

MCMC MTSFB RECOMMENDATION

RECOMMENDATION

DIGITAL TERRESTRIAL TELEVISION BROADCAST - QUALITY OF SERVICE

Developed by



Registered by



Registered date:

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Committee representation

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Samsung Malaysia Electronics (SME) Sdn. Bhd.

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Foreword

This recommendation for Digital terrestrial television broadcast - Quality of service ('this Recommendation') 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 Recommendation shall continue to be valid and effective until reviewed or cancelled.

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DIGITAL TERRESTRIAL TELEVISION BROADCAST - QUALITY OF SERVICE

0. Introduction

This Recommendation details the Quality of Service (QoS) measurement and parameters for the Digital Terrestrial Television Broadcast (DTTB) based on the Digital Video Broadcasting on Terrestrial Version 2 (DVB-T2) technology.

Items in this specification are divided into requirement and optional categories. Where a requirement is stated as “required”, its inclusion is necessary for the achievement of a minimum compliance with the recommendation. Additional optional level of service may be provided by the service provider to enhance the consumer proposition. The word “shall” implies that the item is a requirement (mandatory) while the word “may” or “should” implies that a statement is optional.

This Recommendation uses a number of national and international standards from the Digital Video Broadcasting (DVB), European Telecommunications Standards Institute (ETSI), International Standards Organization (ISO) and other standardization bodies as a reference 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.

1. Scope

This Recommendation covers the performance figures and measurement methods to ensure the minimum QoS for Free To Air (FTA) and subscription based television service (Pay TV) delivered over digital terrestrial platform.

This recommendation excludes other service(s) which is provided as part of DTTB such as Over The Top (OTT) and Hybrid broadband broadcast Television (HbbTV) catch-up services. It provides QoS recommendation in four parameters as follows:

- a) service availability;
- b) video quality;
- c) audio quality; and
- d) Program-specific Information/Service Information (PSI/SI) parameters.

2. Normative references

The following normative references are indispensable for the application of this Recommendation. 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
AIT	Application Information Table
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
ETSI	European Telecommunications Standards Institute
FTA	Free to Air
HbbTV	Hybrid Broadband Broadcast Television
HE-AAC	High Efficiency Advanced Audio Coding profile
IEC	International Electrotechnical Commission
LCN	Logical Channel Number
MS	Multi Scale
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/IP	Radio Frequency/Internet Protocol
SDI	Synchronous Digital Interface
SDT	Service Description Table
SI	Service Information
SSIM	Structural Similarity Index
TDT	Time Description Table
TOT	Time Offset Table
TS	Transport Stream
TV	Television
UTC	Coordinated Universal Time

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4. Service availability

All DTTB FTA terrestrial broadcast shall be broadcasted so that it can be received by receivers which complied to the minimum requirements set out in the Malaysian receiver specification as specified in the SKMM MTSFB TC-T004-2013. The service availability of the DTTB service shall be minimum of 99.97 % according to the yearly service availability formula as follow:

$$\text{Yearly service availability} = \frac{\text{up-time (minutes)}}{\text{minutes in a year (minutes)}} \times 100 \%$$

5. Video quality

5.1 Performance figure

The video quality shall not fall below the video performance figures as specified in Table 1 for more than 30 consecutive frames. Multi Scale/Structural Similarity Index (MS-SSIM/SSIM) and Peak Signal-To-Noise Ratio (PSNR) defined in 5.3 and 5.4, or their equivalent shall be used.

Table 1. Video quality performance figure

Parameter	Video quality performance figure
MS-SSIM/SSIM	0.91
PSNR (dB)	35

In the event of any dispute, the video quality performance may be determined by subjective quality testing following the procedure as recommended by ITU-R BT.500-13 and ITU-T P.910.

5.2 Measurement method

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

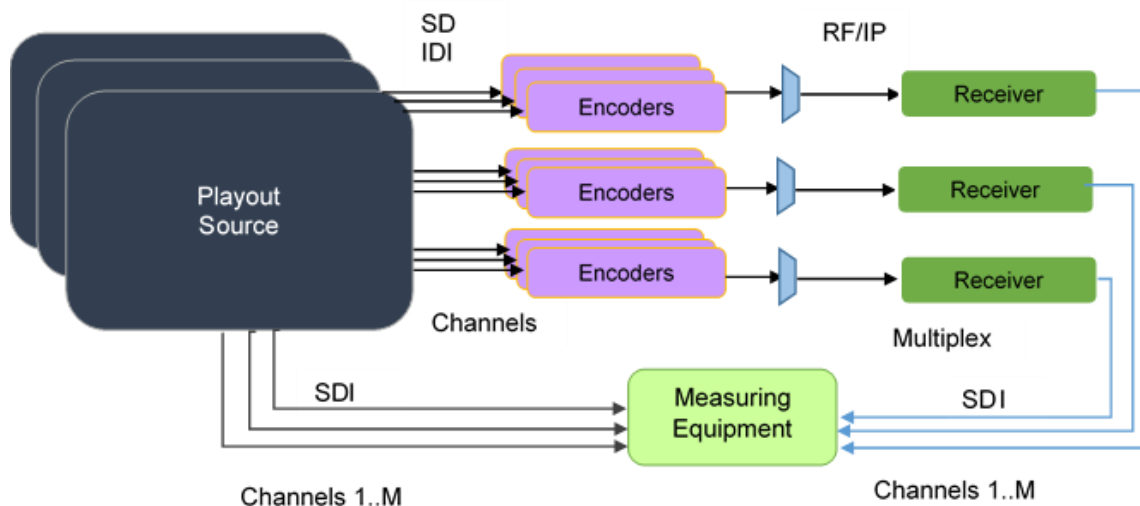


Figure 1. Illustration of end-to-end video quality measurement set-up

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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 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 High-Definition Multimedia Interface (HDMI) to SDI converter may be used. A direct wired connection for the Radio Frequency/Internet Protocol (RF/IP) segment link may be used to achieve QEF condition.

5.2 Structural Similarity Index (SSIM)

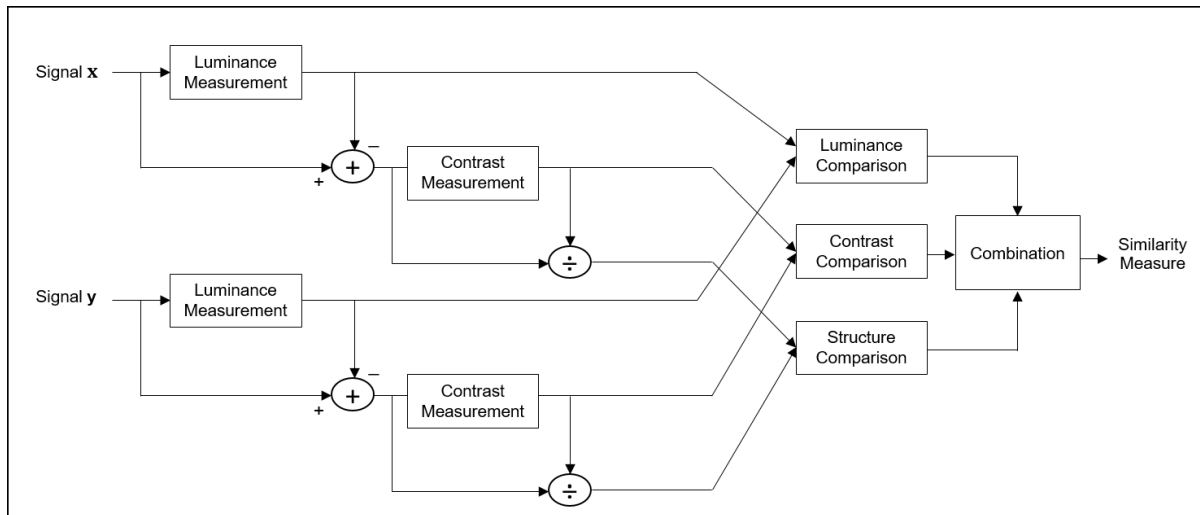


Figure 2. SSIM diagram

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 error). The visible errors begin at ≤ 0.98 .

5.3 Peak Signal-To-Noise Ratio (PSNR)

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

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

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 Y, Cb and Cr, the PSNR separately indicates the logarithmic ratio of the maximum possible total deviation of all pixels from the nominal value of the reference (MAX) and the current total deviation (Mean Square Error (MSE)).

5.4 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.

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5.5 Video bit rates

The per-channel video bit rates on the RF/IP segment shown in Figure 1 should be as per the average bit rate with stat mux shown in Table 2.

Table 2. Average bit rate with stat mux

Source	Resolution	Recommended fixed bit rate (Mbps)	Average bit rate with stat mux (Mbps)
High-Definition (HD)	1080i x 1920	7.3	5.48
Standard-Definition (SD)	576i x 720	2.5	1.88

6. Audio quality

6.1 Audio source

For the purpose of measurement, the audio format from CASP to the encoder, as illustrated in Figure 1, shall be Audio Engineering Society/European Broadcasting Union (AES/EBU).

6.2 Audio bit rates

The minimum bit rate for main audio component shall be encoded at “excellent” audio quality and supplementary services may be encoded at “good” audio quality in final emission according to the ITU-R BS.1548. For example, the bit rates to be used for High Efficiency Advanced Audio Coding profile (HE-AAC) are shown in Table 3.

Table 3. Bit rates to be used for HE-AAC

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

6.3 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 sync error on the original material; AV sync should be within ± 10 ms at the broadcast side.

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

The PSI/SI parameters as listed in clause 7 are specified from SKMM MTSFB TC-T004-2013, which the recommendation based on localisation requirements and field testing experience of other deployments of DVB-T2 systems. These are highly recommended to be included in the service provider's rules of operation.

7.1 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 5 s.
- d) The Time Offset Table (TOT) shall be transmitted at least every 5 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.
- j) All Sections of the Application Information Table (AIT) shall be transmitted every 1 s.

7.2 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 as in Table 3 with the same Program Identity (PID), "table_id" and "table_id_extension" and with the same or different "section_number" shall be 25 ms.

7.2.1 Program Association Table (PAT)

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

7.2.2 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.

7.2.3 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.

7.2.4 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.

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7.2.5 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.

7.2.6 Service Description Table (SDT) “SDT_actual”

“SDT_actual” is mandatory for each TS in the network.

7.2.7 Event Information Table (EIT)

7.2.7.1 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.

7.2.7.2 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.

7.2.8 Application Information Table (AIT)

AIT signal shall be as specified in ETSI TS 102 796 V1.2.1.

7.2.9 Table segmentation

7.2.9.1 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.

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.

7.2.9.2 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.

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7.2.9.3 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 be increased by one. Any change of the version number shall be seen as an indication as an update to the table.

7.3 Mandatory broadcast descriptors

7.3.1 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.

7.3.2 Network name descriptor

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

7.3.3 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 V1.14.1.

7.3.4 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.

7.3.5 Content descriptor

The descriptor classifies the event according to classes specified in ETSI EN 300 468 V1.14.1. It is mandatory to include content descriptor for all EIT p/f events.

7.3.6 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.

7.3.7 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.

7.3.8 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.

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7.3.9 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 V1.2.1.

7.3.10 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.

7.3.11 Logical channel descriptor (LCN)

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.

7.3.11.1 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.

7.3.11.2 LCN v1 and LCN 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.

7.4 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”.

7.4.1 Original network id

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

7.4.2 Transports stream id

xxxxxxx

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.

7.4.3 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”).

7.4.4 Network id

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

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7.4.5 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.

7.5 Subtitles

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

7.6 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.

7.7 Character sets

The text strings shall be transmitted using table 00 as defined in ETSI EN 300 468 V1.14.1 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 V1.14.1. 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 V1.14.1 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.

7.8 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 8859-1 and inserted in order into the 24 bit field. This shall be set to “MYS”.

7.9 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.

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Annex A (normative)

Normative references

SKMM MTSFB TC-G001:2013, *Compression Table of Service Information (SI) Descriptions for Digital Terrestrial Television Broadcast Service*

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

SKMM MTSFB TC-G002:2013, *Middleware Profile for Digital Terrestrial Television Broadcast Service*

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

ISO 3166, *Codes for the representation of names of countries and their subdivisions*

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

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

ETSI EN 300 468 V1.14.1, *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 TS 102 796 V1.2.1, *Hybrid Broadcast Broadband TV*

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Members of the Digital Terrestrial Television Working Group

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