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

Version 3.0

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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 June 2015. IRDs launched before that date shall conform either to the Unified Requirements specification V.2.0 [3] or V.3.0 by choice of the IRD manufacturer.

1.2 Version History

Version	Date	Comments
V. 1.0	10.10.2010	Release Ver. 1.0
V. 2.0	13.12.2011	Annual update
V. 3.0	18.12.2014	Third edition

1.3 References

[1] NorDig Unified Requirements for Integrated Receiver Decoders for use in cable, satellite, terrestrial and IP-based networks, version 2.5.1 (2014-08-25)

[2] Security requirements of digital HDTV receiver for the Finnish market, Version 2.0. (2011-12-13)

[3] Unified Requirements of HDTV DVB-C and DVB-T2 digital receiver for Finnish market, Version 2.0 (2011-12-13)

[4] Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems, ETSI TS 102 006, V1.3.2 (2008-07).

[5] CI Plus Specification – Content Security Extensions to the Common Interface v1.3.1

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

[7] Digital Video Broadcasting (DVB): Digital broadcasting systems for television, sound and data services: Specification for Service Information (SI) in Digital Video Broadcasting (DVB) systems, ETSI EN 300 468, V1.14.1

[8] Digital Broadcasting Systems for Television, Sound and Data Services; Guidelines on the Implementation and Usage of DVB Service Information, ETSI TR 101 211, V1.12.1.

[9] Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams, ETSI EN 300 472, V1.3.1. (2003-05)

[10] ETSI TS 102 796 1.2.1 Hybrid Broadcast Broadband TV

[11] TS 102 796 V1.2.1 Errata 1 dated 24 October 2013

[12] HbbTV specification v1.5, HbbTV Association 2012 (2012-03-16)

[13] OIPF Release 1 Specification Volume 5 – Declarative Application Environment [V1.1] – (2009-10-08)

[14] OIPF Release 1 Specification Volume 7 – Authentication, Content Protection and Service Protection [V1.1] – (2009-10-08)

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

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

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

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

[19] Marlin Developer Community, Marlin – Broadband Network Service Profile Specification, version 1.2
[20] Marlin Developer Community, Marlin – Simple Secure Streaming Specification, version 1.0
[21] Marlin Integration to Hybrid Broadcast Broadband TV, Version 1.0, Draft003
[22] Microsoft PlayReady http://www.microsoft.com/playready/default.mspx
[23] PlayReady Documentation CHM file, available to PlayReady licensees, version 2.0
[24] PlayReady Format Specification, included in MSPR1, version 2.0
[25] PlayReady Integration to HbbTV Specification, version 1.0
[26] PlayReady Binding to MPEG-DASH Specification, version 1.0

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
DASH	Dynamic Adaptive Streaming over HTTP
DRM	Digital Rights Management
DTT	Digital Terrestrial TV
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
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
MMI	Man-Machine Interface
NIT	Network Information Table
ONID	Original Network ID
OTA	Over-The-Air

PAL	Phase Alternating Line
PCM	Pulse Code Modulation
PSI	Program Specific Information
PVR	Personal Video Recorder
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
UHF	Ultra High Frequency
VHF	Very High Frequency

2 Scope

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

Common requirements for all IRDs are specified in chapters 1 - 12. Additional requirements for PVR IRDs are specified in chapter 13 and additional requirements for Hybrid IRDs are specified in chapter 14. The annexes are explanatory and intended for informative purposes.

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

When IRD supports multiple transmission media, IRD shall be validated as follows:

- IRD contains DVB-C tuner, it shall be validated for Finnish Cable Ready HD requirements.
- IRD contains DVB-T/T2 tuner, it shall be validated for Finnish Antenna Ready HD requirements.

3 Background

Digital terrestrial and cable television broadcasts were started in Finland in 2001. Analogue switchoff was completed in Finnish Terrestrial networks in September 2007 and in Finnish Cable networks in March 2008. No analogue broadcasts are available in either Cable or Terrestrial. Currently digital television covers 99,9% of Finnish people.

First HD broadcasts began in Cable networks in late 2008 and HD services were introduced to terrestrial networks simultaneously with DVB-T2 in November 2010. Cable and Terrestrial operators offer both free-to-air and pay-tv services in both standard and high definition.

In Finland approximately 54 % of households are connected into Cable and/or IPTV network and approximately 40 % of households into Terrestrial network.

Latest information on the current situation can be found at FiCom website *http://www.testatutlaitteet.fi/* following the link 'Briefly in English'.

3.1 Finnish Digital Television - Terrestrial Networks

Finnish Digital Terrestrial Network consists of three different networks. As per the status of December 2014 networks are:

- DNA DVB-T2 network
- Digita DVB-T and DVB-T2 networks

In some parts of Finland it is possible to receive digital terrestrial channels from the neighboring countries Sweden, Norway, Estonia and Russia.

All Finnish Digital Terrestrial Networks share the same Original Network ID (0x20F6). Each service can be uniquely defined by the DVB triplet (ONID, TSID and SID).

NorDig Unified specification [1] best service selection shall be applied, since Digita DTT network services can be received from multiple frequencies depending of the region. For the networks NorDig Unified specification [1] SFN rules shall also be applied.

DVB-SI information may not be cross-distributed between the networks, but it is cross-distributed within each network. All networks utilize NorDig LCN numbering and this numbering should not conflict between the networks.

Encrypted services in Finnish DTT networks are scrambled using the Conax CAS.

3.2 Finnish Digital Television - Cable Networks

The biggest cable television operators are DNA/Welho, Elisa, TeliaSonera and Anvia. These operators also act as super-head-end operators for digital television services.

Cable operators collect their signals from the Finnish digital terrestrial networks and digital satellite transmissions from available satellites. Some additional locally distributed and generated signals are also transmitted. Cable TV operators may also exchange signals between each other.

The free TV signals on the Finnish digital terrestrial network are mostly publicly available all around the Cable networks. Other services are usually offered as a part of pay-TV packages. Encrypted services in Finnish Cable networks are scrambled using the Conax CAS. Simulcrypt with other CA systems may exist on some of the networks.

4 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 as specified in the NorDig Unified specification [1].
4. HE-AAC Level 4, E-AC-3, AC-3 and MPEG1L2 audio including downmix, transcoding and pass-through shall be all supported as specified in the NorDig Unified specification [1].
5. CI+ interface v1.3 or later and/or embedded CA system.
6. IRD with embedded CA system shall have Conax with chipset pairing [2]. Support for Conax messaging, link protection and secure fingerprinting are optional.
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 downconverted to the analogue outputs.
8. Support for tuning analogue signals is optional.
9. HbbTV, if implemented, shall be v1.5.

4.2 Video requirements

The IRD shall comply with the video requirements as specified in the NorDig Unified specification [1].

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 one of the available audio tracks is 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 B.

5 IRD Installation

5.1 IRD Installation – General requirements

IRD first time installation shall be a guided procedure. 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
iv. Automatic scan

5.1.1 Language selection

Finland has two official languages. Finnish is spoken by 90% of the population and Swedish by 6%.

IRD user interface shall be available at least in Finnish, Swedish and English languages.

Primary audio language and primary subtitling language shall be set by the user selection in the first time installation.

Secondary audio language and secondary subtitling language should be set to e.g. another of the two official languages.

5.1.2 Country selection

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

5.1.3 Signal source selection

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.

5.1.5 Services with multiple LCN numbers

The IRD shall support multiple LCN numbers for a same service. The operators may broadcast a service with the same ONID, SID and TSID triplet simultaneously with up to 8 different LCN numbers. IRD shall present such services in the service list on as many channel positions as they are signaled in the NIT table.

5.2 DVB-T/T2 requirements

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. Scan shall continue with UHF IV – V bands using 8 MHz raster and bandwidth
3. Both DVB-T and DVB-T2 shall be scanned
4. Automatic scan shall enable automatic service list updates. Consequently IRD shall detect and react to all SI changes.
5. 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 list and LCN requirements

Service lists shall be built based on the priority for LCN numbers for services which have *original_network_ID* of Digital Terrestrial Television in Finland (0x20F6). 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

There are several independent networks with ONID 0x20F6 and all of them shall be simultaneously selectable. The NorDig LCNv2 channel list names for these networks should not be visible.

5.3 DVB-C requirements

5.3.1 Automatic scan

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

1. Search shall cover the following transmission parameters and their combinations:
2. Carrier frequencies: 114MHz + N x 8MHz, where N is an integer in the range 0 to 93
3. Modulation modes: 16QAM, 64QAM, 128QAM, 256QAM
4. 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.
5. Automatic detection of modulation mode and symbol rate is highly recommended.
6. 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.
7. IRD shall assume the found *NIT_actual* table is up to date and consistently describes the whole cable network.
8. 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.
9. IRD shall install the services using the information acquired from the *NIT_actual* and *SDT_actual* tables of each multiplex.
10. After all multiplexes have been tuned, IRD shall not scan the other remaining frequencies.
11. Automatic scan through the full frequency range shall take no more than 15 minutes in worst case.

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

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

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

1. 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.
2. Default service lists after automatic scan shall include all found TV and Radio services.
3. IRD may support user-defined service lists or 'favorite service lists', which can be edited and sorted by the user.
4. 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.
5. Default service list shall be deleted by performing a factory reset. There may additionally be a dedicated menu item for service list deletion.
6. The service lists shall not be deleted without user approval.

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 waken 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. In case of PVR IRD, automatic service list updates shall not disturb the active and scheduled recordings.
9. IRD shall not consider total loss of reception (for example caused by antenna cord removal) as a network evolution.

6.2 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.

6.3 System time

IRD shall have a continuously running real-time clock as specified in the NorDig Unified specification [1]. By default this real-time clock shall be acquired from the network using TDT/TOT tables.

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. The 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. The IRD shall display at least the transmission parameters that are required for tuning the selected multiplex manually.
3. Network name shall be available for the user.

8 System Software Update (SSU)

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

1. Default SSU functionality shall have automatic search for the SSU enabled.
2. IRD shall support SSU file broadcasted with bitrate down to 64 kbps (without IRD timing out due to slow download).

3. Fully automatic or semi-automatic SSU functionality shall not disturb active and scheduled recordings.

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 from the menu.
3. IRD shall indicate which one of the available subtitling tracks is 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 shall be selected according to the currently selected user interface language, if multiple initial teletext pages are 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 [9].
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 serial number, system software version and hardware version information shall be available for the user in the menu.
3. Time in the user interface shall be displayed as the local time with daylight saving. Time shall be displayed using 24h notation. Date should be presented as ‘day.month.year’.

11 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.

12 IRD accessories and packaging

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)

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)

13 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.

13.1 General PVR requirements

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.

PVR IRD supporting external USB mass media for PVR storage should be able to provide 1.5A current on 5V for a USB 2.0 or higher port dedicated for the recording target in order to minimize chances for power shortage for USB-powered mass media.

13.2 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.

13.2.1 PVR IRD with integrated CA system

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.

13.2.2 PVR IRD with CI+

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].

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.

13.3 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.

13.4 Service and event metadata

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

13.5 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.

13.6 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.

14 Interactive Profile and HbbTV

IRD following the Interactive Profile shall support all mandatory features and requirements of HbbTV v1.5 as specified in ETSI TS 102 796 v1.2.1 [10] specification (including HbbTV Errata [11]), NorDig Unified Specification [1] plus the extensions in this document. It is expected that most of these extensions will be incorporated into the next version of the HbbTV specification.

IRD shall support either Marlin DRM or Microsoft PlayReady DRM. In the future, additional DRMs may be required according to the evolution of the market.

14.1 Receiver capabilities signaling

14.1.1 Application/oipfCapabilities object usage (informative)

The device capabilities are returned by the application/oipfCapabilities object that is defined in section 10.3 of [10] and required by section 7.2 of the present document.

The xmlCapabilities property of the application/oipfCapabilities object shall provide the DRMSystemID of the DRM supported by the receiver, as defined in section 9.3.10 of [13].

14.2 HbbTV services integration with Receiver native UI

14.2.1 Applications visual signalling

The user interface displayed on channel change is the responsibility of the receiver manufacturer. However, the presence of broadcast-related HbbTV services may be indicated to the consumer in this user interface.

This information shall be presented whenever this UI is recalled (e.g. when pressing “INFO” button or equivalent).

14.2.2 Applications launching

It is accepted that the receiver UI may need to temporarily "gain focus" and use some keys requested by the running HbbTV application. This may be when the receiver requires the user to interact with the system user interface, for example a dialogue box saying "You have lost broadband connection. Press RED to close this message", or a CI+ MMI message.

It is the responsibility of both the receiver implementation and the application implementation to ensure that starting and stopping applications does not cause any A/V glitch when that application has not modified the broadcast video.

14.2.3 Synchronization

It is expected that "do it now" stream events support, as mandated by HbbTV, will be sufficient. A "do it now" event should be executed by the receiver in less than 2s.

This duration shall be measured between the "do-it-now" event occurring in the Transport Stream at the input of the receiver, and the call to the corresponding function registered with "addStreamEventListener".

14.2.4 Reliability

Broadcasters shall take every precaution necessary to ensure their applications conform to the specifications and do not use any non-specified extensions. HbbTV applications shall be properly tested before being deployed. To preserve a positive perception of interactivity by the end user, it is also important that the HbbTV software implementation ensures a good level of robustness regarding faulty applications and low resources availability (e.g. insufficient memory).

Therefore it is required that receiver manufacturers take every precaution necessary to prevent an HbbTV application to alter or crash the whole software of the receiver, and shall ensure the receiver can continue to operate under the following conditions:

1. An application is opened and closed by the user 20 times consecutively
2. The user changes the program selection before the application has been completely loaded, whether from broadcast or broadband.
3. The receiver downloads, or attempts to download an XML, HTML, or media file, which has been truncated.
4. A broadband application download is prematurely interrupted by a TCP connection reset, or a sustained packet loss.
5. A broadcast application download is prematurely interrupted by a carousel removal on the broadcast side.
6. The receiver attempts to download an initial HTML page, with a file size of 100MB (for the avoidance of doubt, it is not required that such a page can be properly loaded and rendered)
7. An application attempts to carry out operations requiring more memory than the receiver has available. (For example, creation and initialization of an arbitrarily large array)
8. The browser raises exceptions that are not explicitly caught by the application
9. An application enters an infinite loop (including infinite recursion)

In all of these cases the receiver shall remain responsive to channel change requests.

During the execution of an application, the exit function (see below) shall terminate the application in all circumstances.

14.2.5 EXIT function

HbbTV specification [10] describes an "EXIT or TV or comparable button" in Table 15 with a status of optional. This function shall be mandatory for receivers. Its role shall be to terminate the currently running HbbTV application, as described in [10] section 6.2.2.1 ("Directly by the user").

Note that exiting a broadcast-related application results in the autostart application of the current channel being re-started from the beginning. It does not offer the possibility to exit from HbbTV.

14.3 Streaming Protocols

14.3.1 Constant Bit Rate Streaming

Support for unicast streaming that is defined in clause 7.3.2.1 of [10] is required.

14.3.2 Adaptive Bit Rate Streaming

Support for adaptive streaming that is defined in Annex B of [12] is required.

For the avoidance of doubt, the support of Segments being delivered over https and the support of MPD delivery over https are not mandated by the present document.

14.3.3 DASH Profile Mapping to Audio/Video media format (informative)

For the avoidance of doubt, it is reminded that support of the Base media file format live profile implies that the receiver is able to decode streams when each „moof" box contains only one track fragment box „traf" and the associated media data box „mdat" contains only the media samples referenced from that track fragment box.

14.3.4 ABR Trick Modes Support (informative)

The receiver shall allow the HbbTV application to control the Play, Pause, Stop, Fast Forward and Fast Rewind keys as defined in [10]. This will enable the service provider to disable trick modes when required.

Note: 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.

14.3.5 Content Protection System Signalling

In case content is protected by one or more of the required DRM system(s), these DRM system(s) shall be identified in the DASH MPD using the schemeIdUri attribute of the ContentProtection element of a Representation, or of a Group of Representations.

14.3.6 Content Encryption

Content protected with a DRM shall be streamed using [17] in compliance with Section 7.2.3 of this document. Support for [15] that is defined in Annex C of [12] is required by this specification.

For the avoidance of doubt, the receiver is not required to support DRM encryption for content not streamed using [17].

For all DRMs providing Content Protection on the hybrid platform, the DRM/HbbTV integration will be based on the principles as defined in Section 7.6 of [13].

Receiver manufacturers shall implement at least Marlin or PlayReady DRM.

Receivers shall comply with the relevant DRM vendor robustness and compliancy rules, and special care shall be taken when implementing the DRM secure key box in the receiver.

14.3.7 Marlin

When Marlin is supported by the receiver:

- Receivers shall support the Receiver-Centric approach as defined in Section 4.1 of [14] and [13]. Receivers shall further support Marlin Simple Secure Streaming as per [18] and [21].

14.3.8 PlayReady

When PlayReady is supported by the receiver:

- Receivers shall support Microsoft PlayReady as per [25] and [26] to allow Content Protection operations and Protected Content consumption.
- For PlayReady signaling to the HbbTV application, the CA System ID to be used is provided in [25]
- For PlayReady signaling in the MPEG-DASH asset, the format and values to be used (including SystemID) are provided in [26] and [24]
- The specifications are provided by Microsoft to PlayReady licensees.

14.3.9 DRM private information handling

If DRM private data are available in the DASH MPD and in the „pssh" box located in the „moov" box, the receiver shall use the information from the MPD.

If DRM private data are available in the DASH MPD and in the „pssh" box located in the „moof" box, the Receiver shall use the information from the „pssh" box.

14.4 Protection of Broadcasters Signals

14.4.1 Display model for television services

When the video plane of the receiver as specified in Section 10.1.1 of [10] is displaying content provided by a service provider, either broadcast or broadband, full screen or resized, the following restrictions shall apply:

1. The usage of the HbbTV application graphic plane is reserved for the applications under the control of the broadcaster (i.e. signalled in the AIT or launched by an application signalled in the AIT).
2. CI+ MMI messages and the receiver system UI are allowed to use the receiver-specific application graphic plane.

14.4.2 Broadband Content Recording

It shall not be possible for the user to directly initiate the recording of broadband delivered content onto any form of local storage when that content has been requested by an HbbTV application. Attempting to record by pressing a REC button or equivalent shall be ignored.

14.5 Receiver & Application Security

14.5.1 Receiver Security – Software and Hardware Requirements

Interactive Profile IRD shall be compliant with the compliance and robustness rules of the supported Conax CAS and DRM solutions which may have impact on the overall design and manufacturing of the receiver.

14.5.2 HbbTV Application Security (informative)

This aspect of the trust model considers how a receiver may trust applications that are downloaded and run.

In an HbbTV model, there are two possible sources for applications, including broadcast and broadband channels. It is important for the platform trust model to address what HbbTV applications may be allowed to run, and for those that can run, what functionality they are allowed to access.

14.5.3 Broadcast-Related Application Authentication

In this case, the authentication of an application coming from the broadcast network is implicit. Inserting an application in a broadcast signal by an unauthorized person is not so easy, hence considering a broadcast application as trusted and authenticated by default can be accepted.

14.5.4 Broadcast-Independent Application Authentication

This is out of scope of this document.

Annex A 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*.

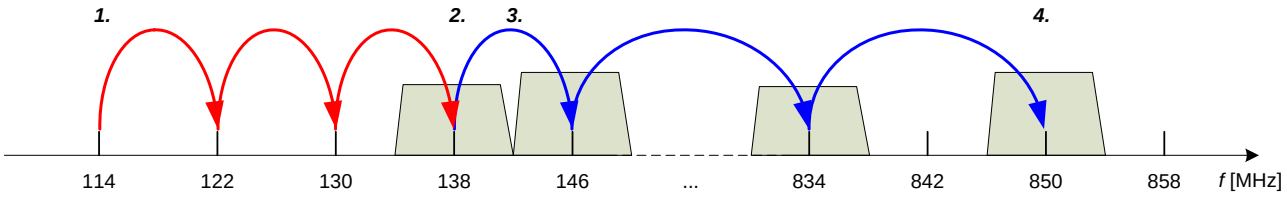

Figure 1. Example of Automatic scan in DVB-C network of four multiplexes

Annex B Signalization of the visual impaired audio

Broadcast-mixed Visual impaired audio is commonly available in domestic broadcasts in Finland. For example, Finnish Broadcasting Company (Yle) provides visual impaired audio for all subtitled events.

As per the status in December 2014, the Finnish broadcasters signalize the Visual Impaired audio in the following manner due to compatibility with legacy IRDs.

Broadcaster updates the PMT table 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 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.

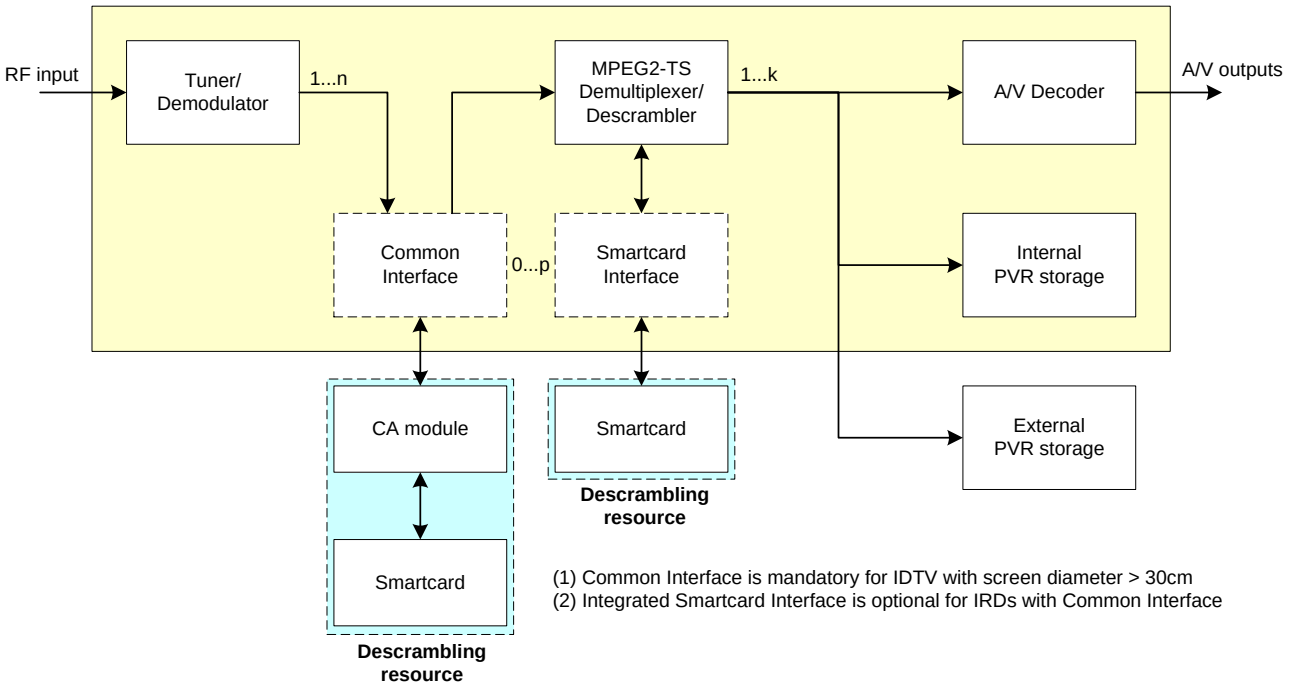

Figure 2. Simplified PVR IRD block diagram

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.

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.

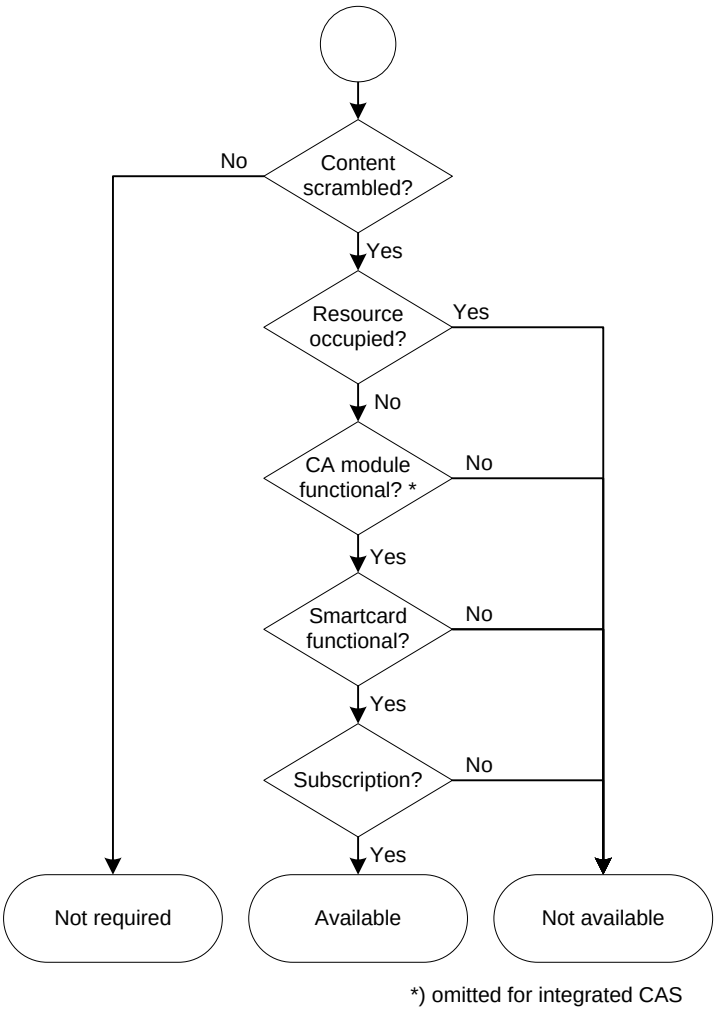

Figure 3. Example check on descrambling resource availability

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 [13].

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 [14].

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.