Unified Requirements of DVB-C and DVB-T2 digital receivers for the Finnish market

Version 4.3

2022-12-24

Table of contents

1   Introduction

1.1   General

This document describes the functional and technical requirements for digital DVB-T2 and DVB-C receivers for the Finnish Digital Terrestrial and Cable Television market.

The requirements in this specification document come into force on 1st of January 2022. IRDs launched before that date **shall** conform either to the Unified Requirements Specification V.4.1 or V.4.2 (this document) by choice of the IRD manufacturer.

1.2   Version History

Version	Date	Comments
V. 1.0	2010-10-10	Release Ver. 1.0
V. 2.0	2011-12-13	Annual update
V. 3.0	2014-12-18	Third edition
V. 4.0	2016-10-28	Harmonized release together with Unified Rules of Operation 4.0 and Unified IRD Test Plan 4.0.
V. 4.1	2018-01-30	Annual update. References to NorDig Unified 2.6 and NorDig Unified Test Plan 2.6
V. 4.2	2021-06-24	References to NorDig Unified 3.1.2 and NorDig Unified Test Plan 3.1.2.
V. 4.3	2022-12-24	References to NorDig Unified 3.2 and NorDig Unified Test Plan 3.2.

1.3   References

[1]   NorDig Unified Requirements for Integrated Receiver Decoders for use in cable, satellite, terrestrial and IP-based networks, version 3.2 (2022-05)

[2]   Security requirements of digital HDTV receiver for the Finnish market, Version 4.3. (2022-12-24)

[3]   Unified Rules of Operation for Cable and Terrestrial networks in Finland, Version 4.0 (2021-04-13)

[4]   Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems, ETSI TS 102 006, V1.4.1 (2015-06).

[5]   CI Plus Specification – Content Security Extensions to the Common Interface v1.4.3

[6]   EN 50221 (02-1997): "Common Interface Specification for Conditional Access and other Digital Video Broadcasting Decoder Applications"

[7]   Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams, ETSI EN 300 472, V1.4.1. (2017-04)

[8]   Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream, ETSI TS 101 154 V2.5.1 (2019-01)

[9]   SFS 4175; Numeroiden ja merkkien kirjoittaminen, 5th edition; Finnish Standards Association SFS, (2006)

[10]   Digital Terrestrial TV Broadcast Receivers; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU, ETSI EN 303 340 V1.2.1 (2020-09)

[11]   ETSI TS 102 796 1.6.1 Hybrid Broadcast Broadband TV

[12]   OIPF Release 1 Specification Volume 5 – Declarative Application Environment [V1.2] – (2012-09-21)

[13]   OIPF Release 1 Specification Volume 7 – Authentication, Content Protection and Service Protection [V1.2] – (2012-09-21)

[14]   ISO/IEC 23001-7 MPEG Common Encryption (Previously Annex I of [ISOBFF])

[15]   ISO/IEC 14496-12 ISO Base File Format

[16]   ISO/IEC 23009-1 Information technology –Dynamic adaptive streaming over HTTP (DASH) – Part 1: Media presentation description and delivery formats

[17]   Marlin Simple Adaptive Streaming (working draft WD001)

[18]   Marlin Developer Community, Marlin – Broadband Network Service Profile Specification, version 1.2

[19]   Marlin Developer Community, Marlin – Simple Secure Streaming Specification, version 1.0

[20]   Marlin Integration to Hybrid Broadcast Broadband TV, Version 1.0, Draft003

[21]   Microsoft PlayReady http://www.microsoft.com/playready/default.mspx

[22]   PlayReady Documentation CHM file, available to PlayReady licensees, version 2.0

[23]   PlayReady Format Specification, included in MSPR1, version 2.0

[24]   PlayReady Integration to HbbTV Specification, version 1.0

[25]   PlayReady Binding to MPEG-DASH Specification, version 1.0

[26]   HbbTV DRM / DASH Reference Video Application, https://github.com/HbbTV-Association/ReferenceApplication

1.4   Abbreviations and definitions

Shall   Requirement which is mandatory to implement

Should   Requirement which is not mandatory to implement but strongly recommended

AC-3	Audio Codec-3 (Dolby Digital)
AIT	Application Information Table
AVC	Advanced Video Codec
BER	Bit Error Ratio
CAS	Conditional Access System
CI	Common Interface
CI+	Common Interface Plus
CRID	Content Reference Identifier
DASH	Dynamic Adaptive Streaming over HTTP
DRM	Digital Rights Management
DVB	The Digital Video Broadcasting Project
DVB-C	DVB standard for Digital Cable Transmission
DVB-S	DVB standard for Digital Satellite Transmission
DVB-S2	DVB standard for Digital Satellite Transmission – 2nd generation
DVB-T	DVB standard for Digital Terrestrial Transmission
DVB-T2	DVB standard for Digital Terrestrial Transmission – 2nd generation
HbbTV	Hybrid Broadcast Broadband TV
HDCP	High-Bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDTV	High Definition Television
HE-AACL2	High-Efficiency Advanced Audio Coding Version 1 Level 2
HE-AACL4	High-Efficiency Advanced Audio Coding Version 1 Level 4
HEVC	High-Efficiency Video Coding
HOH	Hard-Of-Hearing

EIT	Event Information Table
EPG	Electronic Program Guide
E-AC3	Enhanced AC-3
GUI	Graphical User Interface
IDTV	Integrated Digital TV-set
IRD	Integrated Receiver Decoder
LCN	Logical Channel Number
NIT	Network Information Table
ONID	Original Network ID
OTA	Over-The-Air
PAL	Phase Alternating Line
PSI	Program Specific Information
PTS	Presentation Time Stamp
PVR	Personal Video Recorder
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
SAS	Specific Application Support
SDT	Service Description Table
SFN	Single Frequency Network
SI	Service Information
SID	Service ID
SQI	Signal Quality Indicator
SSI	Signal Strength Indicator
SSU	System Software Update
STB	Set-Top-Box
TDT	Time/Date Table
TOT	Time Offset Table
TS	Transport Stream
TSID	Transport Stream ID
UHD	Ultra High Definition
UHDTV	Ultra High Definition Television
UHF	Ultra High Frequency
USB	Universal Serial Bus
VHF	Very High Frequency

2   Scope

This documentation provides functional and technical requirements and clarifications for DVB-C and DVB-T/T2 receivers to be used in Finnish digital television environment.

Unless otherwise noted or overridden with the requirements in this specification, the IRD **shall** be compliant with the requirements in NorDig Unified Specification [1] NorDig Basic IRD profile and Security requirements of digital HDTV receiver for the Finnish market [2]. Hybrid IRDs **shall** be additionally compliant with requirements in NorDig Unified Specification [1] Hybrid Profile.

Common requirements for *Finnish Cable Ready HD* and *Finnish Antenna Ready HD* are specified in chapters 1 - 13. Additional requirements for PVR IRDs are specified in chapter 14 and additional requirements for Hybrid IRDs are specified in chapter 15. The annexes are explanatory and intended for informative purposes.

IRD supporting multiple transmission media **shall** be validated as follows:

1.   IRD contains DVB-C tuner, it **shall** be validated for *Finnish Cable Ready HD* requirements.
2.   IRD contains DVB-T/T2 tuner, it **shall** be validated for *Finnish Antenna Ready HD* requirements.
3.   Hybrid IRD **should** be validated for *Finnish Antenna Ready SMART HD* requirements.

3   Background

This document is intended for specifying the IRDs to be used in Finnish Cable and Terrestrial networks described in the Unified Rules of Operation [3]. More information on the background and operational environment is found in the Unified Rules of Operation.

4   General IRD requirements

4.1   Minimum IRD interface and hardware requirements

The IRD **shall** conform to the IRD hardware and firmware requirements in NorDig Unified specification [1] with the following additions and clarifications:

1. Antenna Ready HD IRDs **shall** have at least one tuner/demodulator block for terrestrial input, supporting DVB-T and DVB-T2 requirements as specified in the NorDig Unified specification [1].
2. Cable Ready HD IRDs **shall** have at least one tuner/demodulator block for cable input, supporting DVB-C requirements as specified in the NorDig Unified specification [1].
3. MPEG-2 and MPEG-4 AVC video **shall** be supported as specified in the NorDig Unified specification [1].
4. HE-AAC Level 4, E-AC-3, AC-3 and MPEG1L2 audio including down-mix, transcoding and pass-through **shall** be all supported as specified in the NorDig Unified specification [1].
5. IRD **shall** have Common Interface [6] supporting CI+ v1.4 [5] or later and/or an embedded CA system for conditional access.
6. IRD with embedded CA system **shall** support Conax with chipset pairing [2]. Support for Conax messaging, link protection and secure fingerprinting are optional. Hybrid IRD may have additional methods for conditional access and DRM.
7. Analogue video outputs, if implemented, **shall** provide PAL video with standard definition resolution and frame rate equal with standard PAL signal, regardless of the source video. That is, high-definition signal **shall** be down-converted for the analogue outputs.
8. Support for tuning analogue signals is optional.
9. HbbTV, if implemented, **shall** be as per HbbTV specification 2.0.3 (ETSI TS 102 796 1.6.1) [11] including all published errata.

4.2   Video requirements

The IRD **shall** comply with the video requirements as specified in the NorDig Unified specification [1] with the following additions and clarifications:

1. HDTV IRD supporting HEVC **shall** be able to decode HEVC HD video as per ETSI TS 101 154 [8], as further specified in chapter 6.2.1.
2. UHDTV IRD supporting HEVC **shall** be able to decode HEVC UHD video as per ETSI TS 101 154 [8], as further specified in chapter 6.2.1.
3. IRD **shall** support the default priority order for the IRD between different video streams as per NorDig Unified specification. Additionally, IRD supporting HEVC **shall** prioritize HEVC video component (stream_type 0x24) over the other video stream types.
4. HEVC component **shall not** cause harm to a IRD not supporting HEVC video.
5. Informative: IRD supporting HEVC **should** comply with NorDig Unified v3.2 requirements for HEVC IRD profile.

4.3   Audio requirements

IRD **shall** comply with the audio requirements as specified in the NorDig Unified specification [1] with the following additions and clarifications:

1. The IRD **shall** present information to the user if the selected service has a supplementary audio track available.
2. The IRD **shall** indicate which ones of the available audio tracks are of a supplementary audio type together with its language.

Examples of the practical use of visual impaired audio in Finnish television networks are given in Annex A.

5 IRD Installation and Digital television networks in Finland

The following requirements are applicable for all IRDs.

5.1 IRD Installation – General requirements

1. IRD first time installation **shall** be a guided procedure.
2. The first-time installation **shall** be performed including but not limited to the following steps:
   i. Language selection dialogue
   ii. Country selection dialogue
   iii. Signal source selection (cable or terrestrial)
   iv. Automatic scan
3. The order of the installation procedure steps should be as given in requirement 5.1-2.

5.1.1 Language selection

1. IRD user interface **shall** be available at least in Finnish, Swedish and English languages.
2. Primary audio language and primary subtitling language **shall** be set by the user selection in the first-time installation. The selection may be automatically derived by the IRD from the selected user interface language.
3. Secondary audio language and secondary subtitling language **should** be set to e.g., another of the two official languages.

5.1.2 Country selection

1. IRD intended for multi-regional market **shall** provide the user a possibility to select the country 'Finland'.
2. The IRD **shall** consequently utilize settings conforming to the applicable requirements in this document within the 'Finland' country selection.

5.1.3 Signal source selection

1. If IRD supports more than one transmission media, IRD **shall** provide the user a possibility to select the signal source from which the services are to be installed.

5.1.4 Automatic scan

1. Automatic scan **shall** be performed according to the applicable requirements in chapters 5.2.1 and 5.3.1.
2. IRD **shall not** include analogue channel search in the automatic scan by default.
3. IRD **should** tune to the television service with lowest LCN value after the automatic scan has been completed.

5.2   DVB-T/T2 requirements

The following requirements are applicable for IRD operating in Terrestrial networks.

5.2.1   Automatic scan

Automatic scan **shall** be implemented as specified in NorDig Unified specification [1] with the following additions and clarifications:

1. IRD **shall** have a menu item for automatic scan.
2. IRD **shall** begin the automatic scan with VHF III band using 7 MHz raster and 7MHz bandwidth.
3. Automatic scan **shall** continue with UHF IV – V bands using 8 MHz raster and bandwidth up to the highest specified frequency in the NorDig unified specification [1].
4. Both DVB-T and DVB-T2 **shall** be scanned.
5. Automatic scan **shall** enable automatic service list updates. Consequently, IRD **shall** detect and react to all SI changes.
6. Automatic scan through the full frequency range **shall** take no more than 15 minutes.

5.2.2   Manual scan

Manual scan **shall** be implemented as specified in NorDig Unified specification [1] with the following additions and clarifications:

1. IRD **shall** have a menu item for manual scan.
2. Manual search **shall** require no other transmission parameters from the user but the center frequency or channel ID.
3. Manual scan **shall** disable automatic service list updates and best service selection. Consequently, IRD **shall not** react to any 'quasi-static' SI updates until the user overrides the latest 'Manual scan' by performing a new 'Automatic scan'.
4. Manual scan function **shall not** clear the service list.

5.2.3   Service lists and logical channel numbering

1. IRD **shall** build the service lists based on the priority for LCN numbers for services which have *original_network_ID* of Digital Terrestrial Television in Finland (0x20F6).
2. When other networks are received, they **shall** be placed at the end of channel list using LCN 'last in the list principle'. If the IRD shares a common channel list for both TV and radio services, the order **shall** be:
   i.   TV services according to LCN with ONID 0x20F6
   ii. TV services with ONID other than 0x20F6
   iii. Radio services with ONID 0x20F6
   iv. Radio services with ONID other than 0x20F6
3. There are several independent networks with ONID 0x20F6. Services from all of them **shall** be simultaneously available in a common service list.
4. IRD **shall** identify unique services by the triplet *original_network_id*, *transport_stream_id* and *service_id*. That is, if IRD receives multiple services with a common triplet, IRD **shall** handle them as the same service.
5. The operators may broadcast a service with the same ONID, SID and TSID triplet with up to 8 different logical channel numbers. IRD **shall** present such services in the service list on every channel position as signaled in the NIT table.
6. NorDig LCNv2 channel list names **should** not be visible.

5.2.4   RF performance

IRD shall conform to the DVB-T and DVB-T2 requirements in NorDig Unified specification [1].

5.3   DVB-C requirements

The following requirements are applicable for IRD operating in Cable networks.

5.3.1   Automatic scan

Automatic scan **shall** be implemented as specified in NorDig Unified specification [1] with the following additions and clarifications:

1. IRD **shall** have a menu item for automatic scan.
2. IRD **shall** cover the following transmission parameters and their combinations in the automatic scan:
   a. Carrier frequencies: 114MHz + N x 8MHz, where N is an integer in the range 0 to 93
   b. Modulation modes: 16QAM, 64QAM, 128QAM, 256QAM
   c. Symbol rate: 6.952 MSymbols/s (first attempt). If this rate does not result in reception, the following rates **shall** be attempted in this order: 6.875, 6.900, 6.950, 6.125 and 6.000 Msymbols/s. Automatic detection of modulation mode and symbol rate is highly recommended.
3. IRD **shall** begin the scan as a linear frequency scan of the transmission parameters given above until it finds a multiplex with *NIT_actual* table.
4. IRD **shall** assume the found *NIT_actual* table is up to date and consistently describes the whole cable network.
5. IRD **shall** tune the network according to the *NIT_actual* table using the center frequencies and transmission parameters given in *cable_system_delivery_descriptor* values of each multiplex.
6. IRD **shall** install the services using the information acquired from the *NIT_actual* and *SDT_actual* tables of each multiplex.
7. After all multiplexes have been tuned, IRD **shall not** scan the other remaining frequencies.
8. Automatic scan through the full frequency range **shall** take no more than 15 minutes in typical conditions.

An example implementation for automatic scan is described in Annex B.

5.3.2   Manual scan

Manual scan **shall** be implemented as specified in NorDig Unified specification [1] with the following additions and clarifications:

1. IRD **shall** have a menu item for 'Manual scan'.
2. IRD **shall** be able to scan manually with any combination of the following transmission parameters:

    a. Carrier frequency: 114MHz + N x 8MHz, where N is an integer in the range 0 to 93

    b. Modulation mode: 16QAM, 64QAM, 128QAM, 256QAM

    c. Symbol rate: From 4.000MSym/s, up to 7.000Msym/s

3. Manual scan function **shall** require the user to enter the center frequency. IRD may either require the user to enter the Symbol rate and QAM mode or use automatic detection.
4. Manual scan function **shall** disable automatic service list updates. Consequently, IRD **shall not** react to any 'quasi-static' SI updates until the user overrides the latest 'Manual scan' by performing a new 'Automatic scan'.
5. Manual scan function **shall not** clear the service list.

6   Service information and Program Specific Information

IRD **shall** comply with the requirements for PSI/SI specified in the NorDig Unified specification [1] with the following additions and clarifications.

1. IRD **shall** support the descriptors defined in NorDig Unified [1] and Finnish Unified Rules of Operation [3].
2. IRD **shall** have separate lists for TV and Radio services. IDTV may have a common list, where Radio services are 'last in the list' with their LCN numbers.
3. Default service lists after automatic scan **shall** include all found unique TV and Radio services.
4. IRD may support user-defined service lists or 'favorite service lists', which can be edited and sorted by the user.
5. If user-defined service lists are supported by IRD, these service lists should be automatically updated during automatic channel list updates, i.e. Service name change, SID change or service removal.
6. Default service list **shall** be deleted by performing a factory reset. There may additionally be a dedicated menu item for service list deletion.
7. IRD **shall not** clear the service lists without user approval.
8. IRD **shall** be able to handle multiple consequent "dynamic" PSI/SI table changes and at least start action for the changes in the received "dynamic" PSI/SI data within 1 second.

6.1   Network evolution

1. Since there are several networks available, the IRD **shall** be able to store and track the SI table version number information for each received network.
2. When NIT version change is detected from any available Finnish network, all other receivable networks **shall** also be scanned for network changes as specified in chapters 5.2 and 5.3.
3. SI updates **shall** cause as little disturbance to the end user as possible. Thus the service list updates are recommended to be performed quasi-statically, e.g. after the IRD has been set to stand-by mode.
4. IRD **shall** either ask the user confirmation for initiating a re-scan or inform the user, if the SI update will cause changes in the service list.
5. If user rejects or neglects the update, the IRD may inform the user and request the user confirmation again. This **shall** take place earliest after the IRD has been woken up from stand-by for the next time.
6. Re-scan **shall** be performed as an automatic scan in the corresponding transmission media.
7. SI updates considering data services **shall** be invisible to the end user, unless SSU is targeted to the IRD or an attached CAM. This is further specified in chapter 8.
8. IRD **shall not** delete the old service list before the scan for a new service list has been successfully completed. This is to prevent loss of services or unexpected duplicate entries in the service list, if the automatic service list update is unexpectedly interrupted e.g. by unplugging the IRD from mains.
9. In case of PVR IRD, automatic service list updates **shall not** disturb the active and scheduled recordings.
10. IRD **shall not** consider total loss of reception (for example caused by antenna cord removal) as a network evolution.

6.2   Forward compatibility and robustness

1. IRD **shall** ignore undefined descriptors, unknown descriptors and descriptors in unexpected context. Their presence **shall not** cause harm to the IRD.
2. IRD **shall** ignore undefined and unknown data fields and descriptor values. Their presence **shall not** cause harm to the IRD.

6.2.1   HEVC services

Support for HEVC is optional. IRD supporting HEVC services **should** comply with requirements in NorDig Unified specification [1]. IRD supporting HEVC services **shall** comply with the following requirements:

1. IRD supporting HEVC **shall** support *service_type* assigned to "HEVC digital television service" (0x1F) as per ETSI EN 300 468 [8] and categorize the corresponding services to the TV service list.
2. IRD supporting HEVC **shall** prioritize the *service_type* 0x1F, respectively, over the other service types categorized in NorDig Unified specification [1] as television services.
3. IRD supporting HEVC **shall** comply with "Specifications Common to all HEVC IRDs and Bitstreams" as per ETSI TS 101 154 [8].
4. UHDTV IRD **shall** comply with specifications for "HEVC HDR UHDTV IRDs and Bitstreams" as per ETSI TS 101 154 [8], including both PQ10 and HLG10. Support of only 50Hz and 25Hz frame rates is mandatory, excluding modes with non-square pixel aspect ratios or interlace scan **Error! Reference source not found.**.
5. UHDTV IRD **shall** prioritize *service_type* 0x20 (HEVC/H.265 based TV service with PQ10 HDR (up to UHD, SFR/HFR)) as highest, over 0x1F and other service_types in TV category.

6.3   EPG information

IRD **shall** comply with the requirements for EIT specified in the NorDig Unified specification [1] with the following additions and clarifications:

1. There may be temporary mismatches in the signalization of events in EIT p/f and schedule sections. The IRD **shall** prioritize the event information signalized in *EIT_actual_present*/*EIT_actual_following* sections over other EIT sections. Mismatching EIT data **shall not** cause any harm for the receiver.
2. IRD **shall** handle EPG conflicts caused by overlapping EIT events. Event overlap **shall not** cause any harm for the receiver.
3. IRD **shall** be able to display the multi-lingual EIT data according to user language preferences. If EIT information for an event is not available on the preferred language, event information on another available language **shall** be displayed.

6.4   System time

1. IRD **shall** have a real time clock and time/date (calendar) running continuously as specified in the NorDig Unified specification [1].
2. IRD **shall** display time in the user interface **shall** as the local time with daylight saving.
3. IRD **shall** display time using 24h notation. Hours and minutes **should** be separated with a colon ('hh:mm'). Date **should** be presented in little-endian order separated with dots ('day.month.year') [9].

7   Signal level meter and Network information display

IRD **shall** comply with the requirements for signal and network information by the NorDig Unified specification [1] with the following additions and clarifications:

1. IRD **shall** be able to display signal strength (SSI) and quality information (SQI) for the selected center frequency as specified by NorDig Unified specification [1].
2. IRD **shall** display at least the transmission parameters that are required for tuning the selected multiplex manually.
3. IRD **shall** be able to decode *network_name_descriptor* and *multilingual_network_name_descriptor*. Network name **shall** be available for the user.

8   System Software Update (SSU)

1. IRD **shall** have a mechanism for updating its system software.
2. The system software update **shall** be possible at least by one of the delivery alternatives (#D1, #D2, #D3, #D4, #D5) specified in NorDig Unified Specification [1].
3. Automatic detection for the SSU **shall** be enabled by default.
4. If delivery alternative #D1 is chosen, OTA download through broadcast **shall** support data bitrate down to 64 kbps without IRD timing out due to slow download.
5. Fully automatic or semi-automatic SSU functionality **shall not** disturb active and scheduled recordings.
6. DVB-SSU of CI+ module **shall** be performed as per requirements in NorDig Unified specification [1] regardless of the available mechanisms for IRD system software update.

9   Teletext and Subtitling

IRD **shall** comply with the teletext and subtitling requirements in the NorDig Unified specification [1] with the following additions and clarifications:

1. IRD **shall** automatically display subtitling if and only if it matches the user preferences for primary or secondary subtitling.
2. IRD **shall** automatically display Hard of Hearing (HoH) subtitling if and only if HoH subtitle is enabled at the user preferences.
3. IRD **shall** indicate which ones of the available subtitling tracks are of a HoH type together with its language.
4. User **shall** be able to manually select any of the available subtitling tracks or disable subtitling completely, regardless of the subtitling language, type or format.
5. Initial teletext page should be selected according to the currently selected user interface language, if the service has multiple initial teletext pages simultaneously available.
6. Teletext subpages **shall** be supported, and they **shall** be changing either automatically or by user request.

9.1   Teletext streams and PTS transmission

1. IRD **shall** be able to synchronize the teletext pages and subtitles with the video regardless of existence or accuracy of PTS in the PES header of teletext transmission, following the Annex A in [7].
2. IRD may use the PTS to synchronize the teletext subtitle decoding process but **shall** also be able to perform the decoding process before the maximum retention time of 40ms is elapsed.
3. Consequently, the PVR IRD **shall** be able to display the teletext subtitles in sync also for the recorded content.

10 User Interface

1. All menus **shall** be available in at least Finnish, Swedish and English languages. All menus should be available in all Nordic languages.
2. IRD system software version and hardware version information **shall** be available for the user in the menu.

11 Performance

IRD **shall** comply with the requirements for zapping performance in the NorDig Unified specification [1] with the following additions and clarifications:

1. The maximum average zapping time for IRD with embedded CAS in a live environment with scrambled and free services **shall** be equal or less than 4 seconds. The maximum average zapping time should be equal or less than 3 seconds.
2. The maximum average zapping time for IRD with CI+ and using an Antenna Ready / Cable Ready - certified CI+CAM in a live environment with scrambled and free services **shall** be equal or less than 6 seconds. The maximum average zapping time should be equal or less than 4 seconds.

12 Power management

IRD **shall** comply with the requirements for energy efficiency in the NorDig Unified specification [1] with the following additions and clarifications:

1. IRD **shall** return to the originating power state (standby or active mode) after a power cut.
2. IRD **shall not** activate analog or digital video outputs during standby mode by default.
3. IRD should include a user-configurable sleep timer that is enabled by default.

13 IRD accessories and packaging

1. When delivered, the IRD package **shall** include at least the following parts:
    i. Installation and user manual at least in Finnish and Swedish
    ii. Remote Control Unit with batteries
    iii. Power cord and/or power adapter
    iv. HDMI cable (STB only)
2. The IRD **shall** have at least the following identification numbers:
    i. Model and serial number stamped to device
    ii. Conax chipset pairing ID stamped to device (IRD with integrated Conax CAS)
    iii. Model and serial number stamped to package box
    iv. Conax chipset pairing ID stamped to package box (IRD with integrated Conax CAS)

14 PVR requirements

The PVR IRD is an IRD which is able to store audiovisual content from the broadcast for later viewing. That is, all recording IRDs are considered as PVR IRDs.

The implemented PVR functionalities **shall** conform to the PVR requirements specified in the NorDig Unified specification [1] with the following exceptions, additions and clarifications.

14.1 General PVR requirements

1. All mandatory PVR requirements are applicable to the extent they are technically feasible for the IRD. Technical features of the PVR IRD are defined by
    - number of available demodulators
    - number of available stream outputs in the demultiplexer
    - number of available descrambling resources

Examples of the different implementations are given in Annex C.

2. PVR IRD supporting external USB mass media for PVR storage should be able to provide at least 900mA current on 5V for a Hi-Speed USB 2.0 or later port dedicated for the recording target in order to minimize chances for performance issues with an USB-powered mass media.

14.2 Free and scrambled content

1. PVR IRD **shall** distinguish free services and services likely to be scrambled according to the *free_ca_mode* value in *SDT_actual* table.
2. PVR IRD **shall** be able to record free-to-air content without a descrambling resource.
3. PVR IRD **shall** store all available and descramblable audio, video, DVB subtitling and teletext subtitling components for later viewing.
4. PVR IRD **shall** support content protection according to [1] and [2]. Scrambled content **shall** be re-encrypted during the recording and content **shall not** be extractable by user.
5. If a service has more components than the attached descrambling resource has capability to decrypt, IRD **shall** prioritize the components according to user preferences, component format, type and language prioritization rules given in [1] for component selection.

14.2.1 PVR IRD with integrated CA system

1. Integrated CA system is expected not to limit the capability for multi-program descrambling. Consequently, the number of maximum simultaneous recordings of PVR IRD with integrated CA system **shall** be limited only by the CA system descrambling status and the number of available stream outputs in the demultiplexer.

14.2.2 PVR IRD with CI+

1. Number of maximum simultaneous recordings of PVR IRD with CI+ interface **shall** be limited only by the number of available stream outputs in the demultiplexer and the number of available descrambling capabilities [6].
2. If a PVR IRD has multiple CI+ interfaces, the PVR IRD should give user the choice to either perform the CAM allocation automatically or by user selection.

14.3 Management of recorded content

1. PVR IRD **shall** inform the user if the resources for simultaneous recordings are exceeded and a planned recording cannot be performed. This **shall** be done when user is planning the recording.
2. PVR IRD **shall** inform the user if a planned recording could not be stored completely. This could happen due to several reasons, e.g. running out of PVR storage capacity, loss of signal, and loss of power or lack of available descrambling resources. Incomplete or partial recordings should be available for viewing up to the largest possible extent.
3. PVR IRD **shall** have a mechanism for initializing the PVR storage mass media for its own use. IRD **shall** request for user confirmation before the initialization.
4. PVR IRD with integrated PVR storage mass media **shall** warn the user when the mass media nearly out of free capacity for preventing running out of mass media capacity during an active recording.
5. PVR IRD with integrated PVR storage mass media **shall** have functionality for removing all recordings from the mass media.

14.4 Service and event metadata

1. PVR IRD **shall** store the EIT present information for the recording including at least the *event_name*, and *parental_rating_descriptor* values.
2. The stored EIT information **shall** be available to the user.
3. If the recording consists of multiple events, the EIT present information should be available to the user for all recorded events.
4. PVR IRD **shall** set the parental rating value of a recording either dynamically for each content period as per EIT present or according to the highest parental rating value in the recorded content.
5. Support for event_ID -based recordings is optional for IDTVs without integrated PVR storage mass media.
6. Support for CRID and Broadcast Recording Lists are optional.

14.5 Recording priorities

In addition to the recording priority order in the PVR requirements specified in the NorDig Unified specification [1], PVR IRD manufacturer may choose the priority order for manual recordings, scheduled recordings, one-touch-recordings, time-shift and live viewing.

1. PVR IRD **shall** clearly inform the user of the priority order. The priority order **shall** be consistent.
2. PVR IRD **shall** inform the user for the upcoming priority clashes as soon as they are detected. It is strongly recommended that PVR IRD gives a choice to the user to solve the clash situation manually, allowing the user to override a recording function with another.
3. PVR IRD **shall** be able to perform recording in both active and standby mode. Power saving functionality **shall not** override the planned and ongoing recordings.
4. PVR IRD **shall** allow the user to access the menu system for changing user preferences, for example default subtitling language and audio output settings during recording.

14.6 System time management

Power cuts due to storms and other weather conditions affect to a relatively large portion of the Finnish households, especially in the non-urban areas.

1. PVR IRD **shall** have a mechanism for retaining the system time and update its system clock from the transmitted TDT/TOT after recovering from a power cut. This requirement is optional for IDTV without integrated PVR storage mass media.

2. PVR IRD **shall** handle the daylight saving changes both in active and stand-by mode to prevent disturbance with reserved recordings. This **shall** be done according to the *local_time_offset_descriptor* in TOT section.

15 Interactive Profile and HbbTV (Antenna Ready SMART HD)

This chapter describes the requirements that are part of the Antenna Ready SMART HD logo certification.

15.1 General requirements

1. IRD following the NorDig Hybrid specification **shall** support all mandatory features and requirements of HbbTV v2.0.3 as specified in ETSI TS 102 796 v1.6.1 [11] specification (including possible HbbTV Errata NorDig Unified Specification [1] plus the extensions and clarifications in this document.

2. IRD following the NorDig Hybrid specification IRD **shall** support at least Microsoft PlayReady DRM SDK version 2.5. In the future, additional DRMs may be required according to the evolution of the market.

3. IRD manufacturers **shall** present a certificate of passing the tests for HbbTV v2.0.3 and the additional NorDig-specific test tasks by the latest available HbbTV Test Suite. The Test Suite used shall be version 2022 or later.
   NOTE: Presenting the certificate does not prevent the operator conducting same test suites to verify the results.

4. The device capabilities **shall be** returned by the application/oipfCapabilities object. The xmlCapabilities property of the application/oipfCapabilities object **shall** provide the DRMSystemID of the DRM supported by the receiver.

5. Starting and stopping applications **shall not** cause any A/V glitch when that application has not modified the broadcast video.

6. A "do it now" DSMCC stream event **shall** be executed by the receiver in less than 2s. Execution time is measured from the time the event is received at RF interface to the time the event is raised to the API/Application.

7. Reliability **shall** be ensured by running the following procedure on applications available from the production broadcast signal at the time of certification project. The TV shall complete this test without any effect on stability. TV **shall** always open the correct signaled application of the service.
   a. An application is opened and closed by the user 20 times consecutively.
   b. The user changes the program selection before the application has been completely loaded, whether from broadcast or broadband.
   c. A broadband application download is prematurely interrupted by a TCP connection reset, or a sustained packet loss.

8. HbbTV stack **shall** be adequately protected from the DVB stack to not cause any interruption in broadcast reception if a malfunctioning application is broadcasted.

9. IRD **should not** launch applications which are signaled as using a version of profile of HbbTV they do not support. Applications should check whether the receiver supports the features they require.

10. EXIT function **shall** work as specified in the NorDig Unified Specification [1].

11. Teletext button **shall** exist and work as specified in the NorDig Unified Specification [1].

12. HbbTV **shall** be enabled by default.

13. HbbTV autostart option, if offered, **shall** be enabled by default.

14. Subtitles **should** be supported as specified in HbbTV 2.0.3 chapter "7.3.1.5 Subtitles".
    a. IRDs supporting HbbTV 2.0.3 **shall** provide support for TTML-based broadband subtitles as specified in 7.3.1.5.1.

15. The presence of broadcast-related HbbTV services should be indicated to the consumer in the manufacturer provided user interface (e.g. info banner after channel change).

16. The device runs the test cases defined in the HbbTV DASH-DRM reference application successfully. Application is available at https://github.com/HbbTV-Association/ReferenceApplication and the test URL is supplied after submitting for SMART certification.

15.2 Streaming protocols

15.2.1 Constant Bitrate Streaming

1. IRD **shall** provide support for unicast streaming as defined in clause 7.3.2.1 of [11].

15.2.2 Adaptive Bitrate Streaming

1. IRD **shall** provide support for DASH HbbTV ISOBMFF Live profile as defined in [11]. Other profiles may be supported.

Following additions **shall** be supported:

2. IRD **shall** support initialization file of MPEG DASH segments can be unique for each representation specified in DASH MPD.
3. Live DASH **shall** support seeking (backwards within the buffer and forward to present playtime) within the DVR window, if specified in MPD with "timeShiftBufferDepth".

15.2.3 Trick mode support

1. The receiver **shall** allow the HbbTV application to control the Play, Pause, Stop, Fast Forward and Fast Rewind keys as defined in [11]. This will enable the service provider to disable trick modes when required.
2. Service providers should always request the Play, Pause, Stop, Fast Forward and Fast Rewind keys when playing broadband content. If any trick mode function is not supported, the application should display a suitable message to the user when the relevant key is pressed.

15.2.4 Microsoft PlayReady

When Microsoft PlayReady is supported by the receiver:

1. Receivers **shall** support Microsoft PlayReady as per [24] and [25] to allow Content Protection operations and Protected Content consumption.
2. PlayReady SDK version to be supported **shall** be version 2.5 or later.
3. For the avoidance of doubt, with PlayReady DRM receiver **shall** support at least these delivery methods
   1. license embedded in segment files
   2. pre-fetch via LA URL within the MPD file
   3. using OIPF DRMAgent API

- For PlayReady signaling to the HbbTV application, the CA System ID to be used is provided in [23]
- For PlayReady signaling in the MPEG-DASH asset, the format and values to be used (including SystemID) are provided in [25] and [23].
- The specifications are provided by Microsoft to PlayReady licensees.

15.3 Application security (informative)

1. Broadcast application security is assumed.
2. Trusted and non-trusted application id ranges and API restrictions **shall** be observed.

Annex A   Signalization of the visual impaired audio

Broadcast-mixed Visual impaired audio is commonly available in domestic broadcasts in Finland for subtitled events.

As per the status in December 2022, Visual Impaired audio is signalized in the following manner due to compatibility with legacy IRDs.

Operators update the PMT tables on-demand and visual impaired audio track is added to the elementary_stream loop of the PMT with the following parameters.

- The *ISO_639_language_descriptor* indicates *ISO_639_language_code* 'dut' (Dutch) regardless of the actual language of the content. The *audio_type* is 3 (Visual impaired commentary).
- *Supplementary_audio_descriptor* is additionally broadcasted on some services to indicate the audio stream is a complete and independent stream (*mix_type*='1') containing audio description for the visually impaired (*editoral_classification*='00001'). The *ISO_639_language_code* is present and its value is 'dut' (Dutch) regardless of the actual language of the content.

Annex B   Example for automatic channel search process in DVB-C network

A simplified example of a DVB-C tuning process is depicted below in figure 1. In the example a DVB-C network of four multiplexes is being tuned.

1. Search begins as linear scan from 114MHz in 8MHz steps. In every search step the IRD is trying to detect the signal with the required transmission parameters.
2. IRD detects and locks to the signal. IRD reads the *NIT_actual* table.
3. IRD performs the following steps for each *transport_stream* described in the *NIT_actual*:
   a. Tune to the Frequency-Symbol rate-Modulation combination given in *cable_system_delivery_descriptor*
   b. Read the *SDT_actual* table for acquiring service names
   c. Store the found services to the service list
4. Scanning procedure is completed after installing the services in the last TS of *NIT_actual*.
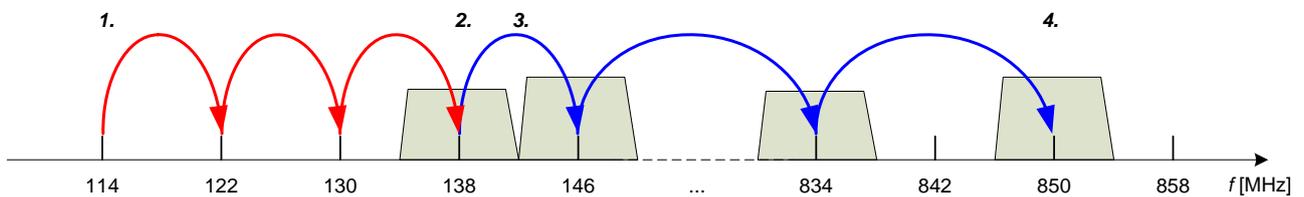

Figure 1. Example of Automatic scan in DVB-C network of four multiplexes

Annex C   PVR resources and limitations

There are several possible set-ups for a PVR IRD in terms of simultaneous recording and viewing. The limiting factors are depicted in figure 2.

IRD with N tuners is expected to be able to demultiplex programs from up to N different transport streams simultaneously.

IRD with K demultiplexer outputs is expected to be able to view and store up to K different free or descramblable services simultaneously. These services are originating from up to N transport streams.

IRD with P available descrambling resources is expected to be able to descramble up to P services simultaneously.
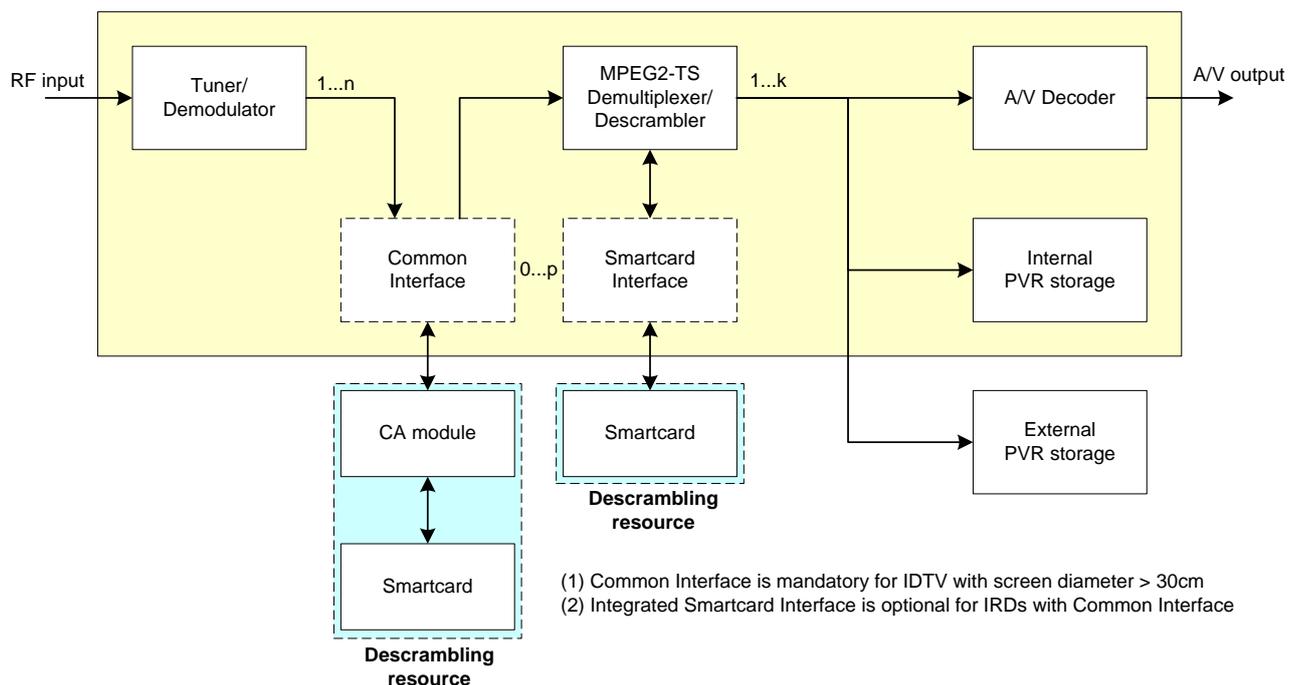

Figure 2. Simplified PVR IRD block diagram

Tuner/demodulator

Tuner/demodulator is considered as a block that is able to retrieve a transport stream from one multiplex. IRD may be able to simultaneously receive one or multiple transport streams.

MPEG2-TS demultiplexer

Demultiplexer can simultaneously output one or more program streams for A/V outputs and for PVR storages. These program streams may be descrambled by the descrambling resource in the common interface or integrated smartcard interface.

PVR storage

PVR storage is a mass media that is used for storing the recorded content. The IRD may support both a fixed internal storage and/or detachable external storage that could be connected through e.g. USB 2.0 interface. An initialized PVR storage is expected to be attached to the PVR IRD in order to be able to perform the supported PVR functions.

Descrambling resource

A descrambling resource is used for decrypting the scrambled program components. Number of simultaneous recordings may be restricted further by the number of available descrambling resources.

PVR IRD is expected to support viewing or storing of up to as many simultaneous scrambled programs as there are available descrambling resources.

PVR IRD is expected to decrypt the scrambled component using an integrated CAS and/or one or multiple CI+ interfaces.
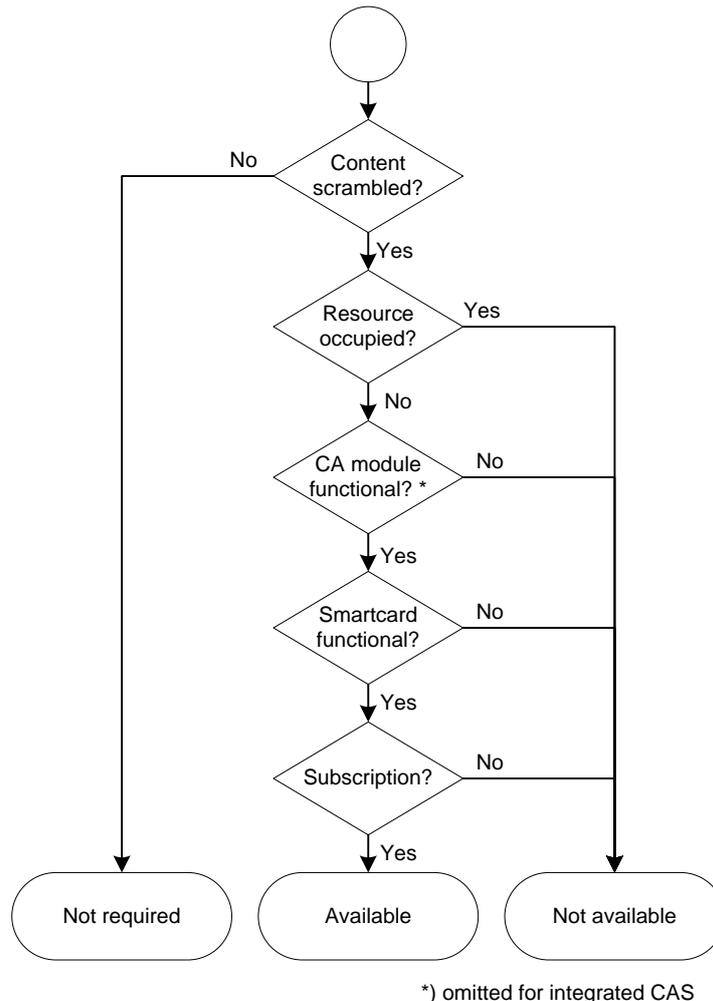

*) omitted for integrated CAS

Figure 3. Example check on descrambling resource availability

An example for CI+ descrambling resource allocation is illustrated in figure 3. When a recording is initiated, the IRD can perform the check for the descrambling resource as follows:

1. Check if the program content is scrambled. In case of planning the recordings, the scrambling status could be predicted by the *free_ca_mode* value of the service in the *SDT_actual* table. In case of the recording is about to take place immediately, the check can be performed by looking *CA_descriptor*s in the PMT table of the service and further by analyzing the elementary streams.
2. Check if the descrambling resource is already occupied.

3. Check if the CA module is inserted and functional. In case of CI+CAM the IRD has to make sure the CAM has been successfully authenticated. If the IRD has an integrated CA system, this step can be omitted and assumed to be successful.
4. Check if the smartcard is inserted and functional. This means ensuring the smartcard is present and communicating with the CI module or the integrated CA system.
5. Check if the smartcard is able to decrypt the content. Consequently, when decrypting is successful, it can be assumed that the descrambling resource can be used this particular program.

If any of these steps above fail, the descrambling resource should be considered as not available. Consequently, the IRD should try the next descrambling resource, if one exists.

If no descrambling resources are available, IRD is expected to inform the user about the lack of available descrambling resources. IRD may then further indicate the reason why the descrambling resource could not be successfully reserved and utilized.

Annex D   HbbTV interaction with Conditional Access Systems and CI Plus (informative)

HbbTV compliant IRD implementing a CI+ interface shall implement the "Content Service Protection" API defined in clause 7.6 of specification [12].

This API can be used to communicate with the smartcard inserted in a CI+ module using the SAS resource implemented by this module in conformance with clause 4.2.3 of specification [13].

It is reminded that the life cycle of an HbbTV application declared on a scrambled service is not related to the ability to access and descramble the audio/video components of this service.

Annex E   Additional HTML Browser features (informative)

The following features from HTML5 should be implemented in the HTML Browser of the IRD:

1. WebSockets API
2. Web messaging
3. Web workers
4. Web storage
5. Server-Sent Events
6. SVG images, image/svg+xml
7. Canvas 2D API
8. Embedded SVG
9. WOFF

Annex F   Subtitling priorities

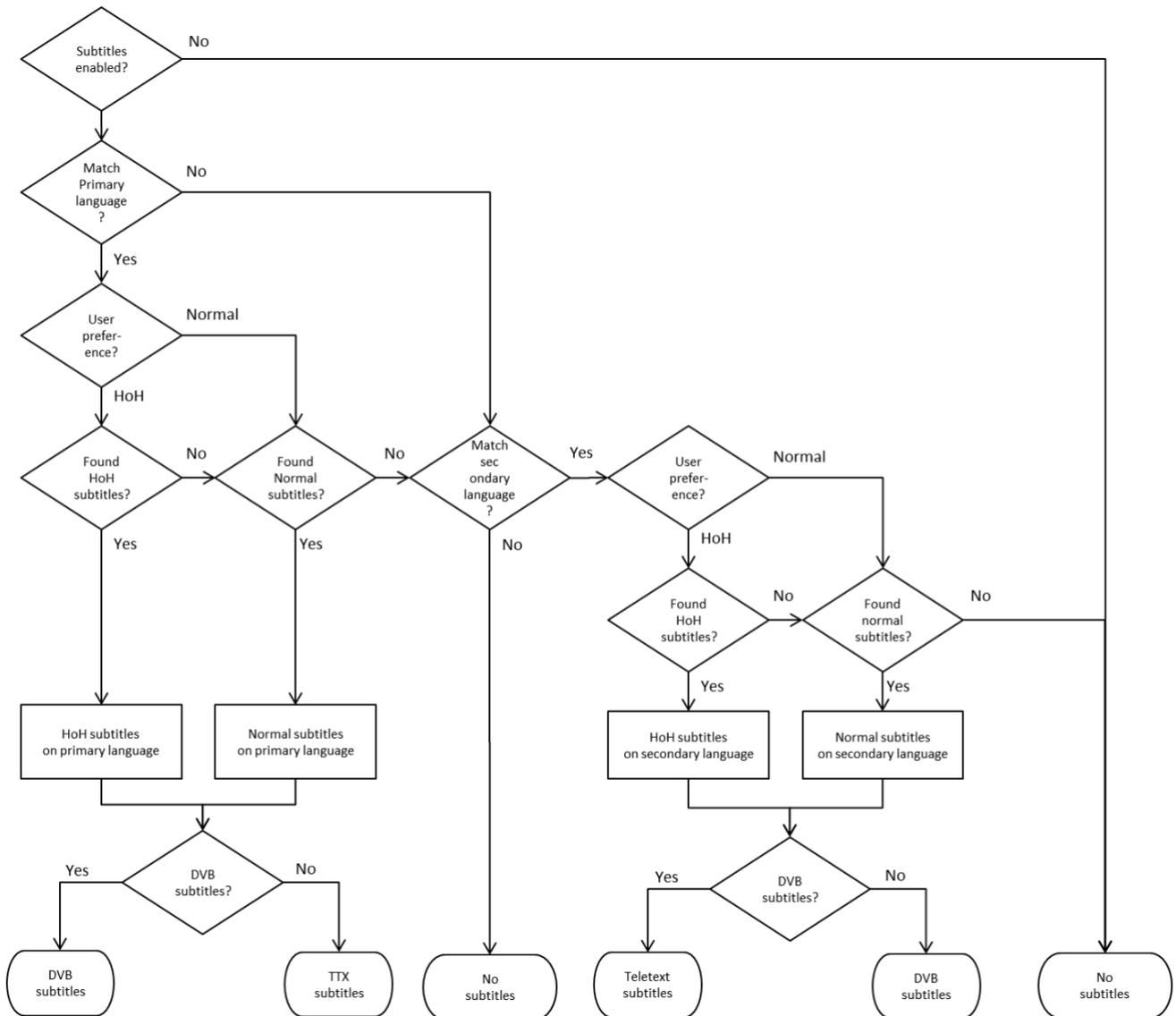Subtitling selection priorities are defined in NorDig Unified Specification [1]. Example logic for selection of subtitling track is given in Figure 4.

Figure 4. Example logic for selection of subtitling