Minimum Receiver Requirements
for
Free-to-Air Digital Terrestrial Television
for
Radio Telefis Éireann

Additions and clarifications to NorDig Unified Requirements 2.0

(MPEG4 AVC, HDTV, MHEG5 etc)

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Contents

1. Introduction

1.1. Scope

This document specifies the minimum receiver (technical) requirements for reception of standard definition television (SDTV) services, high definition television (HDTV) services, and ancillary data services, from the free-to-air (FTA) digital terrestrial television (DTT) transmission network in Ireland. This receiver is hereafter denoted as an Integrated Receiver Decoder (IRD). The IRD shall be DVB compliant, and shall be able to receive MPEG-2 Transport Streams from a DVB-T modulated signal and to decode the services within, including video, audio, data, and subtitling services.

To conform to the minimum receiver specification the IRD shall be compliant with the following standards:

1) NorDig 2.0 Basic Profile @ High Definition Level
2) MHEG-5 UK Profile, version 1.06
3) Additions and clarifications as set out in this document

Note IRDs intended to handle CA (encrypted/scrambled) services (using embedded CAS or via Common Interface) that meet the above standards shall be deemed to conform to the minimum receiver standard and shall be able to handle both FTA services as well as CA services.

This means the only difference in mandatory requirements between a pure FTA IRD and an IRD that can facilitate CA services is the CA System (see chapter 3).

1.2. Document History

Version	Date	Status	Comments
0.1	2008-11-09	Draft	Initial draft document based on Teracom ACD 2.0 document
0.1b	2008-11-11	Draft	Comment 0.1 draft (comments from Teracom, Per Tullstedt , ptu and Petri Hyvärinen, phy)
0.1c	2008-12-17	Draft	Amendments to 0.1b draft - Marcus O'Doherty
1.0	2008-12-19	Issue 1	Final amendments to o.1c draft – Marcus O'Doherty
Contact person(s):			

1.3. Terminology

Mandatory / shall This word means that the item is mandatory.

Recommended / should This word means that this item is not mandatory, but is highly recommended. If included, then it shall be implemented as specified.

Optional This word means that this item is not mandatory, gives added value to different IRD implementations. But if this item is included then it shall be implemented as specified here.

1.4. List of Abbreviations

AAC	(MPEG-4) Advanced Audio Coding (ISO/IEC 14496-3) here refers to HE-AAC level 4
AC3	Dolby Digital audio coding (ETSI TS 102 366)
AC3+	Enhanced AC3, Dolby Digital Plus audio coding, (ETSI TS 102 366)
API	Application Programming Interface (for example DVB MHP)
AVC	Advanced Video Coding (MPEG-4 part 10 ISO/IEC 14496-10, ITU-T H.264)
BAT	(DVB SI) Bouquet Association Table
bslbf	bit string, left bit first
CA	Conditional Access
CAM	Conditional Access Module
CAS	Conditional Access (CA) System
CI	(DVB) Common Interface
DTS	DTS audio (ETSI TS 102 114)
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcast
EICTA	European Information & Communications Technology Industry Association
EIT	(DVB SI) Electronic Programme Guide
EPG	Electronic Programme Guide
EPT	(DVB-T) Effective Protection Target
ESG	(DVB SI) Event Schedule Guide
FTA	Free To Air
H.264	Same as AVC (MPEG-4 part 10 ISO/IEC 14496-10, ITU-T H.264)
HD	High Definition (TV)
HDTV	High Definition TeleVision
HE.AAC	(MPEG-4) High Efficient AAC version 1 Level 4
IRD	Integrated Receiver Decoder
LCD	(NorDig) Logical Channel Descriptor
LCN	(NorDig LCD) Logical Channel Number
MFN	(DVB-T) Multiple Frequencies Network
MHP	Multimedia Home Platform (API)
Mono	Monaural audio, i.e. 1.0 channel audio stream
MHEG	Multimedia and Hypermedia Experts Group
MPEG	Moving Picture Expert Group
Multi-channel	Multichannel audio, i.e. up to 5.1 channel audio stream (i.e. 3.0, 4.0, 5.1 etc)
n/a	Not Applicable
NID	(DVB SI) Network Identifier
NIT	(DVB SI) Network Information Table
NVOD	Near Video On Demand
ONID	(DVB SI) Original Network Identifier
OSD	On Screen Display
P/f	(DVB SI) Present / Following (event)
PCM	Pulse-Code Modulation audio (IEC 60958)
PSI	(MPEG) Programme Specific Information
QEF	(DVB-T) Quasi Error Free (reception)
Sch	(DVB SI) Schedule (event)
SDT	(DVB SI) Service Description Table
S-DTT	Swedish DTT (Digital Terrestrial Television)
SDTV	Standard Definition TeleVision
SFN	(DVB-T) Single Frequency Network
SI	(DVB) Service Information
SID	(DVB SI) Service Identifier (== MPEG Program Number)
SMC	(CA) Smart Card
Stereo	Stereo (left and right) audio, 2.0 channel audio stream
TDT	(DVB SI) Time and Date Table
TOT	(DVB SI) Time Offset Table
TS	(MPEG) Transport Stream
TSID	(DVB SI) MPEG-2 Transport Stream Identifier
uimsbf	Unsigned integer most significant bit first
UTC	Co-ordinated Universal Time

2. General features for a digital receiver

The requirements for IRDs (integrated receiver decoders) in the DTT network in this specification are based on the NorDig Unified receiver specifications Basic Profile at its HD Level (www.nordig.org), and the MHEG-5 version 1.06, UK Profile (www.dtg.org.uk), with some additions and clarifications as included in this document.

All IRDs shall be able to receive and decode MPEG4 AVC (H.264) based SDTV and HDTV services, MHEG5 data services, and DVB subtitling services.

Compared to NorDig Unified 2.0 basic profile specification, the following major additional minimum requirements and clarifications are applicable for all IRDs:

- MPEG4 HD Level mandatory on all IRDs which among other things includes:
  - Video decoding (see chapter 5.2)
    - MPEG4 HP@L4 HDTV (observe this includes HP@L3 SDTV)
    - MPEG2 SDTV
  - Audio decoding (see chapter 5.3)
    - HE.AAC Level 4 multi-channel audio and
    - Enhanced AC3 (“Dolby Digital Plus”) multi-channel audio and
    - MPEG1 Layer 2 stereo audio
  - DVB HD Subtitling
  - Applicable SI for HD level
- MHEG-5 UK Profile, version 1.06 mandatory on all IRDs

IRDs shall include MHEG-5 API UK profile version 1.06 with support of HDTV video as specified in DTG D-Book specification.

When using ‘IRD’ (Integrated Receiver Decoder) it refers to all types of receivers. The IRDs can be divided into the following main implementation categories:

- A STB (Set Top Box) is an IRD which is a separate unit (external) from the TV Set (Display)
- An iDTV (integrated Digital Television Set) is an IRD which is a integrated into the TV Set/Display

In addition to this, there are also IRD implementations as a PC Card (e.g. PCI) or USB/Firewire external receivers or similar, these products together with the PC are treated as an iDTV excluding the CA requirements.

NorDig has spring 2008 publicised technical requirements for MPEG4 HDTV but still as optional (NorDig Unified v2.0). However observe that to meet the minimum receiver requirements set out in this document, all IRDs shall meet the NorDig HD Level requirements (including advanced codecs like MPEG4 AVC HP@L4 HDTV video decoder, HE.AAC multi-channel audio decoder and Enhanced AC3 (“DolbyDigitalPlus”) multi-channel audio decoder).

3. CA System and interfaces for the DTT Network

Support for embedded Conditional Access and DVB CSA filtering and descrambling is optional for free-to-air (FTA) IRDs.

Support for DVB Common Interface is optional for STBs and iDTVs with display screen diagonal smaller than 30cm. Support for DVB Common Interface is however mandatory for iDTVs with display screen diagonal greater than 30cm.

If CAS or Common Interface is included, implementation should conform to the specification set out in section 3 of Teracom Additions and Clarifications Document 2.0 (available at www.boxer.se/tvtdocs).

Informative; the requirements for Common Interface for iDTVs with display larger than 30 cm, follows the European Union Directives.

4. Terrestrial Tuner and Demodulator

This chapter covers the requirement defined for Terrestrial Tuner and Demodulator and refers to the NorDig Unified specification chapter 3.4 with the following clarifications and additional requirements.

4.1. Additional requirements for terrestrial tuner and demodulator

The requirements below replace the NorDig Unified requirements 3.4.4. Tuning/Scanning Procedures in NorDig Unified for all new IRD released 1 July 2009 (until 1 July 2009 the requirements for Tuning/Scanning Procedures are as specified in the NorDig Unified version 2.0).

(Changes/additions compared NorDig Unified 3.4.4. Tuning/Scanning Procedures are marked in yellow. The following text has been proposed to NorDig to be included in next update/release of NorDig Unified).

4.1.1. Reception quality / Tuning / Scanning Procedures

4.1.1.1. General

The NorDig IRD shall provide a scanning procedure over the whole (supported) frequency range.

The NorDig IRD shall be able to provide reception quality information for a selected received frequency according to 4.1.1.2 Status check: Basic in this document.

The NorDig IRD should be able to provide reception quality information for a selected received frequency according to 4.1.1.3 Status check: Advanced.

4.1.1.2. Status check: Basic

The IRD shall provide at least a basic status check function (accessible through the Navigator) that presents reception quality information for a selected frequency (currently viewed by the user).

The basic status check shall include:

- channel id, according to NorDig IRD specification Annex B.2

- centre frequency
- Signal Strength Indicator, SSI (%), according to 4.1.1.6 in this document
- Signal Quality Indicator, SQI (%), according to 4.1.1.7 in this document

4.1.1.3. Status check: Advanced

The IRD should provide an advanced status check function (accessible through the Navigator) that presents the following information:

- channel id, according to NorDig IRD specification Annex B.2
- centre frequency
- signal strength (dBm or dBµV)
- signal strength indicator, SSI (%), according to 4.1.1.6 in this document
- signal quality indicator, SQI (%), according to 4.1.1.7 in this document
- C/N (dB)
- BER before Reed Solomon
- Uncorrected packets

The integration time for the BER and uncorrected packets calculations shall be over a time period of 1 second.

To aid end-user antenna installation, it is recommended the IRD provide an advanced status check for all installed multiplexes (frequencies) or enable the end-user to change the installed multiplexes (frequencies) easily, in order to make the end-user antenna installation easier by providing an overall view of reception quality in all installed multiplexes simultaneously. This view should be updated, cyclically, until this mode is exited.

In addition, it is recommended that also the following information can be presented for the received frequency, transport stream and service:

- DVB-T mode
- transport stream id
- original network id
- network id
- service id

The advanced status check values shall be updated continuously (e.g. every second).

4.1.1.4. Installation mode: Automatic Search, best service

The IRD shall provide a function to perform an automatic search that finds all of the multiplexes and services in the whole (supported) frequency range (See section NorDig Unified **Error! Reference source not found.**). Before the automatic search is started, all service lists shall be deleted (if present).

The IRD shall only display a service once in the service list (i.e. avoiding duplicate of the same services), even if the same service (same triplet original_network_id, transport_stream_id and service_id) is received from multiple transmitters. If the same service can be received from several transmitters, the one with best reception quality, i.e. best reception quality, shall be selected. The criteria for selection of the best received service shall be based on the signal strength and signal quality according to 4.1.1.6 and 4.1.1.7 in this document.

It is recommended that the complete search function should take less than 5 minutes (at a reception location providing maximum 10 receivable DVB-T channels).

Note: In order to speed up the automatic channel search with a reception quality measurement, an approach with an automatic gain controller (AGC) based DVB-T signal detection can be implemented if applicable. IRD implementation may sweep all the supported frequencies by detecting if a RF signal exists by analyzing the AGC. After the sweep the IRD analyses only the frequencies where the AGC reported a RF signal present and verifies if the signal is a DVB-T signal. In case of DVB-T signal reception quality is measured.

4.1.1.5. Installation mode: Manual Search

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

It is recommended that the graphical interface for the manual search make it easy for the end user to perform consecutive manual searches without too much effort.

After a manual search the stored frequency for a service may be different from that found in automatic search. The IRD should in this case not override the frequency stored in manual search with its automatic update procedures (if any).

4.1.1.6. Requirements for the signal strength indicator (SSI)

The value for the signal strength indicator (SSI) shall be referenced to signal level at the IRD RF signal input.

Signal strength shall be able to be determined within a range starting from 15 dB lower than the reference signal level defined in table 3 values and up to 35dB above that value or maximum signal input level defined in NorDig Unified section 3.4.8.4 (maximum signal input level). The absolute accuracy shall be of ±3dB and relative accuracy of ±1dB within received DVB-T mode.

Signal strength indicator shall have a relative value within a range from 0% to 100% and with a resolution of 1%.

The signal strength indicator shall be updated continuously once per second.

The formulas to calculate the signal strength indicator (SSI) value in [%] are defined below.

$SSI = 0$	if $P_{rel} < -15dB$
$SSI = (10/15) * (P_{rel} + 15)$	if $-15\ dB \leq P_{rel} < 0dB$
$SSI = 4 * P_{rel} + 10$	if $0\ dB \leq P_{rel} < 20\ dB$
$SSI = (10/15) * (P_{rel} - 20) + 90$	if $20\ dB \leq P_{rel} < 35\ dB$
$SSI = 100$	if $P_{rel} \geq 35\ dB$

where

$$P_{rel} = P_{rec} - P_{ref}$$

and where

P_{rec} is referenced to signal level expressed in [dBm] at receiver RF signal input

P_{ref} is reference signal level value expressed in [dBm] specified in table 3 below.

Modulation	Code Rate	Reference signal level [dBm]
QPSK	1/2	-81.0
QPSK	2/3	-79.0
QPSK	3/4	-78.0
QPSK	5/6	-77.0
QPSK	7/8	-76.0
16-QAM	1/2	-75.0
16-QAM	2/3	-73.0
16-QAM	3/4	-72.0
16-QAM	5/6	-71.0
16-QAM	7/8	-70.0
64-QAM	1/2	-69.0
64-QAM	2/3	-68.0
64-QAM	3/4	-66.0
64-QAM	5/6	-65.0
64-QAM	7/8	-64.0

Table 3 Specified Pref values expressed in dBm for all signal bandwidths, guard interval and 8k FFT

4.1.1.7. Requirements for the signal quality indicator (SQI)

The value for the signal quality indicator (SQI) shall be referenced to signal quality at the IRD RF signal input.

The absolute accuracy of the C/N measurement shall be of ±1dB. The signal quality indicator shall have a relative value within a range from 0% to 100% and with a resolution of 1%. The signal quality indicator shall be updated continuously once per second.

The signal quality indicator (SQI) in [%] shall be calculated according to the following formulas.

$SQI = 0$ if $C/N_{rel} < C/N_{start}$

$SQI = ((C/N_{rel} - 3)/10) + 1) * BER\_SQI$ if $C/N_{start} \leq C/N_{rel} < C/N_{top}$

$SQI = BER\_SQI$ if $C/N_{rel} \geq C/N_{top}$

where

C/N_{rel} is DVB-T mode depended of the relative C/N of the received signal value in [dB]

and

$C/N_{rel} = C/N_{rec} - C/N_{NordigP1}$

$C/N_{start} = C/N_{NordigP1} - 7$ dB

$C/N_{top} = C/N_{NordigP1} + 3$ dB

where

$C/N_{NordigP1}$ is the required C/N value in [dB] for the non-hierarchical DVB-T mode in profile 1 defined in Table 3.3. For the hierarchical DVB-T modes required C/N value in [dB] is specified in Tables 1 and 2 in Annex B.3.

C/N_{rec} is the C/N value in [dB] of the received signal

BER_SQI is calculated with the formula

$BER\_SQI = 0$	if $BER > 10^{-3}$
$BER\_SQI = 20*LOG_{10}(1/BER)-40$	if $10^{-7} < BER \leq 10^{-3}$
$BER\_SQI = 100$	if $BER \leq 10^{-7}$

where

BER is Bit Error rate measured before Reed Solomon decoding.

The integration time for the BER_SQI calculation shall be over a time period of 5 seconds.

5. Demultiplexing and decoding

This chapter covers the requirement defined for MPEG demultiplexing, Video and Audio decoding, and refers to the NorDig Unified specification chapter 4, 5, 6 and 7 with the following clarifications and additional requirements.

The IRD shall fulfil the NorDig HD Level IRD requirements as specified in the NorDig specification, which for the demultiplexing and decoding, which means following main requirements (see NorDig specification for all details).

5.1. General

To get a better overview of how the different services are constructed with different components/PIDs within the DTT network, here some typical examples:

- Service 1 (SDTV) ; MPEG4 AVC HP@L3 SDTV video, HE.AAC stereo audio (language Original), DVB Subtitling, MHEG5 "superteletext"
- Service 2 (Radio); HE.AAC stereo audio
- Service 3 (HDTV); MPEG4 AVC HP@L4 HDTV video, HE.AAC multi-channel audio, DVB Subtitling and MHEG5 "superteletext"
- Service 4 (SDTV); MPEG4 AVC HP@L3 SDTV video, HE.AAC stereo audio (language Original and undefined audio type), HE.AAC stereo audio (language Original and undefined Hard-of-Hearing), EBU Teletext (subtitling pages), MHEG5 "superteletext"
- Service 5 (Radio); MPEG4 AVC HP@L3 SDTV still picture video (i.e. I-frames only), HE.AAC stereo audio and MHEG5 "superteletext"
- Service 6 (Data); stand-alone MHEG5 interactive application service

5.2. Video

The IRD shall support video decoding for;

- MPEG2 video decoding up to Main Profile at Main Level (MP@ML)
- MPEG4 AVC (H.264) video decoding up to High Profile at Level 3 (SDTV).
- MPEG4 AVC (H.264) video decoding up to High Profile at Level 4 (HDTV).

Observe specifically that this means that all IRD shall support MPEG4 SDTV services using High Profile video encoding tools, MPEG4 AVC (H.264) HP@L3. (This HP@L3 is the common usage for MPEG4 AVC video encoding of SDTV services within the Swedish DTT network).

The IRD shall support still picture for all MPEG4 AVC profiles.

The viewer shall be able to choose between at least one 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 on the transmitted 16:9 aspect ratio picture.
3. display full height 4:3 aspect ratio picture without centre cut-out (i.e. full frame)

Note: Down-converted HD video shall factory default be displayed as 16:9 letterbox on 4:3 displays, and shall be user-selectable thereafter. (Typically HD production will use less safe area within the video, using 4:3 centre cut-out for the down-converted HD video within the IRD could result in the viewer missing essential part of the video).

5.3. Audio

5.3.1. Audio format decoding

The IRD shall support monaural (mono), stereo (including joint stereo) and multi-channel (up to 5.1) audio decoding for:

- MPEG-4 HE AAC Level 4, version 1 (ISO/IEC 14496-3) and
- Enhanced AC3 ("Dolby Digital Plus") (ETSI TS 102 366) and
- MPEG-1 Layer II (ISO/IEC 11172-3), here only up to 2.0 stereo

The IRD should also support parametric stereo audio decoding for MPEG-4 HE AAC Level 4 (i.e. version 2). *(Parametric Stereo (PS) is only applicable for use of MPEG4 HE.AAC version 2 stereo audio and mainly target for use in Radio services, i.e. not applicable for 5.1 or mono audio services and not applicable for any Enhanced AC3 or MPEG-1 Layer II).*

5.3.2. Simultaneous audio format decoding

The IRD shall support audio decoding with at least one audio format at the time, (i.e. some services are using HE.AAC, some Enhanced AC3 and some others MPEG-1 Layer II).

Observe that some services may have several audio streams, for example with different languages but the same audio format.

5.3.3. 2-channel audio downmix

The IRD shall support 2-channel Downmix of both HE.AAC and Enhanced AC3 incoming multi-channel (up to 5.1) stream into a 2 channel output (stereo).

It shall not be required to use external audio (decoder) equipment, like audio home theatre system, for the MPEG4-services with multi-channel audio. External interfacing equipment (like TV display unit) shall not be required to support more than 2 channel PCM audio within main V/A interface (HDMI/SCART).

5.3.4. Audio settings from factory default

Factory default shall be that 2-channel down-mix of multi-channel audio for the Main output (HDMI and SCART).

5.3.5. Variable bitrate

The IRD shall support decoding of variable bitrate of HE.AAC up to level 4 audio stream.

5.3.6. HDMI/SCART audio during digital audio output

The audio should not be silence in main V/A interface (HDMI/SCART) when outputting digital (surround) on digital audio interface (SPDIF) interfaces, i.e. it is recommended to continue outputting 2 channel PCM audio in parallel when outputting multi-channel audio (DTS/AC3/AAC/PCM) on the separate audio interface.

5.3.7. Audio description for visually/hearing impaired

Support for simultaneous decoding of the normal (mono/stereo/multi channel) audio track and the visually/hearing impaired audio track (as described below) is a recommended feature of this specification. Note the IRD shall be able to automatically select the main audio stream (PID) when

broadcasting additional visually/hearing impaired audio with same language (main "normal" audio track is signalised via ISO 639 descriptor with audio type 0x00 'undefined', while the visually/hearing impaired audio track is signalised with audio type 0x02 or 0x03).

Some DTT services may carry an extra (mono) audio track with clear audio description (AD) of the content for visually and/or hearing impaired people (reduced seeing and hearing) as an addition to the normal audio track, (see DVB/ETSI TS 101 154, v1.8.1 or later, Annex E "Receiver-Mixed Audio Description and other supplementary Audio Services").. The intention of this extra audio track is that, for those who require it (e.g. viewers with visual impairments), it shall be mixed together with the normal audio track and the end-user should be able to adjust the volume level of this extra audio track separately compared to the normal audio track to achieve best experience.

The visually and/or hearing impaired audio description track will in case of MPEG1 L.II and HE.AAC audio format be as a separate (mono) audio stream (PID) and in case of Enhanced AC3 format be as extra audio channel within the audio stream (PID).

The IRD should support simultaneous decoding of the normal (mono/stereo/multi channel) audio track and the visually/hearing impaired audio track. For the IRD supporting this, it shall be possible to control (on/off) this visually/hearing impaired audio and when activated the two audio tracks (normal and visual/hearing impaired) shall be mixed into the IRD's outgoing audio (HDMI, SCART).

It should be possible to adjust the relative audio level (volume) between the normal and visual/hearing impaired audio.

It shall not require any AD descriptor within the extra audio track, but if AD_descriptor is included the IRD should make use of it (according to the DVB/ETSI 101 154 Annex E, v1.8.1 or later). If no AD descriptor is included, the IRD should mix the audio description track as no fade of normal/main audio (equal to AD_fade_byte 0x00) and central forward presentation (equal to AD_pan_byte 0x00).

If several normal audio streams are available for the service (for example with different languages), the IRD shall first match the Audio Description track with same ISO 639 language.

In the case of the audio description track is encoded with MPEG1 L.II or HE.AAC codec, the stream (PID) will be identified (signalised) with at least a ISO 639 Language descriptor (and with audio type 0x02 'hearing impaired' or 0x03 'visual impaired commentary').

5.4. DVB and Teletext Subtitling

The IRD shall be capable of decoding both DVB Subtitling and Teletext subtitling and display using the OSD capabilities whilst decoding the full television service (video and audio) to which it is associated (as specified in NorDig Unified specification section 7). Note the IRD is not required to display both DVB and teletext subtitling at the same time.

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

Note: As set out in the in the NorDig specification, if both DVB-subtitling and Teletext subtitling are received simultaneously for one service the IRD shall only display the DVB-subtitling stream.

Ref: NorDig 2.0 s7.2

5.5. MHEG5 Superteletext and EBU Teletext

The IRD shall support decoding and displaying MHEG-5 applications, and shall conform to the following standards: ETSI ES 202 184 v1.1.1, UK/Ireland/Boxer Profile v1.06 (as specified in DTG MHEG5 Specification version 1.06, www.dtg.org.uk including corrigenda).

The IRD shall continuously monitor the PMT and its MHEG5 private data stream PIDs for event based MHEG5 application and react accordingly for changes. (Note that the IRD shall still support decoding and displaying of EBU Teletext normal pages and subtitling as specified in NorDig Unified specification section 7 and as below).

The IRD shall support when an MHEG-5 application as part of a:

- TV or Radio service (service types 0x01, 0x02, 0x0A, 0x16, 0x19) and
- Stand-alone Data service (service type 0x0C)

If both an MHEG5 application and Teletext normal pages are received simultaneously for one and the same service, the IRD shall default priorities and display the MHEG5 application, i.e. the MHEG5 shall default have priority to allocate the Application group keys ('Text' and colour keys) on the remote control. (Typically a service carries either an MHEG5 Text application or EBU Teletext normal pages).

If the selected service includes both subtitling (DVB Subtitling and/or EBU Teletext subtitling) and a MHEG5 application, the IRD shall (according with its user preference settings) at least decode and display the subtitling whenever the user has not entered the MHEG5 application and after the user have left the MHEG5 application.
It is recommended that the IRD supports continued displaying of the subtitling after it has entered the MHEG5 application, in that case MHEG5 application OSD shall be on top of video and subtitling).

Note, EBU Teletext subtitling here refers to teletext subtitling pages and/or teletext subtitle pages for hearing impaired people referenced in Teletext descriptor in PMT. Teletext subtitles not referenced in the teletext descriptor is optional to access for services with MHEG5 application(s), since the 'Text' key will normally be allocated to the MHEG5 application.

When the user tries to access a Text service (using the 'Text' key on the remote control) for services that do not include any MHEG application nor EBU Teletext normal pages, the IRD shall display suitable on-screen message informing the user that the service do not include any Text service (for example as ”Text not available”).

6. Interfaces

This chapter covers the requirement defined for Interfaces and Signal Levels and refers to the NorDig Unified specification chapter 9.

6.1. HDMI and HDCP (NorDig chapter 9.9.4)

The HDCP must be on (enabled/activated) in the signal within the HDMI-link out of the IRD for services in case of any following alternatives:

- if any of service’s components has copyright flag in TS/PES header is set on (‘1’) and/or

- if signalised as must be on via PSI/SI descriptor in PMT as specified in NorDig specification and/or
- if signalised as must be on via CA-system as specified in NorDig specification.

If any of the above alternatives request the HDCP must be on, then the service is here referred to as a 'protected' service.

Only if none of above alternatives signalise that the service must have the HDCP on, then the IRD may send out a signal without HDCP on and then the service is here referred to as an 'open' service.

(Signalised via CA-system refers to "control information" inside the ECM data of the service or in the EMM data).

It shall be possible to change user settings in the IRD for 'open' services if the HDCP shall be on (enabled) or off (disabled). (An IRD may send out signal with HDCP on (enabled) even for 'open' services, this for example to reduce zapping time between services and avoid re-negotiation of the HDMI-link between the devices).

6.2. Analogue HDTV: component YUV/YPbPr

Due to the current strict requirements of content protection for HDTV material and there is today still a lack of copy protection mechanism (like Macrovision) for the analogue HDTV signals (like 720p and 1080i), any analogue video output of the HDTV IRD shall be maximum 576 lines regardless of incoming video signal.

6.3. Data Interface (option)

The NorDig IRD should (1) support one local data interface.

The NorDig IRD data interface should comply with:

1. TS 102 201 section 4.6.1 (RS232C, connector: 9 PIN SUB-D connector, male type) in up to 115200 bit/s transfer speed.
2. Universal Serial Bus Port **Error! Reference source not found.**.
3. Ethernet: IEEE 802.3 **Error! Reference source not found.** 100Base-T physical layer.
4. WLAN (IEEE 802.11**Error! Reference source not found.**).
5. Bluetooth **Error! Reference source not found.**

Note 1: The output from the local data interface shall only allow data as broadcast, without any change of access control. I.e. it shall not t include any data or bitstreams that have been descrambled/removed of access control. Additional security requirements may be imposed for some networks; such requirements must be checked with the relevant CA-operator

[Ref: NorDig 2.0 s9.6]

7. Service Information (SI)

This chapter covers the requirement defined for Service Information, and refers to the NorDig Unified specification chapter 13 and 14.

7.1. Clarifications to NorDig Unified specifications (chapter 13)

Following clarification is applicable in the DTT network.

7.1.1. SI Identification coding

7.1.1.1. Original Network ID and Network ID

The DVB Identifiers for the DTT networks are as follows (according to ETSI ETR 162, today maintained at DVB home page):

DTT Network	Original_Network_ID	Network_ID
Sweden	**0x22F1**	colour B plan (0x3101 to 0x3200)
Denmark	**0x20D0**	colour C plan (0x3201 to 0x3300)
Ireland	**0x2174**	colour C plan (0x3201 to 0x3300)

The IRD should map the original network ids into the appropriate country in the OSD menus (for example together with NorDig Logical Channel descriptor version 1).

Small observation: Within DVBs 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. Which is true for almost all countries, as far as we know of, BUT with one exception; the Swedish DTT. For some reason this was not the case for the Swedish DTT original network id value (0x22F1), Sweden has the ISO3166 numeric country value 752 (0x2F0).

7.1.1.2. Private data specifier values

For the used private data specifier values, the following applies in the DTT network (also according to the DVB SI code allocation, ETSI ETR 162, inserted and used as specified in DVB SI Guidelines);

-
- NorDig private_data_specifier value: **0x00000029**

7.1.2. Logical Channel Descriptor (in NIT)

The IRD shall support both NorDig Logical Channel Descriptors (LCD), version 1 and 2.

7.1.3. Parental rating descriptor (in EIT)

This descriptor is used to give a rating of programme based on age or other criteria and is used to prevent children from viewing unsuitable programmes. The prevention mechanism, blanking of video and muting of sound, shall be included within the manufacturer software and it should make use of 4 digits pin code to access and change settings.

The IRD should start/(stop) its prevention mechanism, blanking video and muting audio, within 1 second after reception of selected service's present (running) event information (EIT pf) containing parental rating higher/(lower) than its user settings. I.e. the IRD should continuous check the parental rating conditions for selected service and each time the user zaps into a new service. It is common that the IRD also informs the viewer that the program event contains unsuitable material.

Example: When the user setting in the IRD for the maturity level is set to 17 years and the present event (EIT pf) for the selected service includes a parental rating descriptor with (country code "SWE" and) rating "0x0F" (i.e. at least 18 years old content), the IRD shall blank the outgoing video (e.g. black frame) and mute the outgoing audio.

7.1.4.Country and Language Codes within PSI & SI (in "all" tables)

Preferably all (main) codes in ISO 3166 and ISO 639-3 should be handled. Due to the quite large number of codes in these specifications, table 5 and 6 specifies the minimum types of codes that shall be handled by the IRD with the recommended translations.

(The codes in ISO 3166 (Country codes) are all in capital letters, the codes in ISO 639-2 (Language codes) are all in lower-case letters and observe the capital vs lower case letter notation in the translations.

Country (in English)	**ISO 3166 code**	**Translation to be used (to native)**	**Comments**
SWEDEN	**SWE**	Sverige	Mandatory
DENMARK	DNK	Denmark	Mandatory
FINLAND	FIN	Suomi	Mandatory
NORWAY	NOR	Norge	Mandatory
IRELAND	IRL	Ireland	Mandatory

Table 5: ISO 3166, Country codes

Both ISO 639-2/B (Bibliographic Code) and ISO 639-2/T (Terminology Code) may be used, but for encoding it is recommended to only use ISO 639-2/B-codes. Of the current used descriptors that are using country or language codes, see also table below for help when to use each code.

Language (in English)	**639-2/B**	**639-2/T**	**Translation to be used in DTT**	**Comments**
	Code	**Code**	**To native**	
Danish	**dan**	dan	dansk	Mandatory
German	der	deu	deutch	Recommended
English	**eng**	eng	English	Mandatory
Finnish	**fin**	fin	suomi	Mandatory
French	fre	fra	francais	Recommended
Irish / Gaelic	**gle**	gle	Gaeilge	Mandatory
Norwegian	**nor**	nor	norsk	Mandatory
Spanish	spa	spa	español	Recommended
Swedish	**swe**	swe	svenska	Mandatory

Table 6: ISO 639-2, Language codes

7.1.5. Text strings and fields size of the SI descriptors

The IRD shall at least be able to handle text strings that is coded ‘Latin Alphabet number 5’ as specified in ISO 8859-9 (and then signalised with a first byte ‘0x05’ in the text field) and text strings coded ‘Latin Alphabet’ as specified in ISO/IEC 6937 (see ETSI EN 300 468, Appendix A). (Observe, the ISO specifications have been updated to include the Euro currency symbol, “€”).

The recommended maximum transmitted field sizes in the descriptors in the DTT network are stated in the table 7 below. These values can be used as a guideline in the IRD implementation (and if the transmitted text strings are longer than below, the IRD could typically truncate after this value).

Name Field	Name Length	Comments
Network Name	24	
Service Provider Name	20	
(Full) Service Name	22	
(Short) Service Name	12	May be used in overview service list, info banner and/or ESG.
Event Name	40	
Short Event Description	250	
Extended Event description	255	
Component Description	32	Typically used in the ESG and/or in the info banner
Application Name	32	(for IRD with DVB MHP v1.1 or MHEG-5)

Table 7 Descriptor field length used in the DTT

7.1.6. Reception of multiple DTT networks

The IRD shall be able to install several (DTT) original networks (with different original network ids).

For multiple original networks (original network ids) the 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 automatically 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).

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 LCD 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.

[Ref NorDig 2.0 s13.2.7.5].

7.1.7. User Service Lists

The IRD should provide functionality for the viewer to build up additional 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 IRD should place new entries at the corresponding part of the user service list.

[Ref: NorDig 2.0 s14.2.1.1]

8. Receiver states

This chapter covers the requirements defined for different receiver states and is only partly covered by the NorDig Unified specification (see NorDig Unified chapter 3.4.4, chapter 13 and 14).

8.1. Installation mode

Installation mode is defined as the state where the IRD is searching, scanning and installing new multiplexes (transport streams) and services that is possible to receive. During (first time) installation mode, the generic user preferences are normally set (like languages, country etc).

It shall be possible to perform an automatic or manual search at any time (see NorDig Unified chapter 3.4.4).

Upon first time installation or after a reset to factory mode, the IRD shall perform an automatic search through the whole supported frequency range.

8.2. (Normal TV viewing mode) Active mode

Active mode is defined as the state where the IRD normally operates on the received services. The IRD continuously demodulate tuned frequency and decode all video, audio and data components.

All received dynamic PSI and SI data (PMT, EIT, TDT/TOT, running status and CA mode) shall be processed within 1 second (see chapter 5 of this document).

Typical dynamic changes that the IRD shall be able to handle are (with in some cases some disturbance):

- New PID(s) (e.g. DVB subtitling) is attached to a service
- PID(s) for video and/or audio is changed for a service
- Change from one (mono/stereo) audio to two dual mono audio mapped in one PID, i.e. change of the audio encoding and in the ISO 639 language descriptor in the PMT.
- Changes of running status and/or CA mode (working together with linkage to replacement)
- Updates in EIT, TOT/TDT

8.3. (Automatic) Update mode

Update mode is defined as when the IRD is able to apply changes in the received "quasi-static" SI data (i.e. SI that is normally stored in the flash memory for service navigations such as Original Network ID, Transport Stream ID, Network ID, Service name, Service ID, Logic Channel Number, RF centre frequency and RF mode etc). The update mode should not affect the basic video and audio (see

chapter 5 of this document). The IRD shall at least enter into update mode once (one time) from the time it has been turned off until the time it has been turned on (i.e. during stand-by mode). (The update mode is allowed to be interrupted by the user). .

For example, the IRD shall in 'update mode' update for:

- new services within installed frequencies (multiplexes/transport streams)
- changes in service name, logical channel number and service provider name
- remove services that are permanently removed from transmitted SI within installed frequencies. The IRD shall not remove any service(s) automatically from the 'visible' service list without user confirmation (to avoid irritation). I.e. the IRD shall automatically inform the user when a service is permanently removed and ask for user confirmation to remove the service from the service list. Removed services that are defined as 'non-visible' shall be removed without user confirmation

For example, the IRD should in 'update mode':

- not overwrite any user preferences

The IRDs Service List shall be based on information from the SDTs. (The services listed in the NIT, e.g. in the NorDig Logic Channel Descriptor, might not be complete).

Updates that require actual tables (SDT actual and/or NIT actual) from another transport stream than the IRD is currently scanned to should wait until the user select a service from a transport stream that contains the actual table(s) for this update.

8.4. Stand-by and power off mode

Stand-by mode is defined as when the IRD does not present any decoded components, like video and audio, on any of the IRD's outgoing connectors (RF loop through shall not be affected in this mode). The user shall be able to turn the IRD from Stand-by into Active mode. The IRD should have a minimum of power consumption during stand-by mode (typical 1W or less).

Power off mode is defined as the mode where the IRD is completely turned off.

9. Controller and Memory

This chapter covers the requirement defined for Controller and Memory, and refers to the NorDig Unified specification chapter 11.

9.1. Clarifications to NorDig Unified specifications (chapter 11)

An upgrade/replacement of the IRD's software is here referred to as System Software Update (SSU). If the SSU is via transmitting the new IRD's software over the broadcast channel it may also be referred to as Over-The-Air (OTA) download.

The IRD shall provide a mechanism to detect corrupt downloaded system software before it is used to replace the current working software. If the received system software is corrupt (refer to sub clause 11.2 in NorDig Unified), the IRD shall keep the current (working) version of the system software, thus making the IRD operational again. If so, the failure to download shall be indicated to the user with an error message that can be used in the contact with the customer relations office. It shall be possible for the user to abort the download (in areas of bad reception quality the download may take too long time) and the IRD shall be operational using the current version of system software.

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

Ends.