TECHNICAL CODE

SPECIFICATION FOR
DIGITAL TERRESTRIAL TELEVISION BROADCAST SERVICE RECEIVER

First Revision

Developed by

Registered by

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DEVELOPMENT OF TECHNICAL CODES

The Communications and Multimedia Act 1998 ('the Act') provides for Technical Standards Forum designated under section 184 of the Act or the Malaysian Communications and Multimedia Commission ('the Commission') to prepare a technical code. The technical code prepared pursuant to section 185 of the Act shall consist of, at least, the requirement for network interoperability and the promotion of safety of network facilities.

Section 96 of the Act also provides for the Commission to determine a technical code in accordance with section 55 of the Act if the technical code is not developed under an applicable provision of the Act and it is unlikely to be developed by the Technical Standards Forum within a reasonable time.

In exercise of the power conferred by section 184 of the Act, the Commission has designated the Malaysian Technical Standards Forum Bhd ('MTSFB') as a Technical Standards Forum which is obligated, among others, to prepare the technical code under section 185 of the Act.

A technical code prepared in accordance with section 185 shall not be effective until it is registered by the Commission pursuant to section 95 of the Act.

For further information on the technical code, please contact:

Malaysian Communications and Multimedia Commission (SKMM)
Off Pesiaran Multimedia
63000 Cyberjaya
Selangor Darul Ehsan
MALAYSIA

Tel: +60 3 8688 8000
Fax: +60 3 8688 1000
http://www.skmm.gov.my

OR

Malaysian Technical Standards Forum Bhd (MTSFB)
L2-E-11, Lab 3, Digital Media Centre
Enterprise 4
Technology Park Malaysia
Lebuhraya Puchong –Sg Besi
Bukit Jalil
57000 Kuala Lumpur
MALAYSIA

Tel: +60 3 8996 5505/5509
Fax: +60 3 8996 5507
http://www.mtsfb.org.my

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Committee Representation

Multimedia Terminal Working Group under the Malaysian Technical Standards Forum Bhd (MTSFB) which developed this Technical Code consists of representatives from the following organisations:

Al Hijrah Media Corporation (TV Alhijrah)

Asiaspace Sdn. Bhd.

BVD Systems Sdn. Bhd.

Conax AS Asia Pacific

Digital TV Labs Limited

LG Electronics (M) Sdn. Bhd.

ManQana Sdn. Bhd.

Measat Broadcast Network Sdn. Bhd. (ASTRO)

Media Prima Berhad

Panasonic R&D Centre Malaysia Sdn. Bhd.

Radio Television Malaysia (RTM)

Rohde & Schwarz Malaysia Sdn. Bhd.

SIRIM Berhad

Sony EMCS (M) Sdn. Bhd.

Strategy and Technology

Telekom Malaysia Berhad

Telekom Research & Development Sdn. Bhd.

U Mobile Sdn. Bhd.

U Television Sdn. Bhd.

Y&R

FOREWORD

This technical code for the Specification for Digital Terrestrial Television Broadcast Service Receiver ('this Technical Code') was developed pursuant to section 185 of the Act 588 by the Malaysian Technical Standard Forum Berhad ('MTSFB') via its Multimedia Terminal Working Group.

This Technical Code was developed for the purpose of certifying communications equipment under the Communications and Multimedia (Technical Standards) Regulations 2000.

This Technical Code cancels and replaces Technical Specification Digital Terrestrial Television Receiver, SKMM WTS STB-FTA Rev. 1.01:2008.

This Technical Code shall continue to be valid and effective until reviewed or cancelled.

SPECIFICATION FOR DIGITAL TERRESTRIAL TELEVISION BROADCAST SERVICE RECEIVER

Introduction

Proposition

This document outlines receiver specification which is capable of receiving both Standard Definition and High Definition Digital Terrestrial broadcast for Malaysia.

Items in this specification are divided into 'Required' and 'Optional' categories. Where a feature is stated as 'Required', its inclusion is necessary for the achievement of a minimum compliance with transmission requirements. Additional Optional functions may be added by the vendor to enhance the consumer proposition and these will be welcomed. In order to be compliant, where a feature is 'Optional' and is included in an offered receiver design, the optional feature must be implemented in accordance with the associated referenced standards. The word "shall" implies that the item is a requirement (mandatory) while the word "may" implies that a requirement is optional.

The term basic profile in this document refers to the profile for receivers which do not implement the interactive application as outlined by 3.2.18.

This specification is not a comprehensive list of all relevant standards relating to consumer equipment that can provide digital terrestrial reception but rather a list of those standards considered relevant to requirements.

The profile is based upon open standards predominantly from the Digital Video Broadcasting (DVB) standards and the European Telecommunications Standards Institute (ETSI).

Purpose

The purpose of this document is to describe the requirements for a certified Free to Air Terrestrial receiver for Malaysia and to refer to detailed specifications that are required for conformant implementation. The profile is in the form of a hardware specification outline, together with an overview of software requirements. The software is to be routinely capable of being upgraded via 'through-the-air-download'.

1.   Scope

The document sets out to identify the baseline functional specification of a H.264 AVC HD digital terrestrial receiver including both Set Top Boxes and IDTV's. Personal Video Recorders (PVRs) are outside the scope of this document. It is intended that a terrestrial receiver conforming to this profile should comprise part of a domestic installation, in conjunction with an external, fixed wideband terrestrial UHF/VHF antenna input. Set Top Box output(s) will connect to the television display (and possibly other domestic equipment).

It is the aim of the specification to ensure that the approved receiver in Malaysia satisfies the minimum requirements of each broadcaster.

1.1 Abbreviations

AFD	Active Format Descriptor
AC-3	Dolby AC-3 audio coding system
CVBS	Composite Video Blanking and Synchronization
D-Book	See technical standards listed elsewhere in this document
BER	Bit Error Rate
C/N	Carrier to Noise Ratio
CLUT	(DVB) Colour Look Up Table
CVBS	Composite Video Baseband Signal
DTS	DTS audio coding system
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcast
DVB-CI	DVB-Common Interface
DVB-T	DVB-Terrestrial
DTG	Digital Television Group – a UK digital television industry organisation
E-AC-3	Enhanced AC-3
EBU	European Broadcasting Union
EPG	Electronic Programme Guide
EIT	Event Information Table
FEC	Forward Error Correction
FFT	Fast Fourier Transform
FTA	Free to Air
HDCP	High-Bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDTV	High Definition Television
HE AAC	High Efficiency Advanced Audio Coding
HE AAC v2	High Efficiency Advanced Audio Coding Version 2 profile
IRD	Integrated Receiver Decoder
iDTVs	Integrated Digital Televisions
MHEG-5	A standard devised for the middleware for interactive services.
MHEG	stands for "Multimedia and Hypermedia information coding Expert Group"
May	Indicates an event or provision which is permitted, but not mandatory
MP@HL	Main Profile at High Level
MP@ML	Main Profile at Main Level
MPEG	Moving Pictures Expert Group
Must	Indicates that a third party must comply to ensure correct operation (present tense) Indicates an existing provision
NIT	Network Information Table
OSD	Onscreen Display
(Opt)	Optional
PAL	Phase Alternating Line
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
(Req)	Requirement
RF	Radio Frequency
RS	Reed-Solomon
SD	Standard Definition

SDT	(DVB) Service Description Table
SDTV	Standard Definition Television
SFN	Single Frequency Network
SI	Service Information
S/PDIF	Sony/Philips Digital Interface
SSU	System Software Update
STB	Set-Top-Box, which is equivalent to a digital Terrestrial receiver
Shall	Indicates a mandatory provision
Should	Indicates a desirable, but not mandatory, provision
(TS)	Transport Stream: A data structure defined in ISO/IEC 13818-1
UHF	Ultra-High Frequency
Y/C	S-Video Signal
YCbCr/YPbPr	Component Video Signal
Will	Indicates an assumption about existing states or future events

2.   References

[1] Commission Determination on the Mandatory Standard for Free To Air Transmission of Digital Terrestrial Television Service (Suruhanjaya Kommunikasi dan Multimedia Malaysia – SKMM).

[2] HDMI "High-Definition Multimedia Interface; specification Version 1.4"

[3] HDCP "High-Definition Digital Content Protection System Revision 1.4"

[4] ETSI EN 300 468 V1.12.1 Digital Video Broadcasting (DVB); Specification for service information (SI) in DVB systems

[5] ETSI TS 101 211 V1.11.1 Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service information (SI)

[6] EN 302 755 V1.3.1 Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)

[7] ETSI TS 101 154 V1.10.1 Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 transport stream

[8] ETSI ETR 162 Digital broadcasting systems for television, sound and data services; Allocation of Service Information (SI) codes for Digital Video Broadcasting (DVB) systems.

[9] ETSI 300 743 v1.3.1 Digital Video Broadcasting (DVB); DVB Subtitling systems.

[10] ISO/IEC 14496-10 2005 Information Technology – Coding of audio visual objects – part 10 – Advanced Coding

[11] SKMM MTSFB TC G002:2013 Middleware Profile for Digital Terrestrial Television Broadcast Service

[12] SKMM MTSFB TC G001:2013 Compression Table of Service Information (SI) Descriptions for Digital Terrestrial Television Broadcast Service

[13] CI Plus Specification. Content Security Extensions to the Common Interface. V1.3

[14] ETSI TS 102 006 (V1.3.2) Digital Video Broadcasting; Specification for System Software Update in DVB Systems.

[15] ETSI TS 102 366 (V1.1.1) Digital Audio Compression (AC-3, Enhanced AC-3) Standard

[16] ISO/IEC 14496-3:2009 Information Technology – Coding of audio visual objects – part 3: Audio

2.1 Overview

This specification uses as a reference a number of national and international standards from the DVB, ETSI, ISO and other standardization bodies to create a Malaysian Digital Broadcast profile. It does not intent to create a set of unique specifications unless deemed necessary by the commercial realities in Malaysia.

3. Requirement

3.1 General Requirement

3.1.1 Power Supply

The receiver may be AC or DC powered. For AC powered equipment, the operating voltage shall be 240 V +5 %, -10 % and frequency 50 Hz ± 1 % as according to MS 406 or 230 V ± 10 % and frequency 50 Hz ± 1 % as according to MS IEC 60038 whichever is current. (Req)

Where external power supply is used, e.g. AC adaptor, it shall not affect the capability of the receiver to meet this specification. Adaptor must be pre-approved by the relevant regulatory body before it can be used with the receiver. (Req)

3.1.2 Power Supply Cord and Mains Plug

The receiver shall be fitted with a suitable and appropriate approved power supply cord and mains plug. Both are regulated products and must be pre-approved by the relevant regulatory body before it can be used with the receiver. (Req)

The power supply cord shall be certified as according to:

a) MS 140; or
b) BS 6500; or
c) IEC 60227-5; or
d) IEC 60245-4.

The main plug shall be certified as according to:

a) 13 A fused plugs: MS 589: Part 1 or BS 1363: Part 1; or
b) 15 A plugs: MS 1577 or BS 546; or
c) 2.5 A, 250 V, flat non-rewirable two-pole plugs: MS 1578 or BS EN 50075.

3.1.3 Electromagnetic Compatibility

The receiver shall comply with the EMC emissions requirements as defined in the MS CISPR 13 or equivalent international standards. The requirements shall cover radiated and conducted emission. (Req)

3.1.4 Electrical Safety

The receiver shall comply with the safety requirements as defined in MS IEC 60065. The supplier shall submit full type test report of MS IEC 60065 or equivalent international standards. (Req)

3.1.5 Marking

The receiver shall be marked with the following information:

a) supplier/manufacturer's name or identification mark;

b) supplier/manufacturer's model or type reference; and

c) other markings as required by the relevant standards.

The markings shall be legible, indelible and readily visible. All information on the marking shall be either in Bahasa Malaysia or English Language. (Req)

3.2 Technical Requirement

3.2.1 Processor and Memory

The processing power and memory configuration of the receiver must be suitable for the routine operation of FTA digital Terrestrial reception, (DVB-T2), together with the embedded operation of the interactive application and the provision of the routine replacement of all software via "over-air download". The related parameter limits specified in this section are believed to be the minimum necessary to achieve these requirements.

3.2.1.1 DDRAM   : 64 Mbytes, Minimum baseline functionality

3.2.1.2 Flash   : 8 Mbytes, Minimum baseline functionality

3.2.1.3 CPU Processor Speed   : 300MHz, Minimum baseline functionality

3.2.2 Services Summary

The receiver must give access to all Malaysian free-to-view digital terrestrial television, radio and enhanced/interactive television services. This must include the capability to efficiently present radio channels, DVB subtitles and interactive elements of all services. It must present DVB subtitles when broadcasted and if requested by the viewer. Set top boxes shall also be able to manage the output video in both widescreen 16:9 and 4:3 picture formats to suit the connected display. Where possible, receivers should be able to present both subtitles and interactive graphics simultaneously. However, not all receivers may be able to do this, the result being that interactive content will not always be available to viewers that wish subtitles to be presented.

3.2.2.1 Time-exclusive Services

The receiver shall handle the transition between the active and inactive states of a time exclusive service in an orderly fashion, presenting clean transitions into and out of video, audio and inter-active

content streams without presentation of any content or application not intended for the selected service.

3.2.3 Video

3.2.3.1 Video Codec

The following codec shall be supported by a compliant receiver. The codec are outlined below and further constraint by [7] TS 101 154. Only clauses 5.5, 5.6 & 5.7 shall apply.

MPEG4 video: H.264 AVC Encoding, as ISO/IEC 14496-10 2005 (Information Technology – Coding of audio visual objects – part 10 –Advanced Coding) - (Req)

The profiles that shall be supported are as follows.

MPEG-4 AVC MP@L3 SD Video stream

MPEG-4 AVC HP@L4 HD Video stream

3.2.3.2 Resolutions

The following resolutions shall be supported by a compliant receiver.

Table 1. References

Format	Resolution	Frame Rate (Field rate)	Progressive / Interlaced	Aspect Ratio
1080i/25	Refer to [7] clause 5.7	25Hz (50 Hz)	Interlaced	16:9
720p/50	Refer to [7] clause 5.7	50Hz (50 Hz)	Progressive	16:9
576i/25	Refer to [7] clause 5.6	25Hz (50 Hz)	Interlaced	16:9 & 4:3

3.2.3.3 Output Resolution Control for Set Top Boxes

Set Top Boxes shall provide either via the Menu System and/or Remote control an option to change the output video format as required by the user. The receiver is to perform a down-conversion or up-conversion from any valid input resolution to a user selected video resolution output. If the Video Output format option is in the menu structure of the receiver for the user to manually select then a pop-up message will appear to confirm the selection or reset automatically to the default selection after a time-out period (similar to changing the output format change display in windows operating system).

3.2.3.4 Widescreen

Set Top Boxes and IDTV's that optionally support Analogue outputs may format the outputs for displays which are either 16:9 or 4:3. Both may also carry out a suitable rescaling of the video to 14:9 when working with SD outputs on a 4:3 display.

3.2.3.5 Active Format Description

Table 2. AFD

INPUT				OUTPUT DISPLAY	
SOURCE		BROADCASTED FRAME	AFD Code		
Source	Source Image	Frame	AFD Code	16:9	4:3
16:9		16:9	1000		
14:9		16:9	1011		
4:3		4:3	1001		

The receiver shall support at least the Active Format Description (AFD) outlined in the table above as specified by [7] Appendix B.

3.2.4   Audio

3.2.4.1 Codec Support

Enhanced Dolby Digital (E-AC3), based on ETSI TS 102 366 [15] and signaled by TS 101 154 [7], Annex C and constrained by clause 6.2. Sampling rates shall be restricted to 32, 44.1 & 48kHz (Opt)

Only pass through of AC-3 audio to the Digital Audio Connector is required when E-AC3 is supported (Req).

MPEG-4 HE AAC audio for services will be encoded according to ISO/IEC 14496-3 [16] and signaled/constrained by ETSI TS 101 154 [7], section 6.4 and Annex C.5.

Stereo only receivers shall support MPEG-4 HE AAC v2 level 4 decoding including mandatory downmix and support of metadata as defined in ETSI TS 101 154 section 6.4.3 and Annex C.5. (Req)

Multichannel capable receivers shall support MPEG-4 HE AAC v2 level 4 decoding including mandatory transcoding into either AC-3 or DTS and support of metadata as defined in ETSI TS 101 154 section 6.4.3 and Annex C.5. (Opt)

3.2.4.2 Decoding Options

Table 3. Decoding Options

Codec	Analogue Output / Speaker (IDTV)	Optical/Coaxial	HDMI*
E-AC3	Down-Mixed. (Optional)	AC-3 transcoded bitstream and pass through. (Optional)	E-AC-3 Bitstream pass through (Optional).
HE-AAC v2 (Stereo)	Decode (Requirement)	Stereo PCM or bitstream pass through (Optional)	Stereo PCM or bitstream pass through (Requirement)
HE-AAC v2 (multichannel)	Down-Mixed (Requirement)	Transcode to AC-3 or DTS Bitstream and pass through.(Optional)	Transcode to AC-3 Bitstream and pass through. (Optional)

NOTES: The above implies that if E-AC3 is broadcasted, it shall always be simulcast with HE-ACC.
         *Only applicable if HDMI output is implemented by the receiver.

3.2.5   Subtitles

A compliant receiver shall be able to decode DVB subtitles according to the specification outlined in [9].

DVB subtitles shall be invoked from a suitable labeled remote control key which is always under the control of the receiver and not controlled by the Middleware application.

All receivers shall also be capable of decoding and presenting correctly subtitles streams which include the display_definition_segment (DDS) as outlined in [9] (Req).

3.2.5.1 Display of Subtitles during Enhanced Programming

Subtitles shall be displayed on a separate logical graphics plane separate from that used for the interactive application outlined in [11] (Req).

3.2.6 Multi-Language Support

The user shall be provided with Primary and secondary language options for both Subtitles and Audio selection. The list of languages provided shall as a minimum contain all the languages outlined in the table below.

Table 4. Multi-language support

Language	ISO 639-3 Code
English	ENG
Bahasa Melayu	MSA
Chinese	ZHO
Tamil	TAM
Original Audio	QAA*

NOTE. * Original Audio is only applicable for Audio.

3.2.6.1 Subtitle Selection

The order of priority for subtitle selection shall be as follows.

(1)   Primary Language.

(2)   Secondary Language.

(3)   Receivers own selection criteria (optional).

The receiver may implement its own selection criteria after (1) & (2) fail to provide a language match.

3.2.6.2 Audio Selection

The order of priority for audio selection shall be as follows:

(1)   Primary Language

(2)   Secondary Language

(3)   Receivers own selection criteria (optional)

The receiver may implement its own selection criteria after (1) & (2) fail to provide a language match.

3.2.7 OSD

The Graphics requirement for the receiver is governed by the graphics requirement of the interactive middleware application outlined in [11]. Receivers shall meet the minimum requirement outline there (Req).

This is not a requirement for receivers complying only with the basic profile.

3.2.8 Receiver Character Set

The receiver shall at least be able to support Table 00 (Latin Alphabet as specified in ISO 6937 which is reproduced in Appendix A of EN 300 468 [4]).

The broadcast shall not signal any character set selection information by ensuring that the first byte in any text field is either 0x1F (restricted to EIT tables) or in the range of 0x20 to 0xFF.

The receiver shall support compressed strings within all types of EIT tables. A compressed string shall be signaled by the method outlined in Appendix A of EN 300 468 [4]. This is done by ensuring that the first byte of any compressed string is 0x1F. The 2nd byte as outlined by [4] shall contain the encoding_type_id.

Strings marked as compressed shall be compressed using Huffman compression as outlined in [12]. The receiver to decompress these strings will require a look up table. The receiver shall incorporate 2 tables signaled by the encoding_type_id outlined in section 3.2.19.

3.2.9 Common Interface

Receivers may incorporate a DVB-CI (Common Interface) slot. If available, this slot shall be a certified CI+ slot as outlined in CI+ specification V1.3 [13] meeting all the required robustness rules.

3.2.10 Tuner / Decoder

A DVB-T2 decoder in accordance to T2 base profile of EN 302 755 [6] (Req)

3.2.10.1 RF Input Connector

In accordance to IEC 60169-2 (Req).

3.2.10.2 RF Loop-through

Set Top Boxes may provide an RF loop through. The connector shall be in accordance to IEC 60169-2 with a typical gain of 0 dB.

3.2.10.3 Input Impedance

75 ohm nominal (Req)

3.2.10.4 Frequency Range and Bandwidth

The receiver shall be able to scan and tune to the following frequency range and bandwidth.

Table 5. Frequency range and bandwidth

	Band	Frequency	Bandwidth
VHF	III	174 – 230 MHz	7 MHz
UHF	IV & V	470 – 860 MHz	8 MHz (signal bandwidth of 7.77 MHz for extended mode and 7.61 MHz for non-extended mode)

The receiver shall at least be able to receive carriers within an offset of up to 166 kHz from the nominal centre frequency.

3.2.10.5 DVB-T2 Operating Modes

The receiver shall support the operating modes as specified by EN 302 755 [6]. The minimum list of modes for each parameter that shall be supported by the receiver is outlined in the table below. (Req)

Table 6. DVB-T2 operating modes

Parameter	Required Modes
Transmission mode	32K Normal & Extended
Constellation	QPSK,16-QAM, 64-QAM & 256 QAM
Constellation Rotation	Rotated and Non Rotated
Code Rate	1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Guard Interval	Tu*19/128, Tu/8, Tu*19/256, Tu/16, Tu/32, Tu/128
Pilot Pattern	PP2, PP4, PP6 & PP7
Antenna	SISO & MISO
PAPR	No PAPR & TR-PAPR
FEC Frame Length	16200 & 64800
Input Mode	Input Mode A & B (Single PLP, Multiple PLP)
Baseband Mode	Normal Mode, High Efficiency Mode

3.2.10.6 Multiple PLP Feature Requirements

The receiver shall support at least the following features related to Multiple PLP as outlined in [6].

(1) Both PLP Type 1 & 2

(2) The receiver should be able to support SI information broadcasted in both the Common as well as the Data PLP.

(3) Receiver shall at least be able to decode one data PLP and the common PLP at any one time.

3.2.10.7 Receiver DVB-T2 Performance Requirement

The performance requirements for this section shall meet the RF requirement based on the list of modes outlined in Annex A.

3.2.11 Service List

After a receiver is installed it must offer the viewer all services that may be received in that geographic region compliant with the regional services requirement. The services being broadcast may change over time. To ensure that the viewer will always be able to access all services being broadcast to the selected region, the receiver must detect and reflect to the viewer any such changes with minimal viewer involvement. All services have an associated (Logical) Channel Number. Use of the logical channel number ensures that the viewer becomes familiar with a specific remote control unit button number for each channel. Access to, and use of, accurate service information is essential if the viewer is to enjoy all of the content being broadcast.

3.2.11.1   Scanning for Services

The receiver shall provide a method for the user to install all services which clears any previous service list that might exist. During this installation process, the receiver shall scan for the RF channels outlined in this document.

When a lock is achieved on a channel, the receiver shall obtain the list of services for the current multiplex from SDT actual. This process shall be repeated till the whole frequency range is complete.

3.2.11.2   Logical Channel Number Descriptor

LCN information shall be broadcasted via a privately defined LCN descriptor as outlined below. This descriptor shall be broadcasted in the TS Loop of the NIT on all multiplexes.

```
logical_channel_descriptor() {
        descriptor_tag                          8  (uimsbf)
        descriptor_length                       8  (uimsbf)
        for (i=0;i<number_of_services;i++){
                service_id                      16 (uimsbf)
                visible_service_flag            1   (bslbf)
                reserved                        5  (bslbf)
                logical_channel_number          10 (uimsbf)
        }
}
```

descriptor_tag : this shall be assigned the value 0x83

visible_service_flag : 1: visible 0:Not Visible

reserved : all reserved bits shall be set to 1. The receiver shall ignore these bits.

service_id : DVB defined service id.

3.2.11.3   Logical Channel Descriptor V2

The LCN V2 privately defined descriptor may be broadcasted. This descriptor contains additional information related to sorting of services depending on region. Receivers shall support this descriptor if broadcasted.

descriptor_tag: This shall be 0x87 (decimal 135)

channel_list_id: This 8-bit id shall uniquely define the Logical Channel List for a particular region. This id shall be unique within the Original Network.

channel_list_name_length: This 8-bit field specifies the number of bytes that follow the channel_list_name_length field for describing characters of the name of the Channel List. The maximum length of the channel list name shall be 23 bytes.

char: This is an 8-bit field. A string of character fields specify the name of the channel list, the channel_list_name. (channel_list_name shall have a maximum length of 23 characters). Text information shall be coded using character table 00 as defined in Annex A of EN 300 468.

country_code: This 24-bit field identifies a country using the 3-character code as specified in ISO 3166. Each character is coded into 8-bits according to ISO 8859-1 and inserted in order into the 24-bit field. This shall be set to "MYS".

service_id: A service_id that belongs to the TS (i.e. services from transport streams not in the current loop shall not appear). One service may only be listed once in each channel list, but may belong to/be listed in more than one channel list.

visible_service_flag: 1: visible 0:Not Visible
reserved: All "reserved" bits shall be set to '1'. The receiver shall ignore these bits.

logic_channel_number: This is the broadcasters preferred Logical Channel Number for the service in question. Rules of operation are as per LCN Management section of this specification.

```
Logical_channel_v2_descriptor (){
        descriptor_tag                          8       Uimsbf
        descriptor_length                       8       Uimsbf
        for (i=0;i<N;i++){
                channel_list_id                 8       Uimsbf
                channel_list_name_length        8       Uimsbf
                for (i=0;i<N;i++) {
                        char                    8       Uimsbf
                }
                country_code                    24      Uimsbf
                descriptor_length               8       Uimsbf
                for (i=0;i<number_of_services;i++){
                        service_id              16      Uimsbf
                        visible_service_flag    1       Bslbf
                        reserved_future_use     5       Bslbf
                        logical_channel_number  10      Uimsbf
                }
        }
}
```

3.2.11.4 Channel Numbering

The Logical Channel Numbers shall be obtained from the LCN descriptor as outlined above. The channel map shall be from 1-999 with valid LCN's being assigned in the range from 1-799 by the broadcaster. The details of the channel map are outlined below.
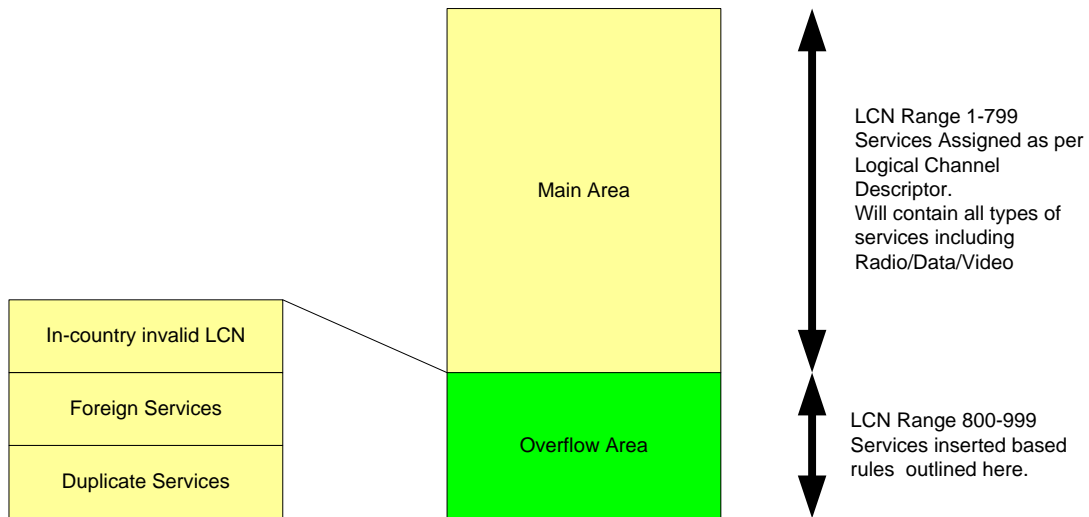
Figure 1. Channel map when there is a valid LCN descriptor

Main Area: Services shall be ordered here according to the channel map as described by the Logical Channel Descriptor. If no valid Logical Channel Descriptor exists, please refer to the no logical channel descriptor section below.

Overflow area: Below is the list of different categories within the overflow area.

In country invalid LCN: Any service which has not been assigned a Logical Channel Number or has been assigned a number outside the valid range of 1-799, shall be placed in the overflow area. This section should only be used when there is a valid Logical Channel Descriptor within the network. Please refer to the no logical channel descriptor section below.

Foreign Services: Any service belonging to an original network other than the in country original network shall be placed in the overflow area.

Duplicate Services: If two or more unique services (unique DVB triplet) are assigned the same Logical Channel Number the service belonging to the multiplex with the best RF quality shall be placed in the LCN assigned by the Logical Channel descriptor. All other services shall be placed in this category of the overflow area.

Receivers may implement their own ordering of services within the overflow area.

When no logical channel descriptor is found within the in country Original Network, all in country services shall be assigned Logical Channel Numbers in any order sequential from 1 onwards.
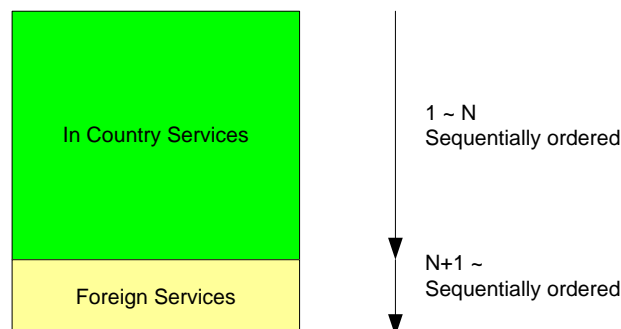

Figure 2. Channel map when LCN descriptor is not broadcasted

Services from the original network of foreign countries shall be placed immediately after the last in country service.

When there are duplicate services (same DVB triplet) only the service from the multiplex with the best RF quality shall be visible to the user, the duplicate shall not be assigned a logical channel number.

3.2.11.5 Regional Broadcast Management

A regional multiplex might contain one or more services which have events that differ from one region to another.

The receiver shall decode the Logical Channel Descriptor Version 2 as outlined above.

During initial install, all channel lists for the country selected by the user shall be collated by the receiver. Once the scan is complete, if there is more than 1 valid channel list, the user shall be given a method to select a preferred list. The wording of the selection items presented to the user shall include the 23 character string broadcasted in the descriptor.

The receiver shall then order the services based on the selected channel list.

Example:

Table 7. Channel list example

channel_list_id	0x00	
channel_list_name	Central Region	
Service ID	**Service Name**	**LCN**
0x1001	News Central Region	001
0x2001	National Entertainment	002
0x2002	National Documentaries	003
0x1002	News Southern Region	100
0x1003	News Northern Region	101

channel_list_id	0x01	
channel_list_name	Northern Region	
Service ID	**Service Name**	**LCN**
0x1001	News Central Region	100
0x2001	National Entertainment	002
0x2002	National Documentaries	003
0x1002	News Southern Region	101
0x1003	News Northern Region	001

channel_list_id	0x02	
channel_list_name	Southern Region	
Service ID	**Service Name**	**LCN**
0x1001	News Central Region	101
0x2001	National Entertainment	002
0x2002	National Documentaries	003
0x1002	News Southern Region	001
0x1003	News Northern Region	100

In the example above, the news service with regional variation is being broadcasted on 3 services. Based on the user selection the receiver shall be able to place at the most appropriate service in the main LCN slot. The screen shots below gives a feel for the process that the user should experience and the interaction expected between the user and the receiver.

Figure 3. User experience during channel list selection

In this example, a news channel has 3 regional variations, Central, Northern and Southern. The service for the users own region should be placed at LCN 1 while the services for the other regions if the receiver is able to receive them shall be placed at LCN 100 onwards.

If the services for other regions are not included in the list, according to LCN ordering rules, these services shall be moved into the overflow region.

3.2.11.6 Network Evolution

The service line up of the network is considered to be quasi static. The receiver shall update the service list according to the rules outlined below to enable the broadcaster to evolve the network as necessary. Network evolution will occur frequently during analogue switch off requiring the receiver to be able to track changes in the network.
The receiver is required only to update its service list when it is possible for it to do a complete scan without interruption to viewer's usage of the receiver. However the receiver may do a partial update of the service list if this does not cause disruption to the viewer.

Service Addition/Deletion

Services shall be added and deleted according to the Service line up in the SDT actual.

Multiplex Addition

During the network evolution scan if a new multiplex is found, the services in the multiplex shall be added to the service list.

Multiplex Deletion

During the network evolution scan if a multiplex which was previously in the network list is no longer found the receiver shall delete all the services in the multiplex from the user service list.

Receivers may optionally implement measures to ensure that a multiplex is not deleted due to the temporary non availability of a multiplex due to transient broadcast conditions (example rain). Concerns regarding temporary lost of multiplexes shall take precedence over the requirement above,

Clash Resolution

The basic rules of operation shall follow the rules as outlined in the LCN management section.

In addition to this the receiver shall also conform to the following rule of operation.

(1) If a new service was found during the network evolution scan and if the assigned LCN is already being used by another service. The new service shall take precedence if the current service was not found during the same scan.

The receiver may give priority to services which have been moved or added by the user instead of following the rules above.

3.2.11.7 Selection via Service List

The initial displayed service list following a full automatic scan must present services in ascending order of LCN (Req)

3.2.11.8 Hidden Services

Services identified as "not visible" in the LCN descriptor shall not appear in the service list presented to the viewer. However such services may be selectable by direct numerical entry. (Req)

3.2.12 EPG

3.2.12.1 EPG "Now/Next"

'Now / Next' screen guide shall be derived using information from DVB SI EITp/f tables as per EN 300 468 [4]. The presentation of the now/next banner is as per manufactures chosen user interface but it is desirable for the following information to be displayed in the bottom third of the screen.

- Current time
- Start time of now and next programme
- End time of now and next programme
- Logical Channel Number
- Channel Name
- Date
- Event name
- Short description
- Extended description
- Genre
- Sub-genre
- Parental ratings

The EPG "Now and next" shall be displayed when the user launches the application via the i (info) button on the remote control. If a descriptor is missing from the EIT table – the receiver shall not display an error message. (Req)

The EPG "Now and next" may be displayed when the user changes channels for approx 2 secs. (Opt)

3.2.12.2 EPG "Schedule"

The receiver shall be able to capture and display at least 7 days of EPG based on broadcasted EIT schedule information. EIT information capture shall be done in the background continuously. This will enable the receiver to display the Full EPG as soon as the EPG button is pressed.

3.2.13 Clock

The receiver shall be able to display real time clock/calendar information. The clock information shall be updated by the incoming TDT and TOT table in the SI. The receiver shall display the clock in local time. (Req)

3.2.14 Set-up

3.2.14.1 Easy to Use and Simple Documentation

Receivers shall be simple to set up and operate and be provided with clear easy to understand user documentation in line with that requirement. (Req)

3.2.14.2 Support Package

The following peripheral items should be included within a baseline receiver package:

- An RF lead/cable for connection of loop-through connector to a second receiver (500mm min length; male F-connectors each end). This is optional for receivers that have a loop through connector.

- Set top boxes shall provide a Composite (CVBS) and stereo audio RCA cable. (1m min length).
- Set Top boxes which provide a Component video output may provide a Component Video Cable with stereo audio RCA cable(s) (1m min length).
- Set Top Boxes may provide a HDMI Cable.
- Remote control and batteries. (Req)
- An easy to understand user manual in English language in either paper or electronic form. If an electronic user manual is provided, there must be a quick installation guide and the electronic user manual must be viewable on the device (Req)
- Receivers may provide a Coaxial cable or optical cable for digital audio (Opt)

3.2.15 Outputs

3.2.15.1   Primary Output

A set top box receiver shall have at least one HDMI output with HDCP. It is optional for IDTV's to have HDMI output(s).

The HDMI profile used by the Set Top Box shall be able to at least output the highest resolution supported by the Set Top Box.

3.2.15.2   Secondary Output

In addition set top boxes shall have the following:

- RCA (phono) providing composite (CVBS) video. Shall meet the characteristics in ITU report 624-4 (Req)

Receivers may provide the following and if provided, it shall conform to copy protection rules in 3.2.15.5.

RCA (phono) providing Component YPbPr output. If available shall meet the characteristics in ITU report 624-4 (Opt)

3.2.15.3   Analogue Phono Audio

Set top boxes shall provide RCA Audio left (Colour – white) & Right (Colour –Red) connectors.

3.2.15.4   Digital Audio Output

SPDIF for pass through (transcoded output) of Dolby Digital (AC-3) either on Optical and/or Coaxial Digital Audio Output(s). Manufactures are requested to state connector type. (Optional)

3.2.15.5   Copy Protection on outputs

The receiver shall provide HDCP digital content protection on the HDMI output for all output resolutions. The receiver is not to output any HD format on any analogue video outputs.

An HD format is defined as any signal having a luminance resolution as defined in [7] TS 101 154 Clause 5.7.

3.2.16 Remote Control

A Remote Control is to be supplied with the receiver. The manufacturer is free to design the remote.

The Remote Commander shall as a minimum have all the keys mandated for the middleware application as outlined by [11].

It shall also provide an EPG button for the user to directly launch the EPG.

The keys mandated by the middleware [11] are not a requirement for a receiver complying only with the basic profile.

3.2.17 Maintenance & Upgrade: Summary

To allow for software changes receivers must be upgradeable in a practical manner, e.g. Over the air download. The process of upgrading should 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 receiver must detect and act upon the broadcast of a relevant software download within 24 hours of its transmission commencing.

3.2.17.1   Over Air Download

Support for the use of DVB SSU, to at least the simple profile as defined in ETSI TS 102 006 [14] is required. (Req) Receivers shall be able to handle the presence of software downloads in any NIT referred carrier signal. (Req)

Receivers shall be capable of automatic (i.e. not user initiated) software upgrade by over-air download with minimal interruption to the viewer. (Req)

Manufacturers shall ensure that the receiver offered shall only respond to a unique OUI code, (Organisation Unique Identifier). This means that the receiver 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 receiver.

The default DVB-SSU mode for receivers shall be with DVB-SSU "enabled".
For Conformance testing manufacturers will be required to deliver two ASI transport streams containing relevant converted binary image files, together with all relevant NIT and PMT data necessary for their receiver to properly undergo a successful DVB-SSU operation. One stream will replace the software in the receiver as demonstrated by a new version number, or some other visible indicator, the other will restore the receiver to its then current configuration.

3.2.17.2   User Software Upgrade

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

- Universal Serial Bus (USB)

- RJ 45 (Ethernet IEE802.3)

- Appropriate Memory Card

3.2.17.3   Status

The receiver shall provide a diagnostic screen triggered by a menu driven option providing the following basic information:

(1)   Software Version

RF signal information which may include one or all of the following information, AGC, Pre FEC Bit Error Rate and/or Post FEC bit Error Rate.

Optionally the receiver may also include the following information:

(1)   Audio PID

(2)   Video PID

(3)   Channel ID

3.2.18   Interactive Application

The receiver shall implement the interactive application outlined in the middleware [11] specification unless the receiver is only complying to the basic profile requirements (Req).

Interactive only services (data services) shall be signaled with a service type of 0x0C. The SDT shall also contain a data_broadcast_descriptor with a data_broadcast_id of 0x0123.

Services signaled above, shall be installed in receivers supporting interactive applications as data only services.

3.2.19 DVB Identifiers

The following DVB identification values shall be used in the broadcast in Malaysia.

Table 8. DVB identifiers

Identifier	Value
Original Network ID	0x21CA
Private Data Specifier	0x0000 21CA
Network ID Range	0x3301 - 3400
Encoding Type ID	English Huffman Table : 0x05
	Bahasa Melayu Huffman Table : 0x06

Annex A

A.1 RF Profile for Malaysia

Identifier	MS 1	MS 2	MS 3	MS 4
Overall				
FFT Size	32K	32K	32K	32K
GI	1/8	19/256	1/128	1/8
SISO/MISO	SISO	SISO	SISO	SISO
PAPR	TR	TR	TR	TR
Bandwidth	8MHz	8MHz	8MHz	7MHz
Carrier Mode	Extended	Extended	Extended	Normal
Pilot Pattern	PP2	PP4	PP7	PP2
L1 Modulation	64 QAM	64 QAM	64 QAM	64 QAM
Data Symbols per Frame (Ldata)	43	61	59	43
OFDM Symbols per Frame (Lf)	44	62	60	44
Frame Duration (ms)	178	239	217	203
Frames Per SuperFrame	2	2	2	2
PLP #0				
PLP Type	1	1	1	1
Time Interleaver Type (TIME_IL_Type)	0	0	0	0
Modulation	256 QAM	256 QAM	256 QAM	256 QAM
Rate	3/4	3/5	2/3	3/4
FEC Type	64 LDPC	64 LDPC	64 LDPC	64 LDPC
Rotated QAM	Yes	Yes	Yes	Yes
FEC blocks per interleaving Frame Full channel (Trial mode)	135	200	200	132
TI blocks per frame (N_TI)	2	3	3	2
Frame_Interval (I_JUMP)	1	1	1	1
TIME_IL_LENGTH	2	3	3	2
Approx. Time Interleaving Length (ms)	89	81	72	101
Data Rate (Mbit/s)	36.9256	32.49116	39.8165	31.5919

A.2 Performance Figures for Malaysia

	Identifier	MS 1		MS 2		MS 3		MS 4	
Section	**Performance Figure**								
A.1	C/N Performance on Gaussian channel (dB)	22.9		18.9		19.7		22.9	
A.2	C/N Performance on 0dB echo channel (dB)	28.0		22.6		23.9		28.0	
A.3	Minimum receiver signal input levels on Gaussian channel (dBm)	-76.2		-80.2		-79.3		-76.9	
A.4	Maximum IRD Signal Input Levels on 0dB echo channel	-71.1		-76.5		-75.1		-71.8	
A.5	Receiver noise figure on Gaussian channel	6.0		6.0		6.0		6.0	
A.6	Maximum receiver signal input levels (dBm)	-35		-35		-35		-35	
A.7	Immunity to "digital" signals in Other Channels								
	Digital ACI N+/-1 C/I (dB)	-28.0		-28.0		-28.0		-28.0	
	Digital ACI N+/-2 C/I (dB)	-38.0		-38.0		-38.0		-38.0	
	Digital ACI N+9 C/I (dB)	-28.0		-28.0		-28.0		-28.0	
A.8	Immunity to Co-Channel Interference from Analogue TV Signals								
	PAL B/G CGI C/I (dB)	7.0		3.0		5.0		7.0	
A.9	Immunity to Adjacent Channel Interference From Analogue TV Signals								
	PAL B/G AGI C/I N+/-1 (dB)	-33.0		-33.0		-33.0		-33.0	
	PAL B/G AGI C/I N+/-2 (dB)	-44.0		-44.0		-44.0		-44.0	
	PAL B/G AGI C/I N+9 (dB)	-44.0		-44.0		-44.0		-44.0	
A.10	Performance in Time-Varying Channels 10Hz doppler (5Hz after AFC) 20µs 0dB echo	3		3		3		3	
A.11	Synchronisation for varying echo power levels in SFN (dB)	31.0		26.1		28.1		31.0	
A.12	C/(N+I) Performance in Single Frequency Networks for more than one echo (dB)	28.0		22.6		23.9		28.0	
A.13	C/(N+I) Performance in Single Frequency Networks inside the guard interval (dB)	28.0		22.6		23.9		28.0	
A.14	C/(N+I) Performance in Single Frequency Networks outside the guard interval (dB)	Echo Delay (µs)	Echo level (dBc)	Echo Delay (µs)	Echo level (dBc)	Echo Delay (µs)	Echo level (dBc)	Echo Delay (µs)	Echo level (dBc)
		-532	-12.0			-133	-9.5	-608	-12.0
		-525	-11.5			-120	-9.0	-600	-11.5
		-510	-10.5	See Note 1		-90	-7.5	-580	-10.5
		-490	-9.0			-60	-5.0	-560	-9.0
		-475	-7.5			-30	-2.0	-540	-7.0
		-448	-2.0	-266	-2	-28	-2.0	-512	-2.0
		448	-2.0	266	-2	28	-2.0	512	-2.0
		475	-7.5			30	-2.0	540	-7.0
		490	-9.0			60	-5.0	560	-9.0
		510	-10.5	See Note 1		90	-7.5	580	-10.5
		525	-11.5			120	-9.0	600	-11.5
		532	-12.0			133	-9.5	608	-12.0

Note 1	There is no allowance for echo outside guard for 19/256 PP4 in Nordig due to 19/256 guard (266us) being very close to the Nyquist limit for PP4 (298.67us) . Nordig defines the max delay for echo outside guard to be 57/64*Nyquist which is equal to the guard interval of 266usec for 19/256 PP4.

Acknowledgement