

Regulating simple set-top boxes

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1.

Introduction

Government bodies world wide are preparing regulation for simple set-top boxes (STB). Since the STB market is both technologically and economically a dynamic market, these preparations pose several questions:

- what is a *simple* STB (definition)?
- what specifications are used?
- risk assessment of the definition
- flexibility of the definitions; how to cope with trends?

The questions are dealt with in this paper. Based on the answers of these questions the paper proposes a definition of simple STB that can be used for regulation and provides some general criteria for energy efficiency of simple STB.

2.

What is a *simple* STB and what specifications are used?

The EU Code of Conduct, the California Energy Commission (CEC) and the Australian standards all have a definition of a simple STB, although the naming differs; see table below.

Table 1 Definitions of simple STB (EU, California, Australia)

EU Code of Conduct	CEC	Standards Australia
<p>The <i>simple digital TV converter</i> is a stand alone device, using an integral or dedicated external power supply, for the reception of (free) Standard Definition (SD) or High Definition (HD) digital broadcasting services and their conversion to analogue RF and/or line signals.</p> <p>The following components/features are included in the power allowance targets but do not constitute a minimum specification (i.e. they may not be present in the device):</p> <ul style="list-style-type: none"> • Tuner/demodulator: <ul style="list-style-type: none"> - Cable version: Single cable tuner/demodulator - Terrestrial version: single RF tuner /demodulator, active antenna powering - Satellite version: single satellite tuner / demodulator, single LNB feed. • Single MPEG Decoder (SD or HD as appropriate) • Analogue Composite and Component video outputs • One Analogue Composite and Component video input • Stereo analogue audio out • Stereo analogue audio in • Support for Off-air Software Upgrade • Electronic Programme Guide (EPG) • Operating system support for Interactive Services (e.g. MHEG /MHP/OpenTV etc) ; no return path • Timer control facilities • Auto standby 	<p>“<i>Digital television adapter</i>” (DTA) means a commercially-available electronic product for which the sole purpose is the conversion of digital video terrestrial broadcast signals to analog NTSC video signals for use by a TV or VCR.</p>	<p><i>DTV STB-Free-to-Air (FTA)</i></p> <p>A commercially available electronic product with a primary purpose to receive and decode FTA terrestrial digital television broadcast signals, for use by a video display device or a recording device.</p> <p>The standard distinguishes Standard definition (SD) decoding (the ability to decode video transport streams that are MPEG 2 MP@ML) and High definition (HD) decoding (the ability to decode video transport streams that are MPEG 2 MP@HL).</p>

From these definitions no universal definition for a simple STB appears. What the definitions have in common is that the box should be able to receive digital (television) broadcasting signals (services). The CEC and Australian definitions are restricted to terrestrial broadcasting, and the Australian definition does not indicate that the received signals have to be converted to analogue RF signals. Both the EU and Australian definitions (explicitly) allow for more functions than the conversion to analogue RF signals. Furthermore, the EU Code of Conduct and the Australian Standard also provide definitions for (more) complex STBs.

If the definitions and specifications of the simple boxes (see Annex I) and the complex are considered, the following conclusions can be drawn. The decisive factor whether a box is a complex box or not seems to be the role of the service provider: a complex box comes with CA support and the service provider is able to control the box. Or, the other way around: a simple box has no CA support.

3.

Risk assessment of the definitions

For regulation a risk assessment of the definition is needed: is the definition robust and flexible enough to be used in regulation? A definition is robust if it can not be (easily) cheated, a definition is flexible if it allows future trends in functionality to be included.

The **robustness** refers to the question whether manufacturers can modify STB design in such way that:

- a) the STB does not meet the definition (and therefore it has not to comply with the regulation)
- b) at costs less than costs needed/saved to fulfill the specifications

A closed definition runs high risks of being circumvented by products that have some functionality that is not included in the definition. The CEC definition is closed (by the words 'sole purpose') but in this case the risks are minimized because the same definition will be used in a subsidy program and therefore it is not likely that condition b) will be fulfilled.

But also a more open definition, e.g. the EU Code of Conduct, can be avoided by jumping to the next category of functionality, the complex STB. An allowance table makes this more difficult, because adding functionalities from an the allowance table does not bring the STB outside the scope, it merely allows some extra power consumption for the added functionalities. Furthermore, in both the Code of Conduct and the Australian Standard the (total) extra power consumption allowed is limited. So, whatever functionality from the allowance table is added, the total standby active consumption of the STB should not be higher than e.g. 15 W.

However, in principle the naming *simple* suggest that also complex boxes exist, which – by definition – are outside the scope of regulation for simple boxes.

The **flexibility** refers to the question whether the definition is flexible enough to cope with trends. What is complex today, can be simple tomorrow and regulation mostly can not be changed overnight and should be stable for a long period, so that it can be used as a design guidance.

What are trends for *simple* STBs? In the near future simple STBs will be used to enable viewing digital broadcasting on analogue TVs. However, it is likely that recording functions will be included and it may have a return channel for interactive applications. The return channel would not necessarily be internet based, it could be PSTN or GPRS.

When TVs have become digital, it is still an open debate whether simple STBs will become obsolete or not. It will depend on the functions that will be included in the TV. If the TV absorbs the features of a simple STB, including recording, then the simple STB will become obsolete. On the other hand, if the TV develops more into a display, (simple) STBs will stay on the market.

The **conclusion** regarding the risk assessment on current definitions of simple STBs is that these are not robust nor flexible enough to be used in regulation¹. Either they are closed and therefore easy to circumvent, or they draw an arbitrary line between simple and other (complex) STBs which can become obsolete with technology and market changes.

In the next section a solution is presented.

4.

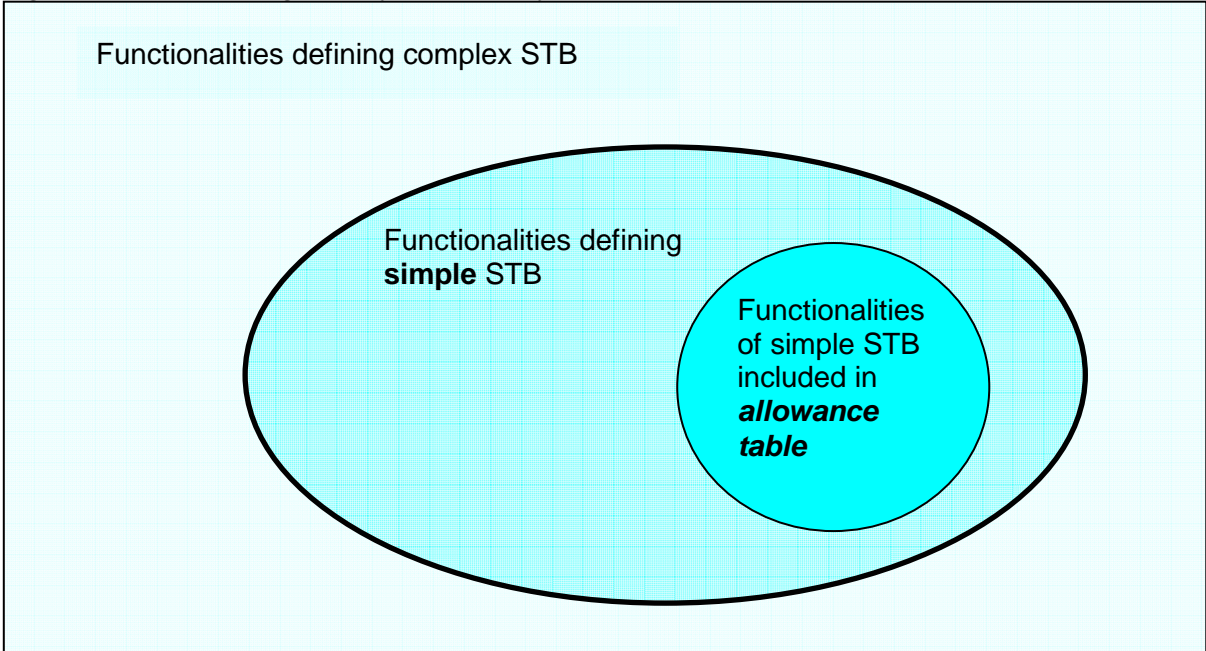
Defining STB by functionality

The conclusion of the foregoing section that current definitions are not suitable for regulation does not mean that regulation of simple STB is impossible. A solution to the identified problems can be found along the following line of reasoning.

The addressee of regulation for (the simple) STB is the manufacturer², so the regulation should focus (only) on aspects that manufacturers are able to influence. Regarding energy efficiency the main strategies for manufacturers are power management and using efficient design and components. However, the extent to which power management can be applied, depends on the functionality that others require from the box.

So, the functionality that others require from the STB is in this line of reasoning the boundary between simple (regulated) STB and complex (not yet regulated) STB. For simple STB the principle of efficient design and components can be differentiated by means of an allowance table.

Figure 1 Defining STB by functionality



In general a STB is equipment for the reception, decoding, processing and local networking of digital broadcasting and related services.

The following categories of functionalities are important for the definition of STB and the allowance table:

¹ However, they might be well suited for e.g. voluntary agreements.

² It can be argued that also the service provider should be addressed. However, most (all?) MEPS regulation targets tangible products – and not services – and therefore the producers of these products. Service providers specify STBs but do not produce them. In the end, when manufacturers are forced by regulation to produce STB with certain (efficiency) characteristics, services providers (and others) have to accept these.

- Conditional Access (CA).
- Networking: the STB provides networking functions, e.g. internet access (e.g. VoIP) and/or principal signals for other products.
- Recording (requires storage medium, e.g. hard disk or DVD).
- Interfacing: USB, IEEE 1394, 802.3 and 802.11, Bluetooth, HDMI, etc.
- Return channel: ADSL modem, Docsis modem, PSTN modem.
- Picture and sound: High Definition, multidecode, surround sound.

The first two categories are different from the rest. Conditional Access functionalities are generally subject to service provider control. Networking can be considered as an always on (AO) function because the functionality in principle need to be delivered at any time, so the STB is not always in control of the (demand of these) functionalities.

This leads to the conclusion that conditional access (CA) and functions that need to be always on (AO) are important differentiators between simple and other (complex) STBs. The AO function determined so far is networking where the STB provides networking functions, e.g. internet access (for e.g. VoIP), and/or principal signals for other products³.

	non-CA	CA
no AO functions	simple STB	
AO function(s)		complex STB

Thus a simple definition of a simple STB is:

a simple STB is a STB with no CA and no AO functions.

5.

General criteria for the energy efficiency of simple STB

In this section some (general) criteria for energy efficiency of simple STB⁴ are applied. They are based on the general principles indicated above: power management and efficient design and components.

Efficient design and components.

The criteria for efficient design and components materialize in power consumption targets. Distinguished is a basic configuration with a basic power consumption target and an allowance table with additional functions for which a power consumption additional to the basic power consumption target is allowed. These allowances might vary by mode. All functions that are not covered by the allowance table are assumed to be covered by the basic configuration (of course unless it concerns CA or AO functions which would bring the product out of the simple STB definition).

Power management

Power management means that the STB is always in the mode with the lowest possible power consumption for the functionality required at that moment. Power management emerges in the following features:

- Timer control facilities (in standby passive): this feature allows the STB to switch from (and to) the standby passive mode without user interaction. Most STBs have an EPG⁵ which allows users to select programmes for recording, either by an external recording device (e.g. VCR) or internally in the STB (e.g. on hard disk or DVD). If a programme is selected, the time control wakes the STB from the standby passive mode a short time before the program start, if applicable the STB sends a signal to the VCR to start recording. When the programme has finished (according to the data in the EPG) the time control puts the STB into the standby passive mode if appropriate.

³ These AO functions are the link between the Code of Conduct for Digital TV Service Systems and the Code of Conduct for Broadband Equipment.

⁴ Annex II provides a first draft of specifications for simple STB according to the simple definition.

⁵ Electronic Program Guide

- Auto power down (automatic standby feature): the STB automatically switches itself into the lowest standby mode (in principle standby passive) after a period in the on mode following the last user interaction. The auto power down feature should be supplementary to the timer control facilities.
- Power management of unusable CA and AO functions:
 - CA boxes in which the CA components (electronics, software and /or hardware) are present but not usable, should fulfill the simple STB Criteria. Some STBs have a CA module but the CA function is not continuously used, e.g. only for pay per view for football matches.
 - If a STB has the components (electronics, software and/or hardware) to provide one or more AO functions but these functions are not usable, the STB should fulfill the simple STB criteria.

The criteria for power management of non-used CA and AO functions should make it less “profitable” to circumvent the definition of a simple STB by adding CA and/or AO functions that are not usable in the delivered state of the equipment.

Annex I
Overview of specifications

EU Code of Conduct

Specifications for simple digital TV converter boxes

Mode	From 1-1 2006 to 31-12-2007			
	Cable	Terrestrial	Satellite	DSL
	Simple Converters			
Standby Passive	2W	2W	2W	2 W
ON	7W	7W*	10W	7 W***
	Simple converters for High Definition TV Services			
Standby Passive	2 W	2 W	2 W	2 W
ON (standard definition output)	11 W	11 W**	14 W	11 W***
ON (high definition output)	12 W	12 W**	15 W	12 W***

* 9 W: in case of double RF tuner

** 14 W: in case of double RF tuner

*** If the DSL box includes the ADSL modem then there is an additional 2W allowance in **ON mode power** (this allowance is valid only for DSL boxes)

California Energy Commission

Table U-3
Standards for Consumer Audio and Video Equipment

Appliance Type	Effective Date	Maximum Power Usage (Watts)
Compact Audio Products	January 1, 2007	2 W in Audio standby-passive mode for those without a permanently illuminated clock display 4 W in Audio standby-passive mode for those with a permanently illuminated clock display
Televisions	January 1, 2006	3 W in TV standby-passive mode
Digital Versatile Disc Players and Digital Versatile Disc Recorders	January 1, 2006	3 W in Video standby-passive mode
Digital Television Adapters	January 1, 2007	1 W in STB standby-passive mode, 8 W in STB on mode

TABLE 2
MAXIMUM POWER LEVELS FOR FTA DTV STB
(FROM AC SUPPLY)

Product type	Passive standby–Max power (W)	Active standby–Max power (W)	On mode –Max power (W)
		MPA/MPL	MPA/MPL
Standard Definition Option 1	1.0 W	8 W/15 W	8 W/15 W
or Option 2	2.0 W	7 W/15 W	7 W/15 W
High Definition Option 1	1.0W	12 W/19 W	15 W/22 W
or Option 2	2.0W	11 W/19 W	14W/22W

TABLE 4
ADDITIONAL POWER CONSUMPTION ALLOWANCE

The following additional power consumption allowances are for features which are additional to those included in the basic platform features listed in Table 1. These allowances can be added to the MPA up to the MPL for STBs that have these functions. Multiple implementations of the same feature attract multiple allowances.

Feature	Additional power consumption (Active Standby Mode)	Additional power consumption (On Mode STB FTA only)
SCART Port	1.0 W	1.0 W
IEEE1394 interface	0.8 W	0.8 W
Ethernet interface 100 Mb	0.4 W	0.4 W
Wireless interface	0.7 W	0.7 W
SPDIF port	0.1 W	0.1 W
Serial USB interface (low power mode)	0.3 W	0.3 W
Home automation interface	0.4 W	0.4 W
Broadband modem	2.0 W	2.0 W
Cable modem	0.7 W	Not applicable
Extra LNB/masthead amplifier feed	No allowance	No allowance
Additional tuner	2.0 W	2.0 W
Powered remote IR receiver	0.25 W	Not applicable
PSTN Modem	0.7 W ¹	0.7 W ¹
HDMI	TBA ²	TBA ²

¹This allowance only applies if a second PSTN modem is present. The initial PSTN modem power consumption is included in the basic features platform in Table 1. Keith Jones is checking this allowance with European Code of Conduct members.

² It was agreed at the TE-001-08 meeting to investigate the inclusion of an allowance for HDMI. Keith Jones is also checking this allowance with European Code of Conduct members.

Annex II

Definition and specifications for simple STB

Definitions

A STB is equipment for the reception, decoding, processing and local networking of digital broadcasting and related services. This includes broadcasting by means of IP (internet).

A *simple STB* is an STB with no conditional access (CA) and no functions (other than RF loop through) that are always on (AO).

A complex STB is an STB with conditional access and/or functions that are always on.

An example of AO-functions is networking where the STB provides networking functions, e.g. internet access (e.g. for VoIP) or principal signals for other products.

In the *basic configuration* the following components/features are included in the power consumption target but do not constitute a minimum specification (i.e. they may not be present in the device).

STB			
<i>CABLE</i>	<i>TERRESTRIAL</i>	<i>SATELLITE</i>	<i>DSL</i>
Single cable tuner /demodulator	Single RF tuner /demodulator Active antenna powering	Single satellite tuner /demodulator Single LNB feed	No tuner /demodulator
Single MPEG2 Decoder (SD or HD as appropriate)			
RF Modulator / Loop-through			
IR Remote Control			
Support for Off-air Software Upgrade			
Electronic Programme Guide (EPG)			
Timer control facilities			
Auto standby			
Analogue Composite and Component video outputs			
Single Analogue Composite and Component video input			
Stereo analogue audio out and in			
Operating system support for Interactive Services (e.g. MHEG, MHP, OpenTV)			

The following *additional power consumption allowances* are for features which are *additional* to those included in the basic configuration. Multiple implementations of the same feature attract multiple allowances. All features that are not covered by the allowance table are assumed to be covered by the basic configuration, unless it concerns CA or AO functions which would bring the product out of the scope of the definition of a simple STB.

Additional (to the basic configuration) feature	Additional (AC) power consumption Standby active mode	Additional (AC) power consumption On-mode
Internal hard disk drive	2.2 W	
IEEE1394 interface	0.8 W	
Ethernet interface 100Mbit	0.4 W	
Home network interface	2.5 W	
Serial USB interface	0.3 W	
Home automation interface	0.4 W	
ADSL modem	2 W	2 W
Docsis modem	4.5 W	
PSTN modem		
LNB feed	1.3 W (with an additional 80 mA for the LNB current)	

Tuner/demodulator	2 W	2 W
Powered remote IR receiver (loaded at 15mA)	0.25 W	
MPEG 4, multidecode platform		
Surround sound		

Specifications

A *simple STB in the basic configuration* should comply with the following power limits.

Mode	From XX to YY			
	Cable	Terrestrial	Satellite	DSL
Standby Passive	2W	2W	2W	2 W
Standby Active				
ON	8 W	8 W	11 W	11 W

If the simple STB has additional features according to the additional features list above, the allowance for the additional features shall be added to the power limits for the basic configuration to determine the power limit of the simple STB with additional features. In any case the total maximum allowed power shall not exceed the following limits.

Simple STB with additional features; maximum power limits

Mode	From XX to YY			
	Cable	Terrestrial	Satellite	DSL
Standby Passive				
Standby Active				
ON				

STB with CA or AO functions (complex STB)

Complex STB with CA but no AO functions of which the CA is unusable in the delivered state should meet the simple STB specifications.

Complex STB with no CA and one or more AO functions of which all of these functions are unusable in the delivered state should meet the simple STB specifications.

Complex STB with CA and one or more AO functions of which both the CA and all AO functions are unusable in the delivered state should meet the simple STB specifications.