Minimum Receiver Requirements
Digital Terrestrial Television

Additions and clarifications to NorDig Unified Requirements 2.2
### Contents

1. Introduction ..................................................................................................................... 4  
1.1. Scope.............................................................................................................................. 4  
1.2. Document History ........................................................................................................... 5  
1.3. Terminology .................................................................................................................... 5  
1.4. List of Abbreviations ....................................................................................................... 6  
2. General features for a digital receiver ............................................................................. 8  
3. CA System and interfaces for the DTT Network ............................................................. 9  
4. Terrestrial Tuner and Demodulator ................................................................................. 9  
4.1. Requirements for terrestrial tuner and demodulator ....................................................... 9  
4.1.1. Reception quality/Tuning/Scanning Procedures ............................................................ 9  
4.1.1.1. General ................................................................................................................... 9  
4.1.1.2. Status check: Basic ............................................................................................... 9  
4.1.1.3. Status check: Advanced ....................................................................................... 10  
4.1.1.4. Installation mode: Automatic Search, best service ................................................ 10  
4.1.1.5. Installation mode: Manual Search .......................................................................... 11  
4.1.1.6. Requirements for the signal strength indicator (SSI) ................................................ 11  
4.1.1.7. Requirements for the signal quality indicator (SQI) .................................................... 12  
5. De-multiplex and decode .............................................................................................. 14  
5.1. General ......................................................................................................................... 14  
5.2. Video.................................................................................................................................. 14  
5.3. Audio.................................................................................................................................. 15  
5.3.1. Audio format decoding .................................................................................................. 15  
5.3.2. Simultaneous audio format decoding .............................................................. 15  
5.3.3. 2-Channel audio downmix ............................................................................................ 15  
5.3.4. Audio settings from factory default ................................................................................ 15  
5.3.5. Variable Bitrate ............................................................................................................. 15  
5.3.6. HDMI/SCART audio during digital audio output .................................................... 15  
5.3.7. Audio description for the visual impaired ............................................................... 16  
5.4. EBU and DVB Subtitling ............................................................................................... 18  
5.5. MHEG5 Supertext and EBU Teletext .............................................................................. 18
6. Interfaces ......................................................................................................................19
   6.1. Scart (NorDig 2.2 – 8.4)..........................................................................................19
   6.2. HDMI and HDCP (NorDig 2.2 - 8.6)......................................................................20
   6.3. Analogue HDTV ..................................................................................................21
   6.4. Data Interface (option) ......................................................................................21
   7. Service Information (SI) .......................................................................................22
   7.1. Clarifications to NorDig Unified 2.2 specifications (Chapter 12)...............................22
      7.1.1. SI Identification coding ..................................................................................22
      7.1.1.1. Original Network ID and Network ID ..............................................................22
      7.1.1.2. Private data specifier values ........................................................................22
      7.1.2. Logical Channel Descriptor (in NIT) ...............................................................22
      7.1.3. Parental rating descriptor (in EIT) ..................................................................23
      7.1.4. Country and Language Codes within PSI & SI ..................................................23
      7.1.5. Default language settings ..............................................................................24
      7.1.6. Text strings and fields size of the SI descriptors ..............................................25
      7.1.7. Reception of multiple DTT networks ...............................................................26
      7.1.8. User Service Lists .......................................................................................26
   8. Receiver states .......................................................................................................27
      8.1. Installation mode ...............................................................................................27
      8.2. Active mode .......................................................................................................27
      8.3. Update mode .....................................................................................................28
      8.4. Stand-by and power off mode ..........................................................................28
   9. Controller and Memory ..........................................................................................29
      9.1. Clarifications to NorDig Unified specifications (Chapter 11) .................................29
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 from a DVB-T 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 2.2 Basic Profile @ High Definition Level
2) MHEG-5 UK Profile, version 1.06
3) Additions and clarifications as set out in this document
1.2. Document History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>09-11-2008</td>
<td>Draft</td>
<td>Initial draft document based on Teracom ACD 2.0 document</td>
</tr>
<tr>
<td>0.1b</td>
<td>11-11-2008</td>
<td>Draft</td>
<td>Comment 0.1 draft – Teracom comment; Per Tullstedt and Petri Hyvärinen</td>
</tr>
<tr>
<td>0.1c</td>
<td>17-12-2008</td>
<td>Draft</td>
<td>Amendments to 0.1b draft – Marcus O’Doherty</td>
</tr>
<tr>
<td>1.0</td>
<td>19-12-2008</td>
<td>Edition 1</td>
<td>Final amendments to 0.1c draft – Marcus O’Doherty</td>
</tr>
<tr>
<td>2.0</td>
<td>24-10-2010</td>
<td>Edition 2</td>
<td>NorDig 2.2 update – Deasún Mac Giolla an Chloig</td>
</tr>
</tbody>
</table>

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. List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAC</td>
<td>Advanced Audio Coding here refers to HE-AAC level 4 (ISO/IEC 14496-3)</td>
</tr>
<tr>
<td>AC3</td>
<td>Dolby Digital audio coding (ETSI TS 102 366)</td>
</tr>
<tr>
<td>AC3+</td>
<td>Enhanced AC3, Dolby Digital Plus audio coding, (ETSI TS 102 366)</td>
</tr>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>AVC</td>
<td>Advanced Video Coding (MPEG-4 part 10 ISO/IEC 14496-10, ITU-T H.264)</td>
</tr>
<tr>
<td>AFD</td>
<td>Active Format Descriptor</td>
</tr>
<tr>
<td>BAT</td>
<td>Bouquet Association Table</td>
</tr>
<tr>
<td>CA</td>
<td>Conditional Access</td>
</tr>
<tr>
<td>CAM</td>
<td>Conditional Access Module</td>
</tr>
<tr>
<td>CAS</td>
<td>Conditional Access System</td>
</tr>
<tr>
<td>CI+</td>
<td>Common Interface Plus</td>
</tr>
<tr>
<td>CENELEC</td>
<td>Comité Européen de Normalisation Electrotechnique</td>
</tr>
<tr>
<td>DTT</td>
<td>Digital Terrestrial Television</td>
</tr>
<tr>
<td>DVB</td>
<td>Digital Video Broadcast</td>
</tr>
<tr>
<td>EICTA</td>
<td>European Information &amp; Communications Technology Industry Association</td>
</tr>
<tr>
<td>EIT</td>
<td>Electronic Programme Guide</td>
</tr>
<tr>
<td>EPG</td>
<td>Electronic Programme Guide</td>
</tr>
<tr>
<td>ESG</td>
<td>Event Schedule Guide</td>
</tr>
<tr>
<td>FTA</td>
<td>Free To Air</td>
</tr>
<tr>
<td>H.264</td>
<td>as AVC</td>
</tr>
<tr>
<td>HD</td>
<td>High Definition</td>
</tr>
<tr>
<td>HDTV</td>
<td>High Definition Television</td>
</tr>
<tr>
<td>HE.AAC</td>
<td>High Efficient AAC version 1 Level 4</td>
</tr>
<tr>
<td>IRD</td>
<td>Integrated Receiver Decoder</td>
</tr>
<tr>
<td>I-DTT</td>
<td>Irish – DTT</td>
</tr>
<tr>
<td>LCD</td>
<td>Logical Channel Descriptor</td>
</tr>
<tr>
<td>LCN</td>
<td>Logical Channel Number</td>
</tr>
<tr>
<td>MFN</td>
<td>Multiple Frequencies Network</td>
</tr>
<tr>
<td>MHP</td>
<td>Multimedia Home Platform (API)</td>
</tr>
<tr>
<td>Mono</td>
<td>Monaural audio, i.e. 1.0 channel audio stream</td>
</tr>
<tr>
<td>MHEG</td>
<td>Multimedia and Hypermedia Experts Group</td>
</tr>
<tr>
<td>MPEG</td>
<td>Moving Picture Expert Group</td>
</tr>
<tr>
<td>Multi-channel</td>
<td>Multichannel audio, i.e. up to 5.1 channel audio stream (i.e. 3.0, 4.0, 5.1 etc)</td>
</tr>
<tr>
<td>n/a</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>NID</td>
<td>Network Identifier</td>
</tr>
<tr>
<td>NIT</td>
<td>Network Information Table</td>
</tr>
<tr>
<td>NVOD</td>
<td>Near Video On Demand</td>
</tr>
<tr>
<td>ONID</td>
<td>Original Network Identifier</td>
</tr>
<tr>
<td>OSD</td>
<td>On Screen Display</td>
</tr>
<tr>
<td>P/f</td>
<td>Present / Following (event)</td>
</tr>
<tr>
<td>PCM</td>
<td>Pulse-Code Modulation audio (IEC 60958)</td>
</tr>
<tr>
<td>PSI</td>
<td>Programme Specific Information</td>
</tr>
<tr>
<td>QAM</td>
<td>Quadrature Amplitude Modulation</td>
</tr>
<tr>
<td>STB</td>
<td>Set Top Box</td>
</tr>
<tr>
<td>SDT</td>
<td>Service Description Table</td>
</tr>
<tr>
<td>S-DTT</td>
<td>Swedish DTT</td>
</tr>
<tr>
<td>SDTV</td>
<td>Standard Definition Television</td>
</tr>
<tr>
<td>SFN</td>
<td>Single Frequency Network</td>
</tr>
<tr>
<td>SI</td>
<td>Service Information</td>
</tr>
<tr>
<td>SID</td>
<td>Service Identifier</td>
</tr>
<tr>
<td>SMC</td>
<td>Smart Card</td>
</tr>
<tr>
<td>Stereo</td>
<td>Stereo (left and right) audio, 2.0 channel audio stream</td>
</tr>
<tr>
<td>TDT</td>
<td>Time and Date Table</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>TOT</td>
<td>Time Offset Table</td>
</tr>
<tr>
<td>TS</td>
<td>Transport Stream</td>
</tr>
<tr>
<td>TDT-É</td>
<td>Teilifís Digiteach Trástíre na hÉireann</td>
</tr>
<tr>
<td>TSID</td>
<td>MPEG-2 Transport Stream Identifier</td>
</tr>
<tr>
<td>UHF</td>
<td>Ultra High Frequency</td>
</tr>
<tr>
<td>UTC</td>
<td>Co-ordinated Universal Time</td>
</tr>
<tr>
<td>VHF</td>
<td>Very High Frequency</td>
</tr>
</tbody>
</table>
2. General features for a digital receiver

The requirements for the IRD operating on the Irish DTT network in this specification are based on the NorDig Unified receiver specification Basic Profile at its HD Level, the MHEG-5 version 1.06 Profile with some additions and clarifications as included in this document. See www.nordig.org, and www.dtg.org.uk for further detail.

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

Compared to NorDig Unified 2.2 basic profile specification, the following major additional minimum requirements and clarifications are applicable for all IRD:

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

- Video decoding (see 5.2)
- MPEG4 HP@L4 HDTV
- MPEG4 HP@L3 SDTV
- MPEG2 SDTV
- Audio decoding (see 5.3)
- MPEG1 Layer II stereo audio (Musicam).
- AC 3 (Dolby digital) EAC3 (Dolby Digital Plus) multi-channel audio.
- HEAAC multi-channel audio
- EBU subtitling SD VBI insertion
- EBU subtitling HD VANC insertion as per OP 47
- MHEG 5 version 1.06
- DVB Subtitling

The IRD shall include MHEG-5 API version 1.06 with support of HDTV video as specified in the DTG specification.

As previously stated when using the term IRD (Integrated Receiver Decoder) this refers to all types of receivers. The IRD can 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 iTV (integrated Digital Television) is an IRD which is a integrated into the TV Display

I order to meet the minimum receiver requirements set out in this document, all IRD shall meet the NorDig 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).
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 support for DVB Common Interface Plus is recommended for the IRD and 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 the appropriate EU directives on the subject. 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.

4. Terrestrial Tuner and Demodulator

This chapter covers the requirement defined for Terrestrial Tuner and Demodulator and refers to NorDig Unified specification 2.2 chapter 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 in NorDig Unified.

The IRD shall be able to receive channels in the VHF band III and UHF bands IV and V (see Table 1).

A raster of 8MHz is mandatory for the specified UHF bands and strongly recommended for VHF BIII, a raster of 7 MHz is mandatory for VHF Band III.

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.

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 that presents reception quality information for a selected frequency which is currently viewed by the user.

The basic status check shall include:

- Channel identifier, 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 which is accessible through the Navigator and presents the following information:

- Channel identifier according to NorDig IRD specification Annex B.2
- 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-T mode
- transport stream id
- original network id
- network id
- service id

The advanced status check values shall be updated continuously once 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 multiplex’s and services in the supported frequency range as detailed in Table 1 below: before the automatic search is started; all service lists shall be deleted.

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>47 – 68 MHz</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>104 – 174 MHz</td>
<td>Optional</td>
</tr>
<tr>
<td>174 – 230 MHz</td>
<td>Mandatory</td>
</tr>
<tr>
<td>230 – 300 MHz</td>
<td>Optional</td>
</tr>
<tr>
<td>300 – 470 MHz</td>
<td>Optional</td>
</tr>
<tr>
<td>470 – 606 MHz</td>
<td>Mandatory</td>
</tr>
<tr>
<td>606 – 862 MHz</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>

Table 1: 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 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 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.

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 below and up to 35dB above that value or maximum signal input level as 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:

<table>
<thead>
<tr>
<th>SSI</th>
<th>if $\text{P}_{\text{rel}} &lt; -15 \text{ dB}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{SSI} = (10/15) \times (\text{P}_{\text{rel}} + 15)$</td>
<td>$\text{if } -15 \text{ dB} \leq \text{P}_{\text{rel}} &lt; 0 \text{ dB}$</td>
</tr>
<tr>
<td>$\text{SSI} = 4 \times \text{P}_{\text{rel}} + 10$</td>
<td>$\text{if } 0 \text{ dB} \leq \text{P}_{\text{rel}} &lt; 20 \text{ dB}$</td>
</tr>
<tr>
<td>$\text{SSI} = (10/15) \times (\text{P}_{\text{rel}} - 20) + 90$</td>
<td>$\text{if } 20 \text{ dB} \leq \text{P}_{\text{rel}} &lt; 35 \text{ dB}$</td>
</tr>
<tr>
<td>$\text{SSI} = 100$</td>
<td>$\text{if } \text{P}_{\text{rel}} \geq 35 \text{ dB}$</td>
</tr>
</tbody>
</table>

Table 2: *Signal strength indicator formula*
where

\[ \text{P}_{\text{rel}} = \text{P}_{\text{rec}} - \text{P}_{\text{ref}} \]

\( \text{P}_{\text{rec}} \) is referenced to signal level expressed in [dBm] at receiver RF signal input

\( \text{P}_{\text{ref}} \) is reference signal level value expressed in [dBm] specified in table 3 below:

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code Rate</th>
<th>Reference signal level [dBm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK</td>
<td>1/2</td>
<td>-81</td>
</tr>
<tr>
<td>QPSK</td>
<td>2/3</td>
<td>-79</td>
</tr>
<tr>
<td>QPSK</td>
<td>3/4</td>
<td>-78</td>
</tr>
<tr>
<td>QPSK</td>
<td>5/6</td>
<td>-77</td>
</tr>
<tr>
<td>QPSK</td>
<td>7/8</td>
<td>-76</td>
</tr>
<tr>
<td>16-QAM</td>
<td>1/2</td>
<td>-75</td>
</tr>
<tr>
<td>16-QAM</td>
<td>2/3</td>
<td>-73</td>
</tr>
<tr>
<td>16-QAM</td>
<td>3/4</td>
<td>-72</td>
</tr>
<tr>
<td>16-QAM</td>
<td>5/6</td>
<td>-71</td>
</tr>
<tr>
<td>16-QAM</td>
<td>7/8</td>
<td>-70</td>
</tr>
<tr>
<td>64-QAM</td>
<td>1/2</td>
<td>-69</td>
</tr>
<tr>
<td>64-QAM</td>
<td>2/3</td>
<td>-68</td>
</tr>
<tr>
<td>64-QAM</td>
<td>3/4</td>
<td>-66</td>
</tr>
<tr>
<td>64-QAM</td>
<td>5/6</td>
<td>-65</td>
</tr>
<tr>
<td>64-QAM</td>
<td>7/8</td>
<td>-64</td>
</tr>
</tbody>
</table>

Table 3: Specified Preferred values expressed in dBm for all signal bandwidths with a 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 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.

\[
\begin{align*}
\text{SQI} &= 0 & \text{if } C/N_{\text{rel}} < -7 \text{ dB} \\
\text{SQI} &= ((C/N_{\text{rel}} -3)/10) + 1 \times \text{BER}_{\text{SQI}} & \text{if } -7 \text{ dB} \leq C/N_{\text{rel}} < +3 \text{ dB} \\
\text{SQI} &= \text{BER}_{\text{SQI}} & \text{if } C/N_{\text{rel}} \geq +3 \text{dB}
\end{align*}
\]

where

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

and

\[ C/N_{\text{rel}} = C/N_{\text{rec}} - C/N_{\text{NordigP1}} \]

\[ C/N_{\text{start}} = C/N_{\text{NordigP1}} - 7 \text{ dB} \]

\[ C/N_{\text{top}} = C/N_{\text{NordigP1}} + 3 \text{ dB} \]
where

\[
C/N_{\text{NordigP1}} \text{ is the required } C/N \text{ value in } [\text{dB}] \text{ for the non-hierarchical DVB-T mode in profile 1 defined in Table 3.9. (Nordig 2.2)} \text{ For the hierarchical DVB-T modes required } C/N \text{ value in } [\text{dB}] \text{ is specified in Tables 1 and 2 in Annex B.3.}
\]

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

BER\textunderscore SQI is calculated with the formula

<table>
<thead>
<tr>
<th>BER\textunderscore SQI</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>if BER &gt; $10^{-3}$</td>
</tr>
<tr>
<td>$20 \times \log_{10}(1/\text{BER}) - 40$</td>
<td>if $10^{-7} &lt; \text{BER} \leq 10^{-3}$</td>
</tr>
<tr>
<td>100</td>
<td>if BER $\leq 10^{-7}$</td>
</tr>
</tbody>
</table>

where

BER is Bit Error Rate measured before Reed Solomon decoding.

The integration time for the BER\textunderscore SQI calculation shall be over a time period of 5 seconds.
5. De-multiplex and decode

This chapter covers the requirement defined for MPEG de-multiplexing, Video and Audio decoding, and refers to the NorDig Unified specification 2.2 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, for the de-multiplexing and decoding, which means following main requirements (see NorDig specification for all details).

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 utilize the MPEG-2 Service Information as specified in Part B.
- 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 (1) as defined in chapter 3 NorDig unified 2.2
- 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 to utilise at least 32 elementary streams simultaneously, which requires 32 PID filters.
- The NorDig IRD shall provide at least 32 section filters (2).
- The NorDig IRD shall support variable bit rate elementary streams within a constant bit rate 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 and Radio 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).

Note: 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)

Note: Down-converted HD video shall factory default be displayed as 16:9 letterbox on 4:3 displays.
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 HE AAC 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 with 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 language, audio description or Dolby Digital / plus.

5.3.3. 2-Channel audio downmix
The IRD shall support 2-channel downmix of both HEAAC, AC3 & 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, 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 Video / Audio 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 HEAAC up to level 4 audio stream.

5.3.6. HDMI/SCART audio during digital audio output
The audio output should not be silence on the main Video / Audio interface (HDMI/SCART) 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.
5.3.7. Audio description for the visual impaired

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

As mandatory, the IRD shall support the requirement for broadcast mix 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 support simple rotation of language source via a single button press 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 (blue) button and the selection process available to the viewer should be via the appropriate navigation arrows.

The ability to set the Audio Described language descriptor or code should be available via the STB configuration menu; 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/multi channel) audio track and the visual impaired audio track is an optional feature of this specification. Note the IRD shall be able to automatically select the main audio stream (via PID or descriptor) when receiving additional visual impaired audio with same language (main “normal” audio track signalled via ISO 639 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).

The IRD should support simultaneous decoding of the normal (mono/stereo/multi channel) audio track and the spoken subtitle 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 Phono).
As optional, the IRD may support simultaneous decoding of the normal (mono/stereo/multi channel/metadata) audio track and the spoken subtitle (visual impaired audio track) transmitted as receiver mix.

For the IRD supporting this, it shall be possible to control (select) the visual impaired audio and when activated the audio track (normal or visual impaired) shall be presented to the IRD’s outgoing audio (HDMI, SCART or Phono). The IRD should support simultaneous decoding of the normal (mono/stereo/multi channel) audio track and the spoken subtitle (visual impaired audio track). For the IRD supporting this, it shall be possible to control (select) this visual impaired audio and when activated the audio track (normal or visual impaired) shall be presented to the IRD’s outgoing audio (HDMI, SCART or Phono).

It shall be possible to adjust the relative audio level (volume) between the normal and visual 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).

Some DTT services may carry an extra (mono) audio track with clear audio description (AD) of the content for visually impaired people 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.
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 (Video and Audio) to which it is associated (as specified in NorDig Unified specification section 7). The IRD is not required to display both EBU subtitling and DVB subtitling at the same time. The type of font employed by the IRD OSD for EBU subtitling display should be the Tiresias Screenfont.

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 support for the analogue outputs also support insertion of the Teletext data in the VBI of the analogue CVBS video output. In this case the Teletext decoder of the TV-set might be used instead of the one in the STB. The VBI insertion shall be compliant with ITU-R BT.653-3 [64]. The Teletext data shall be inserted in the lines 6 to 22 and lines 320 to 334 only.

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 output; this data once presented to the IRD OSD circuitry it shall proceed no further. The user shall be able to select primary and secondary subtitling language.

5.5. **MHEG5 Supertext 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, 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 the MHEG5 private data stream PID for event based MHEG5 application and react accordingly to 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 MHEG-5 when the 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. That is to say, MHEG5 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 MHEG5 Supertext application or EBU Teletext normal pages but may carry both due to legacy issues.

If the selected service includes both subtitling (EBU Subtitling and/or DVB subtitling) along with a MHEG5 application, the IRD shall (according with its user preference settings) at least decode and display the subtitle 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 subtitle after it has entered the MHEG5 application, (in that case MHEG5 application OSD shall be on top of video and subtitling).

EBU Teletext subtitling here refers to Teletext subtitling for the hearing impaired and referenced in the descriptor of the PMT as stream type 6 (S). Teletext not referenced in the descriptor as subtitile 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 (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 8 NorDig 2.2.

6.1. Scart (NorDig 2.2 – 8.4)

The IRD shall have one SCART Interface in accordance with EN 50049-1 [7] and EN 50157-2-1 [9].

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 can be replaced with another type of connector in an external IRD deployed for Car TV reception.

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

<table>
<thead>
<tr>
<th>SCART</th>
<th>Requirement</th>
<th>CVBS/Audio</th>
<th>RGB</th>
<th>Pin 8</th>
<th>Pin 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV</td>
<td>Mandatory</td>
<td>Out</td>
<td>Out (1)</td>
<td>Out (2)</td>
<td></td>
</tr>
<tr>
<td>VCR</td>
<td>Optional</td>
<td>In &amp; Out</td>
<td>In</td>
<td>In</td>
<td>In (4)</td>
</tr>
</tbody>
</table>

Table 4: 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 (NorDig 2.2 - 8.6)**

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 - to 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 STB should select the display mode providing the best possible video quality. This is to avoid the possibility of the STB 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 2.2 – 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 on ('1') 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).
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. 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.
3. Ethernet (IEEE 802.3 [47] (100 Base-T, Auto-sense).
4. WLAN (IEEE 802.11).

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.
7. Service Information (SI)

This chapter covers the requirement defined for Service Information, and refers to the NorDig Unified specification 2.2 Chapter 12 and 13.

7.1. Clarifications to NorDig Unified 2.2 specifications (chapter 12)

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:

<table>
<thead>
<tr>
<th>DTT Network</th>
<th>Original_Network_ID</th>
<th>Network ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>0x22F1</td>
<td>Colour B plan (0x3101 to 0x3200)</td>
</tr>
<tr>
<td>Denmark</td>
<td>0x20D0</td>
<td>Colour C plan (0x3201 to 0x3300)</td>
</tr>
<tr>
<td>Ireland</td>
<td>0x2174</td>
<td>Colour C plan (0x3201 to 0x3300)</td>
</tr>
<tr>
<td>Finland</td>
<td>0x20F6</td>
<td>Colour D plan (0x3301 to 0x3400)</td>
</tr>
<tr>
<td>Norway</td>
<td>0x2242</td>
<td>Colour E plan (0x3401 to 0x3500)</td>
</tr>
</tbody>
</table>

Table 5: 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 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).

7.1.1.2. 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

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 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.

<table>
<thead>
<tr>
<th>Country (in English)</th>
<th>ISO 3166 code</th>
<th>Translation to be used (to native)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWEDEN</td>
<td>SWE</td>
<td>Sverige</td>
<td>Mandatory</td>
</tr>
<tr>
<td>DENMARK</td>
<td>DNK</td>
<td>Denmark</td>
<td>Mandatory</td>
</tr>
<tr>
<td>FINLAND</td>
<td>FIN</td>
<td>Suomi</td>
<td>Mandatory</td>
</tr>
<tr>
<td>NORWAY</td>
<td>NOR</td>
<td>Norge</td>
<td>Mandatory</td>
</tr>
<tr>
<td>IRELAND</td>
<td>IRL</td>
<td>Ireland</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>

*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.

<table>
<thead>
<tr>
<th>Language (in English)</th>
<th>639-2/B</th>
<th>639-2/T</th>
<th>Translation to be used in DTT</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code</td>
<td>Code</td>
<td>To native</td>
<td></td>
</tr>
<tr>
<td>Danish</td>
<td>dan</td>
<td>dan</td>
<td>dansk</td>
<td>Mandatory</td>
</tr>
<tr>
<td>German</td>
<td>ger</td>
<td>deu</td>
<td>deutsch</td>
<td>Recommended</td>
</tr>
<tr>
<td>English</td>
<td>eng</td>
<td>eng</td>
<td>English</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Finnish</td>
<td>fin</td>
<td>fin</td>
<td>suomi</td>
<td>Mandatory</td>
</tr>
<tr>
<td>French</td>
<td>fre</td>
<td>fra</td>
<td>francais</td>
<td>Recommended</td>
</tr>
<tr>
<td>Irish / Gaelic</td>
<td>iri / gle</td>
<td>iri / gle</td>
<td>irish / gaeilge</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Norwegian</td>
<td>nor</td>
<td>nor</td>
<td>norsk</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Spanish</td>
<td>spa</td>
<td>spa</td>
<td>español</td>
<td>Recommended</td>
</tr>
<tr>
<td>Swedish</td>
<td>swe</td>
<td>swe</td>
<td>svenska</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Audio Description</td>
<td>nar</td>
<td>nar</td>
<td>narrative</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Original Language</td>
<td>qaa</td>
<td>qaa</td>
<td>original language</td>
<td>Recommended</td>
</tr>
</tbody>
</table>

Table 6: ISO 639 Language codes

7.1.5. Default language settings

The IRD default menu language shall equate to the country setting for the IRD NorDig unified 2.2 - 16.3 “Return to factory mode”:

<table>
<thead>
<tr>
<th>Country</th>
<th>Menu Language</th>
<th>Primary Audio Lang</th>
<th>Primary Subtitling Lang</th>
<th>Secondary Audio Lang</th>
<th>Secondary Subtitle Lang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ireland</td>
<td>English</td>
<td>English</td>
<td>English</td>
<td>Irish</td>
<td>Irish</td>
</tr>
<tr>
<td>Éireann</td>
<td>Gaeilge</td>
<td>English / Béarla</td>
<td>English / Béarla</td>
<td>Irish / Gaeilge</td>
<td>Irish / Gaeilge</td>
</tr>
</tbody>
</table>

Table 7: Dual language default factory settings
7.1.6. 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). (Note: To include updated ISO specification (code 0128) Euro currency symbol (€) additional support requirements are as detailed in NorDig 2.2 - 12.1.7).

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).

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

Table 8: Descriptor field length used in the DTT
7.1.7. 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 the list of all services from one original network (original network id) 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, e.g. matching country setting (preferred) or via user selectable list of available original networks or similar mechanism. In order to simplify this, the 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 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 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 2.2 -12.2.8.5].

7.1.8. 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 2.2-13.2.1.1]
8. Receiver states

This chapter covers the requirements defined for different receiver states and is only partly covered by the NorDig Unified specification 2.2

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 2.2-3.4.4.5).

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, 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:

- 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 language descriptor in the PMT.
- Changes of running status and/or CA mode (working together with linkage to replacement)
- Updates in EIT, TOT/TDT
- Removal or addition of AC3, EAC3 or HEAAC to or from a service.
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 (see chapter 5 of this document). The IRD shall at least enter into automatic 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 (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. 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 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, 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

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 10.1 in NorDig Unified 2.2), 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 may 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.

The IRD shall not download SSU from a DTT network other than the primary or home network which is set by the user preference country setting.

The IRD shall always request confirmation from the user prior to the installation of any such SSU download once received.