TECHNICAL CODE

SPECIFICATION FOR DIGITAL TERRESTRIAL TELEVISION (DTT) BROADCAST RECEIVER (SECOND REVISION)

Developed by

Registered by

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MCMC MTSFB TC T004:2022

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 (MCMC)
MCMC Tower 1
Jalan Impact
Cyber 6
63000 Cyberjaya
Selangor Darul Ehsan
MALAYSIA

Tel: +60 3 8688 8000
Fax: +60 3 8688 1000
https://www.mcmc.gov.my

OR

Malaysian Technical Standards Forum Bhd (MTSFB)
MCMC Centre of Excellence (CoE)
Off Persiaran Multimedia
Jalan Impact
Cyber 6
Cyberjaya
Selangor Darul Ehsan
MALAYSIA

Tel: +60 3 8320 0300
Fax: +60 3 8322 0115
https://www.mtsfb.org.my

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Committee representation

This technical code was developed by Multimedia Broadcast Receiver Sub Working Group under the Broadcast Technology Working Group of the Malaysian Technical Standards Forum Bhd (MTSFB), which consists of representatives from the following organizations:

Fraunhofer IIS

LG Electronics (M) Sdn Bhd

Maxis Broadband Sdn Bhd

Measat Broadcast Network System Sdn Bhd

Media Prima Berhad

Multimedia University

MYTV Broadcasting Sdn Bhd

Samsung Malaysia Electronics (SME) Sdn Bhd

Sharp Electronics (M) Sdn Bhd

SIRIM Berhad

SmarDTV Global S.A.S

Sony EMCS Malaysia Sdn Bhd

Telekom Malaysia Berhad

Wideminds Pte Ltd

Foreword

This technical code for Specification for Digital Terrestrial Television (DTT) Broadcast Receiver (Second Revision) ('this Technical Code') was developed pursuant to the Section 95 and Section 185 of the Act 588 by the Malaysian Technical Standards Forum Bhd ('MTSFB') via its Multimedia Broadcast Receiver Sub Working Group under the Broadcast Technology Working Group.

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

Major modifications in this revision are as follows:

a) Inclusion of other similar device intended for use with the Digital Video Broadcasting - Second Generation Terrestrial (DVB-T2) such as Universal Serial Bus (USB) dongle, PC cards, portable and vehicle-mounted equipment.

b) Update of Electromagnetic Compatibility (EMC) standard to CISPR 32 since CISPR 13 has been withdrawn (Clause 4.1.3).

c) Inclusion of new standard for safety, IEC 62368-1 (Clause 4.1.4).

d) Update of processor and memory requirement to cater the basic receiver performance (Clause 4.2.1).

e) Inclusion of new video codec for High Efficiency Video Coding (HEVC) according to Recommendation ITU-T H.265 and ISO/IEC 23008-2, constrained by clause 5.14 of ETSI TS 101 154 (Clause 4.2.4.1).

f) Inclusion of new audio codec for Moving Picture Experts Group - High Efficiency (MPEG-H) according to ISO/IEC 23008-3, constrained by clause 6.8 of ETSI TS 101 154 (Clause 4.2.5.1).

g) Update of Radio Frequency (RF) input connector standard to IEC 61169-2, since IEC 60169-2 has been withdrawn (Clause 4.2.11.1).

h) Update of operating frequency for DTT broadcast services from 470 MHz – 860 MHz to 470 MHz - 694 MHz for Ultra High Frequency (UHF) (Clause 4.2.11.4).

i) Inclusion of additional method for software upgrade via Network Download (NWDL) (Clause 4.2.18.1).

This Technical Code replaces the SKMM MTSFB TC T004: 2013, *Specification for Digital Terrestrial Television Broadcast Service Receiver*.

This Technical Code shall continue to be valid and effective from the date of its registration until it is replaced or revoked.

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SPECIFICATION FOR DIGITAL TERRESTRIAL TELEVISION (DTT) BROADCAST RECEIVER

1. Scope

This Technical Code specifies the requirements of a Digital Terrestrial Television (DTT) receiver in Malaysia. The DTT receiver may include, but not limited to, Integrated Digital Television (IDTV), Set-Top-Boxes (STB) or any other similar device intended for use with the Digital Video Broadcasting - Second Generation Terrestrial (DVB-T2) such as Universal Serial Bus (USB) dongle, PC cards, portable and vehicle-mounted equipment.

2. Normative references

The following normative references are indispensable for the application of this Technical Code. For dated references, only the edition cited applies. For undated references, the latest edition of the normative references (including any amendments) applies.

See Annex A.

3. Abbreviations

For the purposes of this Technical Code, the following abbreviations apply.

See Annex B.

4. Requirements

4.1 General requirements

The receiver shall comply to all the requirements stated in this section.

In addition, if the receiver supports other communication module, it shall fulfil the additional requirements specified in other related technical codes (if any).

4.1.1 Power supply

The receiver may be Alternating Current (AC) or Direct Current (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.

Where external power supply is used such as AC adaptor, it shall not affect the capability of the receiver to meet this specification. Adaptor shall be pre-approved by the relevant regulatory body before it can be used with the receiver. Adaptor shall be subjected to test under tropical condition as specified in the related standard.

4.1.2 Power supply cord and mains plug

If the receiver is fitted with power supply cord and mains plug, the power supply cord and mains plug shall be pre-approved by the relevant regulatory body with the following requirements:

a) The power supply cord shall be certified according to:

i) MS 2112-5 or BS EN 50525-2-11 or IEC 60227-5 (for Polyvinyl Chloride (PVC) insulated - flexible cables or cords); or

ii) MS 2127-4 or IEC 60245-4 (for rubber insulated - flexible cables or cords).

b) The mains plug shall be certified according to:

i) MS 589-1 or BS 1363 (for 13 A, fused plugs); or

ii) MS 1577 (for 15 A, fused plugs); or

iii) MS 1578 or BS EN 50075 (for 2.5 A, 250 V, flat non-rewireable two-pole plugs with cord for the connection of class II equipment).

4.1.3 Electromagnetic Compatibility (EMC)

The receiver shall comply with the Electromagnetic Compatibility (EMC) emissions requirements as defined in the MS CISPR 32 or equivalent international standards. The requirements shall cover radiated and conducted emission.

4.1.4 Electrical safety

The receiver shall comply with the safety requirements defined in MS IEC 60065, IEC 62368 or any equivalent standards.

4.1.5 Marking

The receiver shall be marked with the following information:

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

b) supplier or 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.

4.2 Technical requirements

4.2.1 Processor and memory

The processing power and memory configuration of the receiver shall be suitable for the routine operation of FTA DTT reception, DVB-T2, together with the embedded operation of the interactive application and the provision of the routine replacement of all software upgrade. The related parameter limits specified in Table 1 shall be complied.

Table 1. Processor and memory requirement specifications

Parameter	Minimum requirements
Double Data Random Access Memory (DDRAM)	At least 256 MB, minimum baseline functionality
Flash	At least 256 MB, minimum baseline functionality
Central Processing Unit (CPU) processor speed	1000 DMIPS 300 MHz, minimum baseline functionality

4.2.2   Receiver capability

The receiver shall give access to all Malaysian FTA DTT, radio and enhanced or interactive television services. The receiver shall include the capability to efficiently present radio channels, Digital Video Broadcasting (DVB) subtitles and interactive elements of all services. It must present DVB subtitles when broadcasted and if requested by the viewer.

The receiver 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.

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

4.2.4   Video

4.2.4.1   Video codec

The following codec and the profiles as described in Table 2 shall be supported by a compliant receiver. The codec is outlined below and further constrained by ETSI TS 101 154 as stipulated in clauses 5.5, 5.6 and 5.7 of ETSI TS 101 154 shall apply. However, for High Efficiency Video Coding (HEVC) supported device, only clause 5.14 of ETSI TS 101 154 is applicable.

Table 2. Codec specifications

Receiver	Codec	Specification	Codec profile
Normal receiver	MPEG4 video	H.264 AVC Encoding, as stipulated in ISO/IEC 14496-10	MPEG-4 AVC MP@L3 SD Video stream
			MPEG-4 AVC HP@L4 HD Video stream
Ultra High Definition (UHD) receiver	HEVC video	H.265 Video codec as stipulated in ITU-T H.265 and ISO/IEC 23008-2	HEVC High-Definition Television (HDTV)
			HEVC UHD TV
			HEVC HDR UHD TV
			HEVC HDR HFR UHD TV

4.2.4.2 Resolutions

The following resolutions as stipulated in Table 3 shall be supported by a compliant receiver.

Table 3. Resolution references

Format	Codec / Resolution	Frame rate (Field rate)	Progressive / Interlaced	Aspect Ratio
1 080 p / 50	H.264	50 Hz (50 Hz)	Progressive	16:9
1 080 p / 25		25 Hz (25 Hz)	Progressive	16:9
1 080 i / 25		25 Hz (50 Hz)	Interlaced	16:9
720 p / 50		50 Hz (50 Hz)	Progressive	16:9
576 i / 25		25 Hz (50 Hz)	Interlaced	16:9 and 4:3
540 p	HEVC	25 Hz (25 Hz)	Progressive	16:9
540 p		50 Hz (50 Hz)	Progressive	16:9
720 p		25 Hz (25 Hz)	Progressive	16:9
720 p		50 Hz (50 Hz)	Progressive	16:9
1 080 p		25 Hz (25 Hz)	Progressive	16:9
1 080 p		50 Hz (50 Hz)	Progressive	16:9
2 160 p		25 Hz (25 Hz)	Progressive	16:9
2 160 p		50 Hz (50 Hz)	Progressive	16:9

NOTES:

1. For codec H.264, it refers to clause 5.7 of ETSI TS 101 154.

2. For codec H.264 (576i/25 format), it refers to clause 5.6 of ETSI TS 101 154.

3. For codec HEVC, it refers to clause 5.14 of ETSI TS 101 154.

4.2.4.3 Output resolution control for STBs and portable digital terrestrial receiver

STBs and portable digital terrestrial receiver shall provide an option to change the output video format as required by the user either via the menu system and/or remote control. 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.

4.2.4.4 Widescreen

The receiver 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 16:9 when working with Standard Definition (SD) outputs on a 4:3 display.

4.2.4.5 Active Format Description (AFD)

The receiver shall support at least the Active Format Description (AFD) as in Figure 1 and specified in Annex B of ETSI TS 101 154.

INPUT				OUTPUT DISPLAY	
SOURCE		BROADCASTED FRAME	AFD Code	16:9	4:3
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		

Figure 1. AFD

4.2.5 Audio

4.2.5.1 Audio codec

The following codec shall be supported by a compliant receiver as below:

a) The receiver may support Enhanced Dolby Digital (E-AC3), based on ETSI TS 102 366 and signaled by Annex C of ETSI TS 101 154 and constrained by clause 6.2 of ETSI TS 101 154. Sampling rates shall be restricted to 32 kHz, 44.1 kHz and 48 kHz. Only pass-through of Dolby AC-3 audio coding system (AC-3) audio to the digital audio connector is required when E-AC3 is supported.

b) Moving Pictures Expert Group 4 (MPEG-4) High Efficiency Advanced Audio Coding (HE AAC) audio services will be encoded according to ISO/IEC 14496-3 and signaled or constrained by clause 6.4 and Annex C.5 of ETSI TS 101 154, based on the decode capabilities below:

   i) Receivers which supported with stereo capabilities only shall support MPEG-4 High Efficiency Advanced Audio Coding Version 2 profile (HE AAC v2) level 4 decoding including mandatory down-mixed and support of metadata as defined in clause 6.4.3 and Annex C.5 of ETSI TS 101 154.

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

c) The receiver may support Moving Picture Experts Group - High Efficiency (MPEG-H) Audio for Next Generation Audio (NGA) services according to ISO/IEC 23008-3 and signaled or constrained by clause 6.8 of ETSI TS 101 154. The audio signals shall be encoded according to the baseline profile restrictions specified in clause 4.8.2.6 of ISO/IEC 23008-3, and the CompatibleProfileLevelSet() config extension element specified in clause 4.8.2.7 of ISO/IEC 23008-3 shall be present MPEG-H audio bitstream pass-through to the digital audio connector is required when MPEG-H audio is supported.

4.2.5.2 Decoding options

The receiver shall support the respective decoding options as stipulated in Table 4.

Table 4. 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)
MPEG-H Audio ISO/IEC 23008-3	Decoded and rendered (Optional)	Stereo PCM, or bitstream pass through, or transcoded to DTS or AC-3 and bitstream passthrough (Optional)	Stereo PCM, or bitstream pass through, or transcoded to DTS or AC-3 and bitstream passthrough (Optional)

NOTES:

1. The above implies that if E-AC3 is broadcasted, it shall always be simulcast with HE-AAC.

2. It is only applicable if HDMI output is implemented by the receiver.

4.2.6 Subtitles

A compliant receiver shall be able to decode DVB subtitles according to the specification outlined in ETSI 300 743. DVB subtitles shall be invoked from a suitable labelled 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 ETSI EN 300 743.

4.2.6.1 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 MCMC MTSFB TC G002.

4.2.7 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 5 below.

Table 5. Multi-language support

Language	ISO 639-3 Code
English	ENG
Malay	MSA
Chinese	ZHO
Tamil	TAM
Original audio	QAA
NOTE: Original audio is only applicable for audio.	

4.2.7.1   Subtitle selection

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

a)   primary language;

b)   secondary language; and

c)   receiver's own selection criteria (optional).

The receiver may implement its own selection criteria after (a) and (b) fail to provide a language match.

4.2.7.2   Audio selection

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

a)   primary language;

b)   secondary language; and

c)   receiver's own selection criteria (optional).

The receiver may implement its own selection criteria after (a) and (b) fail to provide a language match.

4.2.8   On-screen Display (OSD)

The graphics requirement for the receiver is governed by the graphics requirement of the interactive middleware application outlined in MCMC MTSFB TC G002. Receivers shall meet the minimum requirement outline.

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

4.2.9   Receiver character set

The receiver shall at least be able to support use of the character coding for DVB services described in the latest version of the DVB specification ETSI EN 300 468. This specification supports multiple other versions of character codes, including Simplified Chinese and Traditional Chinese characters.

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 Event Information Table (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 signalled by the method outlined in Annex A of ETSI EN 300 468. This is done by ensuring that the first byte of any compressed string is 0x1F. The second byte as outlined by ETSI EN 300 468 shall contain the encoding_type_id.

Strings marked as compressed shall be compressed using Huffman compression as outlined in SKMM MTSFB TC G001. The receiver to decompress these strings will require a look up table. The receiver shall incorporate to two tables signaled by the encoding_type_id outlined in clause 3.2.19 of SKMM MTSFB TC G001.

4.2.10 Common interface

Receivers may incorporate a Digital Video Broadcasting - Common Interface (DVB-CI) slot. If available, this slot shall be certified with CI+ slot as outlined in CI Plus Specification V1.3 or DVB-CI Plus 2.0 slot as outlined in ETSI TS 103 605.

4.2.11 Tuner or decoder

A compliant receiver shall in accordance to T2 base profile of ETSI EN 302 755.

4.2.11.1 Radio Frequency (RF) input connector

A compliant receiver shall be in accordance with IEC 61169-2. For other DVB-T2 receivers such as PC cards, dongles, portable TV, different Radio Frequency (RF) input connector may be used where appropriate.

4.2.11.2 RF loop-through

STBs may provide an RF loop through. The connector shall be in accordance to IEC 61169-2 with a typical gain of 0 dB.

4.2.11.3 Input impedance

Input impedance shall meet 75 Ω nominal.

4.2.11.4 Frequency range and bandwidth

The receiver shall be able to scan and tune to the following frequency range and bandwidth as described in Table 6.

Table 6. Frequency range and bandwidth

Band		Frequency	Bandwidth
Ultra High Frequency (UHF)	IV and V	470 - 694 MHz	8 MHz (7.77 MHz for extended mode) (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.

4.2.11.5 DVB-T2 operating modes

The receiver shall support the operating modes as specified in ETSI EN 302 755. The minimum list of modes for each parameter that shall be supported by the receiver is outlined in the Table 7 below.

Table 7. DVB-T2 operating modes

Parameter	Required modes
Transmission mode	32 K normal and extended
Constellation	Quadrature Phase Shift Keying (QPSK),16-Quadrature Amplitude Modulation (QAM), 64-QAM and 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 and PP7
Antenna	SISO and MISO
PAPR	No PAPR and TR-PAPR
Forward Error Correction (FEC) frame length	16,200 and 64,800
Input mode	Input Mode A and B (single PLP, multiple PLP)
Baseband mode	Normal mode, high efficiency mode

4.2.11.6 M-PLP feature requirements

The receiver shall support at least the following features related to Multiple Physical Layer Pipes (M-PLP) as outlined in ETSI EN 302 755.

a)   Both Physical Layer Pipes (PLP) Type 1 and Type 2.

b)   The receiver should be able to support SI information broadcasted in both the common as well as the data PLP.

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

4.2.11.7 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 C.

4.2.12 Service list

After a receiver is installed, it shall 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 shall detect and reflect to the viewer any such changes with minimal viewer involvement.

All services have an associated Logical Channel Number (LCN). Use of the LCN 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 (SI) is essential if the viewer is to enjoy all of the content being broadcast.

4.2.12.1 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 Technical Code.

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

4.2.12.2 LCN descriptor

LCN information shall be broadcasted via a privately defined LCN descriptor as outlined in Figure 2 below. This descriptor shall be broadcasted in the Transport Stream (TS) loop of the Network Information Table (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)
        }
}
```

Figure 2. LCN descriptor

The LCN descriptor shall be set as follows:

a) descriptor_tag: This shall be assigned with the value 0x83.

b) visible_service_flag: 1 is visible and 0 is not visible.

c) reserved: All reserved bits shall be set to 1. The receiver shall ignore these bits.

d) service_id: This is a 16-bit field which serves as a label to identify this service from any other service within the TS. The service_id is the same as the program_number in the corresponding program_map_section.

4.2.12.3 LCN descriptor V2

The LCN V2 privately defined descriptor may be broadcasted as outlined in Figure 3 below. This descriptor contains additional information related to sorting of services depending on region. Receivers shall support this descriptor if broadcasted.

```
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
```

Figure 3. LCN descriptor V2

The LCN descriptor V2 shall be set as follows:

a) descriptor_tag: This shall be 0x87 (decimal 135).

b) 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.

c) 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.

d) char: This is an 8-bit field. A string of character fields specifies 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 ETSI EN 300 468.

e) 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".

f) 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 or listed in more than one channel list.

g) visible_service_flag: 1 is visible and 0 is not visible.

h) reserved: All "reserved" bits shall be set to '1'. The receiver shall ignore these bits.

i) logic_channel_number: This is the broadcasters preferred LCN for the service in question. Rules of operation are as per LCN management section of this specification.

4.2.12.4 Channel numbering

The LCN shall be obtained from the LCN descriptor as outlined in clause 4.2.12.3. The channel map shall be from 1 to 999 with valid LCN being assigned in the range from 1 to 799 by the broadcaster. The details of the channel map are outlined in Figure 4 below.
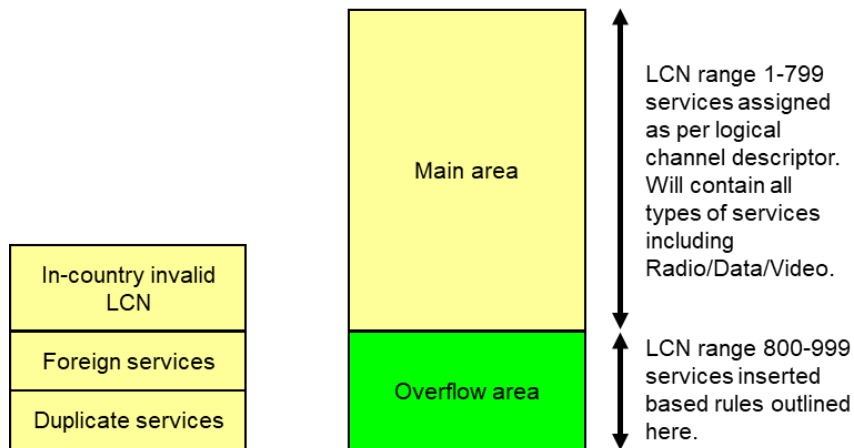
Figure 4. Channel map when there is a valid LCN descriptor

The description of the channel numbering mapping is described as below:

a) 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 overflow area.

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

   i) In country invalid LCN: Any service which has not been assigned a LCN 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.

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

   iii) Duplicate Services: If two or more unique services (unique DVB triplet) are assigned the same LCN 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 order 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 LCN in any order sequential from 1 onwards as outlines in Figure 5.
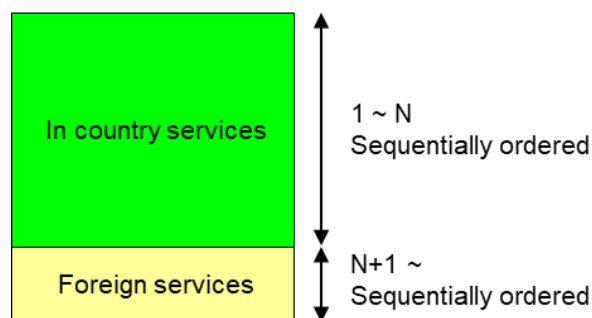
Figure 5. Channel map when LCN descriptor is not broadcasted

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 an LCN.

4.2.12.5 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 installation, 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 one 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. The details are described as in example shown in Table 8 below.

Table 8. Channel list example for three different services

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

Table 8. Channel list example for three different services *(continued)*

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 three services. Based on the user selection the receiver shall be able to place at the most appropriate service in the main LCN slot. The screenshots as in Figure 6 below give a feel for the process that the user should experience and the interaction expected between the user and the receiver.
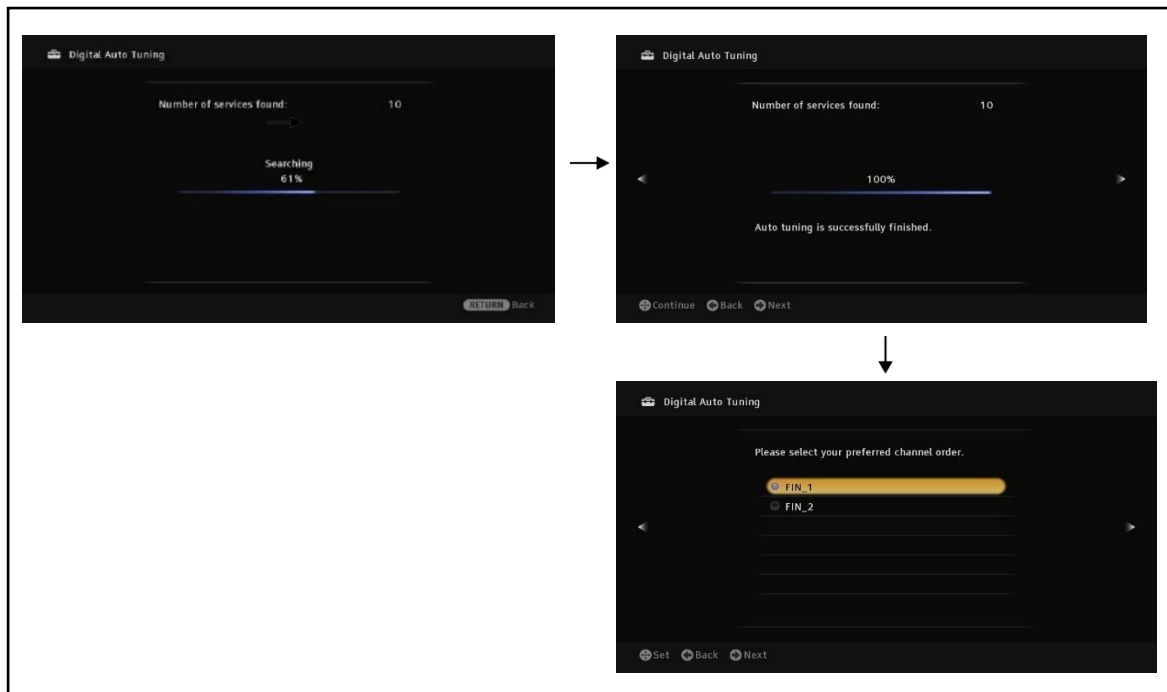
Figure 6. User experience during channel list selection

In this example, a news channel has 3 regional variations, central, northern and southern. The service for the user's 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.

4.2.12.6 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.

a) service addition and deletion

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

b) 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.

c) 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 loss of multiplexes shall take precedence over the requirement above,

d) 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.

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.

4.2.12.7 Selection via service list

The initial displayed service list following a fully automatic scan shall present services in ascending order of LCN.

4.2.12.8 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.

4.2.13 Electronic Programme Guide (EPG)

4.2.13.1 EPG "Now and Next"

"Now and Next" screen guide shall be derived using information from Digital Video Broadcasting Service Information – Event Information Table, present and following (DVB SI EITp/f) tables as per EN 300 468. The presentation of the "Now and 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.

a) current time;

b) start time of now and next programme;

c) end time of now and next programme;

d) LCN;

e) channel name;

f) date;

g) event name;

h) short description;

i) extended description;

j) genre;

k) sub-genre; and

l)   parental ratings.

The Electronic Programme Guide (EPG) "Now and Next" shall be displayed when the user launches the application via the "i" (info) button on the remote control or any equivalent function (i.e. access EPG from virtual menu). If a descriptor is missing from the EIT table – the receiver shall not display an error message.

The EPG "Now and Next" may be displayed when the user changes channels for approximately 2 secs.

4.2.13.2 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 or any equivalent function (i.e access EPG from virtual menu).

4.2.14 Clock

The receiver shall be able to display real time clock/calendar information. The clock information shall be updated by the incoming Time and Date Table (TDT) and Time Offset Table (TOT) table in the Service Information (SI). The receiver shall display the clock in local time.

4.2.15 Set-up

4.2.15.1 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.

4.2.15.2 Support package

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

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

b)   STB shall provide a Composite Video Blanking and Synchronisation (CVBS) and stereo audio Radio Corporation of America (RCA) cable (minimum 1 m length).

c)   STB which provides a component video output may provide a component video cable with stereo audio RCA cables (minimum 1 m length).

d)   STB may provide a High-Definition Multimedia Interface (HDMI) cable.

e)   Required to have remote control and batteries.

f)   An easy-to-understand user manual in English in either paper or electronic form. If an electronic user manual is provided, there shall be a quick installation guide and the electronic user manual shall be viewable on the device.

g)   Receivers may provide a coaxial cable or optical cable for digital audio.

4.2.16   Outputs

4.2.16.1   Primary output

A STB receiver shall have at least one HDMI output with High-Bandwidth Digital Content Protection (HDCP). It is optional for IDTV to have HDMI output.

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

4.2.16.2   Secondary output

In addition, STB shall have the following:

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

Receivers may provide the following and if provided, it shall conform to copy protection rules in clause 4.2.16.5.

b)   RCA (phono) providing component YpbPr output.

If available shall meet the characteristics in ITU-R Report BT.624-4.

4.2.16.3   Analogue phono audio

STB shall provide RCA audio left (colour – white) and right (colour – red) connectors.

4.2.16.4   Digital audio output

Sony/Philips Digital Interface (S/PDIF) for pass-through (transcoded output) of AC-3 either on optical, coaxial digital audio output and/or HDMI-ARC. Manufacturers are requested to state connector type.

4.2.16.5   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 High-Definition (HD) format on any analogue video outputs.

An HD format is defined as any signal having a luminance resolution as defined in clause 5.7 of ETSI TS 101 154.

4.2.17   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 MCMC MTSFB TC G002. However, the receiver with the basic profile is not required to comply.

4.2.18   Maintenance and upgrade

To allow for software changes receivers shall be upgradeable in a practical manner, e.g. Over-The-Air (OTA) download. The process of upgrading should cause minimal disruption to the viewer. However, to minimise 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.

4.2.18.1 Software update

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

Receivers shall be capable of automatic (i.e. not user initiated) software upgrade by Over-Air Download (OAD) or Network Download (NWDL) with minimal interruption to the viewer.

Manufacturers shall ensure that the receiver offered shall only respond to a unique Organisation Unique Identifier (OUI) code. 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 Asynchronous Serial Interface (ASI) transport streams containing relevant converted binary image files, together with all relevant NIT and Program Map Table (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.

4.2.18.2 User software upgrade

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

a) USB;

b) RJ 45 (Ethernet IEEE 802.3); and

c) appropriate memory card.

4.2.18.3 Status

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

a) Software version

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

b) Optionally the receiver may also include the following information:

    i) Audio Packet Identifier (PID);

    ii) Video PID; and

    iii) Channel ID

4.2.19 Interactive application

The receiver shall implement the interactive application outlined in the MCMC MTSFB TC G002 unless the receiver is only complying to the basic profile requirements.

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

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

4.2.20   DVB identifiers

The following DVB identification values shall be used in the broadcast in Malaysia as outline in Table 10 below.

Table 10. 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
(normative)

Normative references

MCMC MTSFB TC G002, *Digital Terrestrial Television (DTT) – Hybrid Broadcast Broadband Television Middleware Profile*

SKMM MTSFB TC G001, *Compression Table of Service Information (SI) Descriptions for Digital Terrestrial Television Broadcast Service*

MS 406, *Specification for voltages and frequency for alternating current transmission and distribution systems (Second revision)*

MS 589-1, *13 A plugs, socket-outlets, adaptors and connection units – Part 1: Specification for rewirable and non-rewirable 13A fused plugs*

MS 1577, *Specification for 15A Plugs and Socket Outlets for Domestic and Similar purposes*

MS 1578, *Specification for flat non-rewirable two-pole plugs, 2.5 A, 250 V, with cord, for the connection of class II-Equipment for household and similar purposes*

MS 2112-5, *Electric Cable and Wire: Polyvinyl Chloride (PVC) insulated cables of rated voltages up to and including 450/750 V – Part 5 : Flexible cables*

MS 2127-4, *Rubber insulated cables of rated voltages up to and including 450/750 V – Part 4: Cords and flexible cable*

MS CISPR 32, *Electromagnetic compatibility of multimedia equipment – Emission requirements*

MS IEC 60038, *IEC standard voltages*

MS IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60227-5, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60245-4, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 1: Cords and flexible cables*

IEC 61169-2, *Radio-frequency connectors – Part 2: Sectional specification – Radio frequency coaxial connectors of type 9,52*

IEC 62368, *Audio/video, information and communication technology equipment*

ISO 3166, *Country Codes*

ISO 8859-1, *Information processing – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*

ISO/IEC 14496-3, *Information technology – Coding of audio-visual objects – Part 3: Audio*

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

ISO/IEC 23008-2*, Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*

ISO/IEC 23008-3, *Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 3: 3D audio*

ITU-R Report BT.624-4, *Characteristics of television systems*

Recommendation ITU-T H.265, *Infrastructure of audiovisual services – Coding of moving video - High efficiency video coding*

ETSI EN 300 468, *Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems*

ETSI EN 300 743, Digital Video Broadcasting (DVB); Subtitling systems

ETSI EN 302 755, *Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)*

ETSI TS 101 154, *Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcast and Broadband Applications*

ETSI TS 102 006, *Digital Video Broadcasting (DVB); Specification for system Software Update in DVB Systems*

ETSI TS 102 366, *Digital Audio Compression (AC-3 Enhanced AC-3) Standard*

ETSI TS 103 605, *Digital Video Broadcasting (DVB); Second Generation Common Interface (CI); Implementation Using the Universal Serial Bus (USB)*

BS 1363: Part 1, *13 A plugs, socket-outlets, adaptors and connection units – Part 1: Specification for rewirable and non-rewirable 13 A fused plugs*

BS EN 50075, *Specification for flat non-wirable two-pole plugs 2.5 A 250 V, with cord, for the connection of Class II-equipment for household and similar purposes*

BS EN 50525-2-11, *Electric cables. Low voltage energy cables of rated voltages up to and including 450/750V (U0/U) Cables for general applications. Flexible cables with thermoplastic PVC insulation*

CI Plus Specification v1.3, *Content Security Extensions to the Common Interface*

Annex B
(informative)

Abbreviations

AC	Alternating Current
DC	Direct Current
AC-3	Dolby AC-3 audio coding system
AFD	Active Format Descriptor
AGC	Automatic Gain Control
ASI	Asynchronous Serial Interface
C/N	Carrier to Noise Ratio
CPU	Central Processing Unit
CVBS	Composite Video Blanking and Synchronisation
DC	Direct Current
DDRAM	Double Data Random Access Memory
DDS	Display Definition Segment
DTS	Digital Theater Systems
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcasting
DVB-CI	Digital Video Broadcasting – Common Interface
DVB SI EITp/f	Digital Video Broadcasting Service Information – Event Information Table, present and following
DVB-T2	Digital Video Broadcasting - Second Generation Terrestrial
E-AC3	Enhanced Dolby Digital
EIT	Event Information Table
EMC	Electromagnetic Compatibility
EPG	Electronic Programme Guide
FEC	Forward Error Correction
FFT	Fast Fourier Transform
FTA	Free-to-Air
HD	High-Definition
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
HEVC	High Efficiency Video Coding

IDTV	Integrated Digital Televisions
LCN	Logical Channel Number
MPEG-4	Moving Pictures Expert Group 4
MPEG-H	Moving Picture Experts Group - High Efficiency
M-PLP	Multiple Physical Layer Pipes
NGA	Next Generation Audio
NIT	Network Information Table
NWDL	Network Download
OAD	Over-Air Download
OSD	On-screen Display
OTA	Over-The-Air
OUI	Organisation Unique Identifier
PID	Packet Identifier
PLP	Physical Layer Pipes
PMT	Program Map Table
PVC	Polyvinyl Chloride
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RCA	Radio Corporation of America
RF	Radio Frequency
S/PDIF	Sony/Philips Digital Interface
SD	Standard Definition
SDT	Service Description Table
SFN	Single Frequency Network
SI	Service Information
SSU	System Software Update
STB	Set-Top-Box
TDT	Time and Date Table
TOT	Time Offset Table
TS	Transport Stream
UHD	Ultra High Definition
UHF	Ultra High Frequency
USB	Universal Serial Bus

Annex C
(normative)

RF profiles and performance figure

C.1   RF profiles for Malaysia

The RF profiles for Malaysia is outline in Table C.1 below.

Table C.1. RF profiles for Malaysia

Identifier	MS 1	MS 2	MS 3	MS 4
Overall				
Fast Fourier Transform (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

C.2 Performance figures for Malaysia

The performance figures for Malaysia are outline in Table C.2 below.

Table C.2. Performance figures for Malaysia

	Identifier	MS 1	MS 2	MS 3	MS 4
<u>Section</u> A.1	<u>Performance figure</u> Carrier to Noise Ratio (C/N) Performance on Gaussian channel (dB)	22.9	18.9	19.7	22.9
A.2	C/N Performance on 0 dB 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 0 dB 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.9	Performance in Time-Varying Channels 10 Hz doppler (5 Hz after AFC) 20 µs 0 dB echo	3	3	3	3
A.10	Synchronisation for varying echo power levels in Single Frequency Network (SFN) (dB)	31.0	26.1	28.1	31.0
A.11	C/(N+I) Performance in SFNs for more than one echo (dB)	28.0	22.6	23.9	28.0
A.12	C/(N+I) Performance in SFNs inside the guard interval (dB)	28.0	22.6	23.9	28.0

Table C.2. Performance figures for Malaysia *(continued)*

Identifier		MS 1		MS 2		MS 3		MS 4	
		Echo delay (µs)	Echo level (dBc)	Echo delay (µs)	Echo level (dBc)	Echo delay (µs)	Echo level (dBc)	Echo delay (µs)	Echo level (dBc)
Section A.13	**Performance figure** C/(N+I) Performance in SFNs outside the guard interval (dB)	-532	-12.0	See Note 1		-133	-9.5	-608	-12.0
		-525	-11.5			-120	-9.0	-600	-11.5
		-510	-10.5			-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	See Note 1		30	-2.0	540	-7.0
		490	-9.0			60	-5.0	560	-9.0
		510	-10.5			90	-7.5	580	-10.5
		525	-11.5			120	-9.0	600	-11.5
		532	-12.0			133	-9.5	608	-12.0

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