

Digital Terrestrial TV Receiver Specification

Minimum Technical Requirements for the Swedish Digital Terrestrial Network

Revision

1.0

Date

2002-05-06

Receiver Specification

Uppgjord - Prepared Ptu,Mnr,Phy,Pap,SB,Est,Yng	Faktaansvarig - Subject responsible Ptu,Mnr,Phy,Pap,SB,Est,Yng	Nr - No.			
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1 Introduction

1.1 Scope

This document specifies the minimum receiver requirements for the Swedish Digital Terrestrial TV (S-DTT) network. This receiver is hereafter denoted as an Integrated Receiver Decoder (IRD). The IRD shall be DVB compliant, able to receive MPEG-2 Transport Streams from a DVB-T modulated signal and to decode and de-scramble the services within.

Services within the S-DTT are normally scrambled with Conditional Access System from Viaccess.

The IRD may be equipped with or without an Application Programming Interface (API) activated. If activated then it shall be OpenTV EN1 (or higher). Currently transmitted API applications are based on OpenTV, but in the future a migration to DVB MHP is expected.

An IRD without an API activated is hereafter denoted to as a Zapper IRD.

The requirements in the network are based on the NorDig receiver specifications (www.nordig.org) and to be more precise for the receivers, the NorDig II receiver specification. The current version of NorDig II specification (v1.0) however defines (mainly) IRDs with an API activated (DVB MHP v1.1) and not (so well) the integrated IRDs in the TV Set (iDTV).

Note: NorDig are at this present stage, spring 2002, evaluating a NorDig specification for Zapper based on the NorDig II specification.

This specification defines the requirements for a S-DTT Zapper IRD and is based on the NorDig II specification with some additions, changes and relaxations. Future revisions of this specification are intended to include more (or all) categories of IRD for the S-DTT (see definition in section 2).

If nothing else is mentioned in this document, the (minimum) receiver and transmission shall first of all comply with at least the mandatory (shall) requirements in the following specification (in order of priority):

- NorDig II Digital Integrated Receiver Decoder Specification, v1.0

Note: All "should" requirements in the NorDig II shall, if nothing else is mentioned in this specification, be considered as "not mandatory".

- ETSI ETR 154, EN 300 468, ETR 211, ETR 162, EN 300 744

The current S-DTT network have the following additional requirements:

- Application Programming Interface (API); OpenTV EN1
- Conditional Access; Viaccess CA
- Senda AB Viaccess Smart Card (SMC).

Also in addition referring to the EACEM specification "Baseline Digital Terrestrial TV Receiver Specification" (TR-030 version 1.1) as a guideline for the IRD's behaviour where applicable and some issues are taken from that specification into this (this EACEM is the same as the IEC 62216-1, "Digital terrestrial television receivers for the DVB-T system – Part 1: Baseline receiver specification").

Although this specification is based on the NorDig II and its requirements, a new document structure is used. Table 1 provides a comparison with NorDig II document structure and information on how the requirements in NorDig II is used (relaxed, changed, clarified or new requirements).

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Table 1: Comparison of document structure in this specification and NorDig II

Chapters in this specification		Chapter in the NorDig II specification	Comment
2	General features for a digital receiver	(2)	
3	Frontend	3	This section (in this specification) complete replaces the text provided in the NorDig II specification.
4	MPEG-2 Demultiplexer and decoder	4, 5, 6	Relaxed requirements (and clarifications) in relation to Nordig II.
5	Teletext and Subtitling	14	Relaxed requirements (and clarifications) in relation to Nordig II.
6	Service Information (SI)	12	Additional requirements to NorDig II to support specific S-DTT SI signalling requirements.
7	Navigator and service lists	13	Additional requirements in relation to NorDig II
8	Receiver states	-	New requirements (installation, scanning, etc.)
9	Controller and Memory	7	Relaxed and additional requirements in relation to NorDig II.
10	Graphics Processing	8	Relaxed requirements (and clarifications) in relation to Nordig II.
11	Interface and signal levels	9, 15	Relaxed and additional requirements in relation to NorDig II.
12	The remote Control	16	Relaxed requirements (and clarifications) in relation to Nordig II.
13	Performance	10	Relaxed requirements (and clarifications) in relation to Nordig II.
14	User preferences	17	No changes from NorDig II
Annex A	The S-DTT network enviroment	-	Informationatiol (not covered in NorDig II)
<i>Note: Chapter 11 in NorDig II is not covered in this specification since it focus on API requirements.</i>			

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1.2 Document History

Version	Date	Comments																																										
0.044	2002-03-18	First draft version. Only covers Zapper STB																																										
0.045	2002-03-22	Updated draft version,																																										
1.0	2002-05-06	<div>First final version, with the following (main) changes from PA0045:</div> <table><tr><th>Section</th><th>Comment</th></tr><tr><td>2</td><td>Minimum key functions and interfaces are updated for a zapper IRD,<ul style="list-style-type: none">- a PAL mod and a RF by-pass is changed from mandatory to recommended- version of embedded Viaccess CA is corrected to v1.2 from v1.1- video and audio interfaces changes to min one of: SCART or PAL mod</td></tr><tr><td>3.1.8</td><td>Editorial change, table 4 moved from 3.1.8.1 to 3.1.8 and clarifications made in 3.1.8.1 and 3.1.8.2.</td></tr><tr><td>4.2</td><td>Revised (clarified) the multi-channel recommendation to be a down-mix</td></tr><tr><td>4.3</td><td>Embedded Viaccess CA v1.2 moved from section 11.2</td></tr><tr><td>5.1</td><td>Editorial changes (clarifications) regarding teletext</td></tr><tr><td>5.3</td><td>Editorial changes (clarifications) regarding teletext</td></tr><tr><td>6.3</td><td>Revised and changed with new requirements regarding IRDs dynamic updates for changes in transmitted SI</td></tr><tr><td>6.3.1.1</td><td>New informative section</td></tr><tr><td>6.3.9</td><td>Revised and changed (removed) the text of this optional requirement</td></tr><tr><td>6.3.10</td><td>Editorial changes</td></tr><tr><td>6.3.11</td><td>New informative section</td></tr><tr><td>7.2.3</td><td>Requirement moved from 8.2.2</td></tr><tr><td>7.2.4</td><td>Requirement moved from 8.2.3, with some new requirements</td></tr><tr><td>7.2.5</td><td>Requirement moved from 8.2.4, with some smaller changes</td></tr><tr><td>8.1.1</td><td>Moved from section 8.1 to this new section</td></tr><tr><td>8.2</td><td>(Normal) Active mode, new section/text</td></tr><tr><td>8.3</td><td>(Automatic) Update mode, new section/text</td></tr><tr><td>8.4</td><td>Stand-by and power off mode, new section/text</td></tr><tr><td>9.3</td><td>Clarification of erroneously received packets for System Software Download</td></tr><tr><td>11.2</td><td>New requirement for any Common Interface, to guarantee operation with a Viaccess CA Module</td></tr></table>	Section	Comment	2	Minimum key functions and interfaces are updated for a zapper IRD, <ul style="list-style-type: none">- a PAL mod and a RF by-pass is changed from mandatory to recommended- version of embedded Viaccess CA is corrected to v1.2 from v1.1- video and audio interfaces changes to min one of: SCART or PAL mod	3.1.8	Editorial change, table 4 moved from 3.1.8.1 to 3.1.8 and clarifications made in 3.1.8.1 and 3.1.8.2.	4.2	Revised (clarified) the multi-channel recommendation to be a down-mix	4.3	Embedded Viaccess CA v1.2 moved from section 11.2	5.1	Editorial changes (clarifications) regarding teletext	5.3	Editorial changes (clarifications) regarding teletext	6.3	Revised and changed with new requirements regarding IRDs dynamic updates for changes in transmitted SI	6.3.1.1	New informative section	6.3.9	Revised and changed (removed) the text of this optional requirement	6.3.10	Editorial changes	6.3.11	New informative section	7.2.3	Requirement moved from 8.2.2	7.2.4	Requirement moved from 8.2.3, with some new requirements	7.2.5	Requirement moved from 8.2.4, with some smaller changes	8.1.1	Moved from section 8.1 to this new section	8.2	(Normal) Active mode, new section/text	8.3	(Automatic) Update mode, new section/text	8.4	Stand-by and power off mode, new section/text	9.3	Clarification of erroneously received packets for System Software Download	11.2	New requirement for any Common Interface, to guarantee operation with a Viaccess CA Module
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1.3 Terminology

Mandatory / shall

This word means that the item is mandatory.

Recommended / should

This word means that this item is not mandatory, but is highly recommended. If included, then it shall be implemented as specified.

Optional

This word means that this item is not mandatory, gives added value to different IRD implementations. But if this item is included then it shall be implemented as specified here.

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1.4 Definitions

IRD	All type of digital Integrated Receivers Decoders
Zapper IRD	A baseline IRD with <u>no</u> API activated for downloaded applications (and with minimum hardware), mainly for basic TV services viewing.
API IRD	An IRD with API activated for downloaded applications (OpenTV EN 1 or DVB MHP v1.1), enabling interactive TV services.
STB	External IRD that is <u>not</u> integrated in the TV Set, i.e. with no built-in monitor/projector and speakers. (Could be equipped with hard disc and/or DVD player functions etc).
iDTV	An IRD that is integrated in the TV Set.
EPG	A downloadable application that may use SI with other features to present information about services, events subscriptions etc. (A comprehensive program guide, normally a transmitted data application that will have the same look on all IRDs).
ESG	A native service navigator that uses the SI to present information of the service's events. (A basic program guide).
Multiplex	An (DVB-T modulated, COFDM) MPEG-2 Transport Stream. (Physical broadcast) interface to the receivers
DVB-T channel	Same as Multiplex above
National multiplex	A DVB-T Multiplex that is transmitted from all (applicable) transmitter sites for that multiplex ("all" of Sweden) and contains the same services and content out from all sites at all time. (Only some SI might differ from one transmitter site to another one).
Regional multiplex	A DVB-T Multiplex that is transmitted from a region (a subset) of all transmitter sites for that a multiplex and for that region contains the same services and content out from all sites at all times. The service bouquet might differ from one region to another.
Network	The coverage area of a group of transport stream, i.e. if several covers the same area they belong to the same network.
Region	A subset of transmitter sites that transmit the same multiplex/(services) A geographical area that has identical services contains at least two networks. This area is identical to the area that covers the licensee regions.
S-DTT	Swedish Digital Terrestrial Television
Service	Is defined by a sequence of events that are broadcast over a longer period of time on the same "logical" place. Here we use the same definition as DVB and therefore a 'service' (service_id) is per definition the same as a 'program' (program_number) as defined by the MPEG group (ITU-T H.222.0)
National service	A service that is transmitted from all transmitter sites for that multiplex.
Regional Service	A service that is transmitted only from a subset (a region) of all transmitter sites for that multiplex. But for all regions that the service belongs to, it is transmitted out from all transmitter sites within these region(s). A regional service only belong to a subset of regions for that multiplex, so if a regional service belongs to all regions for that multiplex, it is a national service.

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1.5 List of Abbreviations

API	Application Programming Interface
BAT	(DVB SI) Bouquet Association Table
bslbf	bit string, left bit first
CA	Conditional Access
CAS	Conditional Access (CA) System
CAM	Conditional Access Module
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcast
EACEM	European Association of Consumer Electronic Manufactures
EIT	(DVB SI) Electronic Programme Guide
EPG	Electronic Programme Guide
EPT	(DVB-T) Effective Protection Target
ESG	(DVB SI) Event Schedule Guide
IRD	Integrated Receiver Decoder
MFN	Multiple Frequencies Network
MHP	Multimedia Home Platform (API)
MPEG	Moving Picture Expert Group
N/A	Not Applicable
NID	(DVB SI) Network Identifier
NIT	(DVB SI) Network Information Table
NVOD	Near Video On Demand
ONID	(DVB SI) Original Network Identifier
OSD	On Screen Display
p/f	(DVB SI) Present / Following (event)
PSI	(MPEG) Programme Specific Information
QEF	(DVB-T) Quasi Error Free (reception)
S-DTT	Swedish DTT (Digital Terrestrial Television)
SID	(DVB SI) Service Identifier
SDT	(DVB SI) Service Description Table
SFN	(DVB-T) Single Frequency Network
SI	(DVB) Service Information
sch	(DVB SI) Schedule (event)
SMC	(CA) Smart Card
TDT	(DVB SI) Time and Date Table
TOT	(DVB SI) Time Offset Table
TS	(MPEG) Transport Stream
TSID	(DVB SI) MPEG-2 Transport Stream Identifier
uimsbf	Unsigned integer most significant bit first
UTC	Universal Time, Co-ordinated

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2 General features for a digital receiver

The IRD for the Swedish Digital Terrestrial TV Network (S-DTT) shall unless explicitly stated in this document, follow the requirements given by the NorDig II specification. This document defines a set of IRD classes as shown in figure 1, that will be used throughout this document. The IRD can be divided into the following categories:

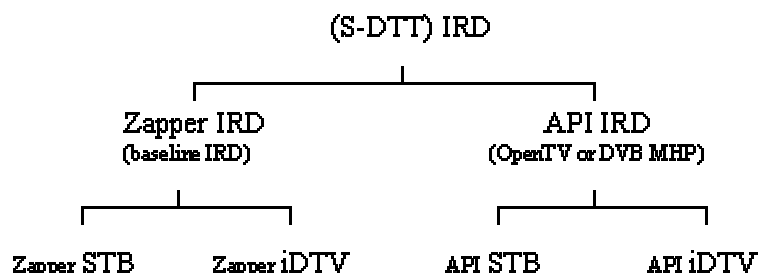


Figure 1: Definition of different categories of the Swedish Digital Terrestrial TV (S-DTT) IRDs

- A Zapper IRD is an IRD without any API (activated).
- An API IRD is an IRD with an API (activated). (OpenTV and/or for the future DVB MHP)
- A STB is an IRD, (Zapper IRD or API IRD) which is a separate unit from the TV Set
- An iDTV is an IRD, (Zapper IRD or API IRD) which is a integrated into the TV Set

To this, there is also IRD implementations as a PC Card, up till today it has not been decided in which category these belongs to. Until it is defined, these cards together with the PC can be treated as an iDTV.

This means, when using 'IRD' it refers to all types of receivers (i.e. zapper IRD and API IRD). When using 'Zapper IRD' it refers to both Zapper STB and to Zapper iDTV and so on.

Table 2 and 3 provides a general overview of the mandatory, optional and recommended features and interfaces for the all the different categories of IRDs defined in this specification. This version of the specification only focus on the Zapper STB, thus the other columns in the table are only provided as an indication of the (draft) differences in requirements between the different classes of IRDs. (If a recommended or optional item in the list below is included in an IRD, then it shall be implemented as specified).

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Table 2: The key minimum functions to be included in an IRD for the S-DTT

Receiver Type Model API	IRD class				
	Zapper		API IRD		
	STB	iDTV	STB	iDTV	
	-	-	OpenTV	MHP	MHP
Key Features					
Based on NorDig II v1.0 specification	subset	subset	Subset	Full	“Full”
Terrester RF tuner/demodulator					
RF front-end, COFDM, 8k (and 2k)	M	M	M	M	M
RF by-pass	R	O	M	R	O
RF modulator	R	O	M	R	O
PAL B/G decoder for analogue services	O	R	O	O	R
MPEG-2 Demultiplexer incl DVB descrambler	M	M	M	M	M
At least one of the following: Embedded CAS, (Viaccess 1.2) and/or Common Interface (for CA Module)	M ¹⁾	M ¹⁾	M ¹⁾	M ¹⁾	M ¹⁾
MPEG-2 Video and Audio Decoder	M	M	M	M	M
EBU Teletext, built-in level 1.5 decoder	R	M	R	R	M
EBU Teletext, the subset subtitling decoder	M	M	M	M	M
DVB Subtitling, (minimum NorDig subset)	M	M	M	M	M
System software update (bootloader/download)	M	M	M	M	M
DVB PSI & SI, Navigator	M	M	M	M	M
Automatic updating and Automatic Scanning	M	M	M	M	M
Graphics Processor, OSD	M	M	M	M	M
Remote Control	M	M	M	M	M
Application Programming Interface, API					
DVB MHP v1.1	-	-	O	M	M
OpenTV EN1	-	-	M	O	O
Interaction Channel	O	O	R	M	M
M Mandatory item to include R (Highly) Recommended item to include O Optional ¹⁾ Embedded CAS is highly preferred in the S-DTT					

Any embedded CA System for use in the Swedish DTT, shall be Viaccess System version 1.2 or later and then labelled by Viaccess

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Below, in Table 3, lists of interfaces that is mandatory, recommended or optional in the S-DTT, for the different types of IRDs. (The included reference, refers to the belong chapter in the NorDig II Specification).

Table 3 The minimum interfaces to be included in an IRD for the S-DTT

Receiver Type Model API	IRD class				
	Zapper		API IRD		
	STB	iDTV	STB	iDTV	
	-	-	OpenTV	MHP	MHP
Physical Interfaces					
RF front, input, terrestrial,	M	M	M	M	M
RF front, output, (by-pass, PAL modulator)	R	O	R	O	O
At least one the following video and audio outputs: SCART 1, TV RF PAL modulator	M				
SCART 1, TV	R	-	M	M	-
SCART 2, VCR	R	R	M	M	R
Analogue Audio Interface, (2 RCA)	R	O	M	M	O?
Digital Audio Interface (S/PDIF)	R	R	R	R	R?
Common Interface (main)	O ²⁾	O ²⁾	O ²⁾	M	O ²⁾
Additional Transport Stream Input	-	-	O	O	O
Smart Card Interface 1	M ³⁾	M ³⁾	M	M	?
Smart Card Interface 2, additional	-	-	-	M	?
Local port for SW upgrade (e.g. RS232)	R	O	R	M?	O
Interaction Channel Interface	-	-	R	M	R
Additional Data Interface	-	-	-	O	-
Remote Control Interface (e.g. IR)	M	M	M	M	M
Remote Keyboard Interface	-	-	O	O	O
M Mandatory item to include R (Highly) Recommended item to include O Optional ²⁾ Optional only if embedded CAS is included ³⁾ Mandatory only if embedded CAS is included					

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Figure 2 below shows all the mandatory and recommended functions and interfaces for the Zapper STB.

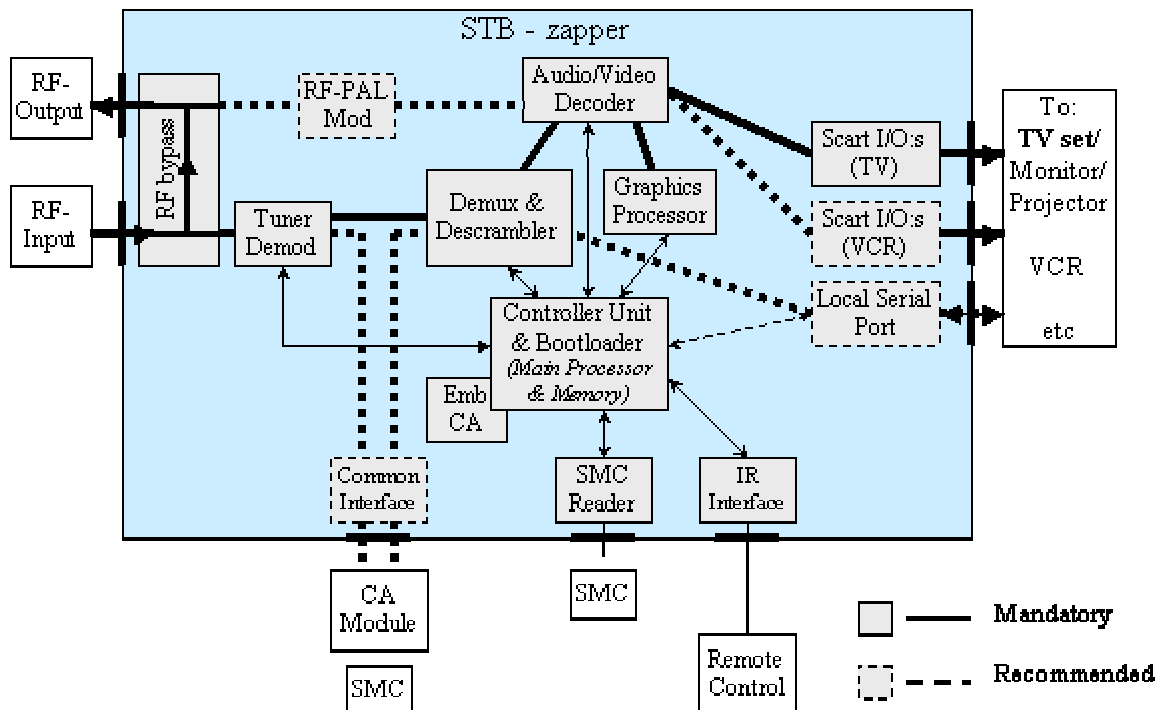


Figure 2: **Zapper STB**. Mandatory and recommended functionality of the hardware and firmware for an external digital receiver, Set Top Box (STB), without any API. Alternatives exist for the CA System and Video and audio interface, as described in table 2 and 3

Figure 3 below is provided as an indication on the outline of the Zapper iDTV (only informational in this specification since the detailed requirements is not yet defined).

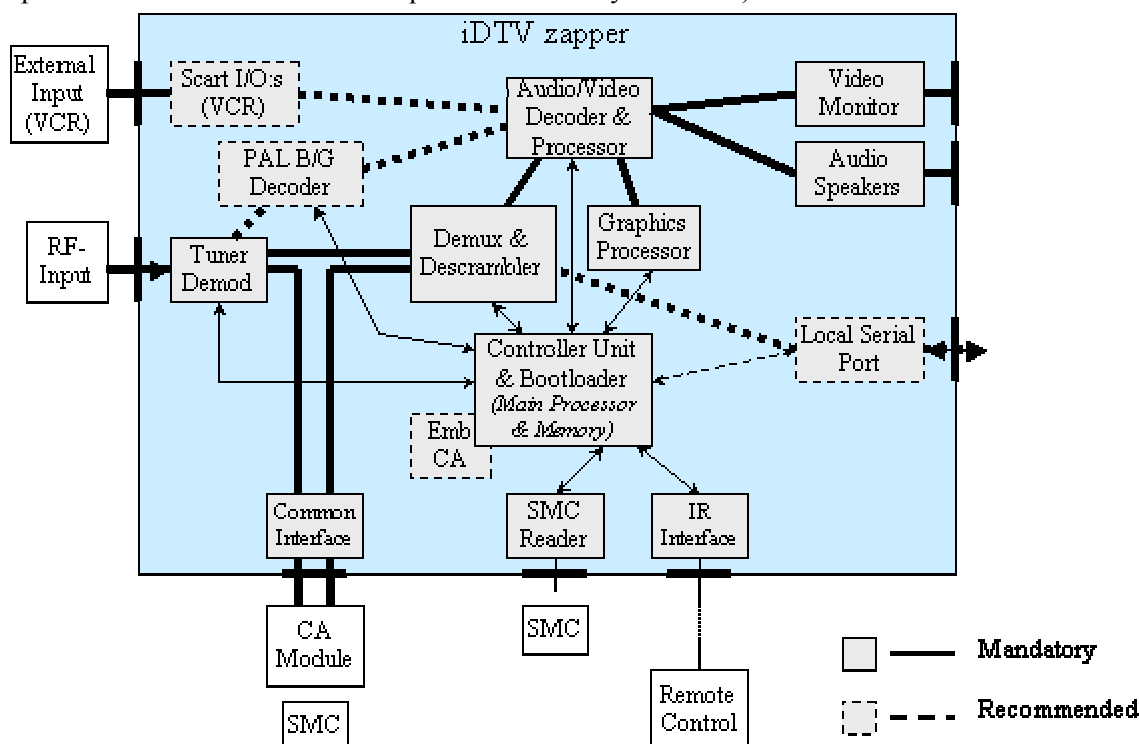


Figure 3: **Zapper iDTV**. Mandatory and recommended functionality of the hardware and firmware for an integrated digital TV receiver (iDTV), without any API (draft, to be revised). Alternatives exist for the CA System and Video and audio interface, as described in table 2 and 3

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2.1.1 Package

The receiver shall minimum include in its package:

- a paper manual in Swedish and/or optional English language, including minimum safety and hardware and service installation instructions
- remote control
- SCART cable (if SCART interface is supported)
- RF cable (if RF by-pass/loop through interface is supported)

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3 Front end

3.1 Changes to NorDig II specifications (chapter 3)

The following sections, 3.1 and 3.2, completely covers the requirements for the front end for all classes of the IRDs (see definition in section 2), including the Zapper IRD. No references in terms of requirements are made to the NorDig II specification, thus this section (3.1) completely replaces the NorDig II front end requirements.

To provide information in terms of changes and/or additions to the requirements defined in NorDig II, all relevant changes and/or additions in relation to NorDig II are marked in **yellow** in the following sub clauses.

3.1.1 General

The IRD shall include one tuner/demodulator for reception of signals from terrestrial transmitters, broadcasting in accordance with EN 300 744 **rev R1.4.1**

The digital transmissions may share frequency bands with other transmissions; successful reception will depend on e.g. network configuration, channel characteristics, time varying interference from other "analogue" or "digital" transmitters and the IRD performance. The transmission networks of DVB-T may include single frequency networks (SFN), and **the coverage area in an SFN is strongly affected of the IRD echo performance.**

3.1.2 Frequencies

The IRD shall be able to receive all channels in the UHF bands IV and V (channel 21-69).

The front end shall be capable of tuning to the centre frequency f_c of the incoming DVB-T RF signal, where:

$$f_c = 474 \text{ MHz} + (N-21) \times 8 \text{ MHz} + f_{fine},$$

$N \in \{21, \dots, 69\}$ (UHF channel number)

$f_{fine} \in [-10 \text{ kHz}, 10 \text{ kHz}]$ (continuous fine frequency offset range)

3.1.3 Modes

The IRD terrestrial front end shall be capable of correctly demodulating all non-hierarchical modes specified in EN 300 744. The frontend shall therefore be able to work with any combination of constellation (QPSK, 16-QAM or 64-QAM), code rate (1/2, 2/3, 3/4, 5/6 or 7/8), guard interval ($T_U/4$, $T_U/8$, $T_U/16$ or $T_U/32$) and transmission mode (2K or 8K). The IRD shall automatically detect which mode (constellation, code rate, guard interval and transmission mode) is being used.

3.1.4 Tuning/Scanning Procedures

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

Note: For detailed requirements of the scanning procedure see chapter 8 of this specification.

3.1.5 Changes In Modulation Parameters

The receiver should be able to detect a change of modulation parameters signaled in the TPS data of the DVB-T signal, in order to reduce the recovery time.

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3.1.6 RF Input Connector

The IRD shall have one input tuner connector, type: IEC female in accordance with IEC 60169-2, part 2. The input impedance shall be 75 ohm.

3.1.7 RF Output Connector

For the IRDs with a RF bypass ($RF_{in} - RF_{out}$), the connector shall be of type: IEC male in accordance with IEC 60169, part 2.

Note: See chapter 2 of this document for the class of IRD this requirement is valid.

3.1.8 Performance

The performance requirements used in this section (3.1.8) are referring to the QEF definition provided in EN 300 744, where Quasi Error Free (QEF) means less than one uncorrected error event per hour. This requirement corresponds to $BER = 10^{-11}$ at the input of the MPEG-2 multiplexer, and the details of how this requirement shall be measured is provided in Annex C of the NorDig II specification.

The performance shall be fulfilled for the entire UHF band.

Table 4: Maximum required C/N (dB) and minimum signal input levels for QEF reception at TS output with 1/4 guard interval and FFT size 8K

Modulation	Code rate	C/N performance (dB)		Minimum input level (dBm)	
		Gaussian Profile 1	Zero dB echo Profile 2	Gaussian Profile 1	Zero dB echo Profile 2
QPSK	1/2	5.1	8.8	-92.1	-88.4
QPSK	2/3	6.9	13.7	-90.3	-83.5
QPSK	3/4	7.9	15.4	-89.3	-81.8
QPSK	5/6	8.9	-	-88.3	-
QPSK	7/8	9.7	-	-87.5	-
16-QAM	1/2	10.8	13.3	-86.4	-83.9
16-QAM	2/3	13.1	17.9	-84.1	-79.3
16-QAM	3/4	14.6	22.1	-82.6	-75.1
16-QAM	5/6	15.6	-	-81.6	-
16-QAM	7/8	16.0	-	-81.2	-
64-QAM	1/2	16.5	19.0	-80.7	-78.2
64-QAM	2/3	18.7	23.2	-78.5	-74.0
64-QAM	3/4	20.2	27.6	-77.0	-69.6
64-QAM	5/6	21.6	-	-75.6	-
64-QAM	7/8	22.5	-	-74.7	-
<p>Profile 1: Gaussian noise (N) is applied together with the wanted carrier (C) in a signal bandwidth of 7.61 MHz.</p> <p>Profile 2: Zero dB echo delay = 1.95 μs to 0.95 times guard interval length, 0 degree phase at channel center.</p>					

Note: Quasi Error Free (QEF) reception corresponds to $BER = 10^{-11}$ at the input to the MPEG-2 demultiplexer.

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3.1.8.1 C/N Performance

The IRD **shall** have at least the performances for the C/N given in Table 4.

3.1.8.2 Minimum Signal Input Levels

The IRD **shall** have a noise figure (NF) better than 8 dB.

The IRD shall have at least the performance for the signal input level given in Table 4.
The IRD shall provide QEF reception for the minimum signal levels (P_{min}) stated below.

$P_{min} = -105.2 \text{ dBm} + \text{NF [dB]} + \text{C/N [dB]}$, where C/N is specified in Table 4 and NF is 8 dB.
(delay = 1.95 μs to 0.95 times the guard interval, 0 degree phase at channel centre)

3.1.8.3 Maximum Signal Input Levels

The IRD shall be able to handle DVB-T signals up to at least a level of -35 dBm.

3.1.8.4 Immunity to “analogue” signals in Other Channels

The IRD **shall** permit adjacent VSB/PAL carriers with up to 35 dB higher power with QEF reception. (The level of the FM sound relative to the vision carrier is -13 dB. The level of the NICAM signal relative to the vision carrier is -20 dB).

On any other channels QEF reception **shall** be possible with “analogue” signals with up to 46 dB higher level than the DVB-T signal.

The requirements in this paragraph refer to the modes {8K, 64-QAM, $R=2/3$, $\Delta/Tu=1/8$ } and {8K, 64-QAM, $R=2/3$, $\Delta/Tu=1/4$ }.

3.1.8.5 Immunity to “digital” signals in Other Channels

The IRD **shall** permit adjacent DVB-T carriers with up to 30 dB higher power level while maintaining QEF reception on selected carrier.

For all other channels, excluding image channels, it **shall** be possible to have DVB-T signals with up to 40 dB higher level while maintaining QEF reception on selected carrier.

For image channels, it **shall** be possible with up to 30 dB higher level while maintaining QEF reception on selected signal.

The requirements in this paragraph refer to the modes {8K, 64-QAM, $R=2/3$, $\Delta/Tu=1/8$ } and {8K, 64-QAM, $R=2/3$, $\Delta/Tu=1/4$ }.

3.1.8.6 Immunity to Co-Channel Interference From Analogue TV Signals

The sensitivity for interference from analogue TV is specified as the minimum carrier to interference ratio, C/I, required for a QEF reception. The IRD **shall** perform better than specified in Table 5 when exposed to interference from a co-channel VSB/PAL signal including video with teletext, an FM sound and a NICAM sub carrier as specified above (see section 3.1.8.4).

Table 5: Carrier to Interference, C/I (dB) for QEF,
when interfered by analogue TV carrier

Constellation	64QAM	
Code rate	2/3	3/4
CEPT mode	C2	C3
C/I	3	7

3.1.8.7 Performance In Time-Varying Channels

The IRD **shall** be able to operate with all signal time variations which naturally exists in connection with fixed roof-top reception (e.g. mast sway, antenna sway) and in-house portable reception (e.g. people

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walking around the receiving antenna). None of the above mentioned performance parameters should be significantly negatively affected when such channel time variations exist.

The increase in required C/N for QEF reception shall be less than 1 dB for a 0 dB echo with frequency separation equal to 20 Hz and a delay of 20 μ s, corresponding to a Doppler of +/- 10 Hz (after AFC), compared to the same 0 dB echo without frequency separation (0 Hz Doppler).

The requirement in this paragraph refer to the modes {8K, 64-QAM, R=2/3, $\Delta/T_u=1/8$ } and {8K, 64-QAM, R=2/3, $\Delta/T_u=1/4$ }.

3.1.8.8 C/(N+I) Performance in Single Frequency Networks

If there exists one or more FFT window positions for the time synchronisation that will give an aggregate available C/(N+I) larger than or equal to the required EPT (Effective Protection Target), the IRD shall be able to find one of these positions, independently of echo profile. The IRD shall also be able to correctly equalise the signal for echoes up to $7T_u/24$ (260 μ s) (Interval of correct equalisation), independently of the echo profile. See also Annex B in NorDig II specification.

For the modes {8K, 64-QAM, R=2/3, $\Delta/T_u=1/8$ }, {8K, 64-QAM, R=2/3, $\Delta/T_u=1/4$ } and {8K, 64-QAM, R=3/4, $\Delta/T_u=1/4$ }, the maximum required C/N value (defined in table 4 for profile 2) for QEF reception shall be possible when the channel contains two static paths with relative delay from 1.95 μ s up to 0.95 times guard interval length, independently of the relative amplitudes and phases of the two paths.

For a specific echo attenuation the required C/N shall have approximately the same value, independent of the actual delay length. The deviation in required C/N from the median value shall be less than 1 dB, for any echo length from 1.95 μ s up to 0.95 times guard interval length.

For echoes outside the guard interval QEF reception shall be possible with echo levels up the values defined in table 6.

Table 6: QEF reception for echoes outside the guard interval

Delay (μ s)	Echo attenuation in dB relative reference									
	-260	-230	-200	-150	-120	120	150	200	230	260
Mode										
8K, 64-QAM, R=2/3, $\Delta/T_u=1/8$	15	-	13	10	5	5	10	13	-	15
8K, 64-QAM, R=2/3, $\Delta/T_u=1/4$	10	5	n/a	n/a	n/a	n/a	n/a	n/a	5	10
8K, 64-QAM, R=3/4, $\Delta/T_u=1/4$	12	6	n/a	n/a	n/a	n/a	n/a	n/a	6	12

3.1.9 RF-PAL Output

For the IRDs with a RF-PAL output, the output interface shall be as specified in chapter 11.2 of this document.

Note: See definition in chapter 2 of this document for the class of IRD this requirement is valid.

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4 MPEG-2 Demultiplexer and decoder

This chapter covers the requirement defined for MPEG-2 Demultiplexing and Audio and Video Decoding, and refers to the NorDig II specification chapters 4, 5 and 6.

4.1 Relaxations to the NorDig II specification (chapter 4, 5 and 6)

The Video Down-conversion (NorDig II subclause 5.2.6) and Default Location Mode (NorDig II subclause 5.2.8) target controlling the video together with DVB MHP application, this functionality is optional for the Zapper IRD.

To be able to locate the up-converted video on the screen (NorDig II subclause 5.2.6) is optional for the Zapper IRD.

The Multichannel Audio (NorDig II, subclause 6.2.3) and the Digital Audio Output (NorDig II, subclause 6.2.4) is recommended for the Zapper IRD.

4.2 Requirements in additional to NorDig II specifications (chapter 4, 5 and 6)

It is recommended that the IRD decodes Dolby AC-3 multi-channel audio to a Dolby Surround ProLogic compatible stereo down-mix (Lt/Rt signal) and outputs it on the (stereo) analogue output connectors (SCART and chinch). The choice and priority between MPEG-1 Layer II audio and Dolby AC-3 for the analogue outputs shall then be as specified in Nordig II chapter 6.2.4 point 1 and 2 (defined for digital output).

When Dolby AC-3 audio is present, it is recommended to show a visual indication in the ESG (e.g. the text "DD5.1", the Dolby "double D" logotype, or a sketched sign with five loudspeakers).

4.3 Clarifications to NorDig II specifications (chapter 4, 5 and 6)

For any embedded CA System, it shall be Viaccess System version 1.2 or later and then labelled by Viaccess.

Displaying 16:9 material on 4:3 monitor as 16:9 letterbox (NorDig II, subclause 5.2.2) is mandatory and is recommended to be default mode.

4.4 Changes to NorDig II specifications (chapter 4, 5 and 6)

None.

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5 Teletext and Subtitling

This chapter covers the requirement defined for Teletext and Subtitling, and refers to the NorDig II specification chapter 14.

5.1 Relaxations to the NorDig II specification (chapter 14)

A (full) Teletext decoder integrated in the IRD (handling both pages and subtitling) shall meet at least the ETSI ETS 300 706 Enhanced Teletext Specification, **level 1.5**.

5.2 Requirements in additional to NorDig II specifications (chapter 14)

None.

5.3 Clarifications to NorDig II specifications (chapter 14)

An (STB) IRD shall minimum include an integrated Teletext decoder that is able to display Teletext subtitling on the OSD (i.e. minimum handling subtitling data), according to the ETSI ETS 300 706 Enhanced Teletext Specification, (even if VBI insertion is used for the teletext pages).

An iDTV IRD (integrated into the TV Set) for the S-DTT shall be able to display Teletext using the OSD, i.e. it shall include an Enhanced Teletext decoder.

The Zapper IRD (STB or iDTV) does not need to support the DVB Subtitling standard according to DVB MHP specification, "only" to the ETS 300 743 with the limitations described in NorDig II, subclause 14.2.

5.4 Changes to NorDig II specifications (chapter 14)

None.

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6 Service Information (SI)

This chapter covers the requirement defined for Service Information, and refers to the NorDig II specification chapter 12.

6.1 Relaxations to the NorDig II specification (chapter 12)

None.

6.2 Requirements in additional to NorDig II specifications (chapter 12)

None.

6.3 Clarifications to NorDig II specifications (chapter 12)

Following clarification is applicable in the S-DTT network.

The IRD shall be able to process the PSI/SI tables, both for the ‘Actual’ and for ‘Other’ transport streams.

The IRD shall at least start updating for any changes in the received “quasi-static” SI data, (NIT and SDT i.e. SI that is normally stored in the flash memory for service navigations such as service_name, service_ID, number of services), after it returns to active from stand-by mode. (The ‘running status’ is not included in the quasi-static SI data. See section 8.3 for more details regarding the update. As a guideline for the implementation, this updating may be performed in the background, to shorten the start-up of the basic video and audio).

The IRD shall at least start action for any changes in the received “dynamic” PSI and SI data, (PMT, EIT, TDT/TOT, running status and CA mode) within 1 second. (As a guideline for the implementation, the trigger for changes in received tables can be based on comparing the ‘version id’ in the tables).

Table 7 lists the mandatory and optional descriptors that the (Zapper) IRD shall receive and interpret.

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Table 7: Overview of mandatory and optional descriptors to be supported for an S-DTT IRD.

Descriptor	Tag value	NIT	BAT	SDT	EIT	TOT	CAT	PMT	AIT
video_stream_descriptor	0x02	-	-	-	-	-	-	Mr	-
audio_stream_descriptor	0x03	-	-	-	-	-	-	Or	-
target_background_grid_descriptor	0x07	-	-	-	-	-	-	Or	-
video_window_descriptor	0x08	-	-	-	-	-	-	Or	-
CA_descriptor	0x09	-	-	-	-	-	Mr	Mr	-
ISO_639_language_descriptor	0x0A	-	-	-	-	-	-	Mr	-
Private_data_indicator_descriptor	0x0F	-	-	-	-	-	-	Mr	-
network_name_descriptor	0x40	Mr	-	-	-	-	-	-	-
service_list_descriptor	0x41	Mr	-	-	-	-	-	-	-
service_descriptor	0x48	-	-	Mr	-	-	-	-	-
linkage_descriptor	0x4A	Mr	*	Mr	*	-	-	-	-
short_event_descriptor	0x4D	-	-	-	Mr	-	-	-	-
extended_event_descriptor	0x4E	-	-	-	Mr	-	-	-	-
component_descriptor	0x50	-	-	-	Mr	-	-	-	-
stream_identifier_descriptor	0x52	-	-	-	-	-	-	Mr	-
CA_identifier_descriptor	0x53	-	*	Mr	Or	-	-	-	-
content_descriptor	0x54	-	-	-	Mr	-	-	-	-
Parental_rating_descriptor	0x55	-	-	-	Mr	-	-	-	-
teletext_descriptor	0x56	-	-	-	-	-	-	Mr	-
local_time_offset_descriptor	0x58	-	-	-	-	Mr	-	-	-
Subtitling_descriptor	0x59	-	-	-	-	-	-	Mr	-
terrestrial_delivery_system_descriptor	0x5A	Mr	-	-	-	-	-	-	-
private_data_specifier_descriptor	0x5F	Mr	*	Mr	Mr	-	-	Mr	Mr 2)
service_move_descriptor	0x60	-	-	-	-	-	-	Mr	-
frequency_list_descriptor	0x62	Mr	-	-	-	-	-	-	-
data_broadcast_descriptor	0x64	-	-	*	*	-	-	-	-
data_broadcast_id_descriptor	0x66	-	-	-	-	-	-	Mr 1-2)	-
application_signalling_descriptor	0x6F	-	-	-	-	-	-	Mr 2)	-
application_descriptor	0x00	-	-	-	-	-	-	-	Mr 2)
transport_protocol_descriptor	0x02	-	-	-	-	-	-	-	Mr 2)
DVB-J_application_descriptor	0x03	-	-	-	-	-	-	-	Mr 2)
DVB-J_application_location_descriptor	0x04	-	-	-	-	-	-	-	Mr 2)
DVB-HTML_application_descriptor	0x08	-	-	-	-	-	-	-	Mr 2)
DVB-HTML_application_location_descriptor	0x09	-	-	-	-	-	-	-	Mr 2)
NorDig private: Logic_channel_descriptor	0x83	Mr	-	-	-	-	-	-	-
Senda private: Channel_list_descriptor	0xF1	-	-	Or	-	-	-	-	-
OpenTV private: Opentvdesc	0x90	-	-	-	-	-	-	Mr 1)	-
OpenTV private: OpentvTrackTagDesc	0xFE	-	-	-	-	-	-	Mr 1)	-
OpenTV private: OpentvTrackAttributesDesc	0xFD	-	-	-	-	-	-	Mr 1)	-
		NIT	BAT	SDT	EIT	TOT	CAT	PMT	AIT
- / * Descriptor not (yet) applicable to be inserted									
Mr Mandatory to receive and interpret if broadcast									
Or Optional to receive and interpret (if broadcasted)									
1) only valid for IRDs with OpenTV API activated, i.e. not applicable for a Zapper									
2) only valid for IRDs with DVB MHP 1.1 API activated, i.e. not applicable for a Zapper									

6.3.1 S-DTT SI Identification coding

6.3.1.1 Original Network ID and Network ID

Within the S-DTT network, the use of IDs is as follows:

- The original_network_id for all S-DTT multiplexes is set to **0x22F1**, (according to ETSI ETR 162).
- The network_ids for the S-DTT network is according to the ETSI ETR 162 colour B plan (i.e. **0x3101 to 0x3200**).

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6.3.1.2 Private data specifier values

For the used private data specifier values, the following applies in S-DTT network (also according to the DVB SI code allocation, ETSI ETR 162, inserted and used as specified in DVB SI Guidelines);

- Senda private_data_specifier value: 0x00000014 (Swedish Terrestrial TV)
- NorDig private_data_specifier value: 0x00000029

6.3.2 Unknown descriptors

If the receiver encounters a descriptor with an unrecognised tag or contex, the receiver should skip over that descriptor (using the length field) and proceed with decoding the following SI data.

6.3.3 Content Descriptor (in EIT)

The Zapper IRD should handle all nibbles listed in the DVB SI specification (ETSI EN 300 468), but shall at least be able to handle the ones listed in table 8 below. If there is no content coding in conformance with table present for an event, the default content description "unclassified" shall be assumed by the receiver.

Table 8: Content nibble level1 coding

Content nibble level 1	Description	Translation to be used in S-DTT
0x0	Unclassified	Odefinierat
0x1	Movie	Film
0x2	News / Current Affairs	Nyheter
0x3	Entertainment	Nöje
0x4	Sport	Sport
0x5	Children's / Youth	Barn
0x6	Music	Musik
0x7	Culture (without music)	Kultur
0x8	Social /political Issues/ Economics	Politik
0x9	Education / Science	Utbildning
0xA	Leisure hobbies	Fritid
0xB	Not supported	
0xC - 0xE	Reserved for future use	
0xF	User defined	

6.3.4 Delivery system descriptor (in NIT)

Note: Due to the terrestrial network environment, this descriptor's parameters may not be in-line for what actually is used for modulating the signal at a specific transmission point (here referring to the parameter centre frequency), as a multiplex may be transmitted on different frequencies from one transmitter site to another. Alternative frequencies that the multiplex may occur are listed in the Frequency_List_Descriptor

6.3.5 Frequency list descriptor (in NIT)

The Frequency List Descriptor lists frequencies where the transport stream occurs, in addition to the frequency given by the system delivery descriptor. (i.e. the transport stream is broadcast on the frequency given by the system delivery descriptor or broadcast on one of the frequencies given by the frequency list descriptor. This feature can be used in terrestrial networks where the same transport stream can be received on more than one frequency.)

An example is given below:

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NIT

...

```

TS_loop {
  transport_stream_ID    0x100
  original_network_id    0x22F1
  Descriptor_loop_2 {
    Terrestrial_delivery_system_descriptor () {
      descriptor_tag      0x5A
      descriptor_length    0x0B
      centre_frequency    0x04354540 (706 MHz) [alternative frequency 1, from site A]
      bandwidth            000        (8 MHz)
      contellation         10        (64-QAM)
      hierarchy_information 000        (non-hierarc)
      code_rate-HP_stream  001        (2/3)
      code_rate-LP_stream  000        (n/a when non-hierarc)
      guard_interval       10        (1/8)
      transmission_mode    01        (8k)
      other_frequency_flag 1         (more frequencies in use)
      reserved_future_use  0xFFFFFFFF
    }
    end terr.delivery.descr
  }
  Frequency_list_descriptor () {
    descriptor_tag      0x62
    descriptor_length    0x15
    reserved_future_use  111111
    coding_type          11          [terrestrial delivery system]
    for (i=0; i<N;i++) {
      centre_frequency    0x0371F540 (578 MHz) [alternative frequency 2, from site B]
      centre_frequency    0x04291040 (698 MHz) [alternative frequency 3, from site C]
      centre_frequency    0x03BB3340 (626 MHz) [alternative frequency 4, from site D]
      centre_frequency    0x0328B740 (530 MHz) [alternative frequency 5, from site E]
      centre_frequency    0x04C7C140 (802 MHz) [alternative frequency 6, from site F]
    }
  }
  end freq.list.descr
  (NorDig) Logic_channel_descriptor () {
    descriptor_tag      0x83
    ... etc...          end TS 0x100
  }

  transport_stream_ID    0x200
  original_network_id    0x22F1
  Descriptor_loop_2 {
    Terrestrial_delivery_system_descriptor () {
      ... etc...
    }
  }
}

```

Note: From each transmitter site, transport stream 0x100 and 0x200 are being transmitted on various frequencies

Figure 4: Example of a terrestrial NIT using the frequency list descriptor

Figure 4 illustrates an example of a terrestrial (MFN) network with six different transmitter sites (A to F, geographical separated), where all sites transmits the transport stream 0x100 on (six) different frequencies (706, 578, 698, 626, 530, 802 MHz). The transport streams syntax are exactly the same out from all site, i.e. the NITs are all the same, the frequencies are listed in the descriptors in the same orders, out from all sites. An IRD may receive the transport stream 0x100 from one or more of the centre frequencies, listed in the two descriptors (delivery system descriptor and/or frequency list descriptor), depending from which transmitter site(s) the IRD actually receive from. (I.e. depending on the geographical location of the IRD). So, an IRD receiving the transport stream from transmitter site A, will use the centre frequency that is listed in the `terrestrial_delivery_system` and an IRD receiving the transport stream from transmitter site B (to F), will use the centre frequency that is listed `frequency_list_descriptor` and so on.

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6.3.6 Linkage descriptor (in NIT and SDT)

The following linkage descriptors are used in the Swedish Digital Terrestrial TV network, see table 9 below.

Table 9 Linkage descriptors in the S-DTT

No	Location	Description	Zapper	API IRD	
			STB or iDTV	OpenTV STB or iDTV	MHP STB or iDTV
0x01	NIT	Linkage to an information service about the network	Mr	Mr	Mr
0x01	SDT	Linkage to an information service for a service	Or	Or	Or
0x02	NIT	Linkage to EPG service	Mr	Mr	Mr
0x03	SDT	Linkage to a CA replacement service	Mr	Mr	Mr
0x04	NIT	Linkage to transport stream that carries EIT schedule information for all services in the S-DTT network	Or	Or	Mr
0x05	SDT	Linkage to (temporary) replacement service	Mr	Mr	Mr
0x09	NIT	Linkage to DVB/ETSI System Software Download service	Or ¹⁾	Or ¹⁾	Or ¹⁾
0x81	NIT	Linkage to NorDig System Software Download service	Or ¹⁾	Or ¹⁾	Or ¹⁾
Mr Mandatory to receive and interpret if broadcast Or Optional to receive and interpret (if broadcasted)					
1) If an IRD support DVB or NorDig System Software Download, then its respective linkage is mandatory					

6.3.7 Parental rating descriptor (in EIT)

This descriptor is used to give a rating of programme based on age or other criteria and is used to prevent children from viewing unsuitable programmes. The prevention mechanism, blanking of video and muting of sound, shall be included within the manufacturer software and it should make use of 4 digits pin code.

It is recommended to use the pin code on the Viaccess smart card. The 8-bit rating field shall be defined as specified in ETSI EN 300 468, but the interpretation (who also should be displayed in the receiver) is recommended to be in accordance with table 10.

Table 10: Recommended interpretation of the 8-bit rating field

Rating	Description	Translation to be used in S-DTT
0x01-0x04	Children	Barn
0x05-0x08	Youth	Ungdom
0x09-0x0F	Adult	Vuxen

6.3.8 Service descriptor (in SDT)

The use of the service types within the S-DTT network is defined in the table 11.

Table 11: Use of service types

Service type	Description	Comment
0x00	Reserved for future use	Not used
0x01	Digital television service	Used
0x02	Digital radio sound service	Used

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0x03	Teletext service	Not used at this stage
0x04	NVOD reference service	Not used
0x05	NVOD time-shifted service	Not used
0x06	Mosaic service	Not used at this stage
0x07	PAL coded signal	Not used at this stage
0x08	SECAM coded signal	Not used
0x09	D/D2-MAC	Not used
0x0A	FM Radio	Not used
0x0B	NTSC coded signal	Not used
0x0C	Data broadcast service	Used, stand alone OpenTV services
0x0D to 0x7F	Reserved for future use	Not used
0x80 to 0xFE	User defined	0x81 used for NorDig bootloader
0xFF	Reserved for future use	Not used

6.3.9 S-DTT private descriptor; the Senda Channel_list_descriptor (in SDT)

This optional Senda private Channel List Descriptor provides the same functionality as the newer *mandatory* NorDig private Logic Channel Descriptor. Description of this Senda version may be handle out on request. *The Senda version will in the future completely be replaced by this newer NorDig version, but under some time ahead now both are transmitted. If by some reason interpretation of both these descriptors is implemented in an IRD, the NorDig version shall have priority of the Senda version.*

6.3.10 Country and Language Codes within PSI & SI (in “all” tables)

Preferably all (main) codes in ISO 3166 and ISO 639-3 should be handled. Due to the quite large number of codes in these specifications, table 12 and 13 specifies the minimum types of codes that shall be handled by the IRD. Table provides a listing on mandatory and recommended codes to should be handle also. (The codes in ISO 3166 (Country codes) are all in capital letters, the codes in ISO 639-2 (Language codes) are all in lower-case letters and observe the capital vs lower case letter notation in the translations.

Table 12: ISO 3166, Country codes

Country (in English)	code	Translation to be used in S-DTT		Comments
		To Swedish	To native	
SWEDEN	SWE	Sverige	Sverige	Mandatory
DENMARK	DNK	Danmark	Denmark	Mandatory
FINLAND	FIN	Finland	Suomi	Mandatory
NORWAY	NOR	Norge	Norge	Mandatory

Both ISO 639-2/B (Bibliographic Code) and ISO 639-2/T (Terminology Code) may be used, but for encoding it is recommended to only use ISO 639-2/B-codes. Of the current used descriptors that are using country or language codes, see also table below for help when to used which code.

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Table 13: ISO 639-2, Language codes

Language (in English)	639-2/B Code	639-2/T Code	Translation to be used in S-DTT		Comments
			To Swedish	To native	
Danish	dan	dan	danska	danske	Mandatory
German	der	deu	tyska	deutch	Recommended
English	eng	eng	engelska	English	Mandatory
Finnish	fin	fin	finska	suomi	Mandatory
French	fre	fra	franska	francais	Recommended
Norwegian	nor	nor	norska	norsk	Mandatory
Spanish	spa	spa	spanska	español	Recommended
Swedish	swe	swe	svenska	svenska	Mandatory

6.3.11 Text strings and fields size of the SI descriptors

The IRD shall at least be able to handle text strings that is coded 'Latin Alphabet number 5' as specified in ISO 8859-9 (and then signalised with a first byte '0x05' in the text field) and text strings coded 'Latin Alphabet' as specified in ISO/IEC 6937 (see ETSI EN 300 468, Appendix A).

The IRD shall be able to handle "control codes", see ETSI ETR 211, section 4.6. The control codes are

- 0x86, short_name_on;
- 0x87, short_name_off.

Example, service name:

'The digital [0x86] Sport Channel [0x87]', full name: 'The digital Sport Channel', short name: 'Sport Channel'.

The transmitted field sizes in the descriptors in the S-DTT network are stated in the table 14 below. These values can be used as a guideline in the IRD implementation (and if the transmitted text strings are longer than below, the IRD could typically truncate after this value).

Table 14 Descriptor field length used in the S-DTT

Name Field	Name Length	Comments
Network Name	24	
Service Provider Name	20	
(Full) Service Name	22	
(Short) Service Name	12	May be used in overview service list, info banner and/or ESG.
Event Name	40	
Short Event Description	255	
Extended Event description	255	
Component Description	32	Typically used in the ESG and/or in the info banner
Application Name	32	(for IRD with DVB MHP v1.1)

6.4 Changes to NorDig II specifications (chapter 12)

None.

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7 Navigator and Service lists

This chapter covers the requirement defined for the Navigator and the handling of Service lists, and refers to the NorDig II specification chapter 13.

7.1 Relaxations to the NorDig II specification (chapter 13)

None.

7.2 Requirements in additional to NorDig II specifications (chapter 13)

7.2.1 Missing of SI data

If information is missing the ESG shall not display an error message, instead the text information field shall stay empty.

7.2.2 Blocking of video and muting of audio

The S-DTT IRD shall provide a procedure that allows the user to configure blanking of video and muting of sound for certain parental rating values (in the parental_rating_descriptor in the EIT p/f).

7.2.3 Deletion of service lists

The IRD shall provide a function to remove all service lists (default and user defined) without affecting other parameters (e.g. user preferences).

7.2.4 Reset to factory mode

The IRD shall provide a function to reset all parameters to factory mode, thus removing all service lists, user preferences, etc. After reset, the IRD shall enter installation state (see section 8.1).

The factory mode shall be set to the following:

- RF-output preset channel: Channel 43 (PAL-G)¹⁾
- Menu language: Swedish
- Primary audio language: Swedish
- Secondary audio language: English
- Subtitling (normal): on
- Primary subtitling language: Swedish
- Secondary subtitling language: English
- Subtitling; hard of hearing/hearing impaired: off

¹⁾ applicable for IRDs with RF PAL modulator

7.2.5 Status check

7.2.5.1 Basic

The IRD shall provide at least a basic status check function (accessible through the Navigator) that presents reception quality information for a selected service (currently viewed by the user).

The basic status check should be presented on the OSD and shall include:

- channel number (ch 21-69)
- signal strength indicator and
- reception quality indicator

with the classification “poor/fair/good” for the indicators e.g. displayed as bars

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The algorithm to calculate the reception quality could be based on a combination of C/N and BER. The signal strength and quality reception indicators should be updated continuously (e.g every second), this to simplify the antenna installation.

7.2.5.2 Advanced

The IRD should provide an advanced status check function that presents the following information on the IRD OSD:

- channel number (ch 21 – 69)
- signal strength (dBμV)
- C/N (dB)
- BER (including information if the current value is classified as “poor/fair/good” for reception)

In addition, it is recommended that also the following information can be presented:

- code rate
- guard interval
- transport stream id
- original network id
- network id
- service id

The advanced status check values shall be updated continuously (e.g. every second).

7.3 Clarifications to NorDig II specifications (chapter 13)

The receiver should only display a service once, even if the same service is received from multiple transmitters. If the same service (same triplet ONID, TSID and SID) can be reached from several transmitters the one with best quality criterion of RF-channel should be chosen, see section 8 of this document.

7.4 Changes to NorDig II specifications (chapter 13)

None.

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8 Receiver states

This chapter covers the requirements defined for different receiver states and is only partly covered by the NorDig II specification. These requirements are therefore specific for the S-DTT network, but will in principal be applicable for most terrestrial networks.

8.1 Installation mode

Upon first time installation or after a reset to factory mode (see section 8.1.4), the IRD shall perform an automatic search (see section 8.1.2.1) through the whole (UHF) frequency spectrum.

After this first time installation (or after a reset to factory mode), the IRD should normally use the installed NIT(-s) sections for updating of new transport streams, new services and other changes (see section 8.3). It shall also be possible to perform an automatic or manual search (see section 8.1.2) at any time.

8.1.1 Background

The following text provides some guidelines for the service installation procedure in a terrestrial IRD.

The terrestrial broadcaster might group a number of neighbouring transmitter sites into the same digital network, (with the same network_id), transmitting the same transport streams. Some other neighbouring transmitter sites might be grouped into another digital network, with another network_id, i.e. a specific transport stream(-s) may be transmitted from more than one transmitter site.

In a terrestrial network it is likely that an IRD will be able to receive the same transport stream from more than one transmitter site (both in Multi Frequency Networks, MFN, and Single Frequency Networks, SFN) depending on the geographical location of the IRD, see figure 5. At some reception points, more than one digital terrestrial network might be received with different network_id's (i.e. not listed in the same NIT section).

Two transport streams with different network_ids, but with the same transport_stream_id and original_network_id, might have some services that are the same (identified with the service_id) and some service that differs. However two or more services with the same combination of service_id, transport_stream_id and original_network_id, are the same service, (just transmitted from different sites).

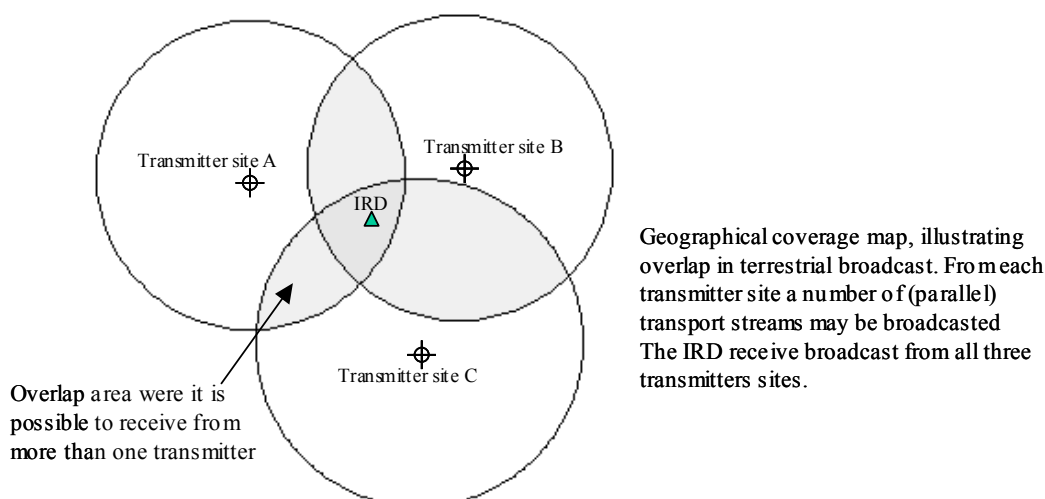


Figure 5: Example of a terrestrial broadcast. From each of the three transmitter sites, transport stream (multiplex) 0x100 and 0x200 is transmitted

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An IRD trying to install the example in figure 5 above transport stream 0x100 from another transport stream (0x200) using the NIT (i.e. the IRD is already scanned to transport stream 0x200 and is about to install transport stream 0x100), may scan through the listed centre frequencies until it find the used frequency at that reception point in any preferred order, e.g. as listed or lowest first.

Since terrestrial signal level/strength varies quite much from one receiving point to another, it is recommended that the IRD continue scanning through all the listed frequencies even after finding the first available frequency. When receiving two or more transport streams with the same transport_stream_id and original_network_id, the IRD may use the network_id to identify whether transport streams are the same or not. The IRD should preferable only list transmitted services coming from the frequency with best reception/signal, (this to avoid that the same service is listed several times) or optional let the user decide which ones to be stored.

8.1.2 Search modes

8.1.2.1 Automatic Search, best service

The IRD shall provide a function to perform an automatic search that finds all of the multiplexes and services in the whole frequency range (channel 21-69). Before the automatic search is started, all service lists shall be deleted (if present).

In case a transport stream has been received from more than one transmitters site, only the best service shall be selected to the IRD service list (i.e. avoiding duplicate of the same services). The criteria to select transport streams should be based on the reception quality, using a combination of signal strength and signal quality (e.g. BER, C/N, CSI (Channel state information)).

During the scanning procedure it is recommended that the IRD use, for each UHF channel, the priority defined in table 15, to speed up the scanning process.

Table 15: Priority order for parameters used at each channel

Priority order	1	2	3	4	5	6	7	8
Parameters								
FFT mode	8K	8K	8K	8K	2K	2K	2K	2K
Guard Interval	1/8	1/4	1/16	1/32	1/8	1/4	1/16	1/32

Note: Priority 1 is the highest priority (1 and 2 being the parameters settings used in S-DTT today).

It is recommended that the complete search function should take less than 5 minutes (at a reception location providing maximum 10 receivable DVB-T channels).

8.1.2.2 Manual search

Besides the automatic search, the IRD shall provide a manual search where the channel number (only) is entered by the end user. The IRD shall tune to this channel, add all new services and replace existing services in the service list (without considering any quality criteria).

It is recommended that the graphical interface for the manual search make it easy for the end user to perform consecutive manual searches without too much effort.

8.2 (Normal) Active mode

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

All received dynamic PSI and SI data (PMT, EIT, TDT/TOT, running status and CA mode) shall be processed within 1 second (see chapter 6.3 of this document).

Typical dynamic changes that the IRD shall be able to handle are (with in some cases some disturbance):

- New PID(s) (e.g. DVB subtitling) is attached to a service

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- PID(s) for video and/or audio is changed for a service
- Change from one (mono/stereo) audio to two dual mono audio mapped in one PID, i.e change of the audio encoding and in the ISO 639 language descriptor in the PMT.
- Changes of running status and/or CA mode (working together with linkage to replacement)
- Updates in EIT, TOT/TDT

8.3 (Automatic) Update mode

Update mode is defined as when the IRD is able to apply changes in the received “quasi-static” SI data (i.e. SI that is normally stored in the flash memory for service navigations such as Original Network ID, Transport Stream ID, Network ID, Service name, Service ID, Logic Channel Number, RF centre frequency and RF mode etc). The update mode should not affect the basic video and audio (see chapter 6.3 of this document). The IRD shall at least enter update mode after it returns to active from stand-by mode.

For example, the IRD shall in ‘update mode’ update for:

- new services within installed transport streams
- changes in service name (and/or service provider name)
- remove services that are permanently removed from transmitted SI. The IRD shall not remove any service(s) automatically from the ‘visible’ service list without user confirmation (to avoid irritation). I.e. the IRD shall automatically inform the user when a service is permanently removed and ask for user confirmation to remove the service from the service list. Removed services that are defined as ‘non-visible’ shall be removed without user confirmation

For example, the IRD should in ‘update mode’:

- ask for a user confirmation before updating for new ‘visible’ service (i.e. service displayed in the service list), changes in service_name, logic_channel_number (to avoid irritation).
- not overwrite any user preferences

The IRDs Service List shall be based on information from the SDTs. (The services listed in the NIT, e.g. in the NorDig Logic Channel Descriptor, might not be complete).

Updates that require actual tables (SDT actual and/or NIT actual) from another transport stream than the IRD is currently scanned to, should wait until the user select a service from a transport stream that contains the actual table(s) for this update.

Note: ‘Visible’ and ‘non-visible’ services referees to the definitions made in the Logic Channel Descriptor in the NorDig II receiver specification. A ‘visible’ service is a service that shall be displayed in the service list. A ‘non-visible’ service is a service that shall not be displayed in the service list, e.g. bootloader service, EPG service and other background services.

8.4 Stand-by and power off mode

Stand-by mode is defined as when the IRD do not present any decoded components, like video and audio, on any of the IRD’s outgoing connectors (SCART, RF PAL modulator, chinch for analogue audio etc, RF loop through shall not be affected in this mode). The IRD shall be able to be turn into active mode by the remote control.

Power off mode is defined as the mode where the IRD is completely turned off.

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9 Controller and Memory

This chapter covers the requirement defined for Controller and Memory, and refers to the NorDig II specification chapter 7.

9.1 Relaxations to the NorDig II specification (chapter 7)

The minimum memory requirements in subclause 7.1.3 in NorDig II are not applicable for the Zapper IRD. The memory requirement for the Zapper IRD is that it shall have memory enough for handling full MPEG-2 video and audio decoding, teletext and DVB subtitling decoding, SI handling, system download (bootload) and capability of running the navigator. The Zapper IRD shall also provide sufficient persistent memory to be able store the user preferences (see section 15 this specification).

The requirement to replace and/or add (an activated) API with another as defined in subclause 7.2.1 in NorDig II is not applicable for a Zapper IRD, thus not a requirement for the Zapper IRD.

One of the following formats and PSI/SI signalling shall be used for over-the-air download:

1. DVB Data Download streams
2. NorDig Bootload streams
3. Proprietary format streams

In case of (3), the PSI and SI signalling of over-the-air download shall be specified by the manufacturer and must be accepted by the network operator.

9.2 Requirements in addition to NorDig II specifications (chapter 7)

The software download mechanism (as defined in subclause 7.2.1 in NorDig II) shall check availability of new system software either when the box enters (recommended) or leaves stand-by mode. If new software version is available the actual upgrade shall be initiated by the user as defined in subclause 7.2.1 in NorDig II.

It is recommended that the user preferences and service lists stored in the IRD is not affected (i.e. deleted) of an update of system software.

9.3 Clarifications to NorDig II specifications (chapter 7)

Due to the varying and noisy environment in terrestrial reception, it is recommended that the Zapper IRD uses a module based over-the-air download. Erroneously received data packets only delay the reception of a small part of the complete software. This will minimise the total time of reception of the complete software.

9.4 Changes to NorDig II specifications (chapter 7)

The Zapper IRD shall provide a mechanism to detect corrupt downloaded system software before it is used to replace the current working software. If the received system software is corrupt (refer to subclause 7.2.1 in NorDig II), the Zapper IRD shall keep the current (working) version of the system software, thus making the Zapper IRD operational again. If so, the failure to download shall be indicated to the user with an error message that can be used in the contact with the customer relations office. It shall be possible for the user to abort the download (in areas of bad reception quality the download may take too long time) and the Zapper IRD shall be operational using the current version of system software.

The recommended data transport protocol (referring to subclause 7.2.2 in NorDig II) is MPEG-2 sections.

The Zapper IRD manufacturer shall provide the required MPEG-2 TS binary file (containing one PID) intended for cyclic broadcast for each new version intended for system software download. For each new version of system software over-the-air download, the manufacturer shall provide all necessary PSI / SI parameters to the network operator required for the new download.

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10 Graphics Processing

This chapter covers the requirement defined for the graphics processing, and refers to the NorDig II specification chapter 8.

10.1 Relaxations to the NorDig II specification (chapter 8)

All graphics processing requirements defined for in the NorDig II specification are replaced with the following requirements for the Zapper IRD.

An OSD graphic display shall be implemented and fulfil at least the following requirements:

- Support resolutions of 720 by 576 pixels and lower
- Support 2 logical display planes:
 - Video plane for full screen MPEG video.
 - Graphic plane for graphics (used for menus, teletext, DVB subtitling)
- Support blending of the graphics with video or stills backgrounds. At least 5 levels of transparency shall be provided (0%, 30%, 50%, 70%, 100%).
- Support aspect ratios as set in the installation setting at the SCART 1 interface (see chapter 17 in NorDig II specification).
- Support the graphics requirements defined for the support of DVB subtitling in the Zapper IRD (see clause 11 in this specification)

10.2 Requirements in additional to NorDig II specifications (chapter 8)

None.

10.3 Clarifications to NorDig II specifications (chapter 8)

None.

10.4 Changes to NorDig II specifications (chapter 8)

None.

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11 Interface and signal Levels

This chapter covers the requirement defined for the mandatory interfaces (see chapter 2 in this document), and refers to the NorDig II specification chapter 9 and 15.

11.1 Relaxations to the NorDig II specification (chapter 9 and 15)

For a SCART VCR Interface, the voltage on PIN 16 is not mandatory but recommended to be forward as specified in the NorDig II specification chapter 9.6.

11.2 Requirements in additional to NorDig II specifications (chapter 9 and 15)

A Common Interface in the IRD shall be able to handle a Red Label Viaccess CA Module and shall support download of new CA system software to a CA Module.

For a RF-PAL Output in the (Terrestrial) IRD for the S-DTT, this interface shall meet the same requirements as stated in the NorDig II specification subclause 9.2 (i.e. same as for the Cable IRD).

11.3 Clarifications to NorDig II specifications (chapter 9 and 15)

None.

11.4 Changes to NorDig II specifications (chapter 9 and 15)

None.

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12 The Remote Control

This chapter covers the requirement defined for the remote control, and refers to the NorDig II specification chapter 16.

12.1 Relaxations to the NorDig II specification (chapter 16)

The text key on the remote control (subclause 16.1.3 in NorDig II) shall only be mandatory if the IRD supports other (non subtitling) Teletext.

The keys “Application” and “EPG/Guide” is not required for a Zapper IRD.

The mapping of key events defined in NorDig II (subclause 16.1.5) is not applicable for the Zapper, thus it is no requirement for the Zapper.

12.2 Requirements in additional to NorDig II specifications (chapter 16)

It is recommended to position the four colour buttons in the following order on the remote control, starting from left to right: red, green, yellow, blue.

12.3 Clarifications to NorDig II specifications (chapter 16)

None.

12.4 Changes to NorDig II specifications (chapter 16)

None.

Receiver Specification

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Dokumentansvarig/Godkänd - Document responsible/Approved Per Tullstedt, Teracom	Datum - Date 2002-05-06	Rev 1.0	File/Tillhör	S-klass I

13 Performance

This chapter covers the requirement defined for the IRD performance, and refers to the NorDig II specification chapter 10.

13.1 Relaxations to the NorDig II specification (chapter 10)

The zapping time (time for changing of service) for TV services requirements defined in NorDig II subclause 10.4 are replaced with the following requirements for the Zapper IRD.

The maximum zapping time for the services, shall satisfy the requirements given in table 16.

Note: The figures in the table shall be met for a GOP length of 12, a repetition rate of ECM of 2 per second and a repetition rate of PAT and PMT of 10 times per second. The picture on the display during the zapping time shall be either frozen or black and the sound shall be muted until the new session has been stabilised. The figures in the table are valid for two channels on one multiplex as well as for two multiplexes.

Table 16: The maximum zapping time requirements

Coming from ↓	Going to ⇒	Digital Scrambled Services	Digital Services	Analogue Services*
Digital Scrambled Services		2.5 second	1.5 second	1 second
Digital Services		2.5 second	1.5 second	1 second
Analogue Services*		2.5 second	1.5 second	1 second
* applicable for IRD that are able to handle both analogue and digital services decoding				

13.2 Requirements in additional to NorDig II specifications (chapter 10)

None.

13.3 Clarifications to NorDig II specifications (chapter 10)

The video performance stated in NorDig II specification 10, shall also be considered as the requirements for the (CVBS) video in the modulated PAL-G signal on the RF PAL output interface.

13.4 Changes to NorDig II specifications (chapter 10)

None.

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14 User Preferences

This chapter covers the requirement defined for the User preferences, and refers to the NorDig II specification chapter 17.

14.1 Relaxations to the NorDig II specification (chapter 17)

None.

14.2 Requirements in additional to NorDig II specifications (chapter 17)

None.

14.3 Clarifications to NorDig II specifications (chapter 17)

None.

14.4 Changes to NorDig II specifications (chapter 17)

None.

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Annex A – The S-DTT Network Environment (Informational)

Annex A - The S-DTT Network Environment (Informational)

Logical structure of the S-DTT

The S-DTT Network is inherently regional as composition of transmitted multiplexes differs from region to region. The degree of regionality differs from service to service. The coverage area for the different multiplexes is asymmetrical.

Figure 6 shows the logical structure of the S-DTT Network, giving an example of three DTT regions α , β and χ . In each region four multiplexes is transmitted, carrying two regional (A and B) and two national multiplexes (C and D). The regional multiplexes within each DVB-T region have all the same Network ID for that specific region (a unique Network IDs is used in each region). All national multiplexes (currently two) have all the same Network ID, i.e. the same Network ID is used in all regions for multiplexes C and D.

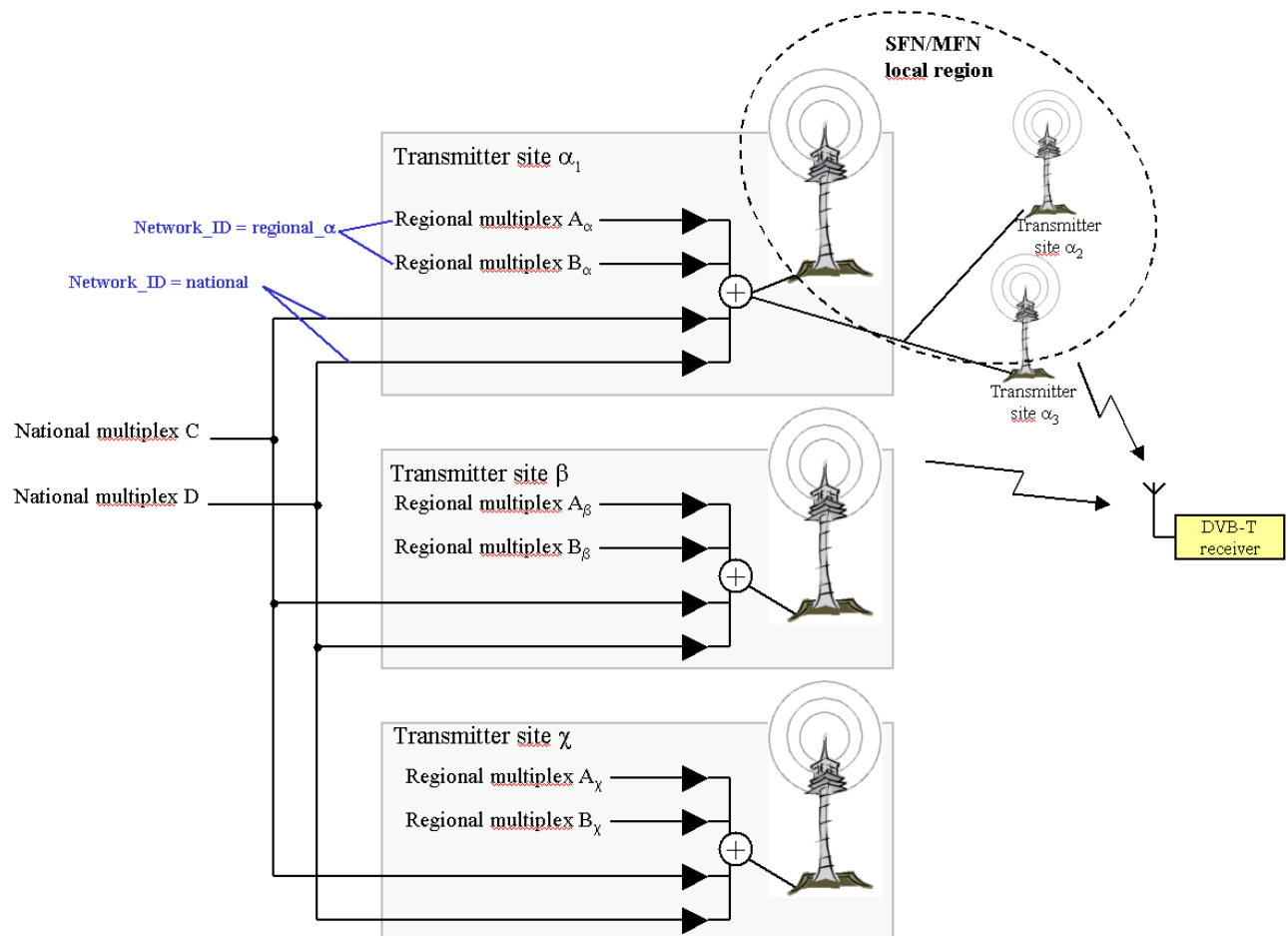


Figure 6: Logical structure of the S-DTT network

To make the picture even more complicated, each region contains several transmitters, which in some case is configured as SFNs and in other cases as MFNs. To comply with this specification is important that the receiver manufacturer understands the structure of figure 6.

The S-DTT digital network and regional architecture year 2002

At this very present (march 2002) two DVB-T modes is used in the different networks, {8K, 64-QAM, $R=2/3$, $\Delta/T_u=1/8$ } and {8K, 64-QAM, $R=3/4$, $\Delta/T_u=1/4$ }. During 2002 a third DVB-T mode, {8K, 64-QAM, $R=2/3$, $\Delta/T_u=1/4$ }, is planned to be transmitted in some regions.

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Annex A – The S-DTT Network Environment (Informational)

Note: The above is provided as informational and relates to why the recommended priority search is defined in section 8 in this specification. It is very important to stress the fact that the requirement for the IRD is to receive and decode all DVB-T modes (i.e. during channel search and dynamically if the DVB-T mode is updated in any region).

Out from each (digital) transmitter site/point, one or several parallel multiplexes are transmitted, referred to as multiplex A, multiplex B etc.

Note: At this very present (march 2002), five parallel multiplexes (A-E) are broadcasting and one more is prepared (F).

An S-DTT technical region/(cell) for a multiplex, is defined by a number of Teracom's FM/TV sites, that will broadcast the same services (the same service bouquet) and the same content at all time, this include any eventual shorter insertion in a national or regional service with regional/local content (e.g. regional/local news or advertising). A multiplex that have only have one region, (i.e. that region consists of all transmitter sites for that multiplex) is defined to as a national multiplex.

Multiplexes C, D and E are (currently) national multiplexes. Multiplexes C-F belongs to the same DVB SI network (i.e. have the same network_id and are listed in the same NIT section). This means that all services and content inside a national multiplex, will at all time be broadcasted from all transmitter sites applicable for each of these multiplexes (no regional service nor content).

Multiplex A and B are (currently) regional multiplexes and with the same regional division within the S-DTT. Multiplexes A and B therefore belongs to the same DVB SI network (i.e. have the same network_id and are listed in the same NIT section for that specific region.

A small transmitter site (potential or broadcasting) is connected to there nearby FM/TV site (main transmitter site) and therefore belongs to the same region division as the nearby FM/TV site. The regional division and connection to nearby FM/TV sites of small transmitter sites, is out of the scope of this document and is handle by Teracom.

Figure 7 show the 19 regional (carrying multiplex A and B) networks and the national network (carrying multiplex C-F). Teracom's 54 main transmitter site (FM/TV sites) are also marked but it shall be noted that the figure does not show the coverage of the multiplexes, nor actual broadcasting digital transmitter sites, only the division of regions and potential (main) transmitter sites.

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Annex A – The S-DTT Network Environment (Informational)



Figure 7: Geographical map of Sweden, illustrating the S-DTT regional (1) and national (2) networks