

TECHNICAL CODE

DIGITAL TERRESTRIAL TELEVISION (DTT) - CONTENT CONTRIBUTION, ENCODING AND MULTIPLEXING PERFORMANCE

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.

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Committee representation

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Radio Televisyen Malaysia

Rohde & Schwarz Malaysia Sdn Bhd

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Foreword

This technical code for Digital Terrestrial Television (DTT) - Content Contribution, Encoding and Multiplexing Performance ('this Technical Code') was developed pursuant to section 185 of the Act 588 by the Malaysian Technical Standards Forum Bhd ('MTSFB') via its Digital Terrestrial Television Working Group.

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

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DIGITAL TERRESTRIAL TELEVISION (DTT) - CONTENT CONTRIBUTION, ENCODING AND MULTIPLEXING PERFORMANCE

0. Introduction

This Technical Code details the performance measurement and parameters for the Digital Terrestrial Television Broadcast (DTTB) based on the Digital Video Broadcasting on Terrestrial Version 2 (DVB-T2) technology.

This Technical Code uses a number of national and international standards from the Digital Video Broadcasting (DVB), European Telecommunications Standards Institute (ETSI), International Standards Organization (ISO), International Telecommunication Union (ITU) and other standardization bodies as a reference. It does not intend to create a set of unique specifications unless deemed necessary or practical by the commercial realities in Malaysia.

1. Scope

This Technical Code covers the performance figures and measurement methods to ensure the minimum performance of content contribution, encoding and multiplexing subsystems of the Free To Air (FTA) and subscription based television service (Pay TV) delivered over a DTTB. In particular, it covers the following:

- a) video encoding performance;
- b) audio encoding performance; and
- c) Program-Specific Information/Service Information (PSI/SI) operational parameters.

This Technical Code excludes other subsystems of the DTTB such as transmission, service availability and Radio Frequency (RF) performance. It also excludes other service(s) which is provided as part of DTTB such as Over The Top (OTT) and Hybrid broadband broadcast Television (HbbTV) services.

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

AAC	Advanced Audio Coding
AAC-LC	Advanced Audio Coding - Low Complexity
AES/EBU	Audio Engineering Society/European Broadcasting Union
AIT	Application Information Table
APL	Average Picture Level
CASP	Content Application Service Provider

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CRC	Carriage Return Character
DSM-CC	Digital Storage Media Command and Control
DTTB	Digital Terrestrial Television Broadcast
DVB	Digital Video Broadcasting
DVB-T2	DVB on Terrestrial Version 2
EIT	Event Information Table
EIT p/f	Event Information Table, present and following
FTA	Free to Air
HbbTV	Hybrid Broadband Broadcast Television
HDMI	High-Definition Multimedia Interface
HE-AAC	High Efficiency Advanced Audio Coding
IEC	International Electrotechnical Commission
LCD	Logical Channel Descriptor
LCN	Logical Channel Number
MS	Multi Scale
MSE	Mean Square Error
NIT	Network Information Table
OTT	Over The Top
PAT	Program Association Table
PID	Program Identity
PLP	Physical Layer Pipe
PMT	Program Map Table
PSI	Program-specific Information
PSNR	Peak signal-to-noise ratio
QEF	Quasi Error Free
RF	Radio Frequency
RF/IP	Radio Frequency/Internet Protocol
SDI	Synchronous Digital Interface
SDT	Service Description Table
SI	Service Information
SSIM	Structural Similarity Index
STB	Set Top Box
TDT	Time Description Table
TOT	Time Offset Table
TS	Transport Stream
TSIP	Transport Stream over Internet Protocol
TV	Television
UTC	Coordinated Universal Time

4. Video encoding performance

4.1 Video source

For the purpose of measurement, the video format from Content Application Service Provider (CASP) to the encoder as illustrated in Figure 1, shall be SDI.

4.2 Performance figure

The video encoding performance shall not fall below the Peak Signal-To-Noise Ratio (PSNR) video performance figures as specified in Table 1 for more than 30 consecutive frames. However, an additional margin of 8 dB below the figure in Table 1 is allowed for frames that include text, such as subtitles.

The Structural Similarity Index (SSIM) or Multi-Scale SSIM (MS-SSIM) video encoding performance figure may also be met (optional). PSNR and SSIM are defined in 4.3 and 4.4 but an equivalent PSNR, SSIM or MS-SSIM may be used.

Table 1. Video encoding performance figure

Parameter	Video encoding performance figure
PSNR (dB)	35
MS-SSIM or SSIM	0.91

It is recognised that subjective quality testing is the definitive method for video encoding performance measurement. Therefore, in the event of any dispute, the video encoding performance shall be re-evaluated by an agreed subjective quality test, for example, following the procedures as recommended by ITU-R BT.500-13.

4.3 Measurement method

The video encoding performance shall be in principal measured in real-time by the service provider as per the equipment set-up illustrated in Figure 1.

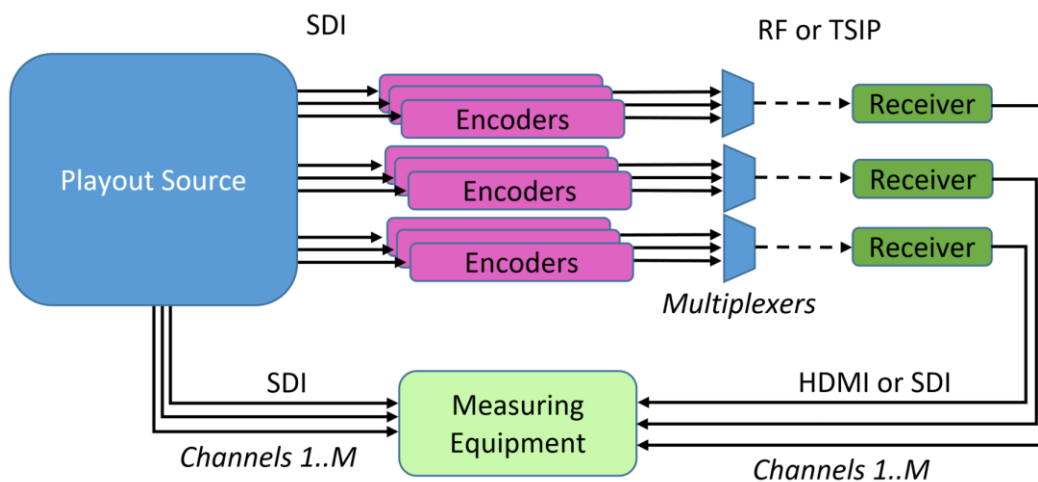


Figure 1. Illustration of end-to-end video and audio encoding performance measurement set-up

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The measurements shall be done on the end-to-end equipment originating from Synchronous Digital Interface (SDI) input of encoders to High-Definition Multimedia Interface (HDMI) or SDI output of a receiver. In DTTB, measurements should be done under Quasi Error Free (QEF) condition. A professional receiver or consumer Set-Top-Box (STB) with HDMI or SDI output may be used. A direct wired connection for the Radio Frequency (RF) segment link may be used to achieve QEF condition.

4.4 Peak Signal-To-Noise Ratio (PSNR)

$$PSNR = 10 * \log_{10} \left(\frac{MAX^2}{MSE} \right)$$

$$MSE = \frac{1}{m * n} * \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i, j) - K(i, j)]^2$$

where,

$I(i, j)$ is nominal value of reference at position i, j; and

$K(i, j)$ is actual value of current frame at position i, j.

Calculation of the PSNR values is based on the same preprocessing as calculation of the "pixel error" values. For the three components luminance (Y), chrominance blue-difference (Cb) and chrominance red-difference (Cr), the PSNR separately indicates the logarithmic ratio of the maximum possible deviation of all pixels from the nominal value of the reference (MAX) and the current total deviation (Mean Square Error (MSE)).

4.5 Structural Similarity Index (SSIM)

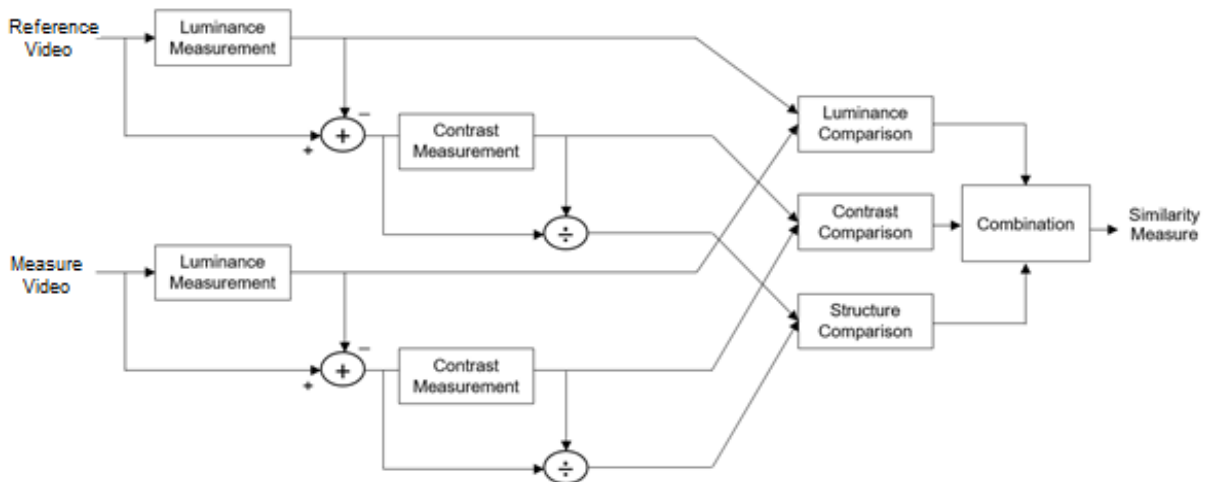


Figure 2. SSIM calculation method diagram

The SSIM calculation method involves a combination of three equally weighted individual results. The first result is generated by comparing the Average Picture Level (APL) of the actual and nominal pictures. The second influence factor is the contrast difference which follows from the standard deviations of Y. Finally, as the third factor the structural difference is taken into account by calculating the normalised standard deviations. The range of values is from 1 (perfect match) to 0 (maximum difference or total distortion). Visible differences begin at ≤ 0.98 .

5. Audio encoding performance

5.1 Audio source

For the purpose of measurement, the audio connector from CASP to the encoder, as illustrated in Figure 1, shall be AES/EBU cable.

5.2 Audio bit rates

The minimum bit rate for main audio elementary stream shall be encoded at “excellent” audio encoding performance. The minimum bit rate for a supplementary audio elementary stream, if available, shall be encoded at “good” audio encoding performance. The audio bit rates of the final emission shall be according to the ITU-R BS.1548. For example, the bit rates to be used for High Efficiency Advanced Audio Coding (HE-AAC) profile are shown in Table 2.

Table 2. Bit rates to be used for HE-AAC

Audio	Excellent quality (kbps)	Good quality (kbps)
AAC-LC multi-channel	360	N/A
HE-AAC multi-channel	120	N/A
AAC-LC stereo	144	N/A
HE-AAC stereo	48	32
High Efficiency Advanced Audio Coding version 2 profile (HE-AAC v2), parametric stereo	N/A	24
HE-AAC mono	N/A	24

5.3 Audio loudness normalisation

It is a recommendation of the EBU based on a study of audio signal levels in production, EBU R 128-2014, that an audio-leveling paradigm is needed. To comply with this technical code, the audio outputs of the multiplexers shall conform to the loudness normalisation and permitted maximum level of audio signals of EBU R 128-2014.

5.4 Audio/video synchronisation

The transmitted audio and video streams shall be broadcast with the correct timing and presentation or decode time stamps, such that the audio and video elements of a correctly received, decoded and reproduced presentation shall have the same synchronisation as the un-encoded essences. There should be no detectable lip synchronisation error on the original material. Audio Video synchronisation should be within ± 10 ms at the broadcast side.

6. Program-Specific Information/Service Information (PSI/SI) tables

The PSI/SI parameters as listed in this clause are specified from SKMM MTSFB TC T004:2013, ETSI TR 101 290, based on localisation requirements and field testing experience of other deployments of DVB-T2 systems. The list of recommended parameters are not exhaustive as the general aim is to provide a minimum "health check" of the most important elements of the Transport Stream (TS). It shall be included in the service provider's rules of operation to comply with this recommendation.

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6.1 Basic monitoring

All first priority parameters listed under 5.2.1 of ETSI TR 101 290 shall be adhered to. The first priority tests are namely:

- a) TS_Sync_loss;
- b) Sync_byte_error;
- c) PAT_error;
- d) PAT_error_2;
- e) Continuity_count_error;
- f) PMT_error;
- g) PMT_error_2; and
- h) PID_error.

Where a similar parameter is also made mandatory in the other clauses of this Technical Code, the clauses in this document shall take precedence.

6.2 Repetition rates

The broadcast shall include the following minimum repetition rates:

- a) all sections of the Network Information Table (NIT) shall be transmitted at least every 10 s;
- b) all sections of the Service Description Table (SDT) for the actual multiplex shall be transmitted at least every 2 s;
- c) the Time Description Table (TDT) shall be transmitted at least every 30 s;
- d) the Time Offset Table (TOT) shall be transmitted at least every 30 s;
- e) all sections of the Event Information Table (EIT) present/following table for the actual multiplex shall be transmitted at least every 2 s;
- f) all sections of the EIT schedule table for day 0 for the actual Transport Stream (TS), shall be transmitted at least every 10 s;
- g) all sections of the EIT schedule table for days 1 and later, for the actual TS, shall be transmitted at least every 30 s, where present;
- h) all sections of Program Association Table (PAT) shall be transmitted at least every 250 ms;
- i) all sections of Program Map Table (PMT) shall be transmitted at least every 250 ms; and
- j) all sections of the Application Information Table (AIT) shall be transmitted every 1 s.

6.3 Minimum time interval

The minimum time interval between the arrival of the last byte of a section to the first byte of the next transmitted section with the same Program Identity (PID), "table_id" and "table_id_extension" and with the same or different "section_number" shall be 25 ms.

6.3.1 Program Association Table (PAT)

PAT is mandatory and shall be transmitted on PID value 0x0000.

6.3.2 Program Map Table (PMT)

For each service in a TS, there shall be a corresponding PMT which the PMT shall be encoded according to ISO/IEC 13818-1. There shall be separate "program_map_PIDs" for each service.

6.3.3 Network Information Table (NIT) "NIT_actual"

"NIT_actual" shall be transmitted in each TS in the network. "NIT_actual" shall always be transmitted on PID value 0x0010.

6.3.4 Time Description Table (TDT)

TDT is mandatory in each TS in the network. The time accuracy shall be within ± 2 s from Coordinated Universal Time (UTC) and ± 0.5 s from time in TOT and TDT times across the complete network.

6.3.5 Time Offset Table (TOT)

TOT is strongly recommended (optional) in each TS in the network. The time accuracy shall be within ± 2 s from UTC and ± 0.5 s from all other TOT and TDT times across the complete network.

6.3.6 Service Description Table (SDT) "SDT_actual"

"SDT_actual" is mandatory for each TS in the network.

6.3.7 Event Information Table (EIT)

6.3.7.1 EIT present/following

It is mandatory to transmit EIT p/f sections for all visible services in the actual TS, where visible service means all services that are not listed as "hidden" in any Malaysian logic channel descriptor (i.e. "visible_service_flag" set to "0"). EIT p/f signaling shall comply with the rules specified in 4.1.4.1 of ETSI TS 101 211 V1.11.1.

6.3.7.2 EIT schedule

It is recommended (optional) to transmit at least 2 days of EIT schedule sections for all visible services in the actual TS, which the visible service means all services that are not listed as "hidden" in any Malaysian logic channel descriptor (i.e. "visible_service_flag" set to "0") and where "2 days EIT" means day 0 and day 1. EIT p/f signaling shall comply with the rules specified in 4.1.4.2 of ETSI TS 101 211 V1.11.1.

6.3.8 Application Information Table (AIT)

AIT signal shall be as specified in ETSI TS 102 796 V1.4.1.

6.3.9 Table segmentation

6.3.9.1 Network Information Table (NIT)

All the first loop descriptors shall be conveyed in the one or more sections of the sub-table starting in the first section. No TS loops shall be started until the first loop descriptors have been completed.

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Therefore, the initial sections shall have the “transport_stream_loop_length” set to “0” if the first loop descriptors continue in the next section.

The “network_descriptors_length” field shall be set according to the number of bytes of the loop contained in the section. The description of a particular TS in a NIT shall not be split across more than one section.

Therefore, the same pair of “transport_stream_id” and “original_network_id” shall not appear in the TS loop of more than one section of a particular sub-table. This limits the maximum size of a second descriptor loop to 1 002 bytes.

6.3.9.2 Service Description Table (SDT) and Event Information Table (EIT)

The description of a particular service in an SDT shall not be split across more than one section. Therefore, the same “service_id” shall not appear in more than one section of a particular sub-table. Similarly, for EIT the description of an event shall not be split across more than one section. Therefore, an “event_id” shall not appear in more than one section of a particular sub-table. These constraints limit the size of the EIT or SDT descriptor loop to that which can fit within the maximum section size for the respective table.

6.3.9.3 Table/section update

When the contents of a table or section are updated, it is mandatory to update both the version number and the Carriage Return Character (CRC) field. Due to transmission errors or operational changes, the version number may not always increase by one. Any change of the version number shall be seen as an indication as an update to the table.

6.4 Mandatory broadcast descriptors

6.4.1 ISO 639 language descriptor

The “ISO_639_language_descriptor” shall be inserted for every audio and subtitle component defined. The list of permissible ISO 639-3 language codes is defined in SKMM MTSFB TC T004:2013.

6.4.2 Network name descriptor

A “network_name_descriptor” shall be inserted for each NIT sub-table.

6.4.3 Service descriptor

A “service_descriptor” shall be inserted for each service defined in the SDT. Permissible service types are 0x01, 0x02, 0x0A, 0x0C, 0x11, 0x16 and 0x19 based on rules defined in ETSI EN 300 468 V1.15.1.

6.4.4 Short event descriptor

The EIT p/f and EIT schedule shall contain a title and a short event descriptor (less than 256 characters) and text information for each “event_id”. Each “event_id” in EIT schedule shall contain a title. A language code is transmitted in order to indicate in which language the title and the text are written. The language code shall be either ENG, MSA, ZHO or TAM as described in SKMM MTSFB TC T004:2013.

6.4.5 Content descriptor

The descriptor classifies the event according to classes specified in ETSI EN 300 468 V1.15.1. It is mandatory to include content descriptor for all EIT p/f events.

6.4.6 Local time offset descriptor

It is mandatory to include local time offset descriptor in each TOT. "MYS" country code shall be used. The parameter "country_region_id" shall be set to "0". Both the "local_time_offset" and the "next_time_offset" shall be set to 8 hours ahead of UTC. "time_of_change" shall contain a time and date within ± 2 years from UTC time in the TOT.

6.4.7 Subtitling descriptor

Each subtitle elementary stream shall be signaled in PMT. The list of permissible ISO 639-3 language codes is defined in SKMM MTSFB TC T004:2013. Subtitle type shall be in the range of 0x10 to 0x14 or 0x20 to 0x24.

6.4.8 Private defined descriptor

If private defined descriptors are used, it shall be broadcast as specified in ETSI TS 101 211 V1.11.1.

Malaysia private defined descriptors (e.g. Malaysian logic channel descriptors) shall use the "private_data_specifier_value" defined in SKMM MTSFB TC T004:2013.

6.4.9 Data broadcast id descriptor

HbbTV related Digital Storage Media Command and Control (DSM-CC) object carousels (ISO/IEC 13818-6 type B) shall be signaled with a "data_broadcast_id_descriptor" including a "data_broadcast_id" value of 0x0123 in accordance with the specification in 7.2.3 and 7.2.6 of ETSI TS 102 796 V1.4.1.

6.4.10 T2 delivery system descriptor

A "T2_delivery_system_descriptor" shall be inserted for each TS in a terrestrial network. All TS in a network shall be defined in the appropriate NIT section.

The remaining part of the descriptor shall immediately follow the "T2_system_id field" and shall be present at most once per T2 system.

6.4.11 Logical Channel Descriptor (LCD)

Every TV or radio service shall be allocated an LCN in the range of 1 to 799 using either the Malaysian LCD v1 or Malaysian LCD v2 as defined in SKMM MTSFB TC T004:2013. No other mechanism shall be broadcast to control the ordering of services other than those defined in SKMM MTSFB TC T004:2013. These descriptors shall be inserted in the second descriptor loop in NIT.

6.4.11.1 LCN clashes

The LCN for each service shall be unique across the network (defined by the "network_id"). This may not always be possible when using LCD v2, due to the use of regional broadcast management. Where possible, the signaling shall make every effort to avoid such clashes.

6.4.11.2 LCD v1 and LCD v2 coexistence

Each network shall use either Malaysian LCD v1 or Malaysian LCD v2 descriptors. Both Malaysian LCD v1 and Malaysian LCD v2 shall not coexist on the same network.

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6.5 Identifiers

The broadcaster shall make services uniquely identified in the broadcast through the combination of only “original_network_id” - “service_id”. The receiver shall identify a service uniquely through the combination of “original_network_id” - “transport_stream_id” - “service_id”.

6.5.1 Original network id

The broadcaster shall use the original network id as defined in SKMM MTSFB TC T004:2013.

6.5.2 Transports stream id

The “transport_stream_id” shall uniquely define a TS within the network. Within a given terrestrial network two (2), TS are identified as identical as long as the TS contains the same set of services.

6.5.3 Service id

Each service shall be associated with a 2 byte “service_id”. The “service_id” is equivalent to the “program_number” used in PAT and PMT. Operators shall allocate a unique “service_id” for each service in the network (“original_network_id”).

6.5.4 Network id

The broadcaster shall use the “network_id” range as defined in SKMM MTSFB TC T004:2013.

6.5.5 Event id

The “event_id” is a 16-bit field which contains the identification number of the described event. Each service provider is free to allocate “event_ids” within their “service_id” domain, with the restriction that an “event_id” shall be unique within the transmitted schedule. An “event_id” shall be associated with a single event within the schedule (i.e. if an event is rescheduled within the currently transmitted schedule, it shall not change its “event_id”). If the event is removed from the schedule (or rescheduled to outside the transmitted schedule) then its “event_id” shall be removed from the schedule. Any replacement event shall be allocated a new “event_id” unique within the transmitted schedule.

6.6 Subtitles

Subtitles shall be encoded as bitmaps and broadcast according to the requirements specified in ETSI EN 300 743 v1.3.1.

6.7 Languages

The “ISO_639_language_descriptor” shall be inserted for every audio and subtitle component defined. The list of permissible ISO 639-3 language codes are defined in SKMM MTSFB TC T004:2013.

6.8 Character sets

The text strings shall be transmitted using table 00 as defined in ETSI EN 300 468 V1.15.1 or using the Huffman compression algorithm as defined in ITU-T P.910. Any other tables than the table mentioned in this paragraph, including control codes are prohibited.

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.

A compressed string in the EIT tables shall be signaled by the method specified in ETSI EN 300 468 V1.15.1. This is done by ensuring that the first byte of any compressed string is 0x1F.

The second byte as specified in ETSI EN 300 468 V1.15.1 shall contain the “encoding_type_id”. Strings shall be compressed using Huffman compression as specified in SKMM MTSFB TC T004:2013.

Broadcasters should keep service names to less than 12 characters and event names to less than 40 characters.

6.9 Country code

This 24 bit field used in various descriptors identifies a country using the 3 character code as specified in ISO 3166. Each character is coded into 8 bits according to ISO/IEC 8859-1 and inserted in order into the 24 bit field. This shall be set to “MYS”.

6.10 Multiple Physical Layer Pipe (PLP)

It is recommended (optional) not to use the common Physical Layer Pipe (PLP) as implementation has been found to differ across manufactures.

Annex A
(normative)

Normative references

SKMM MTSFB TC T004:2013, *Specification for Digital Terrestrial Television Broadcast Service Receiver*

ITU-R BS.1548, *User requirements for audio coding systems for digital broadcasting*

ITU-R BT.500-13, *Methodology for the subjective assessment of the quality of television pictures*

ITU-T P.910, *Subjective video quality assessment methods for multimedia applications*

ISO 3166-1:2013, *Codes for the representation of names of countries and their subdivisions - Part 1: Country codes*

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

ISO/IEC 13818-1, *Information Technology - Generic coding of moving pictures and associated audio information - Part 1: Systems*

ISO/IEC 13818-6, *Information technology - Generic coding of moving pictures and associated audio information - Part 6: Extensions for DSM-CC*

EBU R 128-2014, *Loudness normalization and permitted maximum level of audio signals*

ETSI EN 300 743 v1.3.1, *Digital Video Broadcasting (DVB); DVB Subtitling systems*

ETSI EN 300 468 V1.15.1, *Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems*

ETSI TS 101 211 V1.11.1, *Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)*

ETSI TR 101 290, *Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems*

ETSI TS 102 796 V1.4.1, *Hybrid Broadcast Broadband TV*

Acknowledgements

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