SAORVIEW

Minimum Receiver Requirements

Irish Digital Terrestrial Television

Additions and clarifications to NorDig Unified Requirements 3.1.1

Contents

Version 9.0

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1. Introduction

1.1 Scope

This document specifies the minimum technical receiver requirement for reception of Standard Definition Television (SDTV) services, High Definition Television (HDTV) services and ancillary data services, from the Digital Terrestrial Television (DTT) transmission network in Ireland.

The receiver, hereafter denoted as an Integrated Receiver Decoder (IRD), may be a Set Top Box (STB) or Integrated Digital Television (IDTV).

The IRD shall be DVB compliant, and shall be able to receive MPEG 2 Transport Streams via a DVB-T or DVB T2 modulated signal, decode the services within that transport stream including all video, audio, data, and subtitling services.

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

1) NorDig 3.1.1 Basic Profile - High Definition Level

2) HbbTV version 2.0.1

3) MHEG-5 UK Profile, version 1.06

4) Additions and clarifications as set out in this document

1.2 Document History

Version	Date	Status	Comments
0.1	09-11-2008	Draft	Initial draft document based on Teracom ACD 2.0 document
0.1b	11-11-2008	Draft	Teracom comment; Per Tullstedt and Petri Hyvärinen
0.1c	17-12-2008	Draft	Amendments to 0.1b - Marcus O'Doherty
1.0	19-12-2008	Edition 1	Final – Marcus O'Doherty
2.0	24-10-2010	Edition 2	NorDig 2.2 update – Deasún Mac Giolla an Chloig
3.0	28-03-2012	Edition 3	NorDig 2.3 update – Des Mac Giolla an Chloig
4.0	01-07-2013	Edition 4	NorDig 2.4 update – Des Mac Giolla an Chloig
5.0	10-05-2014	Edition 5	NorDig 2.4 additions – Des Mac Giolla an Chloig
6.0	31-08-2015	Edition 6	NorDig 2.5.1 update – Des Mac Giolla an Chloig
7.0	01-12-2017	Edition 7	NorDig 2.6.0 update – Des Mac Giolla an Chloig
8.0	11-06-2019	Edition 8	NorDig 3.1.0 update – Des Mac Giolla an Chloig
9.0	11-02-2021	Edition 9	NorDig 3.1.1 update – Des Mac Giolla an Chloig / Eamonn Reid

1.3 Terminology

Mandatory   This word means that the item is mandatory and **shall** include the functionality.

Recommended   This word means that the item highly recommended. If included, it **should** then be implemented as specified.

Optional   This word means that the item is optional item and may include alternative or one amongst several alternatives.

1.4 Abbreviations

AAC	Advanced Audio Coding HE-AAC level 4 (ISO/IEC 14496-3)
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
AVC	Advanced Video Coding (MPEG-4 part 10 ISO/IEC 14496-10, ITU-T H.264)
AFD	Active Format Descriptor
BAT	Bouquet Association Table
CA	Conditional Access
CAM	Conditional Access Module
CAS	Conditional Access System
CI+	Common Interface Plus
CENELEC	Comité Européen de Normalisation Électrotechnique
DSM-CC	Digital Storage Media Command & Control
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcast
DVB-T	DVB T Terrestrial Broadcast (ETSI EN 300 744)
DVB-T2	DVB T2 Terrestrial Broadcast (ETSI EN 302 755)
EICTA	European Information & Communications Technology Industry Association
EIT	Event Information Table (DVB SI)
EPG	Electronic Programme Guide
ETSI	European Telecommunications Standards Institute
ESG	Event Schedule Guide (DVB SI)
FTA	Free to Air
H.264	As AVC (MPEG-4 Part 10 ISO/IEC 14496-10, ITU-T H.264)
HbbTV	Hybrid Broadcast Broadband TV
HD	High Definition
HDTV	High Definition Television
HEAAC	High Efficiency AAC version 1 Level 4
IRD	Integrated Receiver Decoder
I-DTT	Irish – DTT
LCD	Logical Channel Descriptor (NorDig)
LCN	Logical Channel Number (NorDig LCD)
MFN	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.
n/a	Not Applicable
NID	Network Identifier (DVB SI)
NIT	Network Information Table (DVB SI)
NVOD	Near Video On Demand
ONID	Original Network Identifier (DVB SI)
OSD	On Screen Display
p/f	Present / Following (Event Information Table, DVB SI)
PCM	Pulse-Code Modulation audio (IEC 60958)
PSI	Programme Specific Information
QAM	Quadrature Amplitude Modulation
STB	Set Top Box
SDT	Service Description Table (DVB SI)

S-DTT	Swedish DTT
SDTV	Standard Definition Television (DVB)
SFN	Single Frequency Network
SI	Service Information (DVB)
SID	Service Identifier (DVB SI)
SMC	Smart Card
Stereo	Stereo (left and right) audio, 2.0 channel audio stream
TDT	Time and Date Table (DVB SI)
TOT	Time Offset Table (DVB SI)
TS	Transport Stream
TDT-É	Teilifís Digiteach Trastíre na hÉireann
TSID	MPEG-2 Transport Stream Identifier (DVB SI)
UHF	Ultra High Frequency
UTC	Co-ordinated Universal Time
VHF	Very High Frequency

2. General features for the digital receiver

The requirements for the IRD operating on the Irish DTT network in this specification is based upon the NorDig Unified receiver specification version 3.1.1 or later at M4 Level, HbbTV version 2.0.1 and MHEG-5 v 1.06 with some additions and clarifications as included in this document.

See www.nordig.org, www.hbbtv.org and www.dtg.org.uk for further detail.

2RN Ireland is an active member of the NorDig group and as such participates fully in the development of NorDig receiver requirements.

The IRD shall be able to receive and decode MPEG4 AVC (H.264) based SDTV and HDTV services, HbbTV and MHEG5 data services, EBU Teletext, EBU and DVB subtitling services.

Compared to NorDig Unified 3.1.1 basic profile specification, the following major additional minimum requirements and clarifications are applicable for all IRD intended for use in Ireland:

MPEG4 HD Level mandatory on all IRD, which among other things include:

- MPEG4 HP@L4 HDTV
- MPEG4 HP@L3 SDTV
- MPEG2 SDTV

- MPEG1 Layer II stereo audio (Musicam).
- AC 3 (Dolby digital) EAC 3 (Dolby Digital Plus) multi-channel audio.
- HEAAC multi-channel audio

- EBU subtitling SD VBI insertion
- EBU subtitling HD VANC insertion
- HbbTV version 2.0.1
- MHEG 5 version 1.06
- DVB Subtitling

See table 2.1 main hardware functions overview for further detail.

As previously stated when using the term IRD (Integrated Receiver Decoder) this refers to all types of receivers. The IRD may be divided into the following main implementation categories:

- A STB (Set Top Box) is an IRD, which is a separate unit from the TV Display.
- An iDTV (integrated Digital Television) is an IRD which is integrated into the TV Display
- A PVR *ready* device is an IRD (STB or iDTV) with basic record capability, the ability to store recordings and/or timeshift recordings for later playback.
- A PVR is an IRD (STB or iDTV) with record capability, the PVR has two RF tuners with the ability to record one service whilst viewing another, the PVR has facility to record and play back all AV components associated with a service i.e. Video, main programme audio, supplementary audio (AD), subtitling etc. The PVR has a built in hard drive (HDD) which is integral to the device. The PVR has the ability to fulfil requirements such as series link; bookable promo and live programme pause see NorDig Unified v3.0.1 Section 14 NorDig PVR.
- A DVB-T IRD is an IRD (STB or iDTV) which supports DVB-T demodulation.
- A DVB –T2 IRD is an IRD (STB or IDTV) which supports both DVB-T and DVB-T2 demodulation.

In order to meet the minimum receiver requirement, set out in this document:

All IRD shall support DVB-T/T2 demodulation; the support of DVB-T2 demodulation changed from an optional to a mandatory requirement on 1st January 2013 for the Irish DTT network. The IRD shall support all DVB-T2 requirements as specified in NorDig Unified IRD specification v3.1.1 and later.

All IRD shall meet the NorDig M4 HD Level requirements *(including advanced codec's such as MPEG4 AVC HP@L4 HDTV video decoder, HEAAC multi-channel audio decoder, AC3 (Dolby Digital) and Enhanced AC3 (Dolby Digital Plus) multi-channel audio decoder).*

IRD Minimum Requirement	DVB-T IRD	DVB-T2 IRD
DVB-T demodulation	M	M
DVB-T2 demodulation	-	M
UHF Band IV-V 7MHz Raster	O	O
UHF Band IV-V 8MHz Raster	M	M
VHF Band III 7MHz Raster	M	M
VHF Band III 8MHz Raster	O	O
DVB-T2 Time Frequency Slicing	-	O
DVB-T2 1.7 MHz raster within VHF band III	-	M
DVB Common Interface Plus	M	M
Video decoding MPEG 2 MP@ML	M	M
Video decoding MPEG 4 HP@L3/4	M	M
Audio decoding MPEG 1 LII (Musicam)	M	M
Audio decoding AC3 (Dolby Digital 5.1)	M	M
Audio decoding EAC3 (Dolby Digital Plus 5.1)	M	M
Audio decoding metadata AC3 & EAC3	M	M
Audio decoding downmix 5.1 to 2.0 (stereo)	M	M
Subtitle decoding EBU & DVB	M	M
Teletext decoding EBU	M	M
MHEG 5 v1.06	M	R
MHEG-IC v6.2.1	-	O
HbbTV v2.0.1	M	M
Output HDMI with HDCP	M	M
Output SCART	M	O
PVR Ready	O	O
NorDig PVR	M	M

Table 1: *Minimum receiver requirement for SAORVIEW approved IRD*

M – Mandatory
R – Recommended
O - Optional

3.   CA System and interfaces for the DTT Network

Support for embedded Conditional Access and DVB Common Scrambling Algorithm (CSA) filtering and descrambling is optional for the free-to-air (FTA) IRD.

However, the support for DVB Common Interface Plus is recommended for iDTV with a display screen diagonal smaller than 30cm. Support for DVB Common Interface Plus is mandatory for iDTV with display screen of greater than 30cm diagonal. This requirement is in adherence with EU directive 2009/136/EC.

Common Interface Plus extension refers to the "CI plus Specification, Content Security Extensions to the Common Interface" version 1.2 or later. The IRD shall support the download of new CA system software to the CA Module via DVB SSU.

Implementation should conform to the specification set out in Section 3 of Teracom Additions and Clarifications Document available and at www.teracom.se

4.   Terrestrial Tuner and Demodulator

This section covers the requirement defined for Terrestrial Tuner and Demodulator and refers to NorDig Unified specification 3.1.1 Section 3 to 3.4 with the following clarifications and additional requirements.

4.1   Requirements for terrestrial tuner and demodulator

The additional requirements below augment the requirements 3.4.4. Tuning & Scanning Procedures as set out in NorDig Unified v3.1.1 - The DVB-T/T2 IRD shall fulfil all the requirements specified by NorDig from the 1st January 2013; the NorDig IRD shall support both DVB-T / T2 demodulation.

The NorDig DVB-T2 IRD shall be able to receive a signal with an offset of up to 50 KHz from the nominal centre frequency, the IRD shall be able to receive channels in the VHF Band III and UHF bands IV and V (see Table 2).

A raster of 8 MHz is mandatory for the specified UHF bands and optional for VHF BIII, a raster of 7 MHz is mandatory for VHF Band III for the NorDig DVB-T IRD, rasters of 7 MHZ and 8 MHZ are mandatory for the NorDig DVB T2 IRD.

4.1.1   Reception quality/Tuning/Scanning Procedures

4.1.1.1 General

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

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

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4.1.1.2 Status check: Basic

The IRD shall provide at least a basic status check function, which will be accessible through the Navigator and presents reception quality information for a selected frequency, which is currently viewed by the user.

The basic status check shall include:

- Channel identifier

- Centre frequency

- Signal Strength Indicator, SSI (%), according to section 4.1.1.6 in this document

- Signal Quality Indicator, SQI (%), according to section 4.1.1.7 in this document

4.1.1.3 Status check: Advanced

The IRD should provide an advanced status check function, which is accessible through the Navigator and presents the following information:

- Channel identifier

- Centre frequency

- Signal strength in dBm or dBµV

- Signal strength indicator SSI (%), according to section 4.1.1.6 in this document.

- Signal quality indicator SQI (%), according to section 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 that the IRD provide an advanced status check for all installed multiplex frequencies or enable the end-user to change the installed multiplex frequency easily, in order to make the end-user antenna installation easier by providing an overall view of reception quality in all installed multiplex's 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 mode, T or T2

- transport stream id

- original network id

- network id

- service id

The advanced status check values shall be updated continuously once every second.

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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 multiplex streams and services in the supported frequency range as detailed in Table 2 below: before the automatic search is started; all service lists shall be deleted.

Note: the support of UHF channels 50 to 68 is no longer required and these should not be utilised or displayed by the IRD.

Range	Band	Frequency range	Requirement
VHF	VHF I	47 – 68 MHz	Not Applicable
	S Band I	104 – 174 MHz	Optional
	VHF III	174 – 230 MHz	Mandatory
	S Band II	230 – 300 MHz	Optional
UHF	S Band III	300 – 470 MHz	Optional
	UHF IV	470 – 606 MHz	Mandatory
	UHF V	606 – 698 MHz	Mandatory

Table 2: *Mandatory and optional frequency bands*

The IRD shall only display a service once in the service list; there should be no duplicate of the same service, even if the same service triplet of 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 shall be selected. The criteria for selection of the best received service shall be based on the signal strength and signal quality according to section 4.1.1.6 and section 4.1.1.7 in this document and as detailed in Annex D of NorDig v3.1.1

It is recommended that the complete search function should take less than 5 minutes (at a reception location providing maximum 10 receivable DVB-T / T2 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/T2 signal detection can be implemented if applicable. IRD implementation may sweep all the supported frequencies by detecting if a RF signal exists by analysing 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/T2 signal. In case of DVB-T/T2, 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/T2 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 ensures that it easy for the end user to perform consecutive manual searches.

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, 4, 5 & 5.1 values below and up to 35dB above that value or maximum signal input level as defined in NorDig Unified section 3.4.10.5 maximum signal input level. The absolute accuracy shall be of ±5dB at RF signal input levels -80dBm to -60 dBm and ±7dB for RF signal input levels higher than -60dBm.

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 = (2/3) * (P_{rel} + 15)	if -15 dB ≤ P_{rel} < 0dB
SSI = 4 * P_{rel} + 10	if 0 dB ≤ P_{rel} < 20 dB
SSI = (2/3) * (P_{rel} - 20) + 90	if 20 dB ≤ P_{rel} < 35 dB
SSI = 100	if P_{rel} ≥ 35 dB

Table 3: *Signal strength indicator formula*

where

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

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 4 for DVB T and table 5 & 5.1 for DVB T2 below:

Modulation	Code Rate	Reference signal level [dBm]
QPSK	1/2	-93
QPSK	2/3	-91
QPSK	3/4	-90
QPSK	5/6	-89
QPSK	7/8	-88
16-QAM	1/2	-87
16-QAM	2/3	-85
16-QAM	3/4	-84
16-QAM	5/6	-83
16-QAM	7/8	-82
64-QAM	1/2	-82
64-QAM	2/3	-80
64-QAM	3/4	-78
64-QAM	5/6	-77
64-QAM	7/8	-76

Table 4: *Specified Preferred values expressed in dBm for all signal bandwidths guard intervals and FFT for DVB T, 8 MHz raster*

Modulation	Code Rate	Reference signal level [dBm]
QPSK	1/2	-96
QPSK	3/5	-95
QPSK	2/3	-94
QPSK	3/4	-93
QPSK	4/5	-92
QPSK	5/6	-92
16-QAM	1/2	-91
16-QAM	3/5	-89
16-QAM	2/3	-88
16-QAM	3/4	-87
16-QAM	4/5	-86
16-QAM	5/6	-86
64-QAM	1/2	-86
64-QAM	3/5	-85
64-QAM	2/3	-83
64-QAM	3/4	-82
64-QAM	4/5	-81
64-QAM	5/6	-80
256-QAM	1/2	-82
256-QAM	3/5	-80
256-QAM	2/3	-78
256-QAM	3/4	-76
256-QAM	4/5	-75
256-QAM	5/6	-74

Table 5: *Specified Preferred values expressed in dBm for a PLP, all signal bandwidths guard intervals and 32k FFT for DVB T2 signals, 8 MHz raster.*

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 for C/N values of 17dB to 27dB at the IRD RF signal input.

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 $C/N_{rel} < -7$ dB
SQI = $(((C/N_{rel} -3)/10) + 1) * BER\_SQI$	if -7 dB $\leq C/N_{rel} < +3$dB
SQI = BER_SQI	if $C/N_{rel} \geq +3$dB

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 3.10. for the hierarchical DVB-T modes, required C/N value in [dB] is specified in Tables 1 and 2 in Annex B-3 NorDig 3.1.1.

      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.

The DVB-T2 IRD shall be provided with a 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 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 for the received PLP according to the following formulas.

SQI = 0	if C/N_{rel} < -3 dB
SQI = $(C/N_{rel} +3)$ * BER_SQI	if -3 dB ≤ C/N_{rel} < 3dB
SQI = SQI	if C/N_{rel} > 3dB

where

C/N_{rel} is DVB-T2 mode depended of the relative C/N of the received signal value in [dB]

and

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

where

C/N_{rec} is the C/N value expressed in [dB] for the received PLP.

BER_SQI is calculated with the following formula

BER_SQI = 0	if BER > 10^{-4}
BER_SQI = (100/15)	if 10^{-4} ≤ BER ≤ 10^{-7}
BER_SQI = (100/6)	if BER < 10^{-7}

where

BER is referenced to Bit Error rate before BCH for the received PLP.

The integration time for the BER calculation shall be over a period of five seconds.

5. De-multiplex and decode

This section covers the requirement for MPEG 2 transport stream de-multiplexing of Video, Audio, Teletext and Subtitle components and refers to the NorDig Unified specification v3.1.1 section 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 v3.1.1, for the de-multiplexing and decoding, which entail the following main requirements.

5.1 General

The de-multiplexer shall be compliant to the MPEG-2 transport layer defined in ISO/IEC 13818-1[54]. The IRD shall support ETSI TS 101 154 [29] and the additional requirements stated below:

- The IRD shall utilise the MPEG-2 Service Information.
- The IRD shall interpret the CA descriptor as defined in ETSI ETR 289 [25].
- The IRD shall be able to decode an ISO/IEC 13818-1 [54] stream with data rates that include all rates up to that the front-end may deliver, as defined in section 3 NorDig unified 3.1.1
- It should be possible to select one or many section-based data streams and output them as data on USB (if present).
- The IRD shall be capable of utilising at least 32 elementary streams simultaneously, which requires 32 PID filters.
- The NorDig IRD shall provide at least 32 section filters.
- The NorDig IRD shall support variable bitrate elementary streams within a constant bitrate transport stream (excluding audio).
- The NorDig IRD shall support a mixture of service types within the same ISO/IEC 13818-1[54] MPEG-2 transport stream (i.e. MPEG-2 SDTV service, MPEG-4 AVC SDTV and HDTV, radio and data services may be multiplexed into the same transport stream).

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).

NB: This means that all IRD shall support MPEG4 SDTV services using High Profile video encoding tools, MPEG4 AVC (H.264) HP@L3.

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 (pillar-box).
3. Display full height 4:3 aspect ratio picture without centre cut-out (i.e. full frame)

NB: Down-converted HD video shall factory default be displayed as 16:9 letterbox on 4:3 displays.

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5.3 Audio

5.3.1 Audio format decoding

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

- MPEG-1 Layer II (ISO/IEC 11172-3) Musicam, up to 2.0 stereo

- MPEG-4 HEAAC version 1 (ISO/IEC 14496-3) and

- AC 3 & Enhanced AC3 ("Dolby Digital / Plus") (ETSI TS 102 366).

5.3.2 Simultaneous audio format decoding

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

Note that some services may have several audio streams e.g. alternative or original language, audio description or Dolby Digital / plus.

5.3.3 2 Channel audio down-mix

The IRD shall support 2 - channel downmix of both HEAAC, AC3 & Enhanced AC3 incoming multi-channel audio (up to 5.1) stream into a 2-channel output (stereo).

It shall not be necessary for the user to employ external audio (decoder) equipment, for the MPEG4-services with multi-channel audio. External interfacing equipment (TV display unit) shall not be required to support more than 2 channel PCM audio within main Video / Audio interface (HDMI/SCART/RCA).

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 HEAAC up to level 4 audio stream.

5.3.6 HDMI/SCART audio output

The audio output should not at any time be silence on the main Video / Audio interface (HDMI/SCART/RCA) when outputting digital (surround) on digital audio interface (SPDIF) interfaces. It is mandatory to output 2 channel PCM audio in parallel to multi-channel audio (DTS/AC3/AAC/PCM) on the separate audio interface.

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5.3.7 Audio description for the visual impaired

Most of the programme elements are to be found in the main audio service, another programme element (such as audio description for the visually impaired, additional audio services such as a spoken director's commentary or alternative / original language) may be found on associated audio services.

As mandatory, the IRD shall support the requirement for broadcast mixed dual language audio description.

Audio description may be carried as a separate broadcast pre-mixed audio track; described, signalled and selected as Narrative or 'nar' in ISO 639-2 language code with audio type 0x00 (as "undefined" or "normal"). The IRD shall recognise the ISO 639-2 language code (nar) and display the word "Narrative" in the appropriate OSD and menu, this functionality is in an identical manner to the display of the ISO 639-2 language codes 'eng' or 'fre' as "English or "French".

The IRD shall support simple rotation of language source via a single button press (e.g. Lang or Audio) and as indicated via an on-screen navigational aid, this functionality shall not be dependent upon other language settings and functions such as subtitle on or off.

The onscreen display (OSD) should clearly indicate the audio language(s) available to the viewer on the channel selected via the (Lang or Audio) button and the selection process available to the viewer should be via the appropriate navigation arrows. The presence of an alternative or dual language track shall be indicated to the viewer via icon on the OSD search and scan banner displayed on channel change.

The ability to set the Audio Described language descriptor or code should be available via the STB configuration menu. *Viz.* The viewer should be able to set the preferred language as (e.g.) Narrative or 'nar' as a default; thus, ensuring that when changing channel, the receiver will automatically select the viewer preference (as aforementioned in this case Narrative, if broadcast) upon every change of television channel.

Support for simultaneous decoding of the normal (mono/stereo/multichannel) audio track and the visual impaired audio track is an optional feature of this specification.

The IRD shall be able to automatically select the main audio stream (via PID, Descriptor or Tag) when receiving additional visual impaired audio with same language (i.e. the main "normal" audio track is signalled via ISO 639-2 language descriptor with audio type 0x00 "undefined" or "normal", while the visually impaired audio track *may* be signalled with audio type 0x02 hearing_impaired, or 0x03 visual_impaired_commentary).

The spoken subtitle or visual impaired audio description track will in case of MPEG1 Layer II and HEAAC audio format be as a separate (mono) audio stream (PID) and in case of AC 3 or Enhanced AC3 format *may* be as an extra audio channel within the audio stream (PID).

Should the IRD support simultaneous decoding of the normal (mono/stereo/multi channel) audio track and the audio described visually impaired audio track. For the IRD supporting this, it shall be possible to control (select) this visually impaired audio and when activated the audio track (normal or visual impaired) shall be presented to the IRD's outgoing audio (HDMI, SCART or RCA).

5.4 EBU and DVB Subtitling

The IRD shall be capable of decoding both EBU Subtitles and DVB Subtitling and display these employing the OSD or EPG functionality within the IRD whilst decoding the full television service (both video and audio) to which it is associated (as specified in NorDig Unified specification v3.1.1 section 7). The IRD is not required to display both EBU subtitling and DVB subtitling at the same time, colour difference display for different or alternate speakers shall be supported.

As defined within the NorDig specification, if both EBU subtitling and DVB subtitling are received simultaneously for one service the IRD shall only display the DVB subtitle.

The IRD shall not insert or present the received EBU subtitle on VBI line 335 (or any other nominated VBI line) to the Set Top Box SCART / RCA output; this data once presented to the IRD OSD circuitry shall proceed no further. The user shall be able to select a primary and secondary subtitling language via the set-up or configuration menu.

5.5 HbbTV / MHEG5 Digitext and EBU Teletext

The IRD shall support decoding and displaying of HbbTV / MHEG-5 applications, and shall conform to the following standards:
- ETSI TS 102 796 v1.4.1 for HbbTV v2.0.1 www.hbbtv.org
- ETSI ES 202 184 v1.1.1 for MHEG5 v1.06 www.dtg.org.uk

The IRD shall continuously monitor the PMT and the HbbTV / MHEG5 private data stream PID for event based application scheduling and react accordingly to changes.
(NB the IRD shall continue to support decoding and displaying of EBU Subtitling as specified in NorDig Unified specification section 7 and as set out below).

The IRD shall support HbbTV / MHEG-5 when the application as part of a:
- TV or Radio service (service types 0x01, 0x02, 0x0A, 0x16, 0x19) and
- Stand-alone Data Broadcast Service (service type 0x0C)

If both an HbbTV and MHEG5 application are received simultaneously for one and the same service, the IRD shall default priorities and display the HbbTV application.
That is to say, HbbTV shall by default have priority to allocate the application group keys ('Text' and colour keys) on the remote control.
Typically, a service carries either an HbbTV application or MHEG application but may carry both due to legacy support.
If the selected service includes both subtitling (EBU Subtitling and/or DVB subtitling) along with an HbbTV or MHEG application, the IRD shall (according to its user preference settings) at least decode and display the subtitle whenever the user has not entered the HbbTV / MHEG5 application and after the user have left the HbbTV/ MHEG5 application. When the user tries to access a HbbTV / MHEG application (using the 'Text' key via the remote control) for services that have had subtitling enabled by the user or by default setup, the IRD shall display a suitable on-screen message informing the user that the OSD function is in use by the subtitle service (e.g." interactive services are not available while subtitles are on").

EBU subtitling here refers to Teletext subtitling for the hearing impaired
and referenced in the descriptor of the PMT as stream type 6 (S). Teletext which is not referenced in the descriptor as subtitle are optional to access for services with an MHEG5 application, 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 via the remote control) for services that do not include an MHEG application or EBU Teletext pages (stream type 6(T)), the IRD shall display a suitable on-screen message informing the user that the service does not include any Text service (e.g. "Text not available").

5.6 HbbTV Digitext and EBU Teletext

For services that have both an EBU Teletext service an a HbbTV Digital Teletext application signalled as available, the NorDig Hybrid shall be able to display the HbbTV Digital Teletext application as well as being able to display the EBU teletext service, it is not required to display both at the same time.

The NorDig hybrid shall start EBU teletext and be able to toggle between any HbbTV Digital Teletext and any EBU Teletext service as described in clause 5.3.4 of HbbTV specification ETSI TS 102 796

5.7 HbbTV and Subtitling

A NorDig hybrid shall support and display simultaneous display of HbbTV application and subtitles (DVB and EBU), both for broadcast and for MPEG 2 TS delivered via broadband.

The NorDig Hybrid shall display the HbbTV application over the subtitles as described in clause 10.1.1 of HbbTV specification ETSI TS 102 796 and if video is converted to other than full screen, the subtitle shall either be rescaled and repositioned or not displayed at all.

5.8 Co-existence of HbbTV and MHEG

If both an HbbTV application and MHEG application are received simultaneously for one and the same service, the IRD shall default priorities and display the HbbTV application.
That is to say, HbbTV shall by default have priority to allocate the application group keys (colour keys) on the remote control.

[Note: HbbTV support was optional for IRD released before 1st July 2015 and required from 1st January 2016].

6. Interfaces

This section covers the requirement defined for Interfaces and Signal Levels and refers to the NorDig Unified specification section 8 NorDig 3.1.1.

6.1 Scart *(option)*

The IRD shall have one SCART Interface in accordance with EN 50049-1 [7] and EN 50157- 2-1 [9]. NorDig v3.1.1 - 8.4 and as listed below.

Note:
- This is not relevant for iDTV-sets or some types of decoders e.g. PC-based receiver card, USB-based -receiver unit, integrated Car TV or portable IRD, the analogue video output interface is optional.
- The SCART interface may be replaced with RCA connector, female type IEC 60603-14 [41], or similar for CVBS PAL output.

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

SCART	Requirement	CVBS/Audio	RGB	Pin 8	Pin 16
TV	Optional	Out	Out	Out (1)	Out (2)
VCR	Optional	In & Out	In	In	In (4)

Table 6: SCART requirements

1. the voltage shall be forwarded from in to out (12V or 6V)
2. the voltage shall be forwarded from in to out (0V or 1 - 3V)
3. the OSD graphics should not be present on the VCR SCART output except for DVB subtitling if present and chosen.
4. The voltage should be forwarded from in to out (0v or 1 – 3v)

Control signal definitions:

- **PIN 8:**   nom. 0 Volt/DC: internal source of the TV set
  nom. 6 Volt: External source, 16:9 format
  nom. 12 Volt: External source, 4:3 format
- **PIN 16:**   nom. 0 Volt/DC: CVBS active
  1-3 Volt/DC: RGB active

Note: Active Format Description (AFD) or Widescreen Switching shall be performed by the IRD Scart pin 8 only.

Widescreen Switching in the form of digital signalling on line 23 of the Vertical Blanking Interval (or WSS) shall **NOT** be present on the output of the STB Scart.

6.2 HDMI and HDCP

The IRD shall be able to use the EDID information provided by the display to automatically determine the STB output. The IRD shall provide an "Original Format" option. *Viz. t*o output the same format as received if supported by the display and as indicated by the EDID information.

If the received format is not supported, the IRD should select the display mode providing the best possible video quality. This is to avoid the possibility of the IRD output producing black or no output if there is a mismatch between received format and display capabilities.

The priority order in Table 8.2 (NorDig 3.1.1 – 8.6.2) 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 IRD to a fixed format.
The fixed format shall include following: 1280x720p@50Hz, 1920x1080i@25Hz/1920x1080p@25Hz and 1920x1080p@50Hz.

The HDCP must be on (enabled or 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 Transport Stream (TS) or Packetised Elementary Stream (PES) header is set to "on" and/or

- if signalled as must be on via PSI/SI descriptor in PMT as specified in NorDig specification and/or

- if signalled as a 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 signal that the service must have the HDCP on, then the IRD may pass the signal without HDCP on and then the service is here referred to as an 'open' service.

(Signal via CA-system refers to "control information" inside the Entitlement Control Message (ECM) data of the service or in the Entitlement Management Message (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 pass a 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).

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6.3 Analogue HDTV

Where SCART, or any other analogue video output (YPbPr, YUV, RGB, RF-PAL or CVBS) are 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.

6.4 VCR Scart for analogue audio (Option).

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

6.5 Connector for analogue audio.

The NorDig IRD analogue interface shall be:
Two RCA connectors, female type IEC 60603-14 [41] or similar. The audio signals shall be as specified in section 6.5 (Audio Prioritisation) of NorDig 3.1.0

6.6 SPDIF connector for digital audio.

The NorDig IRD should include a digital audio interface, based on IEC 60958 [42] and a non-PCM encoded audio bit stream according to IEC 61937 [43], with coaxial or optical connector. The audio signals shall be as specified in section 6.5 (Audio Prioritisation) of NorDig 3.1.0

6.7 Data Interface (option)

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

The 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 (USB) Specification, Revision 2.0, April 27, 2000.
3.   Ethernet (IEEE 802.3 [47] (100 Base-T, Auto-sense).
4.   WLAN (IEEE 802.11).
5.   Bluetooth 2.0 Specification of the Bluetooth System, 4 November 2004, Bluetooth SIG.

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 include any data or bitstreams that have been descrambled or removed of access control.
Additional security requirements may be imposed for some networks; such requirements must be checked with the relevant CA-operator.

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7. Service Information (SI)

This section covers the requirement defined for Service Information and refers to the NorDig Unified specification 3.1.1 Section 12 and 13. The following clarifications are applicable to the Irish DTT network.

7.1 Original Network ID and Network ID

The DVB Identifiers for the DTT networks are as follows:

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)
Finland	0x20F6	Colour D plan (0x3301 to 0x3400)
Norway	0x2242	Colour E plan (0x3401 to 0x3500)

Table 7: DVB identifiers

The IRD should map the original network ids into the appropriate country in the OSD menus (for example together with NorDig Logical Channel Descriptor LCN v1).

NB: Within DVB 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 all countries, with the exception of Swedish DTT. Swedish DTT original network id value (0x22F1), Sweden has the ISO3166 numeric country value 752 (0x2F0).

7.2 Private data specifier values

For the used private data specifier values, the following applies in the Irish 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**
- Irish DTT private_data_specifier value: **0x000022CE**

7.3 Logical Channel Descriptor (in NIT)

The IRD shall support both NorDig LCN v 1 and v 2 Logical Channel Descriptors, where LCN v1 and V2 are carried within one Original Network ID (ONID) the IRD shall sort according to LCD v2, as mandatory it shall **not** be possible to switch LCN sorting off.

7.4 Time and Date Table (TDT) and Time Offset Table (TOT)

The IRD shall have a real-time clock and time and date (calendar) running continuously. The time and date shall be updated by incoming TDT and TOT from the broadcast SI.
The IRD shall display the correct time for each country based on TDT and TOT and the country selected by the user. The EPG shall display correct event times as conveyed by the TDT and adjusted by the offset in the TOT with reference to the country selected by the user.

7.5 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-digit 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 p/f) 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 changes channel to 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 "IRL" 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.

7.6 Country and Language Codes within PSI & SI

Preferably, all (main) codes in ISO 3166 and ISO 639-2 should be handled. Due to the quite large number of codes in these specifications, table 8 and 9 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	Danmark	Mandatory
FINLAND	FIN	Suomi	Mandatory
NORWAY	NOR	Norge	Mandatory
IRELAND	IRL	Ireland	Mandatory

Table 8: 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 Code	639-2/T Code	Translation to be used in DTT To native	Comments
Danish	**dan**	dan	dansk	Mandatory
German	ger	deu	deutsch	Recommended
English	**eng**	eng	english	Mandatory
Finnish	**fin**	fin	suomi	Mandatory
French	fre	fra	francais	Recommended
Irish / Gaelic	**iri**	iri / gle	irish / gaeilge	Mandatory
Norwegian	**nor**	nor	norsk	Mandatory
Spanish	spa	spa	español	Recommended
Swedish	**swe**	swe	svenska	Mandatory
Audio Description	**nar**	nar	narrative	Mandatory
Original Language	**qaa**	qaa	original language	Mandatory

Table 9: ISO 639-2 Language codes

7.7 Default language settings

The IRD default menu language shall equate to the country setting for the IRD (NorDig unified 3.1.1. -
16.4) user preference "Return to factory mode":

Country	Menu Language	Primary Audio Lang	Primary Subtitling Lang	Secondary Audio Lang	Secondary Subtitle Lang
Ireland	English	English	English	Irish	Irish
Éireann	Gaeilge	Béarla	Béarla	Gaeilge	Gaeilge

Table 10: Dual language default factory settings

7.8 Text strings and fields size of the SI descriptors

The IRD shall at least be able to handle text strings that are coded 'Latin Alphabet number 5' as specified in **ISO 8859-9** (and then signalled 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). NB. To include updated ISO specification (code 0128) Euro currency symbol (€) additional support requirements are as detailed in NorDig 2.4 - 12.1.7).

The recommended maximum transmitted field sizes in the descriptors in the DTT network are stated in the table 11 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	Irish language support mandatory.
Service Provider Name	20	Irish language support mandatory.
(Full) Service Name	22	Irish language support mandatory.
(Short) Service Name	12	May be used in overview service list, info banner and/or EPG.
Event Name	40	Not applicable
Short Event Description	250	Event title only
Extended Event description	255	Event description
Component Description	32	Typically used in the ESG and/or in the info banner
Application Name	32	(for IRD with HbbTV 2.0.1 or MHEG-5)

Table 11: Descriptor field length used in the DTT

7.9 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, the IRD shall first sort the list of all services from one original network (ONID) according to that LCD, before sorting and 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 shall be the primary, either via the user preferences, i.e. matching country setting.

In order to simplify this, the IRD should map or 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 shall automatically be the country matching the original network id (and its services shall be listed first in the IRD service list).

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

The primary DTT network shall be listed according to its LCN (version 1 or version 2), 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). It is important to only include visible marked services from additional (secondary) networks and not any service that is marked as non-visible.

It is recommended to keep the relative broadcast LCN 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 3.1.1 -12.2.9.9].

7.10 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 3.1.0-13.2.1.1]

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8. Receiver states

This section covers the requirements defined for different receiver states and is only partly covered by the NorDig Unified specification v3.1.1

8.1 Installation mode

Installation mode is defined as the state where the IRD is searching, scanning and installing a new multiplex or transport stream 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 3.1.1-3.4.4.5).

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 Active mode

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

All received dynamic PSI and SI data (PMT, SDT, EIT, TDT/TOT, running status and CA mode) shall be processed within 1 second.

Typical dynamic changes that the IRD shall be able to handle are:

- Additional PID (e.g. subtitling) attached or intermittent to 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 639-2 language descriptor in the PMT.
- Changes of running status and/or CA mode (working together with linkage to replacement)
- Updates in EIT, TDT/TOT
- Removal or addition of AC3, EAC3 or HEAAC to or from a service

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8.3 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, the IRD shall at least enter into automatic update mode once 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 (multiplex & 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 automatically from the 'visible' service list without user confirmation 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. Services that are defined as 'non-visible' shall be removed from the service list without user confirmation.

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

- not overwrite any user preferences

The IRD Service List shall be based on information from the SDT. (The services listed in the NIT, e.g. in the NorDig Logic Channel Descriptor, may 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.

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9. Controller and Memory

This section covers the requirement defined for Controller and Memory and refers to the NorDig Unified v 3.1.1specification Section 10.

9.1 System Software Update (SSU)

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

As mandatory the IRD shall on all occasions signal to the user via OSD that replacement software for the IRD has been received and is available for installation, the user shall be prompted to accept either the new software download or decline to reject installation of the available software download. The IRD shall not download and/or install software as an automated function.

The IRD shall provide a mechanism to detect corrupt downloaded system software before it is offered to the user for installation as a replacement for the current working software. If the received system software is corrupt (NorDig Unified 3.1.1, 10.1), the IRD shall not signal availability via the OSD to the user and shall make no changes to the current (working) version of the system software. As optional, the IRD may indicate to the user the failure of the software with an error message that may be used in any contact with the customer relations office of the manufacturer concerned. It shall be possible for the user to disable software download permanently via the IRD set-up or configuration menu.

The IRD shall only download SSU software from the primary network as specified in section 7.9 of this document and no other (secondary) network.

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

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10. Personal Video Recorder (PVR) feature requirement

An IRD, which includes PVR functionality (henceforth referred to as PVR) shall support all PVR requirements listed in the NorDig IRD specification with the following clarifications and requirements.

This section covers the requirement defined for PVR and refers to the NorDig Unified v3.1.1 specification sections 12, 14 and 16 with the following clarifications and requirements.

The PVR is defined as an IRD with two RF tuners, with which the user is able to view one channel whilst recording another, it possesses an integral hard drive (HDD) and has the ability to pause the live broadcast, the PVR can record all components of the desired service i.e. video, main programme audio, supplementary programme audio (AD), subtitling etc.

Programming a recording (or booking) refers to the user action of making a booking to record a live event, series and/or other broadcast content, either to be scheduled in the future or for immediately recording from the EPG grid or whilst viewing the service or receiving an on-screen prompt (green button) whilst viewing a programme.

10.1 Complete recording

The PVR shall be capable (at factory default) for all recordings to include all supported components/PID's listed within the PMT of the recorded service (Video, Audio 1, Audio 2, Subtitle, Audio Description, Original Language, PCR etc).

If the (HbbTV/MHEG) application in the transmission is signalled as not to be recorded, the NorDig Enhanced and/or Interactive PVR should not record these application streams.

NB: For a NorDig PVR using removable media formats (such as DVD or Blu-ray) for recordings, such devices shall include all supported components/PIDs for that format and any subtitling shall (according to the user preference settings) be burnt in to the video or converted into a supported subtitling format.

10.3   Optional Trailer booking/Promotional Linking

The trailer booking (or promotional linking) is typically used during a promotion trailer to give the viewer the opportunity to easy and directly program/book their PVR to record the event the trailer is referring to.

The PVR supporting Trailer Booking shall have the ability to decode and process Related Content Signalling as defined in section 12.8 of NorDig unified v3.1.1 (related content descriptor) in order to drive broadcast-triggered native or API based applications typical example Trailer Booking

The event name shall be displayed together with any promotional text at time of booking (when displaying the Trailer booking menu on screen). At the time of booking, the PVR shall not include any event description text from the short event descriptor.

The short event descriptor's event name (from the RCT if signalled) shall be used to provide information about the event in the PVR list of booked recordings. The extended event descriptor's event description text from EIT may also be used in the PVR list of booked recordings to provide information.

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10.4 Series recording or Series link

All events that have the same series CRID belongs to the same Series. An individual event inside a Series is referenced here as an Episode. (For CRID definition, see section 12.4.5. of NorDig unified v3.1.1).

The PVR shall be able to record a complete Series via the CRID.

The PVR shall store and track series CRIDs that are programmed for recording for up to 91 days between occurrences in EIT schedule. To allow broadcasters to reuse a series CRID for a different editorial concept, the NorDig PVR shall discard any series CRIDs not seen in EIT for 91 days.

The display of programmes selected for recording shall include an indication if the programme is included as a consequence of being one of a series.

The IRD should be aware that the default authority may be changed over time (for example a service might have default authority added in SDT); the NorDig PVR should automatically update its stored default authorities (not only during installation) within fifteen minutes from reception.

10.5 Series record for all episodes

The PVR shall support recording of all episodes of a specific series via series CRID in the broadcast transport stream.

It shall be possible for the viewer from EPG to program the PVR to record a series of events. The PVR shall indicate in the EPG that an event is part of a series and the PVR shall, if the user selects to record the event that belongs to a series, request the user to confirm what to record:

1. Only the single event selected.

2. Several or All events (episodes) of the series

10.6 Series record limited to a number of episodes for a series

The PVR should support recording of a (limited) number of episodes of a specific series via series tagging in the broadcast. The limitation should either be a period of time or a specific number of episodes.

10.7 Series, only one instance/copy of each episode

The PVR should support the feature to only record one instance/copy of each episode in a series for series recording, in order to more efficiently handle to handle repeat programming.

10.8 Split recording

A programme may consist of multiple EIT events within the same service or over several services. i.e. a film might be divided into two parts/blocks interrupted by a news programme in the middle (see fig 1 -A) or a longer sport event might be split into several parts/blocks over several services, (see fig 1-B).

Signalling carried in the SI allows the PVR to identify and record all the events containing the parts of a single programme. A "split programme" is a single piece of content, which comprises of two or more EIT events having the same CRID and IMI value with the gap from the scheduled end time (start_time plus duration) to the scheduled start time of any two of those events is less than 3 hours.

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The PVR shall consider a split programme to be segments of a single item of content. When selecting a split programme for recording, the PVR shall select and record all constituent events so that the complete programme content is recorded.
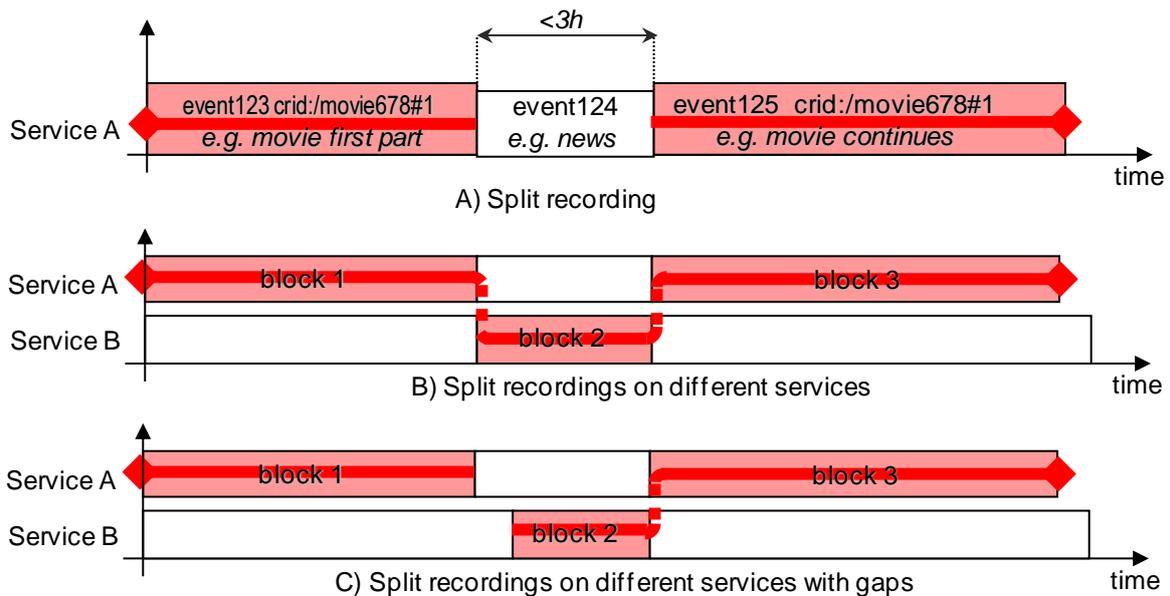

Figure 1: *Handling of split recordings by the PVR. Split programme events (events with the same CRID value that are broadcast close in time to each other) shall be recorded with one and the same programming by the PVR.*

A)   The maximum gap time between events with the same programme CRID value that shall still be treated as belonging to the same programme for recording.

B)   Split programme over several services.

C)   Split programme with gap and over separate services

There are cases where a PVR may during the time of programming a recording only see a single event with the booked CRID and IMI combination (for example initially only the first part/block of the split programme has so far been included in the EIT). The PVR shall continue to monitor the EIT for additional events with the same CRID and IMI combination and include them to the selected recording.

In case of overlap between the split events and if the PVR has limitation in recording capacity when back-to-back recording, then the PVR shall first finalise recording of the first part or event of the split programme (according to the events start time and duration) before starting recording the next part of the split programme, this is the same behaviour as back-to-back recordings.

During the lifecycle of the EIT schedule, broadcasters may change programmes from split to single or vice versa.

In the PVR split recordings shall clearly be marked in the list of recordings as constituent parts belonging to the same programme, for example as one and the same entity or similar. It shall be enough to select only one entity from the file list of recording to get a playback of the complete programme, including all constituent events.

10.9   Safe margins

The PVR shall have a factory default safe margin setting of one minute before the events start time and five minutes after the event is no longer present. The margin before the event start time shall be based on the latest possible EIT update. For safe margin, recording the PVR should insert index markers into the recording when the event status changes to running and another when the event becomes not_running. It shall be possible via the set-up or configuration menu to deactivate safe margin settings.

As a default, setting safe margins shall have a lower priority than any back to back recording (NorDig v3.1.1 14.3.11)

10.10   Presentation and management of scheduled recordings

The PVR at all times keep track of future scheduled recordings, the PVR shall present to the user all scheduled recordings on one screen (manual single, manual repeated and series).

For scheduled series recordings, the PVR shall present to the user all future scheduled instances of the series that can be detected from the broadcast EIT data.

The user shall be able to delete any future scheduled recording. The user shall be able to delete one individual scheduled recording belonging to a series without deleting the series.

10.11   Presentation and management of acquired recordings

In addition to NorDig v3.1.1 14.2.1, the user shall be able to view a list of acquired recordings where all episodes of a series are grouped into the same item on the list and displayed as such. Series items should be marked for the user that the item includes several episodes or events. Each such item representing a group of recorded series shall be expandable on request by the user so that all recorded episodes are displayed.

10.12   Cache in background

The PVR shall support during normal viewing mode monitor and cache all EIT section data including EIT present/following, EIT schedule and EIT other as a background function. The PVR shall update its cached EIT data for any dynamic changes in the EIT broadcast data. To improve presentation of EPG data after start-up, the PVR should store the most up to date cache of EIT data to the PVR persistent memory (HDD).

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