 Digital Audio Output (option)

The digital audio output (S/PDIF) as defined in section 9.7 shall always give either a valid PCM-output according to IEC 60958 [32] or a non-PCM encoded audio bit-stream according to IEC 61937 [33]. The user shall be able to choose between the following storable output modes on the digital audio output interface:

1. Forced PCM output according to IEC 60958 [32] (Part1 General, Part 3 Consumer).
2. Non-audio-data output according to IEC 61937 [33] when present -and if not present output PCM according to IEC 60958 [32]. Non-audio-data-formats like Dolby Digital AC-3, HE AAC and DTS MPEG2-BC shall be possible to order and enable/disable according to priority set by the user.

~~The NorDig IRD shall, when the digital audio output function is present, be able to implement, by software, new future formats (e.g. MPEG 2 AAC, DTS etc.) in the priority list if/when they get allowed to be broadcast by DVB ETSI TS 101 154 [23] and if/when they are implemented in IEC 61937 [33] to be output as non-audio-data at a S/PDIF interface.~~

If the specific IRD can also tune analogue PAL, the Nicam-stereo, if present, or alternatively analogue audio shall be AD-converted to PCM-audio as stereo or 2 channels of mono to be output at the S/PDIF-interface.

~~The NorDig IRD should to be able to A/D convert incoming analogue audio signals (e.g. VHS) and output them to the digital audio interface (see section 9.7).~~

6.1.2.5 Half Sampling Rates

The NorDig IRD should support the half-sampling rates (22.05 and 24 kHz).

6.1.3 Applications

The NorDig IRD shall be able to read and use the ISO 639 language descriptors associated with the audio-streams in the ISO/IEC 13818-1 [42] MPEG2 transport stream.

The user shall be able to select storable preferences for primary and secondary audio language. If an audio-stream according to the primary audio language preference is not associated with the chosen service the NorDig IRD shall automatically choose the audio stream according to the secondary audio language preference, if present. In addition the user shall be able to manually select between all audio-streams that are associated with the active service.

The NorDig IRD shall be able to handle dynamic changes of audio component(s) (PID/PIDs) in a service. The IRD shall automatically identify if an audio component is added or removed between two programme events in the same service). The NorDig IRD should have minimum disturbance for such changes of audio format

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

- **change of audio PID value (typical examples are during regional news insertions) (case SVT regional news insertion)**
- **change from dual channel audio (with different language) into stereo or mono channel audio (case Finland, with two official languages)**
- **change from stereo or mono channel audio into dual channel audio (with different languages and the IRD's user preferences) (case Finland)**
- **removal of one audio component/PID, the NorDig IRD shall use next preferred audio component/PID (for example; a service broadcasts two or more audio components/PIDs and**

then removes one of them, like removal of Dolby Digital during regional news broadcast). (case SVT regional news insertion)

- addition of one audio component with higher preferred user settings (for example; a service adds an audio component/PID, like add Dolby Digital audio component, after a regional news broadcast). (case SVT regional news insertion)

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

- change of number of audio codec, (for example change from MPEG1 Level II into HE AAC, Dolby Digital or Dolby Digital Plus)
- change of ISO 639 language for an audio component.

The NorDig IRD shall be able to read the audio information contained in the DVB_SI stream_content and component_type of the component descriptor as defined in EN 300 468 [10], see chapter 12. The NorDig IRD should be able to present the audio information, including the descriptors for audio description for the visually impaired and audio for the hard of hearing, contained in the component descriptor to the user for information and selection purposes.

6.2 Additional Audio Decoder requirements for HDTV Level IRDs

6.2.1 General

The HDTV level IRD shall support reception of multi-channel (up to 5.1) audio in addition to the mandatory audio requirements for SDTV level IRDs. The HDTV level IRD shall provide audio outputs for stereo/mono and should provide outputs for multi-channel audio. There may also be additional audio channels and audio components for additional languages and/or for impaired people; these channels/components shall be treated as specified below.

The multi-channel audio may be carried by "System A" and/or via "System B", as determined for the relevant network; i.e. both "System A" and "System B" shall be supported for networks where there is no mandatory operator acceptance of IRDs, while either "System A" or "System B" may be required for networks where an operator is in charge of specifying the functionality of the IRDs and ensuring that the minimum requirements are met.

6.2.2 Audio formats

The NorDig HDTV Level IRD shall in addition to the audio requirements for SDTV level IRDs support the formats specified below.

The NorDig HDTV Level IRD as a part of an integrated digital TV set (IDTV) that can not play out a complete multi-channel audio signal should have an S/PDIF output and/or a HDMI output, see sections 9.7 and 9.11.

If the IDTV has an analogue stereo audio output on a Cinch connector, the audio shall be in sync with the video display.

The NorDig HDTV Level STB shall have an HDMI output and should have an S/PDIF output, see sections 9.7 and 9.11.

All IRDs shall have at least one of the following audio decoders functional.

All IRDs shall have hardware capabilities for both audio decoders (A and B).

- System A: Dolby Digital Plus [66] with ability to transcode to Dolby Digital [66].
- System B: HE AAC [65] with ability to transcode to Dolby Digital [66] or DTS [70].

The audio system(s) shall be implemented as specified in this chapter.

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

- Pass-through of native bitstream (Dolby Digital, Dolby Digital Plus and HE AAC) (1).
- Dolby Digital Plus bitstream transcoded to Dolby Digital, if Dolby Digital Plus is implemented in the IRD
- PCM stereo from the decoded or down-mixed bitstream
- PCM multi-channel from the decoded bitstream is optional.
- Multichannel HE AAC bitstream transcoded to Dolby Digital or DTS, if HE AAC is implemented in the IRD
- Pass-through of DTS bitstream is optional.

Note 1: HE AAC on HDMI is optional for IRDs releases before January 2009

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

- Dolby Digital Plus bitstream transcoded to Dolby Digital, if Dolby Digital Plus is implemented in the IRD
- PCM stereo from the decoded or down-mixed bitstream
- Multichannel HE AAC bitstream transcoded to Dolby Digital or DTS, if HE AAC is implemented in the IRD
- Pass-through of Dolby Digital bitstream
- Pass-through of DTS bitstream is optional.

The NorDig HDTV Level IRD shall be capable of decoding and down-mixing the following formats for the analogue outputs:

- HE AAC, if HE AAC is implemented in the IRD
- Dolby Digital, if Dolby Digital Plus is implemented in the IRD
- Dolby Digital Plus, if Dolby Digital Plus is implemented in the IRD
- MPEG1 layer II (Musicam)

An audio signal shall always be present on the analogue outputs (SCART and stereo out, see section 9.7) whenever one of the four formats is received.

6.2.3 Audio prioritising

The default settings of the NorDig HDTV Level IRD for digital audio output shall be PCM Stereo according to IEC 60958 [32]. The NorDig HDTV Level IRD shall provide output formats in accordance with Table 6.1. The user shall be able to select multi-channel audio for the digital outputs, when the outputs are equipped for multi-channel audio.

The NorDig HDTV Level IRD shall use the stereo audio source to provide PCM stereo if both multichannel and stereo sources are available for the selected language. If multiple stereo or multichannel sources are available, selection shall be based on the language descriptor. If the audio source is not matching with the language settings, the NorDig HDTV Level IRD shall always select one of the stereo audio sources. Table 6.1 shows examples of possible situations and signals on digital outputs dependent on user settings.

Available input formats	Output on S/PDIF and HDMI	
	When Stereo is selected (default)	When Multichannel is selected
MPEG1 layer II	PCM	PCM
HE AAC stereo	PCM	PCM
MPEG1 layer II & Dolby Digital	PCM	Dolby Digital (see note 1)
MPEG1 layer II & Dolby Digital Plus	PCM	Dolby Digital Plus on HDMI (see note 2) Dolby Digital Plus transcoded to Dolby Digital on S/PDIF (see note 1)
MPEG1 layer II & HE AAC multichannel	PCM	HE AAC multichannel on HDMI (see note 3) HE AAC transcoded to Dolby Digital or DTS on S/PDIF
HE AAC stereo & Dolby Digital	PCM	Dolby Digital (see note 1)
HE AAC stereo & Dolby Digital Plus	PCM	Dolby Digital Plus on HDMI (see note 2) Dolby Digital Plus transcoded to Dolby Digital on S/PDIF (see note 1)
HE AAC stereo & HE AAC multichannel	PCM	HE AAC multichannel on HDMI (see note 3) HE AAC transcoded to Dolby Digital or DTS on S/PDIF

Table 6.1 Examples of possible simulcast situations and signals on digital outputs dependent on user settings

Note 1: The S/PDIF output shall in any case comply with the content of the table above. For HDMI however, the following feature should be implemented:

When an HDMI Sink device indicates in its E-EDID structure that it only supports Basic Audio (i.e. two-channel L-PCM from the original stereo signal or from a stereo down-mix from the multi-channel signal), then the HDMI output will provide Basic Audio. This feature would then take precedence over the requirement of Dolby Digital, Dolby Digital Plus, HE AAC multi-channel and DTS in the table above whenever the Sink device indicates that only Basic Audio is supported. Observe however that the HDMI output could be different from S/PDIF output, since S/PDIF still has to comply with multi-channel format requirements as in the table above.

Note 2: If an HDMI sink device indicates in its E-EDID structure that Dolby Digital decoding is supported, but Dolby Digital Plus decoding is not supported, the IRD shall transcode Dolby Digital Plus streams to Dolby Digital prior to HDMI transmission.

Note 3: If an HDMI sink device indicates in its E-EDID structure that Dolby Digital or DTS is supported, but HE AAC decoding is not supported, the IRD shall transcode HE AAC streams to Dolby Digital or DTS prior to HDMI transmission.

6.2.4 Clean Audio

The NorDig HDTV Level IRD should support the “Clean Audio” concept by implementing an easy way to adjust the balance between the centre channel and other channels in the audio stream before making a stereo down-mix.

Note: NorDig will consider mandating this function when A/V decoder chipsets are available with this capability integrated within the audio decoder

6.2.5 Audio stream mixing

The audio decoder should be capable of simultaneously decoding two elementary streams containing different programme elements, and then combining the programme elements into a complete programme.

Note: NorDig will consider mandating this function when A/V decoder chipsets are available with this capability integrated within the audio decoder

Most of the programme elements are found in the main audio service. Another programme element (such as a spoken subtitle for the visually impaired or additional audio services such as a spoken director's commentary or alternative languages) may be found in an associated audio service.

6.2.6 Audio description

{Audio description using stream mixing is planned for a future update of this specification}

6.2.7 Adjustment of video/audio-delay

The NorDig HDTV Level IRD shall support the possibility to adjust the audio-delay on the S/PDIF output (if available) up to 250 ms and it should be adjustable in 10 ms steps, as the IRD may have several different user set-ups, resulting in different a/v delays; e.g. the IRD may be connected to several types of external audio-amplifiers and the STB may be connected to several types of external screens

6.2.8 Audio handling when changing service or audio format

The NorDig HDTV Level IRD shall gracefully handle change of service or audio format at the audio outputs without significant disturbances to the end user.

6.2.9 IRD Internal Reference Level

The NorDig HDTV Level IRD shall have an internal digital audio reference level equivalent to the Dolby dialogue normalization reference level of -31 dBFS (equivalent to -20 dBFS Leq for the analogue outputs).

The NorDig HDTV Level IRD shall adjust the output level of all audio decoders to match the internal reference level so that perceived programme loudness is consistent for all audio coding schemes. For IRDs featuring Dolby Digital Plus, this should be consistent with Dolby Technical Bulletin 11: Requirement Updates for Dolby Digital and Dolby Digital Plus in DVB Products [67]. IRDs featuring Dolby Digital or Dolby Digital Plus decoding shall include the PCM Level Control feature described therein.

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

For information HE AAC has a reference level of -31.75 dBFS.

6.2.10 HE AAC requirements for all pass-through, decoding and transcoding

The NorDig HDTV Level IRD compatible to HE AAC shall be capable of decoding HE AAC Level 2 (mono, stereo) at sampling rates of 48 kHz according to ETSI TS 101 154 [23], Annex H.

The NorDig HDTV Level IRD compatible to HE AAC shall be capable of decoding HE AAC Level 4 (multi-channel, up to 5.1) at sampling rates of 48 kHz according to ETSI TS 101 154 [23], Annex H (downmix).

The NorDig HDTV Level IRD compatible to HE AAC shall be capable of transcoding HE AAC Level 4 (multi-channel, up to 5.1) at sampling rates of 48 kHz according to TS 101 154 [23], Annex H to Dolby Digital or DTS.

If featured, transcoding to Dolby Digital audio streams shall be according to TS 102 366 [66] at a fixed bit rate of 640 kbps.

If featured, transcoding to DTS audio streams shall be according to TS 102 114 [64] at a fixed bit rate of 1,536 Mbps.

6.2.11 Metadata Requirements for HE AAC

The NorDig HDTV Level IRD shall support the use of the following aacPlus (HE AAC) metadata embedded in the audio stream when decoding HE AAC and transcoding HE AAC multichannel to Dolby Digital or DTS:

- Dynamic Range Control according to ISO/IEC 14496-3 [65]
- Program Reference Level according to ISO/IEC 14496-3 [65].
- Mix Down Parameters according to "Transmission of MPEG4 Ancillary Data" part of DVB specification ETSI TS 101 154 [23]

6.2.12 Dolby Digital and Dolby Digital Plus requirements for all pass-through, decoding and transcoding

- The NorDig HDTV Level IRD compatible with Dolby Digital Plus shall decode Dolby Digital streams at all bit rates and sample rates listed in ETSI TS 102 366 [66] (not including Annex E).

- The NorDig HDTV Level IRD compatible with Dolby Digital Plus shall additionally decode Dolby Digital Plus streams with data rates from 32 kbps to 3 024 kbps and support all sample rates listed in TS 102 366 [66] Annex E.

The NorDig HDTV Level IRD shall be capable of transcoding Dolby Digital Plus bitstreams to Dolby Digital bitstreams according to TS 102 366 [66]. Transcoding to Dolby Digital audio streams shall be at a fixed bit rate of 640 kbps.

6.2.13 Metadata Requirements for Dolby Digital and Dolby Digital Plus

The IRD shall support the use of a complete set of Dolby metadata embedded in the audio stream when decoding Dolby Digital or Dolby Digital Plus bitstreams, transcoding Dolby Digital Plus bitstreams to Dolby Digital, or creating a PCM stereo downmix from a decoded Dolby Digital Plus or Dolby Digital bitstream.



7 The Bootloader (System Software Update)

Unchanged

8 Graphics Processing

An OSD graphic display shall be implemented and fulfil at least the following requirements:

8.1 *NorDig Basic*

- i. Support resolutions of 720 by 576 pixels and lower.
- ii. Support at least one colour look-up table (CLUT) with a minimum of 16 entries including transparency. It should be possible to choose any 24-bit RGB colour into the 16 entries.
- iii. Support 2 logical display planes:
 - o Video plane for full screen MPEG video.
 - o Graphic plane for graphics (used for menus, teletext, DVB subtitling, etc.)
- iv. Support blending of the graphics with video or stills backgrounds. At least 5 levels of transparency shall be provided (0%, 30%, 50%, 70%, 100%).
- v. Support aspect ratios as set in the installation setting (at the SCART 1 interface, or equivalent for iDTV and other video interfaces, see sections 9.6, 9.11 and 9.12), see also chapter [17].

8.2 *NorDig Enhanced, Interactive and Internet Access*

- i. **For NorDig SDTV Level IRDs:** Support resolutions of 720 by 576 pixels and lower.
For NorDig HDTV Level IRDs: Support resolutions of 1920 by 1080 pixels and lower.
- ii. Support at least 16 bit graphics (RGBa 4:4:4:4 and/or RGB 5:6:5) as defined in DVB MHP v1.1.2 (BlueBook) [27]
- iii. Support 3 logical simultaneous overlapping display planes:
 - o Graphic plane I for MPEG I-still frames, JPEGs, GIFs, PNGs and / or decimated live MPEG video.
 - o Video plane for full screen MPEG video.
 - o Graphic plane II for graphics (full screen).
- iv. Support blending of the graphics with video or stills backgrounds. At least 16 levels of transparency shall be provided.
- v. Support aspect ratios **for SDTV signals** as set in the installation setting (at the SCART 1 interface, or equivalent for iDTV and other video interfaces, see sections 9.6, 9.11 and 9.12), (see also chapter [17]).

9 Interfaces and Signal Levels

9.1 Introduction

Unchanged.

9.2 RF-PAL Output (option)

Unchanged.

9.3 Interaction Channel Interface

Unchanged.

9.4 Smart Card Interface

Unchanged.

9.5 Transport Stream Input/Output (Common Interface)

Unchanged.

9.6 SCART Interfaces

Unchanged.

9.7 Audio **Output** Interfaces (Option)

9.7.1 VCR SCART connector for analogue audio

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

9.7.2 Cinch connector for analogue audio

The NorDig IRD analogue audio interface **based on Cinch** connectors shall be:

- Two Cinch connectors, female type IEC 60603-14 [31].

The audio signals shall be as specified in section 6.1 for the NorDig SDTV level IRD, and as specified in section 6.2 for The NorDig HDTV level IRD.

9.7.3 S/PDIF connector for digital audio

The NorDig IRD (1) digital audio interface, based on S/PDIF, shall support IEC 60958 [32], with a coaxial and/or an optical connector.

The audio signals shall be as specified in section 6.1 for the NorDig SDTV level IRD, and as specified in section 6.2 for NorDig HDTV level IRD.

Note 1: It is highly recommended to equip NorDig IRDs that primarily target HDTV with an S/PDIF interface

9.8 Data Interface (option)

Unchanged.

9.9 Remote Control Interface

Unchanged.

9.10 Remote Keyboard Interface (Option)

Unchanged.

9.11 The HD Interface for NorDig HDTV Level IRDs

9.11.1 General

The NorDig HDTV level IRDs with display (iDTV-sets) shall support the requirements that are specified for high definition video interfaces by EICTA for compliant HD Ready iDTV-sets [58].

The NorDig HDTV level IRDs without display (STBs) shall have at least one High-Definition Multimedia Interface (HDMI) with type A connector [60], supporting displays that comply with the EICTA HD-Ready requirements [58].

9.11.2 Video Output and Display

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

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

The priority order in Table 9.1 should be used when instantly deciding the format in the “Decoder Composition Output”, see 5.2.2.1 Reference Model for Video Decoder.

It shall also be possible to manually set the default output format from the HDTV level STB to a fixed format. The fixed format shall include at least one of the following formats: 1280x720p@50Hz, 1920x1080i@25Hz/1920x1080p@25Hz and 1920x1080p@50Hz.

The preferred default output shall be stored in the STB, see section 17.1.

Received Luminance Resolution (Horizontal x Vertical)	1 st priority for “Decoder Composition Output”	2 nd priority for “Decoder Composition Output”	3 rd priority for “Decoder Composition Output”	4 th priority for “Decoder Composition Output”	5 th priority for “Decoder Composition Output”
50 Hz motion portrayal:					
720x576/25/I, 4:3 or 16:9	1920x1080/50/P (optional), 4:3 Pillar Box or 16:9 Full Frame	720x576/50/P, 4:3 or 16:9	1280x720/50/P, 4:3 Pillar Box or 16:9 Full Frame	1920x1080/25/I, 4:3 Pillar Box or 16:9 Full Frame	(NA)
1280x720/50/P	1920x1080/50/P (optional)	1280x720/50/P	1920x1080/25/I	720x576/50/P	(NA)
1920x1080/25/I	1920x1080/50/P (optional)	1920x1080/25/I	1280x720/50/P	720x576/50/P	(NA)

25 Hz motion portrayal:					
720x576/25/P, 16:9 (2)	1920x1080/25/P	1920x1080/50/P (optional), 2:2 Pull Down	720x576/50/P, 16:9, 2:2 Pull Down	1280x720/50/P, 2:2 Pull Down	1920x1080/25/I, Progressive scan Segmented Frame (PsF) pixel mapping
1280x720/25/P (2)	1920x1080/25/P	1920x1080/50/P (optional), 2:2 Pull Down	1280x720/50/P, 2:2 Pull Down	1920x1080/25/I, Progressive scan Segmented Frame (PsF) pixel mapping	720x576/50/P, 16:9, 2:2 Pull Down
1920x1080/25/P	1920x1080/25/P	1920x1080/50/P (optional), 2:2 Pull Down	1920x1080/25/I, Progressive scan Segmented Frame (PsF) pixel mapping (1)	1280x720/50/P, 2:2 Pull Down	720x576/50/P, 16:9, 2:2 Pull Down
59.94 Hz and 29.97 Hz motion portrayals (2):					
1280x720/59.94/P	1920x1080/59.94/P (optional)	1280x720/59.94/P	1920x1080/29.97/I	No signal (or optionally 720x480/59.94/P)	(NA)
1920x1080/29.97/I	1920x1080/59.94/P (optional)	1920x1080/29.97/I	1280x720/59.94/P	No signal (or optionally 720x480/59.94/P)	(NA)
23.98 Hz motion portrayal (2):					
1280x720/23.98/P (2)	1920x1080/23.98/P	1920x1080/59.94/P (optional), 2:3 Pull Down	1280x720/59.94/P, 2:3 Pull Down	1920x1080/29.97/I, 2:3 Pull Down	No signal (or optionally 720x480/59.94/P, 2:3 Pull Down)
1920x1080/23.98/P	1920x1080/23.98/P	1920x1080/59.94/P (optional), 2:3 Pull Down	1920x1080/29.97/I, 2:3 Pull Down	1280x720/59.94/P, 2:3 Pull Down	No signal (or optionally 720x480/59.94/P, 2:3 Pull Down)

Table 9.1 “Optimized/Original Format” display – priority order

Note 1:

Progressive Scan Segmented Frame (PsF) has the very same mapping of the pixel components as an interlace format and there are no obvious way for the HDMI-sink to recognise whether the format has 25 Hz motion portrayal PsF or 50 Hz motion portrayal interlace. However, it is highly recommended that the originally received 25P-format, and the Decoder Composition Output in the reference model (see Figure 5.1), are not processed in any way (e.g. vertical low pass filtering) targeting interlace output, but simply mapped into PsF in a straight clean way to avoid picture degradation.

Note 2: See note 3 to Table 5.1

A selection of a fixed format between the STB and the display shall be possible. This is to avoid initialising problems when changing format on the HDMI interface. The following fixed formats shall be supported:

- “720p” – 1280x720p50 (or 59.94, depending on received frame rate, see note 3 to Table 5.1)
- “1080i” – 1920x1080i25 (or 29.97, depending on received frame rate, see note 3 to Table 5.1)
- “576p”-720x576p50

The following fixed formats are optional, but recommended:

- “1080p50”-1920x1080p50 (or 59.94, depending on received frame rate, see note 3 to Table 5.1)
- “1080p25”-1920x1080p25 (or 23.98, depending on received frame rate, see note 3 to Table 5.1)

For NorDig HDTV iDTVs the output video shall always be converted to the display’s native resolution.

9.11.3 Audio Output

The Audio Output is specified in section 6.2.3.

9.11.4 Signal protection

The HDMI interface shall support the High-bandwidth Digital Content Protection (HDCP) [61].

The received service may be flagged with a need for content protection or not (CP “ON” or “OFF”) via either the PMT-table or the CA-system or both, as specified by the relevant network/CA-operator. Signals that the IRD is entitled to receive shall be sent to the HDMI-sink (display) in accordance with the following conditions:

- A. In case the received service is flagged with no need for content protection, the signal may be sent to the sink with HDCP disabled.
In case both the PMT-table and the CA-system are used for signalling of such flag, and the HDCP is set to “OFF”, the signal shall only be sent to the sink when both the flag received via the PMT-table and the flag received via the CA-system indicate no need for content protection.
- B. In case the received service is flagged with content protection required via either the PMT-table or the CA-system, the signal shall only be sent to the sink with the HDCP enabled, i.e. when the HDMI sink satisfies the HDCP requirements and HDCP protection is established on the HDMI-link.

The IRD shall (1) provide an option for setting the preferred HDCP-state, (“HDCP-user setting”) to either ON or OFF. The HDCP-user setting shall apply to all services receivable by the IRD. Changes to this setting shall survive channel change, stand-by and power on/off.

Note 1:

This option shall be available via the IRD’s menu system, unless otherwise specified by the relevant network/CA-operator.

Table 9.2 defines the required actions of the IRD, based on the required content protection for the received service and the selected HDCP-user setting. The required content protection level and the required HDCP-state may be flagged via the PMT-table (see section 12.7.3) and/or the CA-system (as specified by the relevant network/CA-operator).

Content Protection level flagged via			HDCP-user setting		Description (IRD actions)
Mode	CA-system (1)	PMT-table (2)	"ON"	"OFF" (3)	
1	HDCP Not wanted	0x00 (HDCP Not wanted)	DISABLE HDCP	OK (5)	HDCP shall be disabled for this service regardless of HDCP user setting (Return to HDCP-user setting when leaving this service)
2	HDCP Wanted	0x00 (See above)	OK (4)	ENABLE HDCP	HDCP shall be set to ON for viewing this service (Return to HDCP-user setting when leaving this service)
3	CP Not needed	0x01* Not needed *) Default value if no signalling	OK (4)	OK(5)	Content protection is not required. HDCP may be set to ON or OFF
4	CP Required	0x01 (See above)	OK (4)	Display message (6)	Content protection is required. HDCP ON is required for viewing this service
5	CP Not needed	0x02 (cond' al requirement)	OK (4)	OK(5) if SD content Display message (6) if protected content is received	HDCP may be set to ON or OFF for SD (see table 12.20) HDCP ON is required for HD for viewing this service
6	CP Required	0x02 (See above)	OK (4)	Display message (6)	Content protection is required. HDCP ON is required for viewing this service
7	CP Not needed	0x03 (CP required)	OK (4)	Display message (6)	Content protection is required. HDCP ON is required for viewing this service
8	CP Required	0x03 (See above)	OK (4)	Display message (6)	Content protection is required. HDCP ON is required for viewing this service

Note 1:

The specified modes may be omitted or redefined by the relevant network/CA-operator. Modes 2, 4, 6 and 8 are not relevant when the CA-system is not used for signalling of required content protection level.

Note 2:

The Content protection levels are fully defined in table 12.20.

Note 3:

“HDCP OFF” is not recommended for the HDCP user setting in networks where some programmes will require “HDCP ON”, because it may lead to excessive zapping times.

Note 4:

No change needed (HDCP is ON)

Note 5:

No change needed (HDCP is OFF)

Note 6:

The IRD shall inform the end user that the HDCP user setting must be turned ON in order to view protected content.

Table 9.2 IRD actions versus required (signalled) Content Protection level and HDCP user setting

9.12 Additional analogue interfaces (optional) for NorDig HDTV Level IRDs

9.12.1 General

The NorDig HDTV level IRD may provide down-converted versions of the received HDTV signals via analogue interfaces, where the output signal is down-converted to SDTV format, see section 5.2.2.12.

9.12.2 Analogue video interface (optional)

The NorDig HDTV level IRD may have one analogue interface for video.

This interface shall comply with the CEA-specification for YPrPb, see [59]

The video signal shall be in SDTV format and comply with the requirements specified in section 5.2.2.12 (Down-conversion of High Definition Video for Standard Definition output).

9.12.3 Analogue audio interfaces (optional).

The NorDig HDTV Level IRD may provide analogue audio output signals via the SCART and/or the Cinch connectors, as specified in sections 9.7.1, 9.7.2 and 6.2.2 Audio formats.



10 Performance

Unchanged.



Part B: The system software with application programming interfaces (API)



11 IRD System Software and API

Unchanged.

12 Service Information

12.1 General

12.1.1 General Requirements

The NorDig IRD shall be able to process, i.e. sort out, store and make available through the Man-Machine Interface (NorDig Basic) or the MHP API (NorDig Enhanced, NorDig Interactive and NorDig Internet Access) the incoming SI data (descriptors) as tabulated in sections 12.2-12.7, i.e. these are (minimum) mandatory descriptors for the receiver to decode and interpret, (see also Table 12.2 for an overview over minimum broadcast and receiver requirements). The processing shall be compliant with EN 300 468 [10] and ETSI TR 101 211 [22].

The NorDig IRD with an MHP-based profile (NorDig Enhanced, NorDig Interactive and NorDig Internet Access) shall support all the DVB SI additions as defined in the DVB-MHP specification version 1.1 [26].

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

The NorDig IRD shall be able to process the PSI/SI tables, both for the ‘Actual’ and for ‘Other’ transport streams.

The NorDig IRD shall at least start updating for any changes in the received “quasi-static” SI data after it returns to active from stand-by mode. “Quasi static” SI-data includes NIT and SDT, i.e. SI that is typically stored in the flash memory for service navigations, such as service name, service_ID, number of services. (The ‘running status’ is not included in the quasi-static SI data. As a guideline for the implementation, this updating may be performed in the background, to shorten the start-up of the basic video and audio).

The NorDig IRD shall at least start action for any changes in the received “dynamic” PSI and SI data, (PMT, EIT, TDT/TOT, running status and CA mode) within 1 second. (As a guideline for the implementation, the trigger for changes in received tables can be based on comparing the ‘version id’ in the tables).

NorDig IRDs with IP-based front-end shall support “TS Full SI” and should support “TS Optional SI”, as specified in ETSI TS 102 034 [29]. With respect to DVB SI as specified in ETSI EN 300 468 [10], the following general requirements and comments apply:

a) The NorDig IRD with IP-based front-end shall process the following DVB SI tables if present in the transport stream (see also Table 12.1):

- Service Description Table (table_id = 0x42 – Actual transport stream)
 - Event Information Table, Present/Following and Schedule
 - Time and Date Table/Time Offset Table
- See section 12.6 for complete procedure to retrieve network time.
- Conditional Access Table (CAT)
 - Programme Map Table (PMT)

b) For NorDig IRDs with IP-based frontends the NIT is not used. Instead the IRDs shall look for the Service Provider Discovery Information as defined in ETSI TS 102 034 [29]. The entry point(s) for Service Provider Discovery Information shall be according to the mechanisms defined in ETSI TS 102 034 [29]. A service list shall be built based on the information in the Service Provider Discovery Information. See also Annex D.

c) In order to locate possible bootloader streams retransmitted from e.g. satellite, the NorDig IP IRD shall look in the Broadcast Discovery Record (according to ETSI TS 102 034 [29]). A bootloader service shall be signaled as a particular service with service_type set to 0x81.

As the NorDig IRD needs information like manufacturer, HW version, SW version etc., the NorDig private Linkage Descriptor shall be included in the Broadcast Discovery Records. The XML scheme of the private Linkage Descriptor is given in section 13.4.4.1.

12.1.2 PSI/SI classification

Static PSI/SI data is defined as the PSI/SI data that must be updated by the IRD in Installation mode (channel search or first time initialization).

Quasi static PSI/SI data is defined as the PSI/SI data that must be updated by the IRD in (automatic) Update mode (i.e. when it is toggled between stand-by mode and active mode or vice versa).

Dynamic PSI/SI data is defined as the PSI/SI data that must be updated by the IRD in active/TV viewing mode (i.e. within 1s after a change in the data occurs).

12.1.3 Private data specifier value

NorDig defined private descriptors and data inside PSI and/or SI tables are recognised with private_data_specifier_value set to 0x00000029, used according to ETSI TR 101 211 [22] and ETSI ETR 162 [18].

12.1.4 Service Types

The NorDig IRD shall minimum handle the service types listed in Table 12.1 below.

Service types that are not supported by the NorDig IRD should be ignored. (If the (SDTV) IRD do not support MPEG-4 AVC video decoder, it should not list/install within the TV service list service types for advanced codec; 0x16 and 0x19).

Class of service (description of service type)	Service type	SDTV IRD	HDTV IRD	Category type	Priority within category
basic TV service (mainly MPEG-2 based SDTV)	0x01	M	M	TV	3
Radio service (mainly MPEG-1 L.II based)	0x02	M	M	Radio	2
Teletext service	0x03	M	M	Others	
Advanced codec based Radio service (MPEG-4 HE.AAC and DolbyDigitalPlus)	0x0A	O	M	Radio	1
Data broadcast service (e.g. for SSU service)	0x0C	M	M	Others	
Stand alone DVB MHP service	0x10	M 1)	M 1)	Others 1)	
Advanced codec based SDTV service (MPEG-4 AVC)	0x16	O	M	TV	2
Advanced codec based HDTV service (MPEG-4 AVC)	0x19	O	M	TV	1
Others	others	O	O	Others	
M; Mandatory, R; (Highly) Recommended, O; Optional item to support 1) Mandatory to support for IRD's that include DVB MHP API					

Table 12.1: Overview of service types, service category groups and priority between the service types

Informative: During migration period simulcasting of the content in (MPEG2) SDTV and in (MPEG4 AVC) HDTV may occur. Simulcasting may be under the same service (service_id) or on separate services (separate service_ids).

While waiting for any new DVB recommendation of signalisation, for service simulcasting on separate service_ids and as a help for the HDTV IRD to know that these services are two versions of the “same” service/content, a linkage ‘NorDig Simulcast replacement service’ (linkage type 0x82) will be broadcasted from the SDTV version pointing to the HDTV version of the same service.

The service types ‘Advanced codec based Radio service’ (0x0A), ‘advanced codec based SDTV service’ (0x16) and ‘advanced codec based HDTV service’ (0x19) will only be used for services only including advanced codec streams (MPEG4 AVC, HE.AAC, AC3+, i.e. these service types will not include any MPEG-2 video nor any MPEG1 L.II audio). These service types will be used when it is not desirable that an “old” SDTV IRD install and list a service.

The service type ‘digital TV service’ (0x01) will be used for services including MPEG-2 video stream. It may also be used for service simulcasting MPEG2 and MPEG4 AVC video and for service only including MPEG-4 AVC video. All IRDs (SDTV and HDTV) will install service type ‘digital TV service’ (0x01). This service types (0x01) will be used for a service that only includes MPEG-4 AVC video when it is desirable that an “old” SDTV IRD install and list a service (even if the SDTV IRD can not decode the video, used for promotion purpose).

The logic channel number shall, as far as possible, be unique within each original network id for each service type category (TV, Radio and Others).

12.1.5 Service Categories

The services are group into three service type categories; TV (1), Radio (2) and Others/data (3) services:

- (1) TV category includes services with service type; 0x01 digital (MPEG-2) TV service, 0x16 advanced codec SD TV service and 0x19 advanced codec HD TV service.
- (2) Radio category includes services with service type; 0x02 digital radio sound service and 0x0A advanced codec digital radio sound service.
- (3) Others/(data) category includes all other service types that are not included in TV (1) and Radio (2) categories.

The NorDig IRD (1) shall during installation of services create a common service list for each category (i.e. all 0x01, 0x16 and 0x19 within same TV category list and so on for the Radio and Other/data categories).

Note 1: This requirement is optional for NorDig SDTV IRDs that are launched before 1 July 2008

Informative: These categories enables the (HDTV) IRD to create a common TV category service list for all TV service types (0x01, 0x16 and 0x19) and similar for Radio and Other/data service lists.

12.1.6 Used PSI/SI descriptors

Descriptor	Tag value	NIT (4)	BAT	SDT	EIT	TOT/ TDT	CAT	PMT
video_stream_descriptor	0x02	-	-	-	-	-	-	mb Mr
audio_stream_descriptor	0x03	-	-	-	-	-	-	mb Or
target_background_grid_descriptor	0x07	-	-	-	-	-	-	Ob Or
video_window_descriptor	0x08	-	-	-	-	-	-	Ob Or
CA_descriptor	0x09	-	-	-	-	-	mb Mr	mb Mr
ISO_639_language_descriptor	0x0A	-	-	-	-	-	-	mb Mr
carousel_id_descriptor	0x13	-	-	-	-	-	-	mb Mr (1)
network_name_descriptor (4)	0x40	Mb Mr	-	-	-	-	-	-
service_list_descriptor (4)	0x41	Ob Mr	-	-	-	-	-	-
satellite_delivery_system_descriptor (4)	0x43	mb Mr	-	-	-	-	-	-
cable_delivery_system_descriptor (4)	0x44	mb Mr	-	-	-	-	-	-
service_descriptor	0x48	-	-	Mb Mr	-	-	-	-
linkage_descriptor (5)	0x4A	mb Mr	-	Ob Mr	*	-	-	-
short_event_descriptor	0x4D	-	-	-	mb Mr	-	-	-
extended_event_descriptor	0x4E	-	-	-	Ob Mr	-	-	-
component_descriptor	0x50	-	-	-	Ob Mr	-	-	-
stream_identifier_descriptor	0x52	-	-	-	-	-	-	Ob Mr
CA_identifier_descriptor	0x53	-	-	Ob Mr	Ob Mr*	-	-	-
content_descriptor	0x54	-	-	-	mb Mr	-	-	-
parental_rating_descriptor	0x55	-	-	-	Ob Mr	-	-	-
teletext_descriptor	0x56	-	-	-	-	-	-	mb Mr
local_time_offset_descriptor	0x58	-	-	-	-	Mb Mr	-	-
subtitling_descriptor	0x59	-	-	-	-	-	-	mb Mr
terrestrial_delivery_system_descriptor (4)	0x5A	mb Mr (2)	-	-	-	-	-	-
private_data_specifier_descriptor (4)	0x5F	mb Mr	-	mb Or	mb Or	-	-	mb Mr
frequency_list_descriptor (4)	0x62	Ob Mr	-	-	-	-	-	-
data_broadcast_id_descriptor	0x66	-	-	-	-	-	-	mb Mr
AC-3 descriptor	0x6A	-	-	-	-	-	-	mb Or
application_signalling_descriptor	0x6F	-	-	-	-	-	-	mb Mr (1)
service_identifier_descriptor	0x71	-	-	Ob Mr (1)				
user defined	0x80-0xFE	-	-	-	-	-	-	-
NorDig private: logic_channel_descriptor (Version 1) (4)	0x83	Ob Or	-	-	-	-	-	-
NorDig private: logic_channel_descriptor (Version 2) (5)	0x87	Ob Mr (3)	-	-	-	-	-	-
Forbidden	0xFF	Fb	Fb	Fb	Fb	Fb	Fb	Fb
- Descriptor not applicable or not yet used as minimum within NorDig								
Mb Mandatory to Broadcast, always/all time								
mb Mandatory to Broadcast if applicable, i.e. if certain criteria is met (e.g. if scrambling is used)								
Ob Optional to broadcast, but recommended (if applicable)								
Fb Forbidden to broadcast (may cause misinterpretation)								
Mr Mandatory to receive and interpret if broadcast								
Or Optional to receive and interpret (if broadcasted)								
* Optional for satellite and cable IRDs.								

Note 1:	Mandatory for IRD with MHP API based profiles
Note 2:	Mandatory to broadcast, in accordance with ETSI TR 101 211 [22].
Note 3:	This descriptor (version 2) is mandatory to receive and process for IRD released after 1 July 2007, see section 12.2.7.
Note 4:	Descriptors carried in the NIT are not relevant for IRDs with IP-based Front-end, see Annex D
Note 5:	Descriptors are included in the SD&S scheme IRDs with IP-based Front-end, see Annex D

Table 12.2 Overview over minimum used descriptors in NorDig broadcast and receivers

12.2 Network Information Table (NIT)

12.2.1 The Network information Table Descriptors

NIT descriptors	Cable IRD	Satellite IRD	Terrestrial IRD
Network_name_descriptor	mandatory	mandatory	mandatory
Service_list_descriptor	mandatory	mandatory	mandatory
Satellite_delivery_system_descriptor	n/a	mandatory	n/a
Cable_delivery_system_descriptor	mandatory	n/a	n/a
Terrestrial_delivery_system_descriptor	n/a	n/a	mandatory
Linkage_descriptor	mandatory	mandatory	mandatory
Private_data_specifier_descriptor	mandatory	mandatory	mandatory
Frequency_list_descriptor	optional	optional	mandatory
(NorDig) logic_channel_descriptor (Version 2)	mandatory(1)	mandatory(1)	mandatory(1)

Table 12.3 NIT descriptors

Note 1: ~~Version 2 of this descriptor is optional for IRDs that are released before 1 July 2007.~~

Note 2: The NIT is not used with NorDig IRDs with IP-based frontends. Hence if NIT is transmitted, the NorDig IP IRDs shall ignore this table. Instead, the information provided by the NIT will be replaced by the Service Discovery and Selection mechanisms, specified in Section 13.4.

12.2.2 Cable Delivery System Descriptor

Unchanged.

12.2.3 Terrestrial Delivery System Descriptor

Unchanged.

12.2.4 Linkage Descriptor

The following linkage_type values shall be interpreted by a Nordig IRD receiver, when used inside the NIT

0x01, linkage to a service that contain information about the network

0x02, linkage to an EPG service (1)

0x04, linkage to transport stream which carries EIT schedule information for all of the services in the network (i.e. "barker channel" service).

0x09, linkage to DVB System Software Update service (bootloader), see section 7

0x81, linkage to NorDig bootloader (software download) service, see section 7. When more than one bootloader is available in the network, the descriptor may occur once or several times in the descriptor loop.

Note 1: Not relevant for NorDig Basic

12.2.5 Frequency List Descriptor

Unchanged.

12.2.6 NorDig linkage for bootloader

Unchanged.

12.2.7 NorDig private; Logic_Channel_descriptor (LCD)

12.2.7.1 NorDig private; Logical Channel Descriptor (version 1)

Note: This older version of the NorDig Logical Channel Descriptor will be replaced by the newer version 2 below.

The logic channel descriptor is used in the second descriptor loop in the NIT, i.e. in each “TS loop”. Data in this descriptor shall be treated as quasi-static and is used to order services in the receiver’s default **service lists**.

Syntax	No. of bits	Identifier
logical_channel_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<number_of_services;i++){		
service_id	16	uimsbf
visible_service_flag	1	bslbf
reserved	1	bslbf
logical_channel_number	14	uimsbf
}		
}		

Table 12.5 Logical_Channel_descriptor

descriptor_tag: This shall be assigned to be 0x83 (decimal 131)

visible_service_flag: This 1-bit field when set to ‘1’/’true’ 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’/’false’ 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).

reserved: All “reserved” bits shall be set to ‘1’ (observe, however, that the IRD shall be able to handle (neglect) future use of reserved bits).

logic_channel_number: this is a 14-bit field which indicates the broadcaster preference for ordering services. It shall be working together with service_type. **The logic channel number shall be grouped into three service type categories; TV, Radio and Others/data services as specified in 12.1.5.** Each broadcaster shall, as far as possible, allocate unique logic_channel_number within his original_network for each service type **category (TV, Radio and Others)**. The logic_channel_number use is defined in Table 12.6.

visible service flag	Logic channel number (decimal value)	Description
0	0	Service not suitable for selection by the user. For example, the value zero may be used for data services only intended for selection from interactive applications or for firmware download services etc.
1	0	Reserved for future use
0	1 – 16383	Reserved for future use
1	1 – 9999	Service displayed in service list and ESG. Accessible via P+/- keys or from numeric keys (same value as decimal value of logic_channel_number)
1	> 9999	Reserved for future use

Table 12.6 Logic_channel_number allocation

All “visible” services shall be displayed in the service list(s), sorted according to logic_channel_number and be addressed with a number in the service list equal to the logic_channel_number, as far as possible. The receiver may have several default service lists (or sections inside one) for the different service_types, for example one for each service_type or typically three main categories; TV, Radio and Others (“Others” is not applicable for IRDs without API, see chapter: 11 IRD System Software and API: NorDig Basic). If the receiver has several service_lists, the addressing of each service in each list shall match, as much as possible the logic_channel_number value (if no collision within a list).

Services shall first be ordered depending on their original_network_id, secondly to their **service category, thirdly to their** service_type and last on their logic_channel_number (independently of several services have collision in the logic_channel_number or if they are listed or not in the logic_channel_descriptor). I.e. first all services from one original network and within that original_network first all **TV category** services, after that **all Radio category** services and last **all Other category services**. After that original network any next original network that the IRD is able to receive and so on.

Services listed in the logic_channel_descriptor, shall have higher priority when ordering the services in the default service list, than services that are not listed. With other words, broadcast services may not be listed in any logic_channel_descriptor and these shall be displayed and accessible in the default service list, but be located last in the service list, in order to their service_type.

Note: If several services are allocated to the same logic_channel_number, (within the same channel list, as may be the case if several terrestrial regions can be received at the same location or several satellite networks are received), one service shall be ordered according to the logic_channel_number and the others shall be placed last in that list. Empty spaces in the broadcast logic channel numbering shall then not be used, instead they shall be located last, after the service with highest logic_channel_number of that service_type (The broadcaster may quite consciously choose to leave empty spaces in the logic channel numbering, for future services, etc, in order to avoid a complete rearrangement of the list). How to choose which service **within same service type** that should be placed according to the channel list is up to the receiver manufacturer.

The examples in Table 12.7 and Table 12.8 below illustrates how broadcasted services shall be ordered in the IRD's service lists according to (a terrestrial) broadcast.

S_ID	ON_ID	TS_ID	N_ID	VSF	LCN	Service type	Comment
100	100	10	101	1	10	0x01 (TV)	
100	200	10	200	1	10	0x01 (TV)	other network provider
110	100	10	101	1	11	0x01 (TV)	
90	100	10	101	-	-	0x01 (TV)	no logic_channel_descr attached to this service
120	100	10	101	1	23	0x01 (TV)	
200	100	10	101	1	23	0x02 (Radio)	other type of service
120	100	10	102	1	23	0x01 (TV)	same service from other terrestrial region (and other transmitter point)
130	100	10	101	1	24	0x01 (TV)	
400	100	10	101	0	100	0x01 (TV)	e.g. sub-service, information channel
500	100	10	101	0	0	0x0C (Data)	e.g. Bootloader or EPG service

Table 12.7 Example of broadcast of SI and services. The abbreviations are defined as: S_ID; service_ID, ON_ID; original_network_ID; TS_ID; transport_stream_ID, NID; network_ID, VSF; visible_service_flag, LCN; logic_channel_number.

Table 12.8 exemplifies how services shall be listed in the receiver (from broadcast above) in a receiver with at least two service_lists, one for TV and one for Radio services. Displayed for the viewer in each service list, will typically be the number (LCN) and the service_name. Here Service 400, only accessible via direct keying (numeric keys) 100 or linked from other service (e.g. EPG), not accessible via P+/- and not displayed in any service lists nor ESG.

TV service list				Radio service list			
Number	S_ID	ON_ID	N_ID	Number	S_ID	ON_ID	N_ID
10	100	100	101	23	200	100	101
11	110	100	101				
23	120	100	101				
24	130	100	101				
25	90	100	101				
26	120	100	102				
27	100	200	200				

Table 12.8 Receiver service list example

12.2.7.2 NorDig private; Logical Channel Descriptor (version 2)

Note: The (new) logic channel descriptor (LCN) version 2 is used in the second descriptor loop in the NIT, i.e. in each transport streams loop. Several LCN's (version 2) may be listed in each TS loop.

Data in this descriptor shall be treated as quasi-static and is used to order services in the receiver's default **service lists**. The descriptor enables an IRD to create a (first time) default orders of the services in the IRD's service lists controlled by the operator, observe that this shall not affect the end-user defined lists in the IRD, if any.

Syntax	No. of bits	Identifier
Logical_channel_descriptor(){		
descriptor_tag	8	Uimsbf
descriptor_length	8	Uimsbf
for (i=0;i<N;i++){		
channel_list_id	8	Uimsbf
channel_list_name_length	8	Uimsbf
for (i=0;i<N;i++) {		
char	8	Uimsbf
}		
country_code	24	Uimsbf
descriptor_length	8	Uimsbf
for (i=0;i<number_of_services;i++){		
service_id	16	Uimsbf
visible_service_flag	1	Bslbf
reserved_future_use	1	Bslbf
logical_channel_number	14	Uimsbf
}		
}		

Table 12.9 Logical_Channel_descriptor (version 2)

descriptor_tag: This shall be assigned to be 0x87 (decimal 135)

channel_list_id: This is an 8-bit field which serves as a label to identify the channel list (uniquely allocated within each original_network_id). The user shall be able to select a preferred channel list to be used, when several are available during the first-time installation (or complete re-installation).

channel_list_name_length: This 8-bit field specifies the number of bytes that follow the channel_list_name_length field for describing characters of the name of the Channel List. Maximal length is 23 bytes for the channel_list_name.

Note: There might be several channel lists available that are not relevant for the specific IRD. The box shall ignore these automatically by supporting the following behaviour:

Primary: Ignore all channel lists that is not according to the default country setting.

Secondly: Only include LCD according to the NIT that is default for NIT search.

To avoid several non relevant service lists if for any reason a complete search has to be done, the LCD shall still be chosen from the NIT that is according to the default settings.

char: This is an 8-bit field. A string of character fields specify the name of the channel list, the channel_list_name. (Maximal length is 23 bytes for the channel_list_name). Text information is coded using the character sets and methods described in EN 300 468, annex A. The IRD is recommended to use the channel_list_name to present information on the OSD, for example when the user chooses a preferred channel list among several to create the IRD's service list(s).

country_code: This 24-bit field identifies a country using the 3-character code as specified in ISO 3166 [40]. Each character is coded into 8-bits according to ISO 8859-1 [41] and inserted in order into the 24-bit field. In the case that the 3 characters represent a number in the range 900 to 999, then country_code specifies an ETSI defined group of countries. These allocations are found in ETSI ETR 162 [18].

EXAMPLE: Sweden has 3-character code "SWE", which is coded as:
'0101 0011 0101 0111 0100 0101'.

The IRD may use this field (in combination with the IRD's user preference settings) to propose a channel list to be chosen as preferred when several are available.

service_id: A service_id that belongs to the TS (i.e. services from other TS shall not be listed). One service may only be listed once in each channel list, but may belong to/be listed in more than one channel list.

visible_service_flag: This 1-bit/boolean field when set to '1'/true indicates that the service is normally visible and selectable (subject to the service type being suitable etc.) via the receiver service list. See details section 12.2.7.1 NorDig private; Logical Channel Descriptor (version 1): visible_service_flag

Reserved: All "reserved" bits shall be set to '1', See details section 12.2.7.1 NorDig private; Logical Channel Descriptor (version 1): Reserved.

logic_channel_number: This is a 14-bit field which indicates the broadcaster preference for ordering services. See details section 12.2.7.1 NorDig private; Logical Channel Descriptor (version 1): logic_channel_number. The logic_channel_number use is defined in Table 12.6.

Table 12.10 below illustrates how broadcast services shall be ordered in the NorDig IRD's service lists, by use of LCN Version 2; with an example from a terrestrial broadcast.

CL_ID	ON_ID	TS_ID	S_ID	N_ID	VSF	LCN	Service type	Comment
1	100	10	100	101	1	10	0x01 (TV)	
1	200	10	100	200	1	10	0x01 (TV)	other network provider and other combination channel_list_id, ONID
1	100	10	110	101	1	11	0x01 (TV)	
-	100	10	90	101	-	-	0x01 (TV)	no logic_channel_descr attached to this service
1	100	20	120	101	1	23	0x01 (TV)	
1	100	20	200	101	1	23	0x02 (Radio)	other type of service
1	100	20	120	102	1	23	0x01 (TV)	same service from other terrestrial region (and other transmitter point)
1	100	20	130	101	1	24	0x01 (TV)	
1	100	10	400	101	0	100	0x01 (TV)	e.g. sub-service, information channel
2	100	10	100	101	0	0	0x01 (TV)	Same service listed in a other channel list
1	100	10	500	101	0	0	0x0C (Data)	e.g. Bootloader or EPG service

Table 12.10 Example of broadcast of SI and services, LCN Version 2. The abbreviations are defined as: CL_ID; Channel_list_ID, ON_ID; original_network_ID; TS_ID; transport_stream_ID, NID; network_ID, S_ID; service_ID, VSF; visible_service_flag, LCN; logic_channel_number.

Table 12.11 exemplifies how services shall be listed in the receiver (from broadcast above) in an NorDig IRD with at least two service_lists, one for TV and one for Radio services and here with the channel list CL_ID 1 and ON_ID 100 as the chosen preferred channel list. Displayed for the viewer in each service list, will typically be the number (LCN) and the service_name. Here Service 400, only accessible via direct keying (numeric keys) 100 or linked from other service (e.g. EPG), not accessible via P+/- and not displayed in any service lists nor ESG.

TV service list				
Number	ON_ID	TS_ID	S_ID	N_ID
10	100	10	100	101
11	100	10	110	101
23	100	20	120	102
24	100	20	130	101
25	200	10	100	200
26	100	10	90	101

Radio service list				
Number	ON_ID	TS_ID	S_ID	N_ID
23	100	20	200	101

Table 12.11 Receiver service list example

The service [ONID, TSID, SID] = 100, 20, 120 is listed only once (even though that service is transmitted twice). This due to that the IRD in this example above has a stronger and a better reception (quality) of the TS where service [ONID, TSID, SID, NID] = 100, 20, 120, 102 belongs to, than for the TS where the service [ONID, TSID, SID, NID] = 100, 20, 120, 101 belongs to.

12.2.7.3 NorDig LCD simultaneous version 1 and version 2 transmissions

Within one and the same network (i.e. within one Original Network ID), the NorDig IRD should be able to sort service/channel into the service list when transmitting both NorDig logical channel descriptor (LCD) version 1 and version 2.

When broadcasting both LCD version 1 and version 2 within one Original Network ID, the NorDig IRD supporting both descriptors shall only sort according to the version 2 (i.e. NorDig LCD version 2 has higher priority).

12.2.7.4 Reception of multiple (DTT) networks and NorDig LCD

Comment: There are several areas within the Nordic region where DTT networks from the neighbouring countries can be received (for example southern part of Sweden, where Danish and German DTT can be received). Below follows a clarification to the use of the NorDig logical channel descriptor (LCD), regarding reception from multiple DTT networks

The NorDig IRD with terrestrial front-end shall be able to install several (DTT) original networks (with different original network ids).

For multiple original networks (original network ids) the NorDig IRD shall first sort/list all services from one original network (original network id) according to that LCD, before sorting/listing the next original network. The first original network is the primary network and any additional received original networks are referred to as secondary network(s).

The user shall be able to set which original network that shall be the primary, either via the user preferences, e.g. matching country setting (preferred) or via user selectable list of available original networks or similar mechanism. In order to simplify this, the NorDig IRD should map/translate the original network id into the country name. This means that for IRD where the user has set the country setting, the primary network should automatic be the country matching the original network id (and its services shall be listed first in the NorDig IRD's service list).

(Automatic) updates within the NorDig IRD shall not change within the IRD's service list the relative order between the installed primary network and secondary network(s).

For IRDs with terrestrial front-end, intended for the Nordic area it is recommended to include a translation list of all Northern Europe DTT original network ids. For original networks transmitting LCD version 2, the country code will be found directly within the descriptor without any mapping.

The primary DTT network shall be listed according to its LCD (version 2 or version 1), then additional (secondary) network(s) shall be listed, one-by-one, with its services after the primary network's last listed services (i.e. not use empty logical numbers within first network). This means that the services from the additional DTT network(s) will not be listed according to its LCN values. Important is to only include visible marked services from additional (secondary) networks and not any service that is marked as non-visible. It is recommended - if possible- to keep the relative order between the listed services within any secondary network(s).

If the IRD manufacture chose to have multiple service lists, (one for each original network id or similar), then the primary network shall be the IRD's default service list after the installation.

Note: Within DVB's SI code allocation (ETR162), there is normally an un-written code of practise for digital terrestrial networks that the original network id has been allocated by the DVB office to the value of 0x2000 plus the country's ISO 3166 Country code value. This is true for almost all countries, but not for e.g. the Swedish DTT, which has original network id value (0x22F1).

12.3 Service Description Table (SDT)

12.3.1 The Service Descriptor Table Descriptors

Unchanged.

12.3.2 Service Descriptor

The service_type (under the service_descriptor) value 0x81 is reserved for the bootloader use (see section 7).

12.3.3 CA Identifier Descriptor

Unchanged.

12.3.4 Linkage Descriptor

The following linkage_type value shall be interpreted by a NorDig IRD when used inside the SDT:

0x03, linkage to a CA replacement service. When present, the receiver shall automatically switch to the replacement service if the receiver are not able descramble the (original) service and if the receiver are able to receive the SDT containing the original service during the replacement, also switch back when 'free_CA_mode' is set to "0".

0x05, linkage to a service replacement service. When present, the receiver shall automatically switch to the replacement service if the 'running_status' is set to "1" (not running) and if the receiver are able to receive the SDT containing the original service during the replacement, also switch back when 'running_status' is set to "4" (running).

0x82, NorDig Simulcast replacement service, linkage from an (MPEG2) SDTV based service to an (MPEG4 AVC) HDTV replacement service with the same content. It may be used during simulcasting of a service in both an SDTV and an HDTV version on separate service ids with same content within the same original network id. This linkage may be included in the (MPEG2) SDTV service (service_type 0x01) within the SDT pointing to the HDTV version (service_type 0x19) of the service. Whenever it is used, it will be used quasi-static.

When an SDTV service includes this NorDig simulcast replacement service linkage (0x82) pointing to the HDTV version of the service, the NorDig HDTV IRDs that are able to receive

both the SDTV and the HDTV services shall only include the HDTV version/(service) of the two services within its TV service list.

(Clarification: If no 'NorDig simulcast replacement service' linkage is included, both services shall be included. If only the (MPEG-2) SDTV version (service_type 0x01) is possible to receive (due to e.g. reception problems/limitations), the (HDTV) IRD shall include this service even if it carries a linkage 'NorDig simulcast replacement service').

12.4 Event Information Table Present/Following (EIT p/f)

Unchanged.

12.5 Event Information Table Schedule

Unchanged.

12.6 Time and Date Table and Time Offset Table

Unchanged.

12.7 PSI Requirements

12.7.1 Program Map Table Descriptors

Program map Table
teletext_descriptor
Subtitling_descriptor
stream_identifier_descriptor
video_stream_descriptor
CA_descriptor
ISO_639_language_descriptor
Private_data_specifier_descriptor
data_broadcast_id_descriptor (1)
application_signalling_descriptor (1)
carousel_id_descriptor (1)
(NorDig) Content_Protection_descriptor

Table 12.16 PMT descriptors

Note 1: This descriptor is only mandatory for the MHP receivers (i.e. Enhanced, Interactive and Internet Access Profiles)

12.7.2 Component priority multiple video or audio streams

For services that transmit in parallel more than one type of video/audio stream under the same service (service_id) (typical example during simulcasting within same service), following applies.

NorDig IRD not supporting a specific advanced codec, shall not default choose that advanced codec stream. For example, an (SDTV) IRD that do not include any AC3 (down-mix) decoder, (maybe only supports pass-through of AC-3 to the digital audio output), shall not default choose the AC3 audio stream. Instead it shall default first choose the basic MPEG-1 Layer II audio stream.

The NorDig (HDTV Level) IRD that supports more advanced codecs for video and audio decoding, shall priorities the service's components (video and/or audio) with advanced codec, default according to priority listed below.

Video codec	Stream_type	Priority
MPEG-4 AVC HP@L4 HD video stream	0x1B	1 (highest)
MPEG-4 AVC HP@L4 / L3 SD video stream	0x1B	2
Basic, MPEG-2 MP@ML video stream (or MPEG1)	0x02 (0x01)	3 (lowest)

Table 12.17 Default priority order for the IRD between different video streams

Audio codec	Stream_type	Priority
MPEG-4 HE.AAC (or LC.AAC) v2 audio stream	0x11	1 (highest)
Dolby Digital Plus, AC3+ (Enhanced AC3) audio stream	0x06	2
Dolby Digital (AC3) audio stream	0x06	3
Basic, MPEG-1 Layer II audio stream	0x03	4 (lowest)

Table 12.18 Default priority order for the IRD between different audio streams

(For several streams of same type, then the primary stream shall be the one according to the ISO 639 descriptor, typical case when several audio streams with different languages).

12.7.3 Content_Protection_descriptor

This descriptor is used to signal the content protection level for the received service.

The IRD shall use the signalled Content Protection level together with the IRD's HDCP user setting to determine if HDCP needs to be enabled or disabled on the HDMI output interface, see section 9.11.4.

The Content Protection descriptor shall be conveyed in the descriptor loop immediately following the program_info_length field in the Program Map Table. The descriptor only applies to the service to which the program map table is applicable. If the descriptor is missing for a service, it shall be interpreted as content protection level 0x01 (see Table 12.20).

Syntax	Number of bits	Identifier
Content_Protection_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
Content_Protection_level	8	uimsbf
}		

Table 12.19 Semantics for the Content_Protection_descriptor

descriptor_tag: The descriptor tag is an 8-bit field which identifies the descriptor. The value for the Content_Protection_descriptor is 0xA0 (decimal 160, i.e. within the "user defined" range).

descriptor_length: The descriptor length is an 8-bit field specifying the total number of bytes of the data portion of the descriptor following the byte defining the value of this field. The value is always 0x01 for the Content_Protection_descriptor.

Content_Protection_level: The descriptor length is 8-bits, and represents the level of Content Protection required for a program/service. The currently defined levels and their interpretation are defined in Table 12.20:

Content Protection level	Description
0x00	Outputs shall <u>not</u> be protected. Any protection mechanism, such as HDCP, shall be switched off, regardless of video format and resolution
0x01* *) Default value if no signalling	Content protection is not required. The IRD's content protection mechanism may be set to ON or OFF, regardless of video format and resolution.
0x02	Content protection is mandatory for video with higher resolution than 576 horizontal lines, but not for resolutions with 576 or less lines. The IRD's content protection mechanism shall be set to ON for video with higher resolution than 576 horizontal lines, and may be set to ON or OFF for video with resolution lower than or equal to than 576 horizontal lines.
0x03	Content protection is mandatory regardless of video format and resolution. The IRD's content protection mechanism shall be set to ON.
<p>Note: Additional levels may be defined in the future.</p> <p>If the IRD receives other values for the Content Protection level than defined in Table 12.20, it shall neglect all bits except the last two and use these bits for interpreting the Content Protection level.</p> <p>The IRD shall in addition to the information provided in the Content_Protection_descriptor also use Content Protection information provided via the Conditional Access system when determining the required content protection, see section 9.11.4.</p>	

Table 12.20 Specified content protection levels

IRD actions for the various required Content Protection levels, as depending on the HDCP user setting, are specified in section 9.11.4 (table 9.2).

13 Navigator

13.1 General

Unchanged.

13.2 Service List

13.2.1 Service List Requirements

13.2.1.1 Service List Requirements for IRDs, except for IP-based front-end

The NorDig IRD shall maintain a service list based on SI-information. The NorDig IRD identifies a service uniquely through the combination of `original_network_id`, `transport_stream_id` and `service_id`. (The broadcaster however shall make services uniquely identified in the broadcast through the combination of only `original_network_id` and `service_id`).

The service list shall include the services and should also include the corresponding network names. The service list can be completely updated by the user by initiating the tuning/scanning procedure(s) for the connected tuners (see section 3.1.2). The corresponding part of the service list shall be updated within 1 second after reception of an updated SI table; updates should be made each time the NorDig IRD is switched from active to stand-by and shall be made each time the NorDig IRD is switched from stand-by to active.

The IRD shall build up different sections inside one service list or build up several service lists, one for each different service `category` as the default IRD service list(s). Minimum three different sections/lists shall be supported for three different categories of `service_types` and they are 'TV', 'Radio' and 'Data'/'other' services, (see 12.1.5 for service categories).

Whenever two or more services within same category are allocated to the same `logical_channel_number`, the NorDig HDTV IRD shall first priorities the advanced codec services as stated in Table 12.1 above (see chapter 12.1.4 for priority between different services within same service category).

The service list shall be displayed to the user. The user shall be able to select a service from the displayed service list. The selected service shall appear immediately (see section 10.4).

The IRD should provide functionality for the viewer to build up additional personal service lists with the viewer's own preferred services (like mixed `service_type`) and own preferred order or manually re-order the default service list(s). If any network operator makes changes in his part of the service list, the NorDig should place new entries at the end of the corresponding part of the user service list.

The information in the descriptors specified in table 13.1 and 13.2 shall be displayed. The original network operator name may be omitted in case only one network is available.

13.2.1.2 Service List Requirements for IRDs with IP-based front-end

Unchanged.

13.2.2 Service list functions for the Network Information Table (NIT)

Unchanged.

13.2.3 Service List functions for the Service Description Table (SDT)

Unchanged.

13.2.4 Network Evolution and Service Changes

Unchanged.

13.3 *Event Schedule Guide (ESG)*

Unchanged.

13.4 *Service Discovery and Selection for IRDs with IP-based front-end*

Unchanged.

14 Teletext and Subtitling

14.1 Teletext

14.1.1 Teletext for NorDig SDTV Level IRD

During normal operation (decoding of MPEG2-video/audio/data-streams), the NorDig IRD shall be able to demultiplex in parallel the Teletext service transmitted in a packetised format according EN 300 472 [11].

The NorDig IRD shall be able to display Teletext using the OSD and/or by the insertion of the teletext data in the VBI of the analogue CVBS video output. The NorDig IRD shall be able to display Teletext subtitling, meeting the requirements for level 1.5 in ETSI EN 300 706 [12], "Enhanced Teletext Specification", (even if VBI insertion is used for the teletext pages).

The VBI insertion shall be compliant with ITU-R BT.653-3 [47]. The Teletext data shall be inserted in the lines 6 to 22 and lines 320 to 335.

It shall be possible to use the OSD to present the decoded Teletext pages, meeting the ITU-R BT.653-2 level 1.5 requirements.

The user shall be able to select primary and secondary subtitling language.

The Nordic characters defined in the Latin G2 supplementary set shall be supported.

The NorDig IRD with OSD presentation should be able to cache at least 50 decoded Teletext pages in order to improve the access time for frequent used pages. When displaying a certain page the decoder should cache a certain number of pages requested by the customer before that page and decode a certain number of pages that are most likely to be requested by the customer later.

14.1.2 Teletext for NorDig HDTV Level IRD

The NorDig HDTV Level IRD shall (2) be able to display (EBU) Teletext (both normal teletext pages and teletext subtitling pages) using the OSD, meeting the requirements for level 1.5 in ETSI EN 300 706 [12] "Enhanced Teletext Specification".

Note 1: Re-insertion of teletext data into VBI of the video signal for teletext pages is not enough since the VBI signal is not defined for the HDMI. Therefore shall all HDTV IRD implement a full Teletext decoder level 1.5.

Note 2: This requirement may be optional for IRDs that are launched before 2009 in some networks, as decided by the relevant network operator(s).

14.2 DVB Subtitling

14.2.1 General

The NorDig IRD shall be capable of decoding, as a minimum, a subset of the DVB subtitle services as specified in section 14.2.1 and transmitted in conformance with ETS 300 743 [13], and displayed using the OSD capabilities whilst decoding the full television service (video and audio) to which it is associated.

The DVB subtitling shall be able to coexist with applications, and shall coexist with MHP-applications as specified in the DVB-MHP specification v1.1 [26]. The enabling and disabling of the subtitles shall be user controlled through the user interface, but with subtitles enabled as default option. The enabling and disabling of the subtitle composition pages and selection of “normal” or “hard of hearing” subtitling should be user controlled, with composition pages and normal subtitling enabled as default option. The enabling or disabling of the subtitle ancillary pages, if available, should be user controlled, with subtitle ancillary pages enabled as default option. The selection of subtitle ancillary pages shall be independent of the enabling of subtitle composition pages.

The user shall be able to select primary and secondary subtitling language.

In case of ‘hard of hearing’ subtitling mode is selected and if no ‘hard of hearing’ pages are received (signalled in subtitling descriptor), the receiver shall as a default use ‘normal’ pages from the same selected language.

The precision of the presentation of the subtitles shall be within 2 frames.

Note 1: If both DVB-subtitling and Teletext subtitling are received simultaneously the IRD shall only display the DVB-Subtitling stream.

The precision of the presentation of the subtitles shall be within 2 frames.

14.2.2 Subtitling subset

The NorDig IRD shall at least be capable of decoding the following DVB subtitling services:

DDS	Optional for SDTV Level IRDs, mandatory for HDTV Level IRDs: The Display Definition Segment for a subtitle service shall be supported for services that implement DDS, as defined in EN 300 743 [13]. Absence of a DDS implies that the display segment width shall be assumed as 720 pixels and the height as 576 lines.
Object types:	The handling of the object type (0x00) ‘basic object, bitmap’ shall be supported. The handling of the other object types (i.e. 0x01), ‘basic object, character’ and (0x02) ‘composite object, string of characters’) is optional.
Regions:	The number of regions shall be according to the ETS 300 743 [13] specification, however a limitation in the display area due to memory restrictions is allowed. The total number of regions to handle shall be able to cover four complete subtitle rows (per frame) where: SDTV Level IRDs: One subtitle row shall be extendable to 706 pixels * 40 pixels. The regions shall have the possibility to cover 112960 pixels per frame. HDTV Level IRDs: One subtitle row shall be extendable to 1906 pixels * 60 pixels. The regions shall have the possibility to cover 457440 pixels per frame.
Number of objects:	The number of objects shall be at least 128.
CLUT:	The NorDig IRD shall be able to handle at least one colour look-up table (CLUT) with a minimum of 16 entries per region and the possibility to have one colour scheme applied in each of the regions. It shall be possible to choose any 24-bit RGB colour into the 16 entries. The

decoder shall be able to handle the mapping to the closest colour match if the decoder has some limitation in the colour presentation.

The use of the `non_modifying_colour` flag is optional.

Transparency:

The NorDig IRD shall implement at least 5 levels of transparency; 0% (opaque), 30%, 50%, 70% and 100% (completely transparent). Implementation of additional intermediate levels of transparency is optional.

Where the NorDig IRD cannot complement a particular value of semi-transparency it shall replace it with the nearest value of transparency it can implement. However, if the encoded value of transparency is in the range 10%-90% it shall not be approximated as either 0% or 100% transparency.

So, 9% may be approximated as 0% but 10% shall be represented with a value in the range 10% to 90%, such as 30%. Similarly, 91% may be approximated as 100%.

Number of streams:

The receiver shall support at least one DVB-subtitling streams i.e. at least support decoding of one subtitling composition page while support of one simultaneously available ancillary page is optional.

15 Interfaces for Conditional Access

Unchanged.



16 Remote Control and Remote Keyboard

Unchanged.

17 User Preferences

17.1 Stored preferences

The user shall be able to store preferences in persistent memory. The following user preferences shall be implemented in the NorDig IRD.

- Video display preferences as defined in section 5.1.2.
- Audio preferences as defined in section 6.1.2.4 and 6.1.3.
- Primary and secondary audio language as defined in section 6.1.3.
- Primary and secondary subtitling language as defined in chapter 14.
- Service list as defined in section 13.2.
- Country setting for pre-selection of the primary menu, audio and subtitle language settings based on country code as defined in 12.2.7.2.

Additional requirements for the NorDig HDTV level IRD

The user shall be able to store preferences in persistent memory, in addition to the stored preferences specified for SDTV level IRDs. The following user preferences shall be provided for NorDig HDTV level IRDs:

- HDMI Video preferences for:
 - Output video format, as set by the user:
 1. Automatic mode, based on use of EDID, as specified in section 9.11.2
 2. Fixed format, as specified in section 9.11.2
- HDMI Audio preferences for:
 - Audio transcoding if System A and/or B are/is implemented, as specified in sections 6.2 and 9.11
 - Audio output selection (e.g. stereo/multichannel) as specified in sections 6.2 and 9.11
- HDCP preferences as specified in sections 9.11.4
- Audio delay in S/PDIF as specified in section 6.2.5

The following user preferences should be provided for NorDig HDTV level IRDs:

- Clean Audio selection as specified in section 6.2.4.

17.2 Deletion of service lists

The IRD shall provide a function to remove all service lists (default and user defined); this function should not affect other parameters (e.g. user preferences).

17.3 Reset to factory mode

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

The factory mode should be set to the following:

RF input DC power supply source for satellite front-end:	on
RF input DC power supply source for terrestrial front-end:	off (1)
RF-output preset channel:	Channel 43 (PAL-G) (2)
Menu language:	equal to country settings
Primary audio language:	equal to country settings
Subtitling (normal):	on
Primary subtitling language:	as country settings
Subtitling; hard of hearing/hearing impaired:	Off
<p>Note 1: In the first time installation and resetting to factory default settings, the DC power supply shall be switched off. It is recommended that the receiver ask if the DC power supply is turned on in the first time installation and in the installation after resetting to factory settings, to speed up the initialisation procedure.</p> <p>Note 2: Applicable for IRDs with RF PAL modulator</p>	

Table 17.1 Factory default settings for SDTV-level IRDs

Additional requirements for the NorDig HDTV Level IRD:

The factory mode for the NorDig HDTV Level IRD should be set, in the addition to the SDTV Level IRD, to the following settings:

HDMI Audio output	Stereo or a stereo down-mix from system A or B multichannel, see section 6.2
HDMI Video output	Automatic using EDID information
HDCP	ON or as specified by the relevant network/CA operator see section 9.11.4 (1)
<p>Note 1: The HDTV level IRD should provide an option to manually set the HDCP default to "ON" or "OFF", see section 9.11.4.</p>	

Table 17.2 Additional factory default settings for NorDig HDTV level IRDs



Annex A: NorDig Members

Unchanged.

Annex B: Background and options for IRDs with a terrestrial front-end

Unchanged.

Annex C: QEF Quality Measurement Methods

Unchanged.

Annex D: Bootloading and Service Lists in IP-based and other networks

Unchanged.

Annex E: Implementations Guidelines for NorDig Bootloader

Unchanged.



Annex F: Comparison of NorDig profiles