

**MINIMUM REQUIREMENTS FOR
INTEGRATED DIGITAL
TELEVISIONS (IDTVs)**

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Symbols and Acronyms

AAC	Advanced Audio Coding
ACE	Active Constellation Extension
AC-3	Audio Compression-3
ASI	Asynchronous Serial Interface
AVC	Advanced Video Coding
BAT	Bouquet Association Table
BER	Bit Error Rate
CA	Conditional Access
CI	Common Interface
CI+	Common Interface Plus
CISPR	Special International Committee on Radio Interference
CVBS	Composite Video Broadcast Signal
C/N	Carrier to Noise signal ratio
CPU	Central Processing Unit
dB	Decibel
dBm	Decibel Millie Watt
DDRAM	Double Data Random Access Memory
DIT	Data Information Table
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcasting
DVB-T	System defined by the ETSI EN 300 744 standard for providing terrestrial digital broadcasting
DVB-T2	Second generation system defined by the EN 302 755 standard for providing terrestrial digital broadcasting
E-AC-3	Enhanced Audio Compression -3
EIT	Event Information Table
EPG	Electronic Programme Guide
ETSI	European Telecommunication Standards Institute
FEC	Forward Error Correction
FTA	Free-To-Air
FFT	Fast Fourier Transforms
HbbTV	Hybrid Broadcast Broadband TV
HDCP	High-bandwidth Digital Content Protection
HDMI	High Definition Multimedia Interface
HDTV	High Definition Television
HE AAC	High Efficiency AAC
HEM	High Efficiency Mode
I/C	Interference to Carrier signal ratio.
ID	Identification
IDTV	Integrated Digital Television
IEC	International Electro Technical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardisation
ITU	International Telecommunication Union
LCD	Logical Channel Descriptor
LCN	Logical Channel Numbers
LDPC	Low Density Parity Check
mA	milliamps
mm	millimetres

MHz	Mega Hertz
MISO	Multiple Input / Single Output
MPEG	Motion Picture Experts Group
MUL	Multiple Languages
NIT	Network Information Table
NM	Normal Mode
OFDM	Orthogonal frequency-division multiplexing
OSD	On Screen Display
OUI	Organisation Unique Identifier
PAL	Phase Alternating Line
PAT	Program Association Table
PAPR	Peak-to-Average Power Ratio
PID	Packet Identifier
PIN	Personal Identification Number
PLP	Physical Layer Pipe
PMT	Program Map Table
PP	Pilot Pattern
PSI	Programme Specific Information
QAM	Quadrature Amplitude Modulation
QEF	Quasi Error Free
QPSK	Quadrature Phase Shift Keying
RCA	Phono connector or cinch connector
RCU	Remote Control Unit
RF	Radio Frequency
RST	Running Status Table
RTC	Real Time Clock
SCART	21-pole connector for connecting audio/video equipment
SDT	Service Description Table
SDTV	Standard Definition Television
SFN	Single Frequency Network
SI	Service Information
SIT	Selection Information Table
SISO	Single Input Single Output
S/PDIF	Sony/Philips Digital Interface
SSU	System Software Update
ST	Stuffing Table
STA	Common TV Antenna (block distribution)
TDT	Time and Date Table
TOT	Time Offset Table
TR	Tone Reservation
TS	Technical Specification
T _U	Useful symbol period
TV	Television
UHF	Ultra High Frequency
USB	Universal Serial Bus
VBI	Vertical Blanking Interval
VHF	Very High Frequency
WLAN	Wireless Local Area Network

1 Introduction

The document defines the minimum technical requirements for integrated digital televisions (IDTVs) for use with the DTT networks. The requirements are established to enable equipment manufacturers and/or suppliers to bring into Uganda IDTVs that will provide good indoor reception of digital terrestrial transmission signals. The requirements.

The requirements cover both Free-To-Air (FTA) and Pay TV services.

In this document, all requirements with the phrase “shall” are mandatory. Where the phrase “*may*” is used on a specific requirement, the requirement is recommended.

In the case of where a specific feature is silent in the document, the feature is regarded as being optional. The inclusion of optional features can be seen as part of the marketing strategy of the manufacturer.

1.1 Definitions

For the purpose of this document, the following definitions apply:

(a) Digital Terrestrial Television

Terrestrial delivery of digital transmissions in the UHF/VHF frequency bands using the DVB-T2 standard as set out in ETSI EN 302 755[1].

(b) Free-to-Air

Service which is broadcast and capable of being received without payment of subscription fees.

(c) Integrated Digital Television (IDTV)

This is a television with a built-in digital tuner for receiving and displaying digital TV transmission.

(d) Multiplex

A group of digital terrestrial television (DTT) channels that are combined together into one output signal for broadcast.

2 General Requirements

2.1 Electromagnetic compatibility, equipment security (EMC compatibility)

The IDTV shall comply with § 5.3, § 5.6 and § 5.7 of ISO/IEC CISPR 13[2] or ISO/IEC CISPR 22 [3] or the equivalent international standard based on any of the two mentioned standards.

2.2 Power Supply

An IDTV may be AC powered or DC powered. For AC powered IDTV, it shall be equipped for power supply from the 230 V \pm 10 % / 50 Hz \pm 2% mains. Where external power supply is used, e.g. AC adaptor, it shall not affect the capability of the IDTV to meet the rest of the minimum specifications.

2.3 Identification of the equipment

2.3.1 Brand and Model

The IDTV shall be marked with the supplier or manufacturer's Brand name and Model. This shall be clearly indicated on either the IDTV front or back panel.

2.3.2 Type approval mark.

The IDTV shall be marked with the UCC type approval mark to indicate to the public that the IDTVs meet the required minimum technical specifications. This mark will be issued by Uganda Communications' Commission after the particular brand and model has been type approved. This mark can be placed either at the manufacturing point or at the sale point.

2.4 Safety Requirements

The IDTV shall be tested for compliance with the International Electrotechnical Commission IEC 60065[4] safety standards.

2.5 Support Package

The following peripheral items shall be included in the package:

- Remote control unit complying with Section 5.5 together with 'AA' or 'AAA' sized batteries.
- An easy to understand user manual and quick installation guide in English language. Electronic user manuals may also be provided and viewable on the IDTV.

2.6 Power Supply Cord and Mains Plug

The IDTV shall be fitted with a suitable and appropriate approved power supply cord and mains plug.

The power supply cord shall be certified as according to any of the following standards standards:BS 6500[5] ,IEC 60227-5[6], IEC 60245-4[7] and any other international standards.

The main plug shall be certified as according to 13 A fused plugs: BS 1363/MS 589- Part 1[8].

2.7 Processor and Memory

The processing power and memory configuration of the IDTV shall be suitable for the routine operation of digital terrestrial reception, together with the embedded operation of the interactive application and the provision of the routine replacement of all software via “over-air download”. The configurations shall cater for DDRAM , flash memory, storage memory and CPU processor for the minimum baseline functions.

2.8 Maintenance & Upgrade

To allow for software changes, the IDTVs shall be upgradeable in a practical manner, for example , Over the air download. The process of upgrading shall cause minimal disruption to the viewer. However, to minimize the diversity of deployed software builds and to most efficiently use the available broadcast capacity, the IDTV shall detect and act upon the broadcast of a relevant software download within 24 hours of its transmission commencing.

2.8.1 Over Air Download

- Support for the use of DVB SSU, to at least the simple profile as defined in ETSI TS 102 006 [9] is required.The IDTVs shall be able to handle the presence of software downloads in any NIT referred carrier signal.
- The IDTVs shall be capable of automatic (in otherwards not user initiated) software upgrade by over-air download with minimal interruption to the viewer.
- Manufacturers shall ensure that the IDTVs offered shall only respond to a unique OUI code. This means that the IDTV offered shall not react to any other OUI from any other manufacturer nor react to any other OUI from the same company which relates to a different model IDTV.
- The default DVB-SSU mode for IDTVs shall be with DVB-SSU “enabled”.

2.8.2 User Software Upgrade

The IDTV may provide one or more of the following data interfaces to enable the user to perform software upgrades.

- Universal Serial Bus (USB)
- RJ 45 (Ethernet IEEE802.3)
- Appropriate Memory Card

2.9 Operating Buttons of the IDTV

The IDTV shall have the following buttons:-

- a. Power button - To turn the IDTV on and off
- b. Program button (CH-and CH+)-To scroll up and down through the channels
- c. Volume button (V- and V+) - To adjust the volume output level
- d. Menu button- To display the program guide , TV set up and other useful information

3 Front-end Characteristics

3.1 Radio Frequencies and Bandwidths

The IDTVs shall be able to receive on all channels of TV band III (174-230MHz at a channel bandwidth of 7MHz and on all channels of TV band IV and V (470-694 MHz) at a channel width of 8 MHz as shown in **Table 1**.

Table 1: Mandatory Frequency Bands

BAND	FREQUENCY RANGE (MHZ)	SIGNAL BAND WIDTH (MHZ)
VHF III	174 - 230	7
UHF IV	470 - 606	8
UHF V	606 - 694	8

Annex 1 provides details of the TV RF channels and channel numbers.

3.2 Maximum Frequency offset

The IDTV shall be able to receive signals with an offset of up to 50 KHz from the nominal frequency.

3.3 Operating Modes

The IDTV shall be able to demodulate all non-hierarchical modes specified in the ETSI EN 302 755 [1]. The frontend shall work compatibly with any combination of constellation (QPSK, 16-QAM,64-QAM, 256 QAM), code rate ($\frac{1}{2}$, $\frac{3}{5}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$), guard interval ($\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{128}$, $\frac{19}{128}$, $\frac{19}{256}$) and transmission mode (1K, 2K,4K,8K,16K,32K [Normal Mode],8K extended, 16K extended , 32K extended).

The IDTV shall be able to detect which DVB-T2 mode is being used. The DVB-T2 parameters or modes are outlined in **Table 2** below.

Table 2: DVB T2 Operational Modes

DVB T2 Parameter	Mode / requirement
Constellation	QPSK, 16 QAM, 64 QAM, 256QAM With or without Constellation rotation.
Code Rate	$\frac{1}{2}$, $\frac{3}{5}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$ or $\frac{5}{6}$
Guard Interval	$T_u/128$, $T_u/32$, $T_u/16$, $T_u*19/256$, $T_u/8$, $T_u*19/128$ or $T_u/4$
Transmission Mode FTT Size	1k, 2k, 4k, 8k normal, 8k extended, 16k normal, 16k extended, 32k normal or 32k extended
Pilot Pattern (PP)	PP1, PP2, PP3, PP4, PP5, PP6 or PP7
Antenna	SISO, MISO
Signaling format for Peak Average Power Ratio (PAPR) reduction	L1-ACE is used and TR is used on P2 symbols only; L1-ACE and ACE only are used; L1-ACE and TR only are used; or L1-ACE, ACE and TR are used.
Forward Error Correction frame length (FEC)	64 800 bits for normal FECFRAME; 16 200 bits for short FECFRAME
Input Mode	A Single PLP or B Multiple PLP

Mode Adaptation	Normal Mode (NM), High Efficiency Mode (HEM)
Scrambling of L1 Post signaling. (L1_POST_SCRAMBLED)	Feature shall be supported by the IDTV

3.4 Operation in Single frequency Network

The IDTV shall be able to operate in SFN with echo signals within the guard interval. When the IDTV tunes to a mix of two signals from a SFN where the received signals are close in amplitude, it is recommended that the IDTV shall be able to select the better signal.

3.5 Reception of multiple DTT networks

The IDTV shall display all existing DTT networks (Original networks).

For multiple original networks, the IDTV shall first sort the list of all services from one original network (ONID) according to that LCD, before sorting and listing the next original network. The first original network is the primary network and any additional received original networks are referred to as secondary network(s).

The user shall be able to set an original network as the primary network depending on the user's preference.

4 Service Information (SI)

The IDTV shall be able to process the necessary SI transmitted within individual DVB-T2 transport data streams so that its proper function is secured and the end user is able to make full use of the services provided. The processing of the SI is governed by the conditions and rules set out in the EN 300 468[10] Standard. A summary of SI transmitted and received in the DVB T2 system is attached in **Annex 2**.

4.1 Use of DVB SI

The IDTV shall be able to decode the DVB SI data in the Transport Stream bit-streams which provides users with information to select services so that the IDTV can automatically configure itself for the selected service.

The IDTV shall comply with the implementation guidelines outlined in the ETSI TR 101 211 [11] for the use of DVB SI as specified in the ETSI EN 300 468[10].

The SI table mechanism, syntax and semantics, and minimally, the Service Description Table (SDT), the Event Information Table (EIT) and the Time and Date Table (TDT) shall be supported.

4.2 System Timing

The IDTV shall be able to make use of TDT for the device system time or Real Time Clock (RTC) setting.

4.3 Optional and Unrecognized SI

For IDTV with recording features, it is recommended that Selection Information Table (SIT) be supported for partial transport stream selection and recording. Support of Bouquet Association Table (BAT), Stuffing Table (ST) and Data Information Table (DIT) is optional. The IDTV shall ignore any incomprehensive SI or tables. The IDTV shall discard any PSI/SI signals if it is unrecognized or not supported.

4.4 PSI/SI and PID Update

The IDTV shall be able to monitor and update all PSI within shorter than 10s intervals and all SI within less than 10s intervals. The IDTV shall update PSI / SI information in memory whenever any update or modification happens on a real-time basis. The IDTV shall be able to take prompt action with changes or modifications on the parameters of transmissions, networks and services.

4.5 Dynamic Response to PAT, PMT, NIT and SDT Updates

The IDTV shall be capable of identifying changes or new services in the current channel/multiplex. And respond to these changes in real time.

Changes may occur, in particular:

- when a new programme is added to the transport stream;
- when the transmission of a certain programme is terminated;

- during regular exchange of programmes within the daily or weekly cycle;
- when switching between the regional programme versions;
- when language versions are added or removed;
- when subtitles are added;
- When the transmission frequency is changed as planned (NIT table)
- When other data services are added, such as SSU.

In the event that the IDTV has a unique or different response to the PAT, PMT, NIT and SDT Updates, the uniqueness should be pointed out to the Commission at the time of applying for type approval for that brand and model.

4.6 Service Identification and Logical Channel Number (LCN)

The IDTV shall be able to automatically scan through the whole frequency range available for each of the available Tuners/Demodulators and tune in to the correct DVB framing structure, channel coding and modulation to deliver the incoming transport stream to the next units. The tuning data shall be stored to allow a quick tune in to the selected transport stream.

The IDTV shall support LCN by using descriptor with tag value 0x83 (Version 1) and 0x87 (Version 2). **Annex 3** provides important notes on logical channel numbers.

4.6.1 Logical Channel Descriptor Simultaneous Version 1 & 2 transmissions

When both the Logical Channel Descriptor version 1 and version 2 are broadcasted within one Original network ID, the IDTV supporting both descriptors shall only sort according to the version 2 (higher priority)

4.6.2 Listing of Broadcast Descriptors

The list of broadcast descriptors is attached in **Annex 4**.

4.7 Responses to Network Changes

4.7.1 Addition and Removal of multiplex on a network

When a multiplex is added to the network, it shall make reference in the second loop of the NIT actual table. The NIT (actual) and SDT (actual and other) version_number shall be changed. The IDTV shall recognise the change of version_number of the NIT table and that a new transport_stream_id is present in the NIT (actual).

In the event that the IDTV has a unique or different response to the addition or removal of a multiplex on the network, the uniqueness should be pointed out to the Commission at the time of applying for type approval for that brand and model.

4.7.2 Addition or removal of service on a multiplex

When a service has been added to a multiplex, there shall be an update in the SDT (actual) for that multiplex which references the new service.

The IDTV shall consider a service to be removed from a multiplex if the service is not referenced in the SDT (actual) of that particular service.

A rescan of any or all the terrestrial multiplexes shall not be required for the IDTV to acknowledge the presence of a new service. The IDTV shall process the SDT (actual) and EIT-present/following (actual) when tuning to a different multiplex or every 2 seconds as recommended by ETSI TR 101 211 [11].

When a new service is added or removed from a multiplex, the IDTV may inform the user that a new service has been added or removed using an appropriate IDTV specific method e.g. a short screen pop-up lasting not more than 3 seconds.

4.7.3 DVB T2 operational mode changes

In the event that there is any DVB T2 operational mode changes, the IDTV shall automatically upgrade or down grade accordingly to adapt to the changed mode without disruption to the viewer. Refer to **Table 2** providing the different operational modes.

5 Services

5.1 Subtitling

5.1.1 Specification for Subtitling

The IDTV shall support DVB subtitling in accordance with ETSI EN 300 743[12] and displayed using the On Screen Display (OSD) capabilities while decoding the full television service (video and audio). The subtitle object code shall be handled as pixels (bitmap).

5.1.2 Multiple Subtitling Language

The IDTV shall be able to handle multiple subtitling streams within the same service and the correspondent PSI/SI information like languages descriptors.

The IDTV shall provide convenient user control for enabling, disabling displaying and to select primary and secondary subtitling languages. In case subtitling is set to “ON” and the subtitle streams do not match any of the settings of preferred languages, the IDTV shall select the first subtitle stream signaled in the elementary stream loop of the PMT.

The recommended factory default setting:

The default setting on the IDTV for subtitling set to “OFF”

The primary preferred language set to “English Language” (ENG)

The secondary preferred language set to “Multiple language” (MULT)

5.1.3 Support for Hearing Impaired

The IDTV may be capable of displaying subtitles for the hearing impaired. The IDTV may be capable of overlaying the subtitle text on the picture. The subtitles for the hearing impaired may differ from the normal subtitles by the amount of text displayed per second, which is controlled by the broadcasted content.

5.2 Electronic Program Guide (EPG)

5.2.1 Specification for EPG

The IDTV shall decode full EIT information with capability to display “Present / Following” (or “Now / Next”) and schedule EPG information in accordance with guidelines given in ETSI TR 101 211[11] and requirements defined in ETSI EN 300 468[10]. The IDTV shall also be able to continue to operate in the absence of EIT transmission.

5.2.2 EPG Presentation

EPG presentation shall include but not limited to the following:

- Service name
- Program title
- Program duration
- Elapsed duration (optional)

- Short description
- Long description (extended text)
- Present / following (now / next) event
- Current date/time
- Parental guidance information

The IDTV shall provide an EPG organizer to access Next seven-day program guide with all information in above list. It shall be a practical and easy to use search function.

5.2.3 Languages and Fonts

The IDTV shall support an easily visible character coding for EPG and other labeling decoding and presentation.

5.2.4 Parental Lock Feature

The IDTV shall have parental lock capabilities to block television program with a particular Classification Code from being shown unless the correct PIN code is entered by the user.

The IDTV shall be able to identify the Classification Code that is applied to the television program and shall allow user to set the rating that he/she wants to block.

The IDTV shall support standard Classification codes.

5.2.5 Parental Rating Display

The parental rating information shall be displayed clearly as part of EPG.

The parental rating descriptor shall be transmitted and the full parental rating information shall be appended to the front of the program title or program description by the broadcaster.

Manufacturers can add additional displays of program ratings, but they shall display the full rating information.

5.3 Multi-Language Support

The IDTV shall provide a mechanism for the selection of primary and secondary language options for both Subtitles and Audio selection. The IDTV shall as a minimum, interpret the language codes outlined in the table below.

Language	ISO 639-3 Code
English	ENG
Swahili	SWH
French	FRA
Original Audio	QAA*
Multiple Languages	MUL**

* Original Audio is only applicable for Audio

** Multiple Languages is only applicable for Subtitle

5.4 Teletext

The IDTV shall be able to demultiplex in parallel with the teletext service transmitted in a packetized format according to ETSI EN 300 472 [13]. The IDTV shall be able to display teletext service, meeting the requirements for at least Level 1.5. Details of the presentation levels are provided in ETSI EN 300 706 [14].

5.5 Remote Control Unit (RCU)

An RCU shall be bundled with the IDTV. It shall be simple and easy to use. Basic functionality such as power, volume control and numerical number 0-9 shall be placed on prominent locations on the remote control.

Color-coded multifunctional buttons shall be included to enhance user experience and ease the navigation on the IDTVs.

The IDTV's remote control interface will need to have inbuilt hysteresis, allowing enough time to capture a single, double or triple digit entry. This is to cater for the possibility of large numbers of services thus requiring the IDTV to expect up to 3 numbers, entered via remote control, to select the LCN of a program service.

The list of basic function keys of remote control unit is attached in **Annex 5**.

It is recommended that manufacturers make available alternative Remote Control Units for those with impaired vision or impaired manual dexterity (e.g. over-sized keys and character fonts, shaped keys).

5.5.1 Reliability

(a) Robustness

The RCU shall be designed to withstand frequent usage, with a robust case that is resistant to damage from being dropped onto hard surfaces or sat upon.

(b) Environmental

The RCU shall be designed to work in the same environmental conditions (i.e. ambient temperature and humidity) as specified for the IDTV decoder.

(c) Key life

The design of the key mechanism shall be such as to provide a minimum of 5 years operation under normal expected usage.

5.5.2 Channel Entry

All television, radio and interactive services will be assigned a three-digit LCN. The RCU shall be configured for three-digit LCN operation.

5.6 Signal Strength and Quality Bar

The IDTV shall be able to display both signal strength and quality (BER) level. This will aid the user in setting up indoor antenna to ensure best reception position or identifying other reception problems.

5.7 Service Unavailability

In the event of service unavailable, poor or no RF signal, the IDTV shall display an on-screen message.

5.8 Listing of All Available Services

The IDTV shall provide a listing of all available services after scanning. The IDTV shall display a given service only once in the service list (so avoiding duplicates of the same service), even if this service (i.e. same path comprising original network identifier, transport stream identifier and service identifier) is received from more than one transmitter. In such a case, the service emanating from the transmission with the highest quality (as defined by signal strength and signal quality) shall be the one chosen to be entered into the service list.

5.9 First-time Power Up

Upon powering up for the first-time, the IDTV shall initiate the following process:

- a) Set OSD language (Default – English);
- b) Prompt tuning/scanning for all available FTA services; and
- c) Set other configurations (user data, preferences and others).

5.10 Tuning

5.10.1 Initial Channel Scan

The tuning/ scan process shall be manually initiated to prevent scanning before the antenna is connected.

5.10.1 Automatic Tuning

The IDTV shall be capable of performing automatic tuning over the frequency ranges indicated in Table 1 and find all the multiplexes and services received in the frequency range.

5.10.2 Manual tuning

In addition to automatic tuning, the IDTV shall be capable of performing manual tuning where the channel number or frequency (or both) is entered by the viewer. The decoder shall tune to the channel entered by the viewer, search all available DTT modes, add any new services and replace existing services in the service list.

6 Interfaces and Connectors

6.1 RF Input Connector

The connector at the input of the IDTV shall be of the IEC female type with an impedance of 75 Ω according to the IEC 61169-2 standard.

6.3 HDMI

The IDTV shall provide HDMI interface for digital video and audio input. HDMI interface shall comply with the specification of HDMI release 1.3 or higher releases.

6.4 Common Interface

The IDTV shall incorporate a DVB-CI (Common Interface) slot and support Common Interface Plus extension. Common Interface Plus extension refers to the “CI plus Specification and Content Security Extensions to the Common Interface” version 1.3 [15] or later.

6.5 Summarized Table of the Audio and Video Interfaces.

The table below show an overview of A/V inputs/outputs to be available in the IDTV.

Table 8: A/V Inputs/Outputs

VIDEO		IDTV
CVBS (composite)	input	M
	output	O
HDMI	input	M
	output	N/A
AUDIO		IDTV
RCA (stereo L/R)	input	M
	output	O
S/PDIF	input	N/A
	output	M
HDMI	input	M
	output	N/A
Headphone output 3.5 mm jack	output	R

M- Mandatory, O- Optional, R- Recommended, N/A - Not Applicable

6.6 Data Interfaces and Interactivity

Table 9 provides an indication of data interfaces to be available in the IDTV.

Table 9: Data Interface

Data Interface	Status
USB	Mandatory
Ethernet under IEEE 802.3 (at least 100Base-T)	Recommended
WLAN under IEEE 802.11, b, g	Recommended

If any data interface is used for recording the received content to an external storage medium, the protection (if any) against unauthorised access shall also be maintained in the data provided at such an interface (i.e., the data at this interface shall not be modified by decoding or removing this protection).

7 Video & Audio Decoding Requirement

7.1 Video Decoding

The IDTV shall be able to decode video formats as specified below for SDTV and HDTV based on the ITU-T Recommendation H.264[16] or ISO / IEC 14496-10[17].

1. Standard Definition SDTV

- Main Profile @ Level 3
- Frame frequency 25 Hz
- Image format / Aspect Ratio 4:3, 16:9
- Definition 720, 704, 544, 480 (point) x 576 (lines).

2. High Definition HDTV

- High Profile @ Level 4
- Frame frequency 25 and 50Hz (see the table below)
- Image format Aspect Ratio 16:9
- Formats supported: at least by details in Table 10 below.

Table 10: Details based on ITU-T R H.264 /or ISO / IEC 14496-10

Vertical size	Horizontal size	Frame rate	Progressive/ Interlaced
1080	1920	25	I
1080	1440	25	I
720	1280	50	P

7.1.1 Aspect Ratio

The IDTV shall provide convenient user control for appropriate aspect ratio switching between 4:3 and 16:9 to adapt to display in different size and aspect ratio.

7.1.2. Active Format Description (AFD)

When AFD is used, the IDTV shall present the video aspect ratio properly according to the current AFD value and response in next frame as defined in the ETSI EN 101 154 Annex B. The IDTV shall support at least the Active Formats shown in Table 11.

Table 11: Active format

Active Format	Aspect ratio of the “area of interest
1000	Active format is the same as the coded frame
1001	“Pillar box” 4:3 (centre)
1010	“Letter box” 16:9 (centre)

Refer to **Annex 6** for the illustration on the required outputs based on the AFD values specified.

7.2 Audio Decoding

The IDTVs shall support (decode) sounds compressed:

- In accordance with the ETSI TS 101 154 [18] i.e. MPEG-1 Audio Layer II (with bit streams according to specification, using sampling rates of 32, 44.1 and 48 kHz and with support to the stereo, joint stereo and mono modes);
- In accordance with the ISO/IEC 14496-3[19] standard, coding MPEG-4 HE AAC. Support to multichannel (surround) audio in this format is also recommended;

The IDTVs may support (decode) sounds compressed:

- In the E-AC-3 (Dolby Digital Plus) format, including multichannel (surround) audio. The equipment may enable transparent E-AC-3 transmission via HDMI output, and provide conversion from E-AC-3 to AC-3 for S/PDIF output. As to multichannel audio, the equipment may enable conversion to stereo audio (L/R) and enable audio description.

8 DVB-T2 Performance Requirements

The performance requirements used in this section are referring to the QEF definition provided in ETSI EN 300 744 [20], where Quasi Error Free (QEF) means less than one uncorrected error event per hour.

The carrier-to-noise (C/N) ratio in Table 12 and minimum receiver signal input level (P_{min}) values in Table 13 are specified for two profiles:

- (a) Profile 1: Gaussian noise (N) is applied together with the wanted carrier (C) in a signal bandwidth of a DVB-T2 signal. No echo is applied.
- (b) Profile 2: The wanted signal (C) includes the direct path signal and an echo. The echo has the same power (0 dB echo) as the direct path signal and is delayed from 1.95 μ s to 0.95 times the guard interval length and has 0 degree phase at the channel center.

8.1 C/N Performance

The IDTV shall have at least the QEF performance for the C/N ratios given in Table 12.

Table 12: Example of maximum required C/N for QEF reception at Transport Stream (with 1/8 guard interval, PP2 and FFT size 32K) for profile 1 and 2 S out

C/N Performance (dB)			
Modulation	Code Rate	Profile 1:Gaussian	Profile 2:0 dB
QPSK	1/2	3.5	5.2
QPSK	3/5	4.7	6.8
QPSK	2/3	5.6	8.4
QPSK	3/4	6.6	9.8
QPSK	4/5	7.2	-
QPSK	5/6	7.7	-
16-QAM	1/2	8.7	10.9
16-QAM	3/5	10.1	12.7
16-QAM	2/3	11.4	14.3
16-QAM	3/4	12.5	16.3
16-QAM	4/5	13.3	-
16-QAM	5/6	13.8	-
64-QAM	1/2	13.0	16.0
64-QAM	3/5	14.8	18.0
64-QAM	2/3	16.2	19.7
64-QAM	3/4	17.7	22.0
64-QAM	4/5	18.7	-
64-QAM	5/6	19.4	-
256-QAM	1/2	17.0	20.6
256-QAM	3/5	19.4	23.1
256-QAM	2/3	20.8	25.1
256-QAM	3/4	22.9	28.0
256-QAM	4/5	24.3	-
256-QAM	5/6	25.1	-

8.2 Maximum Noise Figure

The IDTV shall have a noise figure (NF) for the supported frequency ranges stated in Table 1 equal or better than 6dB.

8.3 Minimum Signal Input Levels

The IDTV shall provide QEF reception for the minimum signal levels (P_{\min}) for the VHF and UHF frequencies as stated in Table 1 (at absolute temperature of 290K) which can be derived as follows:-

- For 7MHz Extended Bandwidth DVB-T2 signal: $P_{\min} = -105.7 \text{ dBm} + \text{NF} + \text{C/N}$, and
- For 8 MHz Normal Bandwidth DVB-T2 signal: $P_{\min} = -105.2\text{dBm} + \text{NF} + \text{C/N}$, and
- For 8MHz Extended Bandwidth DVB-T2 signal: $P_{\min} = -105.1 \text{ dBm} + \text{NF} + \text{C/N}$,

Where

P_{\min} values are listed in Table 13 below as calculated from the equations above together with NF as 6dB ratio in dB and C/N values in Table 12. For all other DVB-T2 modes, the IDTV shall fulfil P_{\min} requirements accordingly, based on the formulas above.

Table 13: Examples of minimum DVB-T2 signal input levels (P_{\min}) for QEF reception at Transport Stream output (with 1/8guard internal, PP2 and FFT size 32K, Extended bandwidth for UHF) for profiles 1 and 2

		Minimum Input Level (dBm)			
		Profile 1: Gaussian		Profile 2: 0 dB	
		VHF Band III	UHF Band IV & V	VHF Band III	UHF Band IV & V
Modulation	Code Rate	7MHz Signal	8MHz Signal	7MHz Signal	8MHz Signal
QPSK	1/2	-96.2	-95.6	-94.5	-93.9
QPSK	3/5	-95.0	-94.4	-92.9	-92.3
QPSK	2/3	-94.1	-93.5	-91.3	-90.7
QPSK	3/4	-93.1	-92.5	-89.9	-89.3
QPSK	4/5	-92.5	-91.9	-	-
QPSK	5/6	-92.0	-91.4	-	-
16-QAM	1/2	-91.0	-90.4	-88.8	-88.2
16-QAM	3/5	-89.6	-89.0	-87.0	-86.4
16-QAM	2/3	-88.3	-87.7	-85.4	-84.8
16-QAM	3/4	-87.2	-86.6	-83.4	-82.8
16-QAM	4/5	-86.4	-85.8	-	-
16-QAM	5/6	-85.9	-85.3	-	-
64-QAM	1/2	-86.7	-86.1	-83.7	-83.1
64-QAM	3/5	-84.9	-84.3	-81.7	-81.1
64-QAM	2/3	-83.5	-82.9	-80.0	-79.4
64-QAM	3/4	-82.0	-81.4	-77.7	-77.1
64-QAM	4/5	-81.0	-80.4	-	-
64-QAM	5/6	-80.3	-79.7	-	-
256-QAM	1/2	-82.7	-82.1	-79.1	-78.5
256-QAM	3/5	-80.3	-79.7	-76.6	-76.0
256-QAM	2/3	-78.9	-78.3	-74.6	-74.0

256-QAM	3/4	-76.8	-76.2	-71.7	-71.1
256-QAM	4/5	-75.4	-74.8	-	-
256-QAM	5/6	-74.6	-74.0	-	-

8.4 Maximum Signal Input Levels

IDTV shall enable QEF reception for T2 signals up to the level of -35 dBm.

8.5 IDTV decoder immunity to digital signals in other channels

IDTV shall enable QEF reception in the presence of an interfering DVB-T2 signal on a neighbouring, mirror or other channel, provided that the maximum admitted ratio between the interfering and useful signal I/C shown in the table below is not exceeded.

Table 14: Minimum required I/C for QEF reception with interfering DVB-T2 signals

Band	Bandwidth [MHz]	Minimum I/C ratio [dB]		
		adjacent channels	other channels	mirror channels
TV band III	7	28	38	---
TV band IV	8	28	38	28
TV band V	8	28	38	28

At the time of applying for type approval, a conformance test report should be submitted indicating the DVB T2 operational modes that were used during testing.

REFERENCED STANDARDS

All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below.

- [1] ETSI EN 302 755 v1.3.1 (2012-04) Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)
- [2] IEC CISPR 13 (Jun 2009) Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and methods of measurement
- [3] IEC CISPR 22 (Sept 2008) Information Technology equipment – Radio disturbance characteristics – Limits and methods of measurement
- [4] IEC 60065 (Feb 2011) Audio, video and similar electronic apparatus – Safety Requirements
- [5] BS 6500 - British Standard, which specifies the requirements for flexible cables with voltage ratings up to 300V/500V used in appliances and equipment intended for domestic, office or similar environments
- [6] IEC 60227-5: Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 5: Flexible cables (cords)
- [7] IEC 60245-4 Edition 2.2-2004 Rubber insulated cables - Rated voltages up to and including 450/750 V - Part 4: Cords and flexible cables
- [8] BS1363/MS589 - Specification for rewirable and non-rewirable 13A fused plugs
- [9] ETSI TS 102 006 v1.3.2 (2008-07) Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems.
- [10] ETSI EN 300 468 v1.13.1 (2012-04) Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems
- [11] ETSI TR 101 211 v1.9.1 (2009-06) Digital Video Broadcasting (DVB) Guidelines on implementation and usage of Service Information (SI)
- [12] ETSI EN 300 743 v1.4.1 (2010-11) Digital Video Broadcasting (DVB); Subtitling systems
- [13] ETSI EN 300 472 v1.3.1 (2003-05) Digital Video Broadcasting (DVB); Specification for Conveying ITU-R System B Teletext in DVB bit streams.
- [14] ETSI EN 300 706 v1.2.1 (2003-04) Digital Video Broadcasting (DVB); Enhanced Teletext Specification
- [15] CI Plus specification V1.3 (2011-01) CI Plus Specification, Content Security Extensions to the Common Interface

- [16] ITU-T Rec. H.264 (2003-12) Advanced video coding for generic audiovisual services
- [17] ISO/IEC 14496-10(2012) Information technology-Coding of audio visual objects- part 10: Advanced video coding
- [18] ETSI TR 101 154 V1.11.1 (2012-11)Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream IEC 61169 Radio-frequency connectors, Part 2: Coaxial matched connectors
- [19] ISO/IEC 14496-3 Information technology ,Coding of audio-visual objects - Part 3: Audio
- [20] ETSI EN 300 744 Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television

ANNEX 1 Table of the TV RF channels and Channel Numbers

TV Band III Bandwidth 7 MHz		TV Band III Bandwidth 8 MHz		TV Band IV/V Bandwidth 8 MHz	
Channel	Frequency ¹ [MHz]	Channel	Frequency ¹ [MHz]	Channel	Frequency ¹ [MHz]
5	177.5	6	178	21	474
6	184.5	7	186	22	482
7	191.5	8	194	23	490
8	198.5	9	202	24	498
9	205.5	10	210	25	506
10	212.5	11	218	26	514
11	219.5	12	226	27	522
12	226.5			28	530
				29	538
				30	546
				31	554
				32	562
				33	570
				34	578
				35	586
				36	594
				37	602
				38	610
				39	618
				40	626
				41	634
				42	642
				43	650
				44	658
				45	666
				46	674
				47	682
				48	690

¹ Frequency in the centre of the channel's frequency range

ANNEX 2 Summary of SI Transmitted and Received in the DVB T2 System

Data contained in the transmitted transport streams intended for processing in DVB T2 IDTV are listed below.

1. Programme Association Table (PAT)
2. Programme Map table (PMT)
3. Conditional Access Table (CAT)
4. Service Description Table (SDT)
5. Event Information Table (EIT) present/following
6. Event Information Table (EIT) schedule
7. Time and Date Table (TDT)
8. Time Offset Table (TOT)
9. Running Status Table (RST)

ANNEX 3 Logical Channel Numbering

Important Notes on Logical Channel Numbering

- LCNs can range from 1 to 999. In order to provide some recognised order to the various program choices, a scheme has been devised which allows services to be selected from
 - 1 a single button push – 1 to 9;
 - 2 a double button push – 10 to 99;
 - 3 a triple button push – 100 to 999.
- The possibility of large numbers of services requires IDTVs to expect up to 3 numbers, entered via remote control, to select the LCN of a program service. This means that the IDTV's remote control interface will need to have inbuilt hysteresis, allowing enough time to capture a single, double or triple digit entry.
- In the DTT implementation of the Logical Channel Number descriptor, a service can be identified by more than one logical channel. This allows Logical Channel “place markers” to be present all the time, pointing to virtual services with no additional data bandwidth overhead, providing the broadcaster with the ability to dynamically re-assign the logical channel number of an intermittent or absent service, to another service that is currently present, even though that service already has an existing LCN allocated to it.
- The implementation of the Logical Channel Number is of benefit to both the broadcaster and the viewer.

For the viewer:

 - 1) A familiar menu of numbered service listings is maintained; and
 - 2) The IDTV will not attempt to select an absent service with unpredictable results.

For the broadcaster:

 - 1) The service list can be efficiently maintained without the need to reserve (waste) valuable data bandwidth to maintain absent (empty) services.
- **Without an organised system of user readable program numbering;**
 1. A broadcaster has no control over the order and priority of the transmitted services;
 2. An IDTV could assign numbers as it finds them, either during the initial set-up and tuning process, or in the process of finding new services.

ANNEX 4 List of Broadcast Descriptors

Descriptors in use (exclude data broadcasting)	Tag	NIT	SDT	EIT	TOT	PMT
network_name_descriptor	0x40	*				
terrestrial_delivery_system_descriptor	0x5A	*				
T2_delivery_system_descriptor	0x7F/0x04 (ext)	*				
service_list_descriptor	0x48	*				
logical_channel_descriptor	0x83	*				
private_data_specifier_descriptor	0x5F	*				
service_descriptor	0x41		*			
multilingual_service_name_descriptor	0x5D		*			
component_descriptor	0x50			*		
short_event_descriptor	0x4D			*		
extended_event_descriptor	0x4E			*		
local_time_offset_descriptor	0x58				*	
iso_639_language_descriptor	0x0A					*
stream_identifier_descriptor	0x52					*
AC-3_descriptor	0x6A					*
subtitling_descriptor	0x59					*
teletext_descriptor	0x56					*
video_stream_descriptor	0x02					*
audio_stream_descriptor	0x03					*
content_descriptor	0x54			*		
parental_rating_descriptor	0x55			*		
Enhanced_AC-3_descriptor	0x7A					*
AAC_descriptor	0x7C					*

Descriptors required for SSU	Tag	NIT	SDT	EIT	TOT	PMT
linkage_descriptor	0x4A	*				
Data_broadcast_id_descriptor	0x66					*

Note: The list is not exhaustive; it shows the typical descriptors that may be broadcast by terrestrial broadcasters.

This is extracted from ETSI EN 300 468 Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems.

ANNEX 5 Basic Function Keys of Remote Control Unit

The IDTV remote control shall include the following keys:-

- a) Power on/off [on/off] – turn the DVB-T2 IDTV on and off
- b) Program up/down [P+, P-] – switch between programs
- c) Volume up/down [V+, V-] – adjust the volume output level
- d) Subtitle/option [Subt/option] – display the subtitle or select other user selectable options (e.g. change subtitling language if several available, audio language/track if several available, video aspect ratio output format etc.)
- e) A navigation or pointing system for navigation on the OSD
- f) OK [OK] – a function that selects or confirms current choice or statement
- g) Multifunctional keys – four color-coded keys for non-dedicated functions. The colors shall be red, green, yellow and blue.
- h) Guide/EPG [Guide] – This function displays an Electronic Program Guide.

ANNEX 6 AFD Illustration for Required TV Output Display

INPUT				OUTPUT DISPLAY	
Source	Source Image	Broadcasted Frame	AFD Code	16:9	4:3
16:9		16:9	1000		
	1010				
		4:3	1010		
4:3		4:3	1000		
	1001				
		16:9	1001		

This is extracted from IDA/MDA TS DVB-T2 IRD Issue 1 Rev 1, March 2013.