**Draft update for NorDig RoO spec. v. 3.1.1****Update to: Video section .**

**Draft 002**

**NorDig Rules of Operation**

**Version 3.1.1**

**for**

**NorDig Unified Receiver Networks**  
Date: dd.mm.yyyy

Following text is only during drafting and will be removed before final NorDig RoO specification

DRAFTING GUIDELINES / Explanation from the editors related to DRAFT versions:

This NorDig RoO spec. for v3.1.1 draft document is based on the official NorDig Unified Test Plan v3.1.1

Yellow highlight marking marks changes in text compared to NorDig Unified Test Plan v2.6.0

* + New modified text: without strikethrough marks new additional text,
  + ~~Removed text~~: with strikethrough marks old text proposed to be removed
* Green marked text: highlighting text that under extra scrutiny during this update (not yet agreed).
* Blue marked text: comments or other raw text that will be removed before final version.
* Grey marked text: refers to text that not are relevant to this review/update.

Guide: To improve version handling and readability, old text from NorDig RoO v2.5 that is proposed to be deleted in future “v3.1.1” should not be removed from draft version.   
Use instead ~~strikethrough~~ and yellow highlighted marking. Microsoft Word function “Track Changes”, will be used in addition to highlight changes, BUT from one draft version to another draft sometimes all “Track Changes” are *Accepted* to easier read changes in updates of proposals during our work.

When drafting a proposal, cross-references should be manually set and same for proposing correction, i.e. yellow mark and manual reference value. NorDig editor will update cross-references when preparing final draft.

**Changes and proposals in this draft - updates**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Ch.** | **Name** | **Status** | **Draft** | **Owner** | **Date** | **Editor** |
| All | Design of RoO document form | Added headline “Requirement from IRD specifications v.3.1.1”  in all main chapters. |  | Peter | 01.11.19 | Peter |
| 8 | PVR | Merged PVR draft and Appendix A. | NorDig Rules of Operation\_ver\_3.1.1\_Teletext\_Subt\_PVR\_draft002. | Peter | 13.11.19 | Peter |
| 2.1 | General | Update of DVB(P)SI Tables | NorDig RoO ver\_3.1.1\_Audio draft004 | Stephan | 07.01.20 | Peter |
| 2.4 | PMT | Update of audio descriptors | NorDig RoO ver\_3.1.1\_Audio draft004 | Stephan | 07.01.20 | Peter |
| 11 | References | Added references list from IRD spec. | NorDig Unified Requirements ver. 3.1.1 | Peter | 07.01.20 | Peter |
| 1.3 | Abbreviations | List updated | NorDig RoO ver\_3.1.1\_Audio draft004 | Stephan | 07.01.20 | Peter |
| 7 | Teletext and Subtitling | Merged Teletext and Subtitling draft003 | NorDig RoO – DVB, TTML and Teletext Subtitling, draft003 | Kjell | 02.03.20 | Peter |
| 5 | Audio Transmission | Merged | NorDig RoO ver\_3.1.1\_Audio draft010 | Stephan | 02.03.20 | Peter |
| 7 | Teletext and Subtitling | Changes of sub chapters numbers | Changes of sub chapters numbers to be in with IRD spec. | Per | 02.04.20 | Peter |
| 7 | Teletext and Subtitling | Merge Teletext and Subtitling draft004 | NorDig Rules of Operation\_ver\_3.1.1\_Teletext and Subtitling draft004 | Per | 04.05.20 | Peter |
| All | Chapter order and  numbers | Reassign and numbering all chapters to be in line with NorDig IRD | Reassigned and numbering the complete documents to be in line with NorDig IRD specification (as much as possible) | Peter | 04.05.20 | Peter |

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# ~~General~~ Introduction

## Scope

The NorDig Rules of Operation contain a set of minimum transmission regulations, which are deemed necessary along with other applicable standards in order to support the basic functionality of the NorDig compliant receiver operating in primary and secondary network environment. In general, it is assumed that transmissions targeted for the NorDig digital receiver are fully compliant with the NorDig Unified specifications.

These Rules of Operation therefore only contain specifications regarding the configuration of transmission parameters and the interpretation of broadcast signalling in the NorDig receiver. The Rules of Operation may also act as a guideline document for digital receiver manufacturers as to how the IRD is to interpret NorDig compliant transmissions.

Editor note: have to be updated with NorDig IRD capabilities

## Document History

Overview:

TBD

|  |  |  |
| --- | --- | --- |
| **Version** | **Date** | **Comments** |
| 0.9 | 2002-05-30 | This is the first approved version pf the NorDig Rules of Operation for NorDig I and II Receiver Networks |
| 1.0 | 2004-10-28 | Updated to reference to NorDig Unified v 1.0.2 |
| 2.5 | 2016-07-21 | Rewritten and updated to reference to NorDig Unified v. 2.5.1 |
| 3.1.1 | 2020-xx-xx | Updated to refence to NorDig Unified v. 3.1.1. This update is a complete update of the RoO specification. The RoO specification is also redesigned corresponding with the IRD Unified specification design layout. |

## Terminology

TBD

## Definitions

TBD

## References

|  |  |
| --- | --- |
| 1. Bluetooth 2.0 | Specification of the Bluetooth System, 4 November 2004, Bluetooth SIG. |
| 1. CEA-770.3 | Consumer Electronics Association (CEA): Standard Definition TV Analogue Component Video Interface, CEA -770.2C, November 2001. [www.ce.org/Standards](http://www.ce.org/Standards). |
| 1. DVB A 011 | Common Scrambling Algorithm. DVB Blue Book A011. |
| 1. EN 50049-1 | Domestic and similar electronic equipment interconnection requirements: Peritelevision Connector |
| 1. EN 60728 and 50083-9 | Cenelec EN 60728-1, Cable networks for television signals, sound signals and interactive services - Part 1: System performance of forward paths.  Cenelec 50083-9, Cabled distribution systems for television, sound and interactive multimedia signals – Part 9: Interfaces for CATV/SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams. |
| 1. EN 50157-2-1 | Domestic and similar equipment interconnection requirements: AVlink-Part 2-1: Signal quality matching and automatic selection of source devices. |
| 1. EN 50221 | Common Interface for Conditional Access and other Digital Video Broadcasting Decoder Applications. |
| 1. EN 50494 | Satellite signal distribution over a single coaxial cable in single dwelling installations |
| 1. EN 55013 | Limits and methods of measurements of radio disturbance characteristics of broadcast receive equipment and associated equipment |
| 1. EN 61319-1 | Interconnections of satellite receiving equipment – Part 1: Europe. |
| 1. ETSI EN 300 421 v1.1.2 | Digital Video Broadcasting (DVB): Digital broadcasting systems for television, sound and data services: Framing structure, channel coding and modulation for 11/12 GHz Satellite services. (DVB-S) |
| 1. ETSI EN 300 429 v1.2.1 | Digital Video Broadcasting (DVB): Digital Broadcasting Systems for Television, Sound and Data Services; Framing Structure, Channel Coding and Modulation for Cable Systems (DVB-C). |
| 1. ETSI EN 300 468 v1.16.1 | Digital Video Broadcasting (DVB): Specification for Service Information (SI) in (DVB) systems. (At time of publication (October 2017) the DVB SI specification v1.16.1 is a still only DVB Blue Book A038 available at DVB’s website, but is planned to become an ETSI standard in the near future). |
| 1. ETSI EN 300 472 v1.3.1 | Digital Video Broadcasting (DVB): Digital Broadcasting Systems for Television, Sound and Data Services; Specification for Conveying ITU-R System B Teletext in Digital Video Broadcasting (DVB) Bitstreams. |
| 1. ETSI EN 300 473 v1.1.2 | Digital Satellite Master Antenna Television Distribution System (SMATV). |
| 1. ETSI EN 300 706 V1.2.1 | Digital Video Broadcasting (DVB): Enhanced Teletext specification |
| 1. ETSI EN 300 743 v1.3.1 | Digital Video Broadcasting (DVB): DVB Subtitling Systems. |
| 1. ETSI EN 300 744 v1.6.1 | Digital Video Broadcasting (DVB); DVB Framing structure, channel coding and modulation for digital terrestrial television (DVB-T). |
| 1. ETSI EN 302 755 v1.2.1 | Frame structure channel coding and modulation for a second-generation digital terrestrial television broadcasting system (DVB-T2). |
| 1. ETSI EN 302 307 v1.2.1 | Digital Video Broadcasting (DVB): Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (2009-08). (DVB-S2) |
| 1. ETSI ETR 162 | Digital Video Broadcasting (DVB); Allocation of Service Information (SI) codes for DVB systems |
| 1. ETSI ETR 289 | Digital Video Broadcasting (DVB); Support for use of scrambling and Conditional Access within digital broadcasting systems. |
| 1. HbbTV Test Suite | HbbTV Test Suite (see details of version in NorDig Test Plan related to HbbTV) |
| 1. ETSI TR 101 202 V1.2.1 | Digital Video Broadcasting (DVB); Implementation guidelines for Data Broadcasting |
| 1. ETSI TS 101 211 V1.12.1 | Digital Video Broadcasting (DVB); Guidelines on the Implementation and Usage of DVB Service Information (SI). |
| 1. ETSI TS 101 154 V2.4.1 | Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream 2018-02. |
| 1. ETSI ES 102 796 V1.5.1 | Hybrid Broadcast Broadband TV (HbbTV), (referring to HbbTV version 2.0.2 functionality) |
| 1. ETSI TS 102 006 V1.4.1 | Digital Video Broadcasting (DVB); Specification for System Software Update (SSU) in DVB Systems |
| 1. ETSI TS 102 034 V1.4.1 | Digital Video Broadcasting (DVB); Transport of MPEG-2 Based DVB Services over IP based Networks |
| 1. ETSI TS 102 114 V1.2.1 | ETSI Technical Specification (TS): DTS coherent acoustics; Core and extensions; 2002-12 |
| 1. ETSI TS 102 201 V1.2.1 | Digital Video Broadcasting (DVB); Interfaces for DVB Integrated Receiver Decoder (DVB-IRD) |
| 1. ETSI TS 102 323 V1.4.1 | Digital Video Broadcasting (DVB); Carriage and signalling of TV-Anytime information in DVB transport streams, 2010-01 |
| 1. ETSI TS 102 366 V.1. 4.1 | ETSI Technical Specification (TS): Digital Audio Compression (AC-3, Enhanced AC-3) September 2018 |
| 1. ETSI TS 102 822-4 V1.5.1 | Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems (“TV-anytime”); Part4: Phase 1 – Content referencing |
| 1. HDCP rev1.4 | Digital Content Protection LLC, “High-bandwidth Digital Content Protection System”, rev. 1.4, July 8, 2009 |
| 1. HDMI rev. 1.4b | HDMI Licensing, LLC: HDMI, “High- Definition Multimedia Interface”, rev. 1.4b, October 11th, 2011 |
| 1. IEC 61169-2 | Radio-frequency connectors – Part 2: Sectional specification – Radio frequency coaxial connectors of type 9,52. |
| 1. ISO/IEC 61169-24 (ISO 169-24) | Radio-frequency connectors – Part 24: [Radio-frequency coaxial connectors with screw coupling, typically for use in 75 Ω cable distribution systems (Type F).](http://webstore.iec.ch/webstore/webstore.nsf/artnum/001029) |
| 1. IEC 60603-14 | Connectors for frequencies below 3 MHz for use with printed boards – Part 14: Detail specification for circular connectors for low-frequency audio and video applications such as audio, video and audio-visual equipment. |
| 1. IEC 60958 | Digital audio interface – Part 3: Consumer applications. |
| 1. IEC 61937 | Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958. |
| 1. IEEE 802.11 | The Working Group for Wireless Local Area Networks (WLANs). |
| 1. IEEE 802.3 | IEEE Standard for Information Technology-Telecommunications and information exchange between systems-Local and metropolitan area networks–Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications |
| 1. IETF RFC 2131 | Dynamic Host Configuration Protocol, March 1997 |
| 1. IETF RFC 2132 | DHCP Options and BOOTP Vendor Extensions, March 1997 |
| 1. IETF RFC 3203 | DHCP reconfigure extension, December 2001 |
| 1. ISO 3166 – Part 1-3 | Codes for the representation of names of countries and their subdivisions:  Part 1: Country codes, 1997  Part 2: Country subdivision code, 1998  Part 3: Code for formerly used names of countries, 1999 |
| 1. ISO 8859-1 | Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1, 1998 |
| 1. ISO/IEC 11172-3 | ISO/IEC: Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 3: Audio |
| 1. ISO/IEC 13818 – 1 | Information Technology – Generic Coding of Moving Pictures and Associated Audio Information. Part 1: Systems. ISO/IEC International Standard IS 13818. |
| 1. ISO/IEC 13818-2 | Information technology – Generic coding of moving pictures and associated audio information: Video, ISO/IEC International Standard IS 13818 |
| 1. ISO/IEC 13818 – 3 | Information Technology – Generic Coding of Moving Pictures and Associated Audio Information. Part 3: Audio. ISO/IEC International Standard IS 13818. |
| 1. ISO/IEC 14496-3 | ISO/IEC: Information technology – Coding of audio-visual objects – Part 3: Audio, 2005 |
| 1. ISO/IEC 14496-10 | ISO/IEC: Information technology — Coding of audio visual objects — Part 10: Advanced Video Coding (MPEG-4 AAD and MPEG-4 HE-AAC), December 15, 2005 |
| 1. ISO/IEC 60958-3 Ed.3.0 | ISO/IEC: Digital audio interface – Part 3: Consumer applications, May 25, 2006 |
| 1. ISO/IEC 7816, 1-3 | Identification cards – Integrated circuit cards with contacts, Parts 1-3. ISO/IEC International Standard IS 7816. |
| 1. ITU-J.122 | (EuroDocsis 2.0): Second-generation Transmission Systems for Interactive Cable Television Services – IP Cable Modems. |
| 1. ITU-J.222.1 | (EuroDocsis 3.0): Third-generation Transmission Systems for Interactive Cable Television Services – IP Cable Modems: Physical Layer Specifications (Annex B) |
| 1. ITU/R Report 624-4 | ITU-R Report 624-4:1990, Characteristics of Television Systems. |
| 1. ITU-R BT.653-3 | ITU-R Recommendation BT653-2:1993, Teletext systems. |
| 1. NorDig RoO | a) NorDig Rules of Operation, ver 1.0, November, 2004 b) NorDig Rules of Operation, ver 2.5. October, 2016 |
| 1. NorDig Test | a) Unified NorDig Test Specification, ver. 2.0. July 2008. b) Unified NorDig Test Specification, ver. 2.2, (Not yet  available) |
| 1. Universal Serial Bus | Universal Serial Bus (USB) Specification, Revision 2.0, April 27, 2000. |
| 1. CI Plus Specification | CI Plus Specification. Content Security Extensions to the Common Interface. Version 1.3.1 (2011-09), from, CI Plus LLP |
| 1. UK DTG D-Book | Digital Terrestrial Television (DTG), Requirements for interoperability, The D-Book 7 Part A, Version 1, March 2011 |
| 1. ETSI TS 102 831 v1.1.1 | Implementation guidelines for a second-generation digital terrestrial television broadcasting system (DVB-T2) |
| 1. ETSI TS 102 822-3-1 v1.6.1 | Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 3: Metadata; Sub-part 1: Phase 1 - Metadata schemas. Version 1.6.1 (2010-07) |
| 1. ISO 639-2 | Codes for the Representation of Names of Languages Part 2: Alpha-3 Code |
| 1. ETSI TS 102 822-3-2 v1.6.1 | Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 3: Metadata; Sub-part 2: System aspects in a uni-directional environment. Version 1.6.1 (2010-07) |
| 1. ETSI TS 102 851 v1.2.1 | Digital Video Broadcasting (DVB); Uniform Resource Identifiers (URI) for DVB Systems. Draft version 1.2.1 until it becomes official release. |
| 1. EBU, R095 | EBU R 095, Recommendation for Safe areas for 16:9 television production July 2016 (or later). |
| 1. EBU R128 | EBU Recommendation R 128, Loudness normalisation and permitted maximum level of audio signals, August 2011. |
| 1. EBU TECH 3344 | EBU – TECH 3344, Practical guidelines for distribution systems in accordance with EBU R 128, (Supplementary information for EBU R 128), version 1.1, October 2011. |
| 1. EBU R68 | EBU Technical Recommendation R68-2000, Alignment level in digital audio production equipment and in digital audio recorders, revised year 2000. |
| 1. EBU TECH 3341 | EBU – TECH 3341, Loudness Metering: ‘EBU Mode’ metering to supplement loudness normalisation in accordance with EBU R 128, (Supplementary information for R 128) , August 2011. |
| 1. ITU-R BS.1770-2 | ITU Recommendation ITU-R BS.1770-2 (march 2011), Algorithms to measure audio programme loudness and true-peak audio level |
| 1. ITU-R BS.1771 | ITU Recommendation ITU-R BS.1771, Requirements for loudness and true-peak indicating meters |
| 1. IEC 62731 | IEC 6273, edition 1.0 (2013-01-29), Text-to-speech for television - General requirements. |
| 1. HbbTV test specification | Test Specification for HbbTV (latest version), Note: Available at <http://www.hbbtv.org/resource-library/#testing-information-and-support> |
| 1. ETSI ES 102 796 V1.4.1 | Hybrid Broadcast Broadband TV (HbbTV) v2.0.1 (allowed option for NorDig HbbTV IRD instead of v2.0.2 [29] until 1 July 2020) |
| 1. ETSI EN 302 307-2 V1.1.1 | Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 2: DVB-S2 Extensions (DVB-S2X), 2015-02 |
| 1. ISO/IEC 23008-2 | Information technology — High efficiency coding and media delivery in heterogeneous environments  Part 2: High efficiency video coding |
| 1. ITU-R BT.601 | Studio encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios |
| 1. ITU-R BT.709 | Parameter values for the HDTV standards for production and international programme exchange |
| 1. ITU-R BT.1700 | Characteristics of composite video signals for conventional analogue television systems |
| 1. ITU-R BT.1847 | 1 280 × 720, 16:9 progressively-captured image format for production and international programme exchange in the 50 Hz environment |
| 1. ITU-R BT.1886 | Reference electro-optical transfer function for flat panel displays used in HDTV studio production |
| 1. ITU-R BT.2020 | Parameter values for ultra-high definition television systems for production and international programme exchange |
| 1. ITU-R BT.2100 | Image parameter values for high dynamic range television for use in production and international programme exchange |
| 1. ITU-R BT.2390 | High dynamic range television for production and international programme exchange |
| 1. HDCP rev2.2 | Digital Content Protection LLC, “High-bandwidth Digital Content Protection System - Mapping HDCP to HDMI”, rev. 2.2, February 13, 2013 and “Errata to HDCP 2.2 on HDMI Specification”, version 2, February 9, 2015 |
| 1. ANSI/CTA-861-G | A DTV Profile for Uncompressed High Speed Digital Interfaces |
| 1. HDMI rev. 2.0b | HDMI Licensing, LLC: HDMI, “High- Definition Multimedia Interface”, rev. 2.0b, March, 2016 |
| 1. ETSI EN 303 560 | Digital Video Broadcasting (DVB); TTML Subtitling Systems Version 1.1.1 (2018-05). |
| 1. ITU-R BT.2408 2. CI Plus ECP specification v1.1 3. ETSI TS 103 190-1 V1.3.1 4. ETSI TS 103 190-2 V1.2.1 5. IEC 61937 - 9:2017 6. ETSI TS 103 420 v1.1.1 7. IETF BCP 47 | ITU-R, Report; Operational practises in HDR television production  CI Plus Specification. Extensions for Enhanced Content Protection  Digital Audio Compression (AC-4) Standard; Part 1: Channel based coding  Digital Audio Compression (AC-4) Standard, Part 2: Immersive and personalized audio  Digital audio - Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 - Part 9: Non-linear PCM bitstreams according to the MAT format.  Backwards-compatible object audio carriage using Enhanced AC-3  Tags for Identifying Languages (https://tools.ietf.org/html/bcp47) |
| 1. HDMI rev. 2.1 | HDMI Licensing, LLC: HDMI, "High- Definition Multimedia Interface", rev. 2.1, November, 2017 |
| 1. ITU-R BS.2051-2 | Advanced sound system for program production July, 2018 |

## List of Abbreviations

Editor note: List have to be updated to be in line with IRD spec.

AAC Advanced Audio Coding, according to ISO/IEC 14496-3 [53 ]

AC-3 Dolby AC-3 audio coding system, according to ETSI TS 102 366 [33]

AC-4 Dolby AC-4 audio coding system, according to ETSI TS 103 190-2 [98]

AFD Active Format Descriptor

API Application Programming Interface

BAT Bouquet Association Table

BCD Binary Coded Decimal

BER Bit Error Ratio

bslbf bit string, left bit first

C/N Carrier to Noise ratio

CA Conditional Access

CAT Conditional Access Table

CENELEC Comité Européen de Normalisation Électrotechnique

CI Common Interface

CID Content Identifier Descriptor

CRC Cyclic Redundancy Check

CRID Content Reference Identifier

CVBS Composite Video Baseband Signal

DAD Default Authority Descriptor

dBFS dB Full Scale

DSM-CC Digital Storage Media Command and Control

DVB Digital Video Broadcasting

DVB-C Digital Video Broadcasting - Cable

DVB-data Digital Video Broadcasting - Data Broadcasting

DVB-MHP Digital Video Broadcasting - Multimedia Home Platform

DVB-S Digital Video Broadcasting - Satellite

DVB-T/T2 DVB-Terrestrial

EBU European Broadcasting Union

ECCA European Cable Communications Association

EICTA European Information & Communications Technology Industry Association

EIT Event Information Table

EITp/f Event Information Table, present/following tables

EITsch Event Information Table, schedule tables

EITp Event Information Table, present table/section of EITp/f

EITf Event Information Table, following table/section of EITp/f

EPG Electronic Program Guide (based on API)

ESG Event Schedule Guide (without any API)

GOP Group of Pictures

HDCP High-bandwidth Digital Content Protection

HDMI High-Definition Multimedia Interface

HDTV High Definition Television

HTTP Hyper Text Transfer Protocol

IDTV integrated Digital TV

IEC International Electrotechnical Commission

IEEE Institute for Electrical and Electronic Engineers

IRD Integrated Receiver Decoder

ISO International Organisation for Standardisation

JOC Joint Object Coding (extension for E-AC-3)

LCD Logical Channel Descriptor

LCN Logical Channel Number

MFN Multiple Frequency Network

MHP Multi Media Home Platform

MPEG Moving Pictures Expert Group

NIT Network Information Table

NVOD Near Video On Demand

OSD On Screen Display

PAL Phase Alternating Line

PAT Program Association Table

PID Packet Identifier

PMT Program Map Table

PSI Program Specific Information

PCR Programme Clock Reference

PVR Personal Video Recorder, (same as PDR, Personal Digital Recorder, or DVR)

QAM Quadrature Amplitude Modulation

QoS Quality of Service

QPSK Quaternary Phase Shift Keying

RF Radio Frequency

RoO Rules of Operation

RS Reed-Solomon

RST Running Status Table

SDT Service Description Table

SDTV Standard Definition Television

SFN Single Frequency Network

SI Service Information

SIT Selection Information Table

ST Stuffing Table

STB Set-top box

TDT Time and Date Table

TOT Time Offset Table

TS Transport Stream

TV Television

UHF Ultra-High Frequency

uimsbf unsigned integer most significant bit first

UTC Universal Time, Co-ordinated

VHF Very-High Frequency

VHS Video Home System

VSB Vestigial Side Band

XML Extensible Mark-up Language

# General Features of the IRD

No RoO specific

# The Frontend of the NorDig IRD

No RoO specification

## Tuning and Navigation

***Requirement from IRD specifications v.3.1.1:***

*Here must be inserted text from IRD spec. v.3.1.1 including chapter references*

The tuning of the NorDig set-top box can either be based on Network Information Table (NIT) signalling within SI or on scanning. The receiver shall identify a service uniquely through a combination of original\_network\_id (ONID) and service\_id (SID). Tuning based on NIT information is detailed below.

## DVB specific identifiers

Each service shall be uniquely identified through the combination *original\_network\_id (ONID) transport\_stream\_id (TSID) service\_id( SID) also* known as the DVB triplet. These, and some other mandatory parameters, are described in the following sections.

### Original\_network\_id

Each network operator originating broadcasting signals shall apply for a 2-byte *original\_network\_id* according to ETSI TR 101 162.

|  |  |  |
| --- | --- | --- |
| **Country** | **ONID** | **Network ID** |
| Denmark | 0x20D0 | Colour plan C (0x3201 ~ 0x3300) |
| Finland | 0x20F6 | Colour plan D (0x3301 ~ 0x3400) |
| Iceland | 0x2160 | Colour plan D (0x3301 ~ 0x3400) |
| Ireland | 0x2174 | Colour plan C (0x3201 ~ 0x3300) |
| Norway | 0x2242 | Colour plan E (0x3401 ~ 0x3500) |
| Sweden | 0x22F1 | Colour plan B (0x3101 ~ 0x3200) |
|  |  |  |

*Table 8: DVB identifiers*

### Network\_id

Each NorDig network operator broadcasts a number of transport streams, each stream is considered as part of that specific network and shall identify uniquely its self by *network\_id*. The allocation of *network\_id* is carried out by ETSI, and allocated values are available in the ETSI document TR 101 162 and as detailed in Table 8.

For terrestrial networks a unique *network\_id* shall be allocated to each Local Service Network (LSN) in the national network. The allocation shall comply to the ETSI TR 101 162 4-colour-map approach, this gives the possibility to allocate up to 256 *network\_ids* within the network.

### Transport\_stream\_id

The *transport\_stream\_id* shall uniquely define a transport stream within the network comprising of a specific combination of services and components. Each multiplex operator shall allocate a *transport\_stream\_id* on a individual basis however all transport streams within a network should carry a unique identifier.

### Service\_id

The *service\_id* shallidentify all unique servicescarried by the multiplex operator on the network.

A service is considered unique if its service name, scheduled events and service components are different to any other service components on the network.

The *service\_id* is equivalent to the program\_number used in PAT and PMT.

### Private\_data\_specifier

A NorDig allocated *private\_data\_specifier* 0x00000029 shall be inserted within the *private\_data\_descriptor* prior to all NorDig Specific signalling e.g. LCN v1 or v1

|  |  |
| --- | --- |
| **Country** | **private\_ data \_specifier** |
| Denmark | 0x00000031 |
| Finland | - |
| Iceland | 0x00002160 |
| Ireland | 0x000022CE |
| Norway | 0x00000030 |
| Sweden | 0x000022F1 |

*Table 9:* Country specific specifier values

A country specific *private\_data\_specifier* shall be inserted within the *private\_data\_descriptor* prior to all country specific signalling.

### Bouquet\_id

One or several *bouquet\_ids* shall be allocated to each service provider. The following general rules are applicable:

1. A service provider shall not allocate more *bouquet\_ids* than it has services to offer.
2. Each service should be presented in one and only one bouquet.
3. A service provider can group several services into one bouquet.
4. A bouquet (with an associated *bouquet\_id*) may contain services from different service providers.
5. The *bouquet\_id* is static and cannot change in time.

*bouquet\_id* registration is the responsibility of the service provider.

### Event\_id

The *event\_id* is a 16-bit field which contains the identification number of the described event. Each service provider is free to allocate *event\_ids* within their service\_id domain, with the restriction that an *event\_id* shall be unique within the transmitted schedule. An *event\_id* shall be associated with a single event within the schedule, i.e. if an event is rescheduled within the currently transmitted schedule, it shall not change its *event\_id*. If the event is removed from the schedule (or rescheduled to outside the transmitted schedule) then its *event\_id* shall be removed from the schedule. Any replacement event shall be allocated a new *event\_id* unique within the transmitted schedule.

A recommended allocation method for new *event\_id* in terrestrial networks is to use odd values for national events and even values for regional events, this to avoid that events that are inserted at different locations will be allocated the same *event\_id*.

The *event\_id* shall be included in the following EIT tables;

EIT\_actual\_p/f

EIT\_other \_p/f

EIT\_actual\_schedule

EIT\_other\_schedule

### Link to EIT schedule

Generally, the linkage to the EIT schedule is implemented by inserting a *linkage\_descriptor* in the first descriptor loop in the NIT. Linkage\_type 0x04 is used for this purpose.

A problem can occur whenever multiple operators offer services from the same satellite transponder. This is best illustrated by the following example:

One satellite network which we will call *X-sat* consists of 4 transport streams, there are two independent operators managing transport streams on this satellite according to the following rule:

* TS1 - transport\_stream\_id 0x0001: operated by "Operator A"
* TS2 - transport\_stream\_id 0x0002: operated by "Operator A"
* TS3 - transport\_stream\_id 0x0003: operated by "Operator B"
* TS4 - transport\_stream\_id 0x0004: operated by "Operator B"

The *network\_id* of *X-sat* is 0x0040, while the original\_network\_id of Operator A and Operator B is 0x0041 and 0x0051 respectively. Operator A transmit their EIT schedule information in TS 1, while Operator B transmit their EIT schedule information in TS 3.

**TS 5 contains 5 services split between "Operator A" and "Operator B" as indicated in Table 10:**

|  |  |  |
| --- | --- | --- |
| **Service** | **Service\_id** | **Commercial operator** |
| Service 1 | 0x0101 | "Operator A" |
| Service 2 | 0x0102 | "Operator A" |
| Service 3 | 0x0103 | "Operator A" |
| Service 4 | 0x0104 | "Operator B" |
| Service 5 | 0x0105 | "Operator B" |

*Table 10: Services in TS 5*

Subscriber A has subscribed for the services from Operator A; they access Service 1 and select the Guide button, with this action subscriber A expects to access the EIT schedule provided by Operator A and transmitted in TS 2.

Subscriber B has subscribed to the services from Operator B; they access Service 4 and select the Guide button, subscriber B expects to access the EIT schedule for Operator B transmitted in TS 3.

Accessing different EIT schedule services on the same transponder cannot be achieved by inserting *linkage\_descriptors* within the NIT, this is resolved by employing the *bouquet\_ association\_ table*. The BAT shall contain bouquet associations for both for Operator A and for Operator B as indicated in Figure 5

Note: each operator has to apply for a unique bouquet\_id from ETSI. The document TR 101 162-ETSI indicates available values for the bouquet\_id. In this example we have for illustrative purposes assumed that the bouquet\_id for Operator A and Operator B is 0x0001 and 0x0002, respectively.

bouquet\_association\_section(){ table\_id 0x4A bouquet\_id 0x0001 ("Operator A") #bouquet descriptors{ bouquet\_name\_descriptor(){ bouquet\_name "Operator A"

}

linkage\_descriptor(){

transport\_stream\_id 0x0002

original\_network\_id 0x0041

service\_id

linkage\_type 0x04

}

}

# transport stream loop{

transport\_stream\_id 0x0001

original\_network\_id 0x0041

#transport stream descriptors{

service\_list\_descriptor(){

<all services in TS1>

}

transport\_stream\_id 0x0002

original\_network\_id 0x0041

#transport stream descriptors{

service\_list\_descriptor(){

<all services in TS2>

}

transport\_stream\_id 0x0005

original\_network\_id 0x0041

#transport stream descriptors{

service\_list\_descriptor(){

service\_id 0x0101

service\_type digital television

service\_id 0x0102

service\_type digital television

service\_id 0x0103

service\_type digital television

}

}

}

}

bouquet\_association\_section(){

table\_id 0x4A

bouquet\_id 0x0002 ("Operator B")

#bouquet descriptors{

bouquet\_name\_descriptor(){

bouquet\_name "Operator B"

}

linkage\_descriptor(){

transport\_stream\_id 0x0003

original\_network\_id 0x0051

service\_id

linkage\_type 0x04

}

}

# transport stream loop{

transport\_stream\_id 0x0003

original\_network\_id 0x0051

#transport stream descriptors{

service\_list\_descriptor(){

<all services in TS3>

}

transport\_stream\_id 0x0004

original\_network\_id 0x0051

#transport stream descriptors{

service\_list\_descriptor(){

<all services in TS4>

}

transport\_stream\_id 0x0005

original\_network\_id 0x0041

#transport stream descriptors{

service\_list\_descriptor(){

service\_id 0x0104

service\_type digital television

service\_id 0x0105

service\_type digital television

}

}

}

}

*Figure 8: BAT containing bouquets for both operators*

Note: that in each bouquet, the *service\_list\_descriptor* for TS 5 contains only the services from the corresponding commercial operator.

**The set-top box is advised to access EIT schedule according to the following algorithm:**

If linkage\_descriptor in first descriptor loop in NIT

{

If linkage\_type = 0x04

{

Tune to Barker Channel;

Read EIT

}

}

Else

{

Find the BAT subtable containing the last accessed service;

Read linkage\_descriptor;

If linkage\_type = 0x04

{

Tune to Barker Channel;

Read EIT

}

}

*Figure 9: EIT schedule algorithm*

It might be the case in secondary distribution networks that only a subset of the services from the primary distribution network will be available. Both PAT and SDT in the secondary distribution network may signal more services than are actually available. The native service navigator, i.e. ESG, shall not display any service that the receiver cannot receive, due to the fact that it is not retransmitted from primary distribution network. A service is available whenever it is included in the *service\_list\_descriptor* in the NIT for the appropriate network.

**The receiver shall decide whether a service shall be presented in the native service navigator by the following algorithm:**

If service\_id is available in any *service\_list\_descriptor* in the appropriate NIT

{

display the service in the (ESG/EPG )

else

do not display the service

}

*Figure 10: Native service navigator algorithm*

The same algorithm shall be used in terrestrial receivers to “hide” services not accessible due to low RF level.

## Specific tuning for Satellite Networks

***Requirement from IRD specifications v.3.1.1:***

*Here must be inserted text from IRD spec. v.3.1.1 including chapter references*

### Multiple operators in the same physical network

One physical network (orbital satellite position) may be shared between multiple operators, e.g. each operator manages different transponders in the same physical network.

On satellite networks, NIT\_actual on each transponder shall describe all transport streams operated by the operator of the actual transport stream as well as all transport streams operated by other operators in the same satellite network. NIT\_other may describe transport streams operated by any other operator in another network (i.e. retransmission into secondary networks).

The principle of multiple operators in the same satellite network is best illustrated by an example.

One satellite network *X-sat* consists of 4 transport streams. There are two independent operators managing these transport streams according to the following rule:

* TS1 - transport\_stream\_id 0x0001: operated by "Operator A"
* TS2 - transport\_stream\_id 0x0002: operated by "Operator A"
* TS3 - transport\_stream\_id 0x0003: operated by "Operator B"
* TS4 - transport\_stream\_id 0x0004: operated by "Operator B"

The *network\_id* of *X-sat* is 0x0040, the *original\_network\_id* of Operator A and Operator B is 0x0041 and 0x0051 respectively. Operator A transmit their EIT schedule information in TS 1, whilst Operator B transmit their EIT schedule information in TS 3.

The network operator ("X-sat") is responsible for NIT generation and all transport streams are signalled in *NIT\_actual,* both from Operator A and Operator B.

**An example of the NIT transmitted in all transport streams is shown in Figure 11:**

**

*Figure 11: NIT transmission with multiple operators*

network\_information\_section(){ table\_id 0x40 (NIT\_actual) network\_id 0x0040 (*X-sat*) #first loop descriptors{

network\_name\_descriptor(){

network\_name "*X-sat*"

}

linkage\_descriptor(){ # link to NorDig software download

transport\_stream\_id 0x0001

original\_network\_id 0x0041

service\_id 0x000A

linkage\_type 0x81

private\_data <according to NorDig specification>

}

}

#transport stream definitions{

transport\_stream\_id 0x0001

original\_network\_id 0x0041 (Operator A)

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

}

transport\_stream\_id 0x0002

original\_network\_id 0x0041 (Operator A)

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

}

transport\_stream\_id 0x0003

original\_network\_id 0x0051 (Operator B)

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

}

transport\_stream\_id 0x0004

original\_network\_id 0x0051 (Operator B)

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

}

}

}

*Figure 12: Example of NIT from "X-sat"*

|  |  |
| --- | --- |
|  |  |

### Set-top box interpretation

For satellite transmission a valid *NIT\_actual* should always be transmitted. Satellite front end software may ignore *NIT\_other* and focus on *NIT\_actual*. Parameters of a default transponder have to be entered manually by the subscribers or may be pre-programmed from the set-top box manufacturer.

## Specific tuning for cable networks

***Requirement from IRD specifications v.3.1.1:***

*Here must be inserted text from IRD spec. v.3.1.1 including chapter references*

Cable operators may use both *NIT\_actual* and *NIT\_other* for two specific reasons:

1. Cable operators often distribute signals to several subnets located in different geographical areas. The *network\_id* is used to distinguish between these subnets.
2. Cable operators retransmitting signals received from satellite may insert the receive network information as *NIT\_other*.

### Transmission of multiple NIT\_other tables

Cable operators must be able to provide multiple NIT tables for different networks. The NorDig receiver should provide a menu for the user to enter the network number of the physical network it is connected to.

The following example has been chosen to illustrate this:

The satellite network *X-sat* transmits *NIT\_actual* containing network information for the satellite network. In addition, NIT\_other from *X-sat* contains network information for the following SMATV operators:

* SMATV A: network\_id = 0x0090
* SMATV B: network\_id = 0x0091

The following transport streams are transmitted in SMATV A:

* TS1 – transport\_stream\_id = 0x0001
* TS2 – transport\_stream\_id = 0x0002

The following transport streams are transmitted in SMATV B:

* TS3 – transport\_stream\_id = 0x0001
* TS4 – transport\_stream\_id = 0x0002

**The NIT transmitted via satellite is indicated in Figure 8**

network\_information\_section(){ table\_id 0x40 (NIT\_actual) network\_id 0x0040 (*X-sat*) #first loop descriptors{

network\_name\_descriptor(){

network\_name "*X-sat*"

}

linkage\_descriptor(){ # link to NorDig software download

transport\_stream\_id 0x0001

original\_network\_id 0x0041

service\_id 0x000A

linkage\_type 0x81

private\_data <according to NorDig specification>

}

}

#transport stream definitions{

<Definition of transport streams in satellite network>

}

}

network\_information\_section(){

table\_id 0x41 (NIT\_other)

network\_id 0x0090 (SMATV A)

#first loop descriptors{

network\_name\_descriptor(){

network\_name "*SMATV A*"

}

linkage\_descriptor(){ # link to NorDig software download

transport\_stream\_id 0x0001

original\_network\_id 0x0040

service\_id 0x000A

linkage\_type 0x81

private\_data <according to NorDig specification>

}

}

#transport stream definitions{

transport\_stream\_id 0x0001

original\_network\_id 0x0040

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

}

transport\_stream\_id 0x0002

original\_network\_id 0x0040

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

}

}

}

network\_information\_section(){

table\_id 0x41 (NIT\_other)

network\_id 0x0091 (SMATV B)

#first loop descriptors{

network\_name\_descriptor(){

network\_name "*SMATV B*"

}

linkage\_descriptor(){ # link to NorDig software download

transport\_stream\_id 0x0001

original\_network\_id 0x0040

service\_id 0x000A

linkage\_type 0x81

private\_data <according to NorDig specification>

}

}

#transport stream definitions{

transport\_stream\_id 0x0001

original\_network\_id 0x0040

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

}

transport\_stream\_id 0x0002

original\_network\_id 0x0040

#second loop descriptors{

satellite\_delivery\_system\_descriptor()

service\_list\_descriptor()

*Figure 13: Satellite NIT transmission including NIT other*

### Set-top box interpretation

For cable set-top boxes the parameters of the “barker channel” shall either be entered manually from the subscriber or pre-programmed by the set-top box manufacturer. Along with the “barker channel” parameters, the set-top box shall ask the subscriber to enter the appropriate network number.

**When the subscriber initiates channel search, the set-top box may perform a search according to the following algorithm:**

Access the “barker channel” NIT;

For all network\_ids in NIT\_actual and NIT\_other{

If network\_id = network number{

# Correct NIT section detected

For all transport streams defined in NIT section{

Read *cable\_delivery\_system\_descriptor*;

Read *service\_list\_descriptor*,

Tune to the transport stream;

Read SDT;

Present all service names for which service\_id is included in *service\_list\_descriptor*;

}

}

}

*Figure 14: Barker channel algorithm*

## Specific tuning for Terrestrial Networks

***Requirement from IRD specifications v.3.1.1:***

*Here must be inserted text from IRD spec. v.3.1.1 including chapter references*

Terrestrial transmission is somewhat different from both satellite and cable transmission due to several reasons, particularly the following two:

* One network operator may cover the same geographical area from several transmitters, i.e. the same services may be received from different transmitters.
* The network may offer regional signals, i.e. signals receivable only in a part of the total network.

Due to these reasons, some special precautions have to be taken for terrestrial transmission. The following sections identify these precautions.

### Definition of terrestrial network concepts

|  |  |
| --- | --- |
| **MFN:** | Multiple Frequency Network is a network that over a specified area transmits with several different frequencies and thereby has the possibility to transmit different transport streams over that area. This property is what we in this document call a **Scalable Network (SN)**. |
| **Preference Network:** | Can be seen as the main network of a viewer in an intersection area of several networks, this network is usually chosen by the user during installation of the STB. |
| **SFN:** | Single Frequency Network is a network where one transport stream is feeding several main-transmitters all transmitting on the same frequency. The transport stream has to be identical in all main-transmitters. This property, that the transport stream is identical over a bigger region, is what we have called a **Non Scalable Network (NSN)** in this document. A NSN can be caused by a SFN or that only one multiplexer is feeding several frequencies. |

### Cross-Carriage of SI

It should always be possible to present all services and events (present and following) to the viewer, which the viewer has the possibility to receive within a Local Service Network (see below). This requires that all SI is cross-distributed over all frequencies in that specific region. The cross-carriage of SI is limited to the finest level of regionality, called a Local Service Network (LSN). The Local Service Network can be defined as the coverage area of a transport stream, i.e. if several transport streams cover exactly the same area they belong to the same Local Service Network. The cross carriage shall be limited within the Local Service Networks with the exception of region who have a mixture of SFN and MFN.

The navigation EPG/ESG, shall not display any service that the receiver can not receive, due to low RF level or status.

The definition that a service is possible to receive is that it is included in the *service\_list\_descriptor* in a received NIT\_actual table. By using this definition the receiver can by a very simple algorithm decide whether or not to present the cross distributed service.

If Service\_id is available in any received NIT\_actual (*service\_list\_descriptor*)

display the service in the (EPG/ESG )

if not available

do not display the service

1. The receiver shall only display a service once, even if the same service is received from multiple transmitters, the receiver shall choose the service belonging to the preferred network.



*Figure 15: an example of the mixture of Multiple- and Single Frequency Networks*

Due to limited bandwidth in the terrestrial network the cross distribution of the SI shall be limited to the following tables:

1. All BAT sub tables for the LSN.
2. SDT other for all services in the LSN, i.e. listed in the NIT (actual)
3. EIT other (present and following) for all services listed within each SDT other. The EIT\_present\_following\_flag shall be set to ”1”, which indicates that the EIT\_present\_following information for the services is present in the current TS.

The LSN can for the purpose of SI be treated as a single terrestrial network unique within the network.



*Figure 16: DVB service delivery model*

The delivery system model is detailed in Figure 16; this restriction is to optimise the use of the bandwidth within the terrestrial network. Depending on aerial installation and receiver location, a receiver may be able to receive multiplexes from more than one LSN. There is normally no cross-carriage of SI specified between LSN, and the receiver must therefore treat the LSN as independent networks. However, where a receiver finds the same combination of original\_network\_id / service\_id in multiplexes received from different LSN the services may be considered to be identical.

As specified above there is an exception to the rule of no cross-distribution between LSN. The cross-distribution in the case of mixture of SFN and MFN will be limited to the SFN. The best way to explain this is probably by example:

One multiplexer (TS 1) is feeding three main-transmitters all transmitting on the same frequency (F1) in a regional Single Frequency Network. Each of these transmitter nodes has other transmitters that are transmitting on the frequencies F2, F3, F 4, F 5 and F 6. These three local transmitters are fed by their own multiplexer transport streams TS2, TS 3, TS 4, TS 5 and TS 6 respectively.

All the transport streams covering the same regional network will cross-distribute the SI between them, just as previously discussed. However, the SFN that covers several LSN will cross-distribute the SI from all the LSN area that it covers and the SI from the SFN is likewise cross-distributed to the MFN.

**An overview of the Network Information Tables for TS 1 and TS 2 in our example is described below:**

**For TS 1:**

Network\_information\_section() {

table\_id 0x40 ( actual )

network\_id 0x3001

transport\_stream\_id 0x0001

{

list of services

}

network\_information\_section() {

table\_id 0x41 ( other )

network\_id 0x3002; 0x3003; 0x0004 *(one for each NIT other table)* ↓ ↓ ↓

transport\_stream\_id 0x0002 -3;0x0004-5; 0x0006 *(for each NIT other table)*

{

list of services

}

**For TS 2:**

network\_information\_section() {

table\_id 0x40 ( actual )

network\_id 0x3002

transport\_stream\_id 0x0002-3

{

list of services

}

network\_information\_section() {

table\_id 0x41 ( other )

network\_id 0x3001

transport\_stream\_id 0x0001

{

list of services

}

# MPEG-2 Demultiplexer

See chapter 5 Video Transmission

# Video

***This chapters aims to ensure that Nordig broadcasters will transmit video content in a format that will be readily supported by the IRD compliant with Nordig Unified Specification v3.1.1 [XX], section "5. Video".***

*~~Here must be inserted text from IRD spec. v.3.1.1 including chapter references~~*

## General requirements

The video resolutions and encoding standards required or supported are defined in Nordig Unified 3.1.1 IRD, section "2.3.14. Main hardware/firmware functions-Overview per configuration".

In short, multiple different types of IRD may exist:

Nordig Basic IRD support: MPEG-2 SD; MPEG-4 AVC SD and HD mandatory

Nordig HEVC IRD support: MPEG-2 SD; MPEG-4 AVC SD and HD; MPEG-H HEVC UHD HDR SRF mandatory

As dditional legacy IRD may still be in operation in some networks like MPEG-2 SD only receivers, broadcasters will need to ensure their broadcast will comply to their target audience.

NorDig transport streams capability~~? Multiplexes Capability~~

~~[from 5.1]~~ A NorDig compliant transport stream may consist of MPEG-2 SD services, MPEG-4 AVC SD services, MPEG- 4 AVC HD services, MPEG-H HEVC UHD services.

~~[from 5.1]~~ A NorDig compliant transport stream may consist of a mix of SD, HD and UHD services where technically feasible by the encoding platforms.

~~[from 5.2]~~ As NorDig specified and certified IRD decode and display both HD and SD services there is no requirement to simulcast HD and SD versions of the same service

The supported bitstreams are listed in the table below



## Supported Resolutions

NorDig Broadcasters targeting NorDig IRD **shall** encode and transmit in one of the following resolutions according to ETSI TS 101 154 [26]:

* Section 5.1 “25 Hz MPEG-2 SDTV IRDs and Bitstreams”, sub-section 5.1.4 “Luminance resolution”.
* Section 5.6 “H.264/AVC SDTV IRDs and Bitstreams”, sub-section 5.6.2 “25 Hz H.264/AVC SDTV IRD and Bitstream”, sub-section 5.6.2.3 “Luminance resolution”.
* Section 5.7 “H.264/AVC HDTV IRDs and Bitstreams”, sub-section 5.7.1.4 “Luminance resolution”.

NorDig Broadcasters targeting NorDig HEVC IRD **may**, in addition to the above,encode and transmit in one of the following resolutions according to ETSI TS 101 154 [26]:

* Section 5.14.4 “HEVC HDR UHDTV IRDs and Bitstreams”, sub-section 5.14.4.3 “Luminance Resolutions”.
* Section 5.14.3 “HEVC UHDTV IRDs and Bitstreams”, sub-section 5.14.3.2 “Luminance resolution” with the exception of non-square pixel aspect ratios.
* Section 5.14.2 “HEVC HDTV IRDs and Bitstreams”, sub-section 5.14.2.2 “Luminance resolution” with the exception of non-square pixel aspect ratios and the exception of interlace scan.

Note: [Consider the different network bandwidths and IRD scaling restrictions] – make evaluation on main IRD park

## Supported Framerates

Nordig Broadcasters targeting Nordig IRD **shall** encode and transmit in one of the following frame rates according to ETSI TS 101 154 [26]:

* Section 5.1 “25 Hz MPEG-2 SDTV IRDs and Bitstreams”, sub-section 5.1.2 “Frame rate”.
* Section 5.6 “H.264/AVC SDTV IRDs and Bitstreams”, sub-section 5.6.2 “25 Hz H.264/AVC SDTV IRD and Bitstream”, sub-section 5.6.2.2 “Frame rate”.
* Section 5.7 “H.264/AVC HDTV IRDs and Bitstreams”, sub-section 5.7.2 “25 Hz H.264/AVC HDTV IRD and Bitstream”, sub-section 5.7.2.2 “Frame rate”.

Nordig Broadcasters targeting Nordig HEVC IRD **may**, in addition to the above, encode and transmit in one of the following frame rates according to ETSI TS 101 154 [26]:

* Section 5.14.1 “Specifications Common to all HEVC IRDs and Bitstreams”, sub-section 5.14.1.7 “Frame rate” (1).
* Section 5.14.4 “HEVC HDR UHDTV IRDs and Bitstreams”, sub-section 5.14.4.5 “Frame Rates” (1).

NorDig broadcasters **should** use only 25 Hz or 50 Hz for HEVC UHD, as

~~The Video Decoder of the NorDig HEVC IRD~~ **~~shall~~** ~~also be able to receive and decode a half frame rate (50Hz) component of a dual PID 100Hz HFR bitstream, according to ETSI TS 101 154 [26] section 5.14.5 “HEVC HDR HFR UHDTV IRDs and Bitstreams and HEVC HFR UHDTV Bitstreams”, subsection 5.14.5.7 “HEVC encoding structure for HFR Bitstreams using dual PID and temporal scalability”.~~

support for frame rates other than 25 Hz, 50 Hz ~~and the reception and decoding of a half frame rate (50Hz) component of a dual PID 100Hz HFR bitstream,~~ is optional in the NorDig HEVC IRD. ~~For HEVC encoded video, only decoding of progressive scan video is mandatory.~~

NorDig Broadcasters **shall** only use progressive scan for HEVC encoded video.

Note 1: The specifications in section 5.14.1.7 **shall** apply with the restrictions in section 5.14.4.5, i.e. only progressive scan support is mandatory.

## Video resolution scaling Up-sampling/Up-converting

Not applicable for RoO

~~Upscaling of (sub-) resolutions of received video~~ **~~shall~~** ~~be made in accordance with ETSI TS 101 154 [26], i.e. (sub-) luminance resolutions in Reference Model Figure 5.1~~ **~~shall~~** ~~be up-scaled by the Decoder Format Converter into the video raster of the Decoder Composition Output.~~

~~Regarding the NorDig STB, the video raster~~ **~~shall~~** ~~either be a manually chosen raster of 1920x1080, 1280x720 or 720x576 or a raster automatically selected via EDID-information as desired by the HDMI Sink (iDTV/display).~~

~~In addition to the raster resolutions above, the NorDig HEVC STB~~ **~~shall~~** ~~provide the raster 3840x2160.~~

~~Regarding NorDig iDTVs, all resolutions of received video~~ **~~shall~~** ~~internally be scaled to the native resolution of the display.~~

~~When upscaling video with an encoded luminance resolution of 720x576 or 704x576 to any square pixel aspect ratio format (e.g. 1280x720, 1920x1080 or 3840x2160), only the centred 702 of the horizontal 720 / 704 pixels~~ **~~shall~~** ~~be used. Those 702 pixels correspond to the 52 microseconds of an active line, hence preserves correct geometry in the up-conversion process.~~

~~When upscaling other 576 line-based input resolutions to any square pixel aspect (output) format (i.e. 1280x720, 1920x1080 or 3840x2160), only the centred horizontal pixels~~ **~~shall~~** ~~be used; e.g. when up-converting (received) 544x576 line resolution format to any square pixel aspect ratio (output) format, only the centred 530 pixels of the horizontal 544~~ **~~shall~~** ~~be used.~~

Note: [Consider the different network bandwidths and IRD scaling restrictions] – make evaluation on main IRD park

## Colorimetry

* BT1700/470/601

The NorDig Broadcaster **shall** ensure that the video source and encoding the “MPEG-2 SDTV ~~MPEG-2~~ bitstreams with the Sequence Display Extension (ISO/IEC 13818-2) [51], as defined in ETSI TS 101 154 [26], section 5.1.5.

The NorDig Broadcaster **shall** encode “H.264/AVC SDTV~~SD AVC~~ bitstreams with the VUI (Video Usability Information) parameters: colour\_primaries, transfer\_characteristics and matrix\_coeffecients (ISO/IEC 14496-10) [54], as defined in ETSI TS 101 154 [26], section 5.6.2.1.

* Limit to BT.709 / The video source shall…

The NorDig Broadcaster **shall** encode “H.264/AVC HDTV~~HD AVC~~ bitstreams with the VUI (Video Usability Information) parameters: colour\_primaries, transfer\_characteristics and matrix\_coeffecients (ISO/IEC 14496-10) [54], as defined in ETSI TS 101 154 [26], section 5.7.1.3.

* Limit to BT.2020 / If making dynamic changes, do it between the program events

The NorDig Broadcaster **shall** encode “HEVC UHDTV ~~UHD HEVC SDR~~ bitstreams with the VUI (Video Usability Information) parameters: colour\_primaries, transfer\_characteristics and matrix\_coeffecients (ISO/IEC 14496-10) [54], as defined in ETSI TS 101 154 [26], section 5.14.3.3.

The NorDig Broadcaster **shall** encode “HEVC HDR UHDTV Bitstreams using HLG10”with the VUI (Video Usability Information) parameters: colour\_primaries, transfer\_characteristics and matrix\_coeffecients (ISO/IEC 14496-10) [54], as defined in ETSI TS 101 154 [26], sections 5.14.4.4.1 and 5.14.4.4.2.

The NorDig Broadcaster **shall** encode “HEVC HDR UHDTV Bitstreams using PQ10”with the VUI (Video Usability Information) parameters: colour\_primaries, transfer\_characteristics and matrix\_coeffecients (ISO/IEC 14496-10) [54], as defined in ETSI TS 101 154 [26], sections 5.14.4.4.1 and 5.14.4.4.3.

~~The NorDig IRD Decoder Format Converter shall use the VUI (Video Usability Information) parameters (ISO/IEC 14496-10) [54] colour\_primaries, transfer\_characteristics and matrix\_coeffecients in received AVC encoded bitstreams and the Sequence Display Extension parameters (ISO/IEC 13818-2) [51] in MPEG-2 encoded bitstreams.~~

~~In addition to the NorDig IRD requirements above, the NorDig HEVC IRD Decoder Format Converter shall use the VUI (Video Usability Information) parameters (ISO/IEC 23008-2) [82] colour\_primaries, transfer\_characteristics and matrix\_coeffecients in received HEVC encoded bitstreams~~.

The NorDig Broadcaster using “HEVC HDR UHDTV Bitstreams using PQ10” **should** provide the “Mastering Display Colour Volume SEI message”, as defined in ETSI TS 101 154 [26], section 5.14.4.4.3.3.2.

The NorDig Broadcaster using “HEVC HDR UHDTV Bitstreams using PQ10” **may** also provide the “Content Light Level Information SEI message”, as defined in ETSI TS 101 154 [82], section 5.14.4.4.3.3.3.

~~Bitstreams according to “HEVC HDR UHDTV Bitstreams using PQ10”, section 5.14.4.4.3 in ETSI TS 101 154 [26],~~ **~~shall~~** ~~be used to provide the “Mastering Display Colour Volume SEI message”, section 5.14.4.4.3.3.2 in ETSI TS 101 154 [26].~~

~~Bitstreams carrying non-live programmes,~~ **~~may~~** ~~also contain the “Content Light Level Information SEI message”, section 5.14.4.4.3.3.3 in ETSI TS 101 154 [82].~~

~~Hence, it is highly recommended that the NorDig HEVC IRD Decoder Format Converter makes use of the “Mastering Display Colour Volume SEI message” when adapting to the luminance and chrominance capability of the connected display. It is in addition recommended that the NorDig HEVC IRD makes use of the “Content Light Level Information SEI message” when available in the bitstream.~~

### NorDig HEVC STB colorimetry

~~The Decoder Composition Output in NorDig’s Video Decoder Reference Model (see chapter 5.1.1)~~ **~~shall~~** ~~be advanced enough to perform all video format conversions (luminance-wise and chrominance-wise) needed to target legacy HDMI-sinks, as well as EDID-enabled adaption to the capability of the connected display, including HDR capability, described in ANSI/CTA-861-G [92]. The complete ANSI/CTA-861-G [92]~~ **~~shall~~** ~~be taken into account except the “6.10 Extended InfoFrame” and “6.10.1 HDR Dynamic Metadata Extended InfoFrame” (1).~~

~~When connected to a Sink (iDTV/display) of any HDMI version, the HDMI 2.0b interface in-line with ANSI/CTA-861-G [92] will give the STB’s Video Format Converter necessary information regarding the desired colorimetry via EDID handshake. The EDID-information~~ **~~shall~~** ~~be used by the Decoder Format Converter of the NorDig HEVC STB to convert colorimetry. However, legacy SDR displays will signal their supported SDR video formats in priority without specifically signalling "Desired Content Max Luminance data" (see 7.5.13 “HDR Static Metadata Data Block” in ANSI/CTA-861-G [92]). Hence, the Decoder Format Converter of the NorDig HEVC STB~~ **~~shall~~** ~~output SDR video formats based on the HDR to SDR conversion methods described by the ITU, e.g. ITU-R BT.2390 [90] and operational practises in HDR television production ITU-R BT.2408 [95].~~

Note: In the case of the High Dynamic Range (HDR) video format ITU-R BT. 2100/PQ [89], it is anticipated that the capabilities of professional reference monitors and consumer displays will evolve differently over time. Consumer displays may have lower luminance and chrominance capabilities than professional reference monitors. Hence, there is a need for both an initial display adaption and a subsequent consumer viewing environment adaption. The latter for example via user control of overall brightness and contrast. Leads on how to best perform the initial display adaption is derived from the conversion methods described by the ITU, e.g. ITU-R BT.2390 [90] and Operational practises in HDR television production ITU-R BT.2408 [95].

~~Note 1: “HDR Dynamic Metadata” in general will be discussed in a future revision of the NorDig Unified Requirements, at the same time as requirements regarding the “HEVC HDR HFR UHDTV IRD and Bitstream” will be added.~~

Note 1: HDR Dynamic Metadata is not specified by the Nordig Unified specifications and therefore is out of scope of this specification

### Programme production colorimetry – informative

Table 5.1 below gives the reference to the standards regarding programme production where to find appropriate chromaticity co-ordinates, opto-electronic transfer characteristics and matrix coefficients to be used for example when deriving luminance and chrominance signals from the red, green and blue primaries (or vice versa, i.e. YCbCr to RGB):

|  |  |  |
| --- | --- | --- |
| **Active composition resolution in the “Decoder Composition Output” (equal to the production resolution) (Horizontal x Vertical)** | **Standards regarding programme production colour parameters** | **Comments** |
| 720x576 | ITU-R BT.1700 [85] (replaces ITU-R BT.470 System B, G) and ITU-R BT.601 [83] | Note that 576 lines in both interlaced scan (576i) and progressive scan (576p) **shall** be processed and output with equal colour parameters.  Standard Dynamic Range production parameters. |
| 1280x720 | ITU-R BT.1847 [86]  (SMPTE 296M) | The colour parameters in SMPTE 296M are the same as in ITU-R BT.709 [84].  Standard Dynamic Range production parameters. |
| 1920x1080 | ITU-R BT.709 [84] (SMPTE 274M) | The colour parameters in SMPTE 274M are the same as in ITU-R BT.709 [84].  Standard Dynamic Range production parameters. |
| 3840x2160 | ITU-R BT.2020 [88] | Standard Dynamic Range production parameters. |
| 3840x2160 | ITU-R BT.2100 [89] | High Dynamic Range production parameters used for PQ10 and HLG10 by DVB (1). |

Note 1: In ITU-R BT.2100 [89] TABLE 9 “Digital 10- and 12-bit integer representation”, both "Narrow range" and "Full range" are defined. DVB is however only specifying the use of 10-bit "Narrow range" in its TS 101 154 [26].

## Dynamic changes in the video stream

The NorDig Broadcaster **may** use dynamic changes of either the video codec or the video format.

Changes shall last more than 5s. ~~After a change of video codec, the IRD should automatically resume decoding and output of valid video within five seconds.~~

The NorDig Broadcaster **may** use dynamic changes in transmission between different video formats and frame rates (e.g. 720p50 to 1080i25/1080p25 and 576i25 to 720p50), including changes in encoded sub resolution (e.g. 720x576 to 544x576) with signalling Random Access Point. (Random Access Point equals H.264/AVC RAP for H.264/AVC and Sequence header for H.262/MPEG-2).

The NorDig Broadcaster **may** use changes in transmitted aspect ratio (e.g. 16:9 / 4:3) ~~within one second after the~~ reception. The transition **shall** cause minimal disturbance of the decoded service.

The NorDig HEVC IRD **shall**, regarding HEVC encoded bitstreams, in addition be able to handle dynamic changes in transmission between encoded (sub-) resolutions (i.e. 3840x2160 in steps down to 960x540) within one second after receiving Random Access Point, ideally without interruption. (Random Access Point equals HEVC DVB\_RAP for H.265/HEVC).

## MPEG-2 Minimum video bandwidth

Nordig Broadcasters ***may*** encode MPEG-2 video down to 1.0Mbps for video resolutions up to full Standard Definition resolution video (720x576). Any lower bitrate ***might*** not be supported by Nordig IRD

## Frame Cropping

The Nordig broadcaster may provide frame cropping signalling for video encoded with 1088 lines, for 1080 line formats. If frame cropping is signalled, the Nordig IRF will use this used to decide which 8 lines should be hidden in the Decoder Composition Output.

~~The NorDig IRD~~ **~~shall~~** ~~support frame cropping for H.264/AVC encoded video. Frame cropping signalling is used to indicate which area of the encoded video that should be displayed.~~

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

~~The NorDig HEVC IRD~~ **~~shall~~** ~~support “conformance cropping window” for H.265/HEVC encoded video according to ETSI TS 101 154 [26] section 5.14.1 “Specifications Common to all HEVC IRDs and Bitstreams”, sub-sections 5.14.1.3 “Sequence Parameter Set” and 5.14.1.5.1 “Aspect Ratio and Overscan Information”.~~

## Overscan

For services carrying H.264/AVC video, the broadcaster **may** use the *overscan\_info\_present* and *overscan\_appropriate* flags to indicate whether the IRD (NorDig IRD and NorDig HEVC IRD) should apply overscan (e.g. by masking with black pixels or by additional cropping plus scaling), or should display the complete broadcast video image (after appropriate Frame Cropping, see Chapter 5.8 Frame Cropping). The flags will be encoded according to Table 5.2.

|  |  |  |
| --- | --- | --- |
| overscan\_info\_present\_flag | Overscan\_appropriate\_flag | Usage |
| 0x0 or not broadcasted | n/a | No preferred display method |
| 0x1 | 0x0 | Important information in entire video frame |
| 0x1 | 0x1 | Decoded picture suitable for |

*Table 5.2 Broadcast overscan flag*

If provided, unless the user requests otherwise, NorDig IRDs **will** interpret and follow the overscan flags according to Table 5.3.

|  |  |  |
| --- | --- | --- |
| overscan\_info\_present\_flag | overscan\_appropriate\_flag | Behaviour |
| 0x0 or not broadcasted | n/a | Implementation dependent |
| 0x1 | 0x0 | Overscan not applied |
| 0x1 | 0x1 | Overscan applied |

*Table 5.3 NorDig IRD and NorDig HEVC overscan behaviour.*

NorDig STBs **will** pass the video unaltered, i. e. without overscan related reformatting to its HDMI output, setting the bits in the AVI Infoframe (see CTA 861 [92]) in accordance with Table 5.4 below.

|  |  |  |
| --- | --- | --- |
| overscan\_info\_present\_flag | overscan\_appropriate\_flag | <S1,S0> (in HDMI AVI Infoframe) |
| 0x0 or not broadcasted | n/a | <0,0> |
| 0x1 | 0x0 | <1,0> |
| 0x1 | 0x1 | <0,1> |

*Table 5.4 Overscan signalling on the HDMI.*

~~Most displays have a user option where it will display the full frame of 1080 line based video formats without any overscan applied. It is recommended that the NorDig iDTVs support such user option to achieve one-to-one pixel mapping on 1920 x 1080 resolution displays. Note that the user, if overriding the received overscan flags, may not see a clean aperture as content producers cannot promise artefact free areas outside the Action Safe Area described in “EBU R 095 Safe areas for 16:9 television production” [71].~~

~~For the NorDig HEVC IRD, in addition to above, regarding Overscan Information via Video Usability Information for services carrying H.265/HEVC video, see ETSI TS 101 154 [26] section 5.14.1 “Specifications Common to all HEVC IRDs and Bitstreams”, sub-sections 5.14.1.5.0 “General” and 5.14.1.5.1 “Aspect Ratio and Overscan Information”.~~

### Safe area for overscan

The amount of applied overscan shall not be in conflict with the broadcasted Action Safe Areas. Please refer to “EBU R 095, Safe areas for 16:9 television production” [71], for appropriate guidelines.

## Video Output and Display

~~The NorDig STB~~ **~~shall~~** ~~use the HDMI EDID information provided by the Sink (iDTV/display) to automatically determine the STB output as specified in section 5.4 and 5.5, and as an alternative enable manual setting of the STB output as specified in section 8.6.~~

~~The NorDig STB~~ **~~shall~~** ~~ensure that it can always present video (where available) for all services in the installed service list, regardless of the capabilities of the connected display.~~

## Restrictions on analogue video output

~~Down-conversion of High Definition Video for Standard Definition output.~~

~~If SCART, or any other analogue video output (Y, Pb, Pr, RF-PAL or CVBS) is available (1), decoded video with a resolution higher than Standard Definition (576i/25),~~ **~~shall~~** ~~always be down-converted to interlaced Standard Definition resolution before output via these interfaces.~~

~~The down-conversion~~ **~~shall~~** ~~be implemented from any received resolution, see section 5.2~~

~~When down-converting any square pixel aspect ratio format (e.g. 1280x720) to 720x576 resolution, the target~~ **~~shall~~** ~~be 702x576 pixels to be centred in the 720x576 grid with nine black pixels inserted as the start of the 720 pixel active line and nine black pixels inserted as the end of the 720 pixel active line.~~

Down-converted HD or UHD (2) video **shall** be displayed as 16:9 letterbox on 4:3 displays. 4:3 centre-cut is *not* an allowed display option, since this would limit the Action Safe Area in HD program production.

~~The conversion should apply appropriate re-interlacing (field mode integration re-interlacing). It~~ **~~shall~~** ~~process and output 720x576i25 in 4:3 frame aspect ratio or 16:9 frame aspect ratio video with colours according to section 5.5.~~

~~Note 1: The NorDig IRD is not required to be equipped with any analogue video output.~~

~~Note 2: UHD video resolution is only applicable for the NorDig HEVC IRD, not the NorDig IRD.~~

## Display of 4:3 aspect ratio content

~~The NorDig IRD~~ **~~shall~~** ~~have methods to display 4:3 transmitted SDTV content on a 16:9 monitor (with any resolution and colorimetry capability). The NorDig IRD~~ **~~shall~~** ~~be able to maintain full height 4:3 picture aspect ratio (pillar box) on a 16:9 display. Other display modes for 4:3 content are optional.~~

~~If SCART is available (1), the user~~ **~~shall~~** ~~have the ability to select appropriate aspect ratio, see section 8.4.~~

~~Note 1: The NorDig IRD is not required to be equipped with any analogue video output.~~

## Rescaling for HbbTV application

~~A NorDig HbbTV IRD~~ **~~shall~~** ~~support rescaling as defined in HbbTV under “video scaling” minimum requirements in clause 10.2.1 of ETSI TS 102 796 [27]. These~~ **~~shall~~** ~~be supported for any of the valid incoming encoded full screen luminance resolutions (see 5.2 for full screen luminance resolution values). The video~~ **~~shall~~** ~~be scaled, preserving the aspect ratio, and when applicable converted colorimetry-wise, such that all of the decoded video is visible within the area of the AV Control object or HTML5 video object. (See HbbTV requirements in ETSI TS 102 796 [27] Appendix E4).~~

## Graphic compositing with HDR video – informative

Recommendation to avoid the ambiguity?

~~When compositing graphic components (e.g. subtitling, HbbTV) with an HDR-based TV service, these graphics may typically utilise a small, perhaps undefined, legacy SDR-based colour volume. Hence ambiguity may occur, primarily luminance-wise, to which HDR-based video colours to map the SDR-based colours of the graphics in the composition, see the Video Decoder Reference Model in section 5.1.1.~~

~~The SDR to HDR conversion methods (and vice versa) for video described by the ITU, e.g. ITU-R BT.2390 [90] and ITU-R’s operational practises in HDR television production ITU-R BT.2408 [95], should be studied as guidance regarding colour volume conversion (both luminance and chrominance) of graphics.~~























# Audio Transmission

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

# Teletext and Subtitling

# Interfaces and Signal Levels

No RoO specification

# Conditional Access

TBD

# System Software Update (SSU)

# Performance

No RoO specification

# Programme Specific Information and Service information (P)SI

# Navigator

Se chapter 3.1 Tuning and Navigation

# PVR

# IRD System Software and API

# User Preferences

No RoO specification