RECOMMENDATION ITU-R BT.1300

# SERVICE MULTIPLEX, TRANSPORT, AND IDENTIFICATION METHODS FOR DIGITAL TERRESTRIAL TELEVISION BROADCASTING

(Question ITU-R 121/11)

(1997)

The ITU Radiocommunication Assembly,

*considering*

a) that digital terrestrial television broadcasting (DTTB) will be introduced in the VHF/UHF bands by many administrations;

b) that the simultaneous transmission of video, sound, data and control signals is required in a DTTB service;

c) that practical implementation of digital terrestrial broadcasting systems may require certain constraints and/or extensions to the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) Standard 13818-1 transport specification;

d) that a common Transport Stream syntax has been established in ISO/IEC Standard 13818-1 (Moving Pictures Expert Group (MPEG-2) Systems);

e) that a common Transport Stream syntax is recommended by Recommendations ITU-R BT.1207 and ITU-R BT.1209 based upon ISO/IEC Standard 13818-1;

f) that the MPEG-2 defines two methods of transport, the Program Stream and Transport Stream method, and that Transport Stream syntax is optimized for use in environments where transmission errors are likely;

g) that the exchange of programming from various sources will continue to be necessary, placing special demands on the transport layer,

*recommends*

**1** that DTTB systems should comply with ISO/IEC Standard 13818-1 service multiplex and Transport Stream syntax as given in Recommendations ITU-R BT.1207 and ITU-R BT.1209, using one of the systems described in Annex 1;

**2** that digital terrestrial television systems should be designed to comply with the method for harmonization of user definable elements summarized in Annex 2.

NOTE 1 – New DTTB systems or functions may require the addition of new standard methods to the appropriate annex.

ANNEX 1

## Service multiplex and transport methods

## 1 Introduction

The service transport method shall conform with the MPEG-2 Transport Stream syntax described in ISO/IEC Standard 13818-1 (MPEG-2 Systems). Permissible constraints and extensions for existing systems have been standardized and are given in § 2 of this Annex.

“Service multiplex and transport” refers to the means of dividing the digital data stream into “packets” of information, the means of uniquely identifying each packet or packet type, and the appropriate methods of multiplexing video data stream packets, audio data stream packets, and ancillary data stream packets into a single data stream consisting of a sequence of 188-byte transport packets.

In developing the transport mechanism, interoperability among digital media, such as terrestrial broadcasting, cable distribution, satellite distribution, recording media, and computer interfaces, is a prime consideration. ITU-R recommends that digital television systems employ the MPEG-2 Transport Stream syntax for the packetization and multiplexing of video, audio, and data signals for digital broadcasting systems. The MPEG-2 Transport Stream syntax was developed for applications where channel bandwidth or recording media capacity is limited and the requirement for an efficient transport mechanism is paramount. It was designed also to facilitate interoperability with the asynchronous transfer mode (ATM) transport mechanism.

# 2 Service transport method

## 2.1 System overview

The specifications for service multiplex and transport systems characteristics of System A and System B are referenced in Appendices 1 and 2, respectively.

The transport format and protocol for System A and System B are compatible subsets of the MPEG-2 Systems specification defined in ISO/IEC Standard 13818-1. Both systems are based on a fixed-length packet transport stream approach that has been defined and optimized for digital television delivery applications.

In both system standards certain extensions and constraints with respect to MPEG-2 Systems are specified. The following sections outline these.

## 2.2 Specification

The syntax and semantics of the specification of the System A and System B standards conform to ISO/IEC Standard 13818-1 subject to the constraints and conditions specified here. The coding constraints that apply to the use of the MPEG-2 Systems specification in the System A and System B are as follows.

### 2.2.1 MPEG-2 Systems standard

#### 2.2.1.1 Video T-STD

The video T-STD is specified in § 2.4.2 of ISO/IEC Standard 13818-1 and follows the constraints for the level encoded in the video elementary stream.

#### 2.2.1.2 Audio T-STD

The audio T-STD for System A is specified in § 3.6 of Annex A of [ATSC, 1995a] (see Appendix 1).

The audio T-STD for System B is specified in § 2.4.2 of ISO/IEC Standard 13818-1.

### 2.2.2 Registration descriptor

System A uses the registration descriptor described in § 2.6.8 of ISO/IEC Standard 13818-1 to identify the contents of programs and elementary streams to decoding equipment.

In System B, the use of the registration descriptor is in accordance with § 2.6.8 of ISO/IEC Standard 13818-1.

#### 2.2.2.1 Program identifier (PID)

Programs which conform to the System A specification will be identified by the 32-bit identifier in the section of the Program Map Table (PMT) detailed in § 2.4.4.8 of ISO/IEC Standard 13818-1. The identifier will be coded according to § 2.6.8, and shall have a value of 0x4741 3934 (“GA94” in ASCII).

#### 2.2.2.2 Audio elementary stream identifier

Audio elementary streams which conform to the System A specification will be identified by the 32-bit identifier in the section of the Program Map Table (PMT) detailed in § 2.4.4.8 of ISO/IEC Standard 13818-1. The identifier will be coded according to § 2.6.8, and shall have a value of 0x4143 2D33 (“AC-3” in ASCII).

### 2.2.3 The program paradigm

The program paradigm specifies the method that shall be used in the System A Standard for allocating the values of the Packet Identifier (PID) field of the transport packet header in a systematic manner. Within one transport multiplex, television programs that follow the program paradigm are assigned a program number ranging from 2 to 255. Note that program number 1 is disallowed, as the resulting base_PID conflicts with PID values used by System B SI as defined in Appendix 2 [ETSI, 1996a]. The binary value of the program number is used to form $b_{11}$ through $b_4$ of the PID. Programs adhering to the paradigm shall have $b_{12}$ equal to '0'. Programs not adhering to the paradigm shall have $b_{12}$ equal to '1'.

The paradigm to identify the transport bit streams containing certain elements of the program is defined in Table 1. The base_PID is defined as:

$$\text{base\_PID} = 16 * \text{program number}$$

where program number refers to each program within one transport multiplex and corresponds to the 16-bit program_number identified in the Program Association Table (PAT) and PMT.

The $b_0$ through $b_3$ of the PID are assigned according to Table 1.

TABLE 1

**PID assignment for the constituent elementary streams of a program table**

| Name | PID definition | Description |
|---|---|---|
| PMT_PID | base_PID+0x0000 | PID for the bit stream containing the program_map_table for the program. |
| video_PID | base_PID+0x0001 | PID for the bit stream containing the video for the program. |
| PCR_PID | base_PID+0x0001 | Implies the video bit stream also carries the Program Clock Reference (PCR) values for the program. |
| audio_PID | base_PID+0x0004 | PID for the bit stream containing the primary audio for the program. The primary audio shall be a complete main audio service (CM) as defined by System A Standard (Appendix 1 [ATSC, 1995a]) and shall contain the complete primary audio of the program including all required voice-overs and emergency messages. |
| data_PID | base_PID+0x000A | PID for the bit stream containing the data for the program. |

The program_map_table must be decoded to obtain the PIDs for services not defined by the paradigm but included within the program (such as a second data channel). According to the program paradigm, every 16th PID is a PMT_PID and may be assigned to a program. If a PMT_PID is assigned to a program by the program paradigm ($b_{12}$ of the PMT_PID is equal to '0'), the next 15 PIDs after that PMT_PID are reserved for elements of that program and shall not be otherwise assigned.

No program-related constraints on the PID allocation are required in System B.

### 2.2.4 Constraints on Program Specific Information (PSI)

In System A, the program constituents for all programs, including television programs that follow the program paradigm and other programs or services that do not follow the program paradigm, are described in the PSI. The following constraints apply to the PSI information:

– Only one program is described in a PSI transport bit stream corresponding to a particular PMT_PID value. A transport bit stream containing a program_map_table shall not be used to transmit any other kind of PSI table (identified by a different table_id).

– The maximum spacing between occurrences of a program_map_table containing television program information shall be 400 ms.

– The program numbers are associated with the corresponding PMT_PIDs in the PID0 PAT. The maximum spacing between occurrences of section 0 of the program_association_table is 100 ms.

– The video elementary stream section shall contain the data stream alignment descriptor described in § 2.6.10 of ISO/IEC Standard 13818-1. The alignment_type field shown in Table 2-47 of ISO/IEC Standard 13818-1 shall be 0x02.

– Adaptation headers shall not occur in transport packets of the PMT_PID for purposes other than for signalling with the discontinuity_indicator that the version_number (§ 2.4.4.5 of ISO/IEC Standard 13818-1) may be discontinuous.

– Adaptation headers shall not occur in transport packets of the PAT_PID for purposes other than for signalling with the discontinuity_indicator that the version_number (§ 2.4.4.5 of ISO/IEC Standard 13818-1) may be discontinuous.

In System B, the program constituents for all programs are described in the PSI as specified in ISO/IEC Standard 13818-1 and in the Service Information (SI) as specified in Appendix 2 [ETSI, 1996a]. The following constraints apply to the PSI information:

– Each section of the PAT and the PMT should be transmitted at least once every 100 ms.

– The Network Information Table (NIT) is defined in compliance with ISO/IEC Standard 13818-1, and the data format is further defined in Appendix 2 [ETSI, 1996a]. The NIT is carried in transport packets with a PID value of 0x0010. Each section of the NIT shall be transmitted at least once every 10 s. 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 table_id and table_id_extension shall be 25 ms.

### 2.2.5 Packetized Elementary Stream (PES) constraints

PES syntax and semantics shall be used to encapsulate the audio and video elementary stream information. The PES syntax is used to convey the Presentation Time-Stamp (PTS) and Decoding Time-Stamp (DTS) information required for decoding audio and video information with synchronism. This section describes the coding constraints for this system layer.

Within the PES packet header, the following restrictions apply:

For System A,

– PES_scrambling_control shall be coded as '00'.

– ESCR_flag shall be coded as '0'.

– ES_rate_flag shall be coded as '0'.

– PES_CRC_flag shall be coded as '0'.

For System B,

– The following trick mode fields shall not be transmitted in a broadcast bitstream: trick_mode_control, field_id, intra_slice_refresh, frequency_truncation, field_rep_cntrl.

Within the PES packet extension in System A, the following restrictions apply.

– PES_private_data_flag shall be coded as '0'.

– pack_header_field_flag shall be coded as '0'.

– program_packet_sequence_counter_flag shall be coded as '0'.

– P-STD_buffer_flag shall be coded as '0'.

#### 2.2.5.1 Video PES constraints

The following constraints are specified in System A.

Each PES packet shall begin with a video access unit, as defined in § 2.1.1 of ISO/IEC Standard 13818-1, which is aligned with the PES packet header. The first byte of a PES packet payload shall be the first byte of a video access unit. Each PES header shall contain a PTS. Additionally, it shall contain a DTS as appropriate. For terrestrial broadcast, the PES packet shall not contain more than one coded video frame, and shall be void of video picture data only when transmitted in conjunction with the discontinuity_indicator to signal that the continuity_counter may be discontinuous.

Within the PES packet header, the following restrictions apply:

– The PES_packet_length shall be coded as '0x0000'.

– data_alignment_indicator shall be coded as '1'.

#### 2.2.5.2 Audio PES constraints

The following constraints are specified in System A.

The audio decoder may be capable of simultaneously decoding more than one elementary stream containing different program elements, and then combining the program elements into a complete program. In this case, the audio decoder may sequentially decode audio frames (or audio blocks) from each elementary stream and do the combining (mixing together) on a frame or (block) basis. In order to have the audio from the two elementary streams reproduced in exact sample synchronism, it is necessary for the original audio elementary stream encoders to have encoded the two audio program elements frame synchronously; i.e., if audio program 1 has sample 0 of frame *n* at time *t*0, then audio program 2 should also have frame *n* beginning with its sample 0 at the identical time *t*0. If the encoding is done frame synchronously, then matching audio frames should have identical values of PTS.

If PES packets from two audio services that are to be decoded simultaneously contain identical values of PTS then the corresponding encoded audio frames contained in the PES packets should be presented to the audio decoder for simultaneous synchronous decoding. If the PTS values do not match (indicating that the audio encoding was not frame synchronous) then the audio frames which are closest in time may be presented to the audio decoder for simultaneous decoding. In this case the two services may be reproduced out of sync by as much as 1/2 of a frame time (which is often satisfactory, e.g., a voice-over does not require precise timing).

The value of stream_id for System A audio shall be 1011 1101 (private_stream_1).

### 2.2.6 Services and features

#### 2.2.6.1 System/Service Information

In addition to the PSI defined in ISO/IEC Standard 13818-1 which gives information for the multiplex in which they are contained, the Service (or System) Information (SI) allows for identification of services or events for the user and can also provide information on services carried by different multiplexes and even other networks. SI data complements the PSI tables specified in ISO/IEC Standard 13818-1 by providing data to aid automatic tuning of decoders, and information intended for display to the user. SI is carried by means of descriptors that are included in PSI information tables or in tables that conform to the private section syntax defined in ISO/IEC Standard 13818-1.

The System A SI shall be generated as specified in Appendix 1 [ATSC, 1996a].

The System B SI is specified in Appendix 2 [ETSI, 1996a] and guidelines for its use are given in Appendix 2 [ETSI, 1996b].

#### 2.2.6.2 Program guide

In System A, at the option of broadcasters, the data to support an interactive program guide may be transmitted in the transport stream. If present, the master program guide data stream shall be transported in PID 0x1FFD. This PID shall be reserved exclusively for the program guide data. The program guide data shall be formatted according to the structure and syntax described in “Program Guide for Digital Television” in Appendix 1 [ATSC, 1996a]. The program guide database allows a receiver to build an on-screen display of program information and contains control information to facilitate navigation.

In System A, each program guide bit stream shall adhere to an STD model that can be described by an MPEG smoothing buffer descriptor (§ 2.6.30 in ISO/IEC Standard 13818-1) with the following constraints:

– sb_leak_rate shall be 250 (indicating a leak rate of 100 000 bit/s)

– sb_size shall be 1 024 (indicating a smoothing buffer size of 1 024 bytes).

Note that the smoothing buffer descriptor is referred to here to describe the STD model for the program guide, and does not imply that a smoothing buffer descriptor for the program guide is to be included in the PMT.

System B SI data may also be used as the basis of an Electronic Programme Guide; presentation methods are outside of the scope of the specification.

#### 2.2.6.2.1 System Information PID and Service Information PIDs

In System A, at the option of broadcasters, certain system information may be transmitted in the Transport Stream. If present, the system information data stream shall be transported in PID 0x1FFC. This PID shall be reserved exclusively for the system information. The system information shall be formatted according to the structure and syntax described in "System Information for Digital Television" in Appendix 1 [ATSC, 1996a]. Constraints applying to specific transmission media are given in that standard.

The System A standard specifies that for terrestrial broadcasting, only Network Text Messages and Virtual Channel messages shall be included and shall be subject to the following constraints.

For the Network Text Message the following constraints apply:

– The transmission_medium field shall be over-the-air.

– The table_type value shall be MNT (Map Name Table).

For the Virtual Channel message the following constraints apply:

– The transmission_medium field shall be over-the-air.

– The channel_type field shall be normal.

– Inverse Channel Maps shall not be included.

– The activation_time field in the VCT_structure shall be constrained to a value of zero, indicating that the data in the message shall be considered immediately valid (rather than at a future time).

– The transmitted VCT shall, at minimum, define access for services carried in the transport stream carrying the table itself.

System B Service Information defines eight tables that are carried in PIDs 0x10 through 0x14, inclusive. The NIT, whose internal structure is not defined in ISO/IEC Standard 13818-1 and which is defined in detail by Appendix 2 [ETSI, 1996a], is assigned the PID value 0x10. The PIDs 0x15 through 0x1F inclusive are reserved for future use by System B.

#### 2.2.6.2.2 System/Service Information STD model

In System A, the System Information bit stream shall adhere to an STD model that can be described by an MPEG smoothing buffer descriptor (§ 2.6.30 in ISO/IEC Standard 13818-1) with the following constraints:

– sb_leak_rate shall be 50 (indicating a leak rate of 20 000 bit/s).

– sb_size shall be 1 024 (indicating a smoothing buffer size of 1 024 bytes).

Note that the smoothing buffer descriptor is referred to here to describe the STD model for the system information, and does not imply that a smoothing buffer descriptor for the system information is to be included in the PMT.

In System B, the Service Information data shall obey the following constraint. 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 PID, table_id and table_id_extension and with the same or different section_number shall be 25 ms.

### 2.2.6.3 Specification of private data services

Private data provides a means of adding new ancillary services to the basic digital television service specified in the System A and System B standards. Private data may be inserted on various layers as specified in ISO/IEC Standards 13818-1 and 13818-2 and provides means for further compatible extension of services.

In System A, private data is supported in two bit stream locations.

– Private data can be transmitted within the adaptation header of transport packets (§ 2.4.3.4 and 2.4.3.5 of ISO/IEC Standard 13818-1).

– Private data can be transmitted as a separate transport stream with its own PID. The contents can be identified as being System A private by using the private_data_indicator_descriptor (§ 2.6.29 of ISO/IEC Standard 13818-1) within the PMT.

In either case, it is necessary that the standards which specify the characteristics of such private_streams be consistent with the System A Digital Television Standard. Standards for private_streams shall precisely specify the semantics of the transmitted syntax as described in the reference document.

In System B, support of private data is given by mechanisms such as:

– within the adaptation header of transport packets;

– as a separate elementary stream whose PID may be referenced by the PMT. The contents may by identified by one or more of the following: stream_type field, registration_descriptor, private_data_indicator_descriptor;

– as private sections;

– as private data within the PES packet header.

#### 2.2.6.3.1 Verification model

##### 2.2.6.3.1.1 Verification model for System A

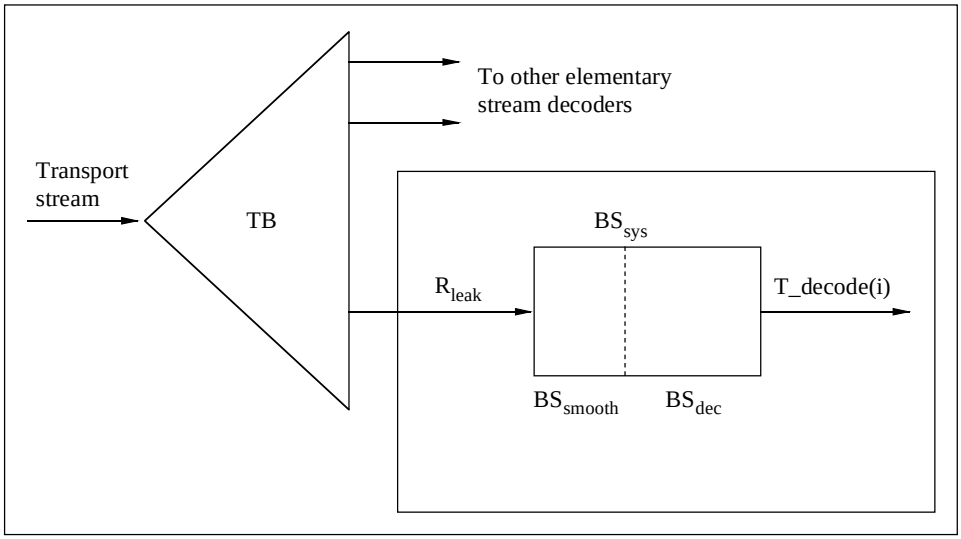
The System A standard is specified in terms of a verification model by defining the characteristics of the transmitted syntax and an idealized decoder. In ISO/IEC Standards 13818-1 and 13818-2, this is accomplished by using the system target decoder T-STD and video buffering verifier VBV models, respectively. The elements required for specification by System A are described in the following paragraphs .

The syntax and semantics of the transmitted bit stream that implements the ancillary service shall be completely and unambiguously specified. The decoding process shall also be completely and unambiguously specified.

An idealized decoder model must be precisely defined for the service. Figure 1 introduces a concrete model for pedagogic purposes. It is modelled after the T-STD.

FIGURE 1

**Ancillary service target decoder**

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The salient features of the model are the size of the transport demultiplexing buffer (TB), the minimum transfer rate out of the transport demultiplex buffer ($R_{leak}$), the required System buffering ($BS_{sys}$), and optionally the partitioning of $BS_{sys}$ between the smoothing portion and the decoder portion. The decoding process, represented as the decoding times T_decode(i), must be completely specified. The behaviour of the $BS_{sys}$ buffer must be completely modelled with respect to its input process and its output process. Certain parameters of the service such as bit rate, etc., should also be specified.

#### 2.2.6.3.1.2 Verification model for System B

The System B standard uses the verification model characterising an idealized decoder, as specified in § 2.4 of ISO/IEC Standard 13818-1 for video, audio and PSI data. For the data streams defined in System B, the models are given by the following specifications:

– § 5.1.4 of Appendix 2 [ETSI, 1996a] for Service Information,

– § 5 Appendix 2 [ETSI, 1995a] for Teletext,

– § 6 of Appendix 2 [ETSI, 1997] for Subtitling Systems.

### 2.2.6.3.2 Stream type and PMT descriptors

A new ancillary service shall be described as a program or elementary stream through documented PSI.

#### 2.2.6.3.2.1 Stream type

Several identifiers that are part of the transport section of the System A Digital Television Standard may be used to identify either the signal or constituent parts thereof; however, the fundamental identifier is the User Private stream type. The stream_type codes shall be unambiguously assigned within the range 0x80 to 0xAF. 0x81 has already been assigned within the Digital Television Standard.

No user private stream type codes are assigned by System B.

#### 2.2.6.3.2.2 PMT descriptors

The Ancillary Service specification shall include all pertinent descriptors that are found within the PMT. Specifically, it is recommended that either the private_stream_identifier or the registration_descriptor, or both, be included. Although this is not required for a stream with a unique stream_type code within the System A standard, it will enhance interoperability in the case where the stream is stored outside the standard, or transmitted in some other network that has its own set of stream_type codes.

System B specifies use of descriptors defined in ISO/IEC Standard 13818-1 as follows:

| | |
|---|---|
| video_stream_descriptor: | shall be used to indicate video streams containing still picture data, or streams which do not comply with the constraints of Main Profile at Main Level. |
| audio_stream_descriptor: | shall be used to indicate audio streams with sampling frequencies of 16, 22.05, or 24 kHz. |
| hierarchy_descriptor: | shall be used to indicate video or audio streams coded as more than one hierarchical layer. |
| target_background_grid_descriptor: | shall be used to indicate target background grids of other than 720 × 576 pixels. |
| CA_descriptor: | shall be encoded as described in Appendix 2 [ETSI, 1995b and 1996c]. |
| ISO_639_language_descriptor: | shall be present if more than one audio (or video) stream with different languages are present within a program. |

## 2.2.7 Assignment of identifiers

In this section, those identifiers and codes which shall have a fixed value are summarized.

### 2.2.7.1 Transport Stream Packet Identifiers

For System A, PID 0x1FFC is used to carry SI (Appendix 1 [ATSC, 1996b]) and PID 0x1FFD is reserved for the Master Program Guide (Appendix 1 [ATSC, 1996a]).

For System B, PIDs 0x10 through 0x14 are used by SI (Appendix 2 [ETSI, 1996a]) and PIDs 0x15 through 0x1F are reserved for future extensions to System B.

#### 2.2.7.2 Stream type

In System A, the stream_type code for streams carrying System A audio shall be value 0x81. The stream_type code for streams carrying Program Identifier tables shall be value 0x85 (see Appendix 1 [ATSC, 1996c]).

In System B, no stream_type codes have been assigned.

#### 2.2.7.3 Descriptors

##### 2.2.7.3.1 System A audio descriptor

In System A Digital Television Standard the audio descriptor shall be included in the TS_program_map_section. The syntax is given in Table 2 of Annex A of System A Standard in Appendix 1 [ATSC, 1995a]. There are the following constraints on the System A audio descriptor:

– The value of the descriptor_tag shall be 0x81.

– If textlen exists, it shall have a value of '0x00'.

##### 2.2.7.3.2 Program smoothing buffer descriptor

In System A, the PMT of each program shall contain a smoothing buffer descriptor pertaining to that program in accordance with § 2.6.30 of ISO/IEC Standard 13818-1. During the continuous existence of a program, the value of the elements of the smoothing buffer descriptor shall not change.

The fields of the smoothing buffer descriptor shall meet the following constraints:

– The field sb_leak_rate shall be allowed to range up to the maximum transport rates specified in § 7.2 in Appendix 1 [ATSC, 1995b].

– The field sb_size shall have a value less than or equal to 2 048. The size of the smoothing buffer is thus ≤ 2 048 bytes.

Inclusion of the program smoothing buffer descriptor in the PMT at the encoding stage and the usage of this information in the decoder is optional for System B compliant services.

##### 2.2.7.3.3 Descriptor tag values

Table 2 identifies descriptor_tag values in use in System A.

TABLE 2

**System A descriptor tag_use**

| Descriptor_tag | Use |
|---|---|
| 0x00-0x01 | Reserved by ISO/IEC Standard 13818-1 |
| 0x02-0x12 | Used by ISO/IEC Standard 13818-1 |
| 0x13-0x3F | Reserved by ISO/IEC Standard 13818-1 |
| 0x40-0x7F | Reserved for harmonization with System B (Appendix 2 [ETSI, 1996a]) |
| 0x80-0xAF | Reserved by System A Digital Television Standard |
| 0xB0-0xFE | User defined |
| 0xFF | Forbidden by ISO/IEC Standard 13818-1 |

Table 3 identifies descriptor tag values in use in System B.

TABLE 3

**System B descriptor tag_use**

| Descriptor_tag | Use |
|---|---|
| 0x00-0x01 | Reserved by ISO/IEC Standard 13818-1 |
| 0x02-0x12 | Used by ISO/IEC Standard 13818-1 |
| 0x13-0x3F | Reserved by ISO/IEC Standard 13818-1 |
| 0x40-0x61 | Used by System B (Appendix 2 [ETSI, 1996a]) |
| 0x62-0x7F | Reserved by System B (Appendix 2 [ETSI, 1996a]) |
| 0x80-0xFE | User defined(1) |
| 0xFF | Forbidden by ISO/IEC Standard 13818-1 |

(1) For inter-operation with System A, descriptor_tag values 0x80 to 0xAF should not be used within the PMT.

### 2.2.7.4 Table identifiers

Table 4 summarizes the allocation of table_ID in the System A Digital Television Standard system.

TABLE 4

**Table ID usage in System A**

| Table_ID | Use |
|---|---|
| 0x00-0x02 | Used by ISO/IEC Standard 13818-1 |
| 0x03-0x3F | Reserved by ISO/IEC Standard 13818-1 for future use |
| 0x40-0x7F | Reserved for harmonization with System B (Appendix 2 [ETSI, 1996a]) |
| 0x80-0xBF | User private |
| 0xC0-0xFE | Used by or reserved for future use by the System A Digital Television Standard |
| 0xFF | Reserved by ISO/IEC Standard 13818-1 for the packet-fill function |

Table 5 identifies table_ID in use in System B.

TABLE 5

**Table ID usage in System B**

| Table_ID | Use |
|---|---|
| 0x00-0x02 | Used by ISO/IEC Standard 13818-1 |
| 0x03-0x3F | Reserved by ISO/IEC Standard 13818-1 for future use |
| 0x40-0x73 | Used by System B (Appendix 2 [ETSI, 1996a]) |
| 0x74-0x7F | Reserved by System B (Appendix 2 [ETSI, 1996a]) for future use |
| 0x80-0x8F | Used by System B (Appendix 2 [ETSI, 1996c]) for CA message sections |
| 0x90-0xFE | User defined(1) |
| 0xFF | Reserved by ISO/IEC Standard 13818-1 for the packet-fill function |

(1) For inter-operation with System A, table_id values 0xC0 to 0xFE should not be used on PIDs carrying PMTs.

### 2.2.8 Extensions to the MPEG-2 Systems specification

This section covers extensions to the MPEG-2 Systems specification.

#### 2.2.8.1 Scrambling control

The scrambling control field within the packet header allows all states to exist in the System A Digital Television Standard as defined in Table 6.

TABLE 6

**Transport scrambling control field**

| Transport_scrambling_control | Function |
|---|---|
| 00 | Packet payload not scrambled |
| 01 | Not scrambled; state may be used as a flag for private use defined by the service provider. |
| 10 | Packet payload scrambled with “even” key |
| 11 | Packet payload scrambled with “odd” key |

Elementary Streams for which the transport_scrambling_control field does not exclusively have the value of '00' for the duration of the program, must carry a CA_descriptor in accordance with § 2.6.16 of ISO/IEC Standard 13818-1.

The implementation of a digital television delivery system that employs conditional access will require the specification of additional data streams and system constraints.

In System B, scrambling may occur at the Transport Stream or PES level. The transport_scrambling_control field shall be encoded as defined in Table 7. The PES_scrambling_control field shall be encoded as defined in Table 8.

TABLE 7

**Transport Stream scrambling control field for System B**

| Transport_scrambling_control | Function |
|---|---|
| 00 | Packet payload not scrambled |
| 01 | Reserved for future System B use |
| 10 | Transport packet payload scrambled with “even” key |
| 11 | Transport packet payload scrambled with “odd” key |

TABLE 8

**PES scrambling control field for System B**

| PES_scrambling_control | Function |
|---|---|
| 00 | Packet payload not scrambled |
| 01 | Reserved for future System B use |
| 10 | PES packet payload scrambled with “even” key |
| 11 | PES packet payload scrambled with “odd” key |

Transport or elementary streams for which the scrambling_control_field does not exclusively have the value of '00' for the duration of the program, must carry a CA_descriptor in accordance with Section 2.6.16 of ISO/IEC 13818-1. The contents of Transport Stream Packets containing conditional access information follow the format for CA message sections specified in Appendix 2 [ETSI, 1996a].

#### 2.2.8.2 Program/Episode/Version Identification

In System A, the Program/Episode/Version Identification (Program Identifier) standard referenced in Appendix 1 [ATSC, 1996c] provides a means of uniquely defining a program, episode, version, and source within the MPEG-2 syntax. The standard provides for a program identifier data packet that may be inserted into the Transport Stream. A PID is assigned to the program identifier data packets that appear in the Transport Stream for each program. This PID is identified in the PMT. The program identifier packet contents may vary to allow specific identification of the separate component works (e.g. programs, commercials, and materials of a promotional nature) that make up the program.

It is believed that this packet can also be conveyed in a System B stream.

### 2.3 Features of ISO/IEC Standard 13818-1 not supported by the System A and the System B standards

The transport definition is based on the MPEG-2 Systems standard, ISO/IEC Standard 13818-1; however, it does not implement all parts of the standard. This section describes those elements which are omitted from System A and System B standards.

#### 2.3.1 Program streams

The System A and System B standards for transmission in broadcast applications do not include those portions of ISO/IEC Standard 13818-1 which relate exclusively to Program Stream specifications.

#### 2.3.2 Still pictures

The System A standard does not include those portions of ISO/IEC Standard 13818-1 Transport Stream specification which relate to the Still Picture model.

ANNEX 1

## Service access methods

## 1 Introduction

In DTTB, one digital multiplex may carry several television services, each comprised of a video component, one or more audio components, and optionally other components as well, including ancillary data. A standardized method is necessary to enable receiving equipment to locate the service of interest and the components of interest in that service, and to enable it to create for the user a suitable navigation environment for friendly access to the digital services available.

Digital transports for DTTB shall include PSI in accordance with § 2.4.4 of ISO/IEC Standard 13818-1 (MPEG-2 Systems) as the standard method to facilitate service access.

## 2 MPEG-2 program specific information

As originally defined in ISO/IEC Standard 13818-1, PSI consists of four types of tables, PAT, PMT, NIT, and the Conditional Access Table (CAT).

An amendment to ISO/IEC Standard 13818-1 has added an additional table, the Transport Stream Description Table (TSDT).

### 2.1 Program Association Table (PAT)

The PAT provides the correspondence between a program_number and the PID value of the Transport Stream packets which carry the program definition (PMT).

Value 0x0000 for program_number is a special case, and indicates that the associated PID shall be the Network PID. The Network PID carries data that defines physical network parameters such as carrier frequencies, modulation methods, etc. The definition of the Network PID is outside the scope of the ISO/IEC Standard 13818-1 specification.

For Transport Streams in which only System B SI is present, program_number 0x0000 may be specified; if specified, the value of the associated PID shall be 0x0010. For Transport Streams in which only System A SI is present, program_number 0x0000 may be specified; if specified, the value of the associated PID shall be 0x1FFC.

For Transport Streams in which both System B and System A SI are present, value 0x0000 for program_number shall not be specified in the PAT.

### 2.2 Program Map Table (PMT)

The PMT specifies the types of elementary components that make up the service and the PID in the Transport Stream that carries them. The PMT provides a method for inclusion of descriptors, at both the level of the service and of each individual component.

### 2.3 Network information

The PAT may reference the Network PID, which carries data whose definition and structure is outside the scope of the MPEG-2 Systems specification.

### 2.4 Conditional Access Table (CAT)

To support the needs of access control, the CAT associates one or more private Entitlement Management Message streams each with a unique PID value.

### 2.5 Transport Stream Description Table (TSDT)

The TSDT is defined to contain data which may indicate the method for including private data in the Transport Stream, or to carry descriptors whose scope includes all services carried in the Transport Stream. ISO/IEC Standard 13818-1 compliant bitstreams are not mandatorily required to carry the TSDT. ISO/IEC Standard 13818-1 compliant decoders are not mandatorily required to decode the data carried in the TSDT.

## 3 System/Service Information (SI)

The SI is included within an MPEG-2 Transport Stream to assist the user in selection of services and/or events within the digital multiplex, and so that the receiver can automatically configure itself for the selected service. Information carried within SI includes descriptions of services both within the Transport Stream carrying the SI and of services on other multiplexes that may be available in the system. In general, SI augments and extends the relevant PSI specified in ISO/IEC Standard 13818-1 (MPEG-2 Systems), PAT and PMT.

The PAT may reference the Network PID through definition of a program_number 0x0000. The definition and structure of tables carried in the Network PID is outside the scope of the MPEG-2 Systems specification. Two standards are in current use which define Network data. In the System A Digital Television standard, System Information for United States terrestrial broadcast is standardized (Appendix 1 [ATSC, 1996a]). In the System B digital television standard, the specification (Appendix 2 [ETSI, 1996a]) provides the definition of Service Information for various transmission media including cable, satellite, and terrestrial broadcast.

### 3.1 System A system information and program guide

System A Digital Television Standard (Appendix 1 [ATSC, 1995b]) specifies that the Network data is carried in PID 0x1FFC. Two tables are defined for broadcast applications, the Virtual Channel Table (VCT) and the Map Name Table (MNT). In addition, a Defined Channels Map (DCM) may be transmitted.

System A specification (Appendix 1 [ATSC, 1996b]) specifies that the Master Program Guide (MPG) is carried in PID 0x1FFD. The specification defines a program guide database. The MPG may reference other guides carried in other PID streams, or on other transport multiplexes.

## 3.2 System B service information

System B standard (Appendix 2 [ETSI, 1996a]) specifies a number of tables, carried in several pre-assigned PID values. Tables include the NIT, the Service Description Table (SDT), the Event Information Table (EIT), the Time Offset Table (TOT), the Running Status Table (RST), the Time and Date Table (TDT), and the Bouquet Association Table (BAT).

## 3.3 Compatible carriage of System A and System B SI

ITU-R recognizes that, due to differing functional requirements, the methods for conveying SI for DTTB will vary to some degree world-wide. The exchange of programming from various sources will continue to be necessary, placing special demands on the transport layer. Harmonization of SI standards simplify such exchanges and facilitate equipment inter-operability.

Harmonization of System A and System B SI involves:

– reservation of certain user-private PID values in each standard;

– compatible allocation of table_ID values;

– compatible allocation of descriptor tag values;

– compatible allocation of stream_type values; and

– compatible rules for use of MPEG-defined descriptors.

### 3.3.1 Transport Stream (TS) descriptors

ISO/IEC has defined the TS_description_section (table_ID 0x03) to carry Transport Stream descriptors in PID 0x0002.

When the TS carries both System A and System B SI, the TS_description_section may be included to indicate that fact. If included, it shall appear in PID 0x0002, and it shall carry an ISO/IEC registration_descriptor formatted as shown in Table 9.

TABLE 9

**ITU-R registration descriptor**

| Syntax | No. of bits | Mnemonic | Value |
|---|---|---|---|
| ITUR_registration_descriptor(){ | | | |
| descriptor_tag | 8 | uimsbf | 0x05 |
| descriptor_length | 8 | uimsbf | 0x0A |
| format_identifier | 32 | uimsbf | |
| recommendation_number | 32 | uimsbf | |
| System_A_SI_present | 1 | bslbf | |
| System_B_SI_present | 1 | bslbf | |
| reserved | 14 | bslbf | |
| } | | | |

descriptor_tag: an 8-bit field that identifies the type of descriptor. For the registration_descriptor the value is 0x05.

descriptor_length: an 8-bit count of the number of bytes following the descriptor_length itself, in this case 10 bytes.

format_identifier: a 32-bit value that unambiguously identifies the standard body supplying the descriptor. For the purposes of associating the TS with this ITU-R Recommendation, the value of the format identifier shall be determined at a later time.

recommendation_number: a 32-bit field that associates the TS with this ITU-R Recommendation number. The value shall be determined at a later time.

System_A_SI_present: a binary flag that indicates, when set, that the TS carries SI in accordance with System A specification (Appendix 1 [ATSC, 1996a]). When the flag is clear, System A SI is not present.

System_B_SI_present: a binary flag that indicates, when set, that the TS carries SI in accordance with System B specification (Appendix 2 [ETSI, 1996a]). When the flag is clear, System B SI is not present.

### 3.3.2 Reservation of PID values

Certain PID values in the "user private" range of each of the SI specifications must be reserved to achieve harmonious carriage of both. To this end:

0x0000 through 0x000F: are reserved by MPEG.

0x0010 through 0x001F: are reserved for carriage of System B SI (Appendix 2 [ETSI, 1996a]). System A (Appendix 1 [ATSC, 1995b]) allows these PID values to be used for PMT and elementary stream components. Applying this restriction to the program paradigm defined in § 5.3 of Annex C of the System A specification (Appendix 1 [ATSC, 1995b]), program number 1 shall not be used. The valid range for program numbers shall be 2 through 255.

0x1FFC: is reserved for carriage of System A SI.

0x1FFD: is reserved for the System A MPG.

### 3.3.3 Allocation of table ID values

Strictly speaking, the scope of one table_ID does not extend beyond the PID that carries the table. To reduce confusion, however, it is very desirable that table_ID values in use in non-private PID streams do not overlap. Therefore, table_ID values shall be allocated as follows.

0x00 through 0x3F: are reserved by MPEG.

0x40 through 0x7F: are reserved for System B SI and extensions to the standard. This range of table_ID values falls into the System A "user private" range.

0x80 through 0xBF: are available for user private tables without conflict with either SI standard.

0xC0 through 0xFE: are reserved for System A SI and extensions to that standard. This range of table_ID values falls into the System B "user private" range.

### 3.3.4 Allocation of descriptor tag values

Descriptor tag values shall be allocated as follows:

0x00 through 0x3F: are reserved by MPEG.

0x40 through 0x7F: are reserved for System B SI and extensions to the standard.

0x80 through 0xAF: are reserved for System A SI and extensions to that standard.

0xB0 through 0xFE: are available for user private descriptor tags without conflicting with either standard

Note that System A specification (Appendix 1 [ATSC, 1996a]) does not define descriptors as part of the normative standard. Informative Annex A in System A specification (Appendix 1 [ATSC, 1996a]) indicates that descriptor tags in the range 0x40 through 0xAF are reserved for use by future normative extensions to the System A standard. It is recommended that these extensions take into account potential conflict with System B and define new descriptors in the range 0x80 through 0xAF only.

### 3.3.5 Allocation of stream type values

The stream_type field is present in the PMT to specify the type of program element carried within the packets identified in the associated elementary_PID field. Stream type values shall be allocated as follows:

0x00 through 0x7F: are reserved by MPEG.

0x80 through 0xAF: are reserved for System A and extensions to the standard (see Annex A, § 5 in Appendix 1 [ATSC, 1996a]).

0xB0 through 0xBF: may be used by System B SI and extensions to that standard.

0xC0 through 0xFF: are available for user private stream types without conflict with either standard.

### 3.3.6 Rules for use of descriptors in the PMT

Given that the PMT is a structure that would be processed in common between equipment conforming to the two SI standards, certain compatibility considerations arise.

#### 3.3.6.1 MPEG-2 registration descriptors

System A specifies that an MPEG-2 registration_descriptor shall appear in the PMT at the service level to identify a service as compliant with the System A standard. The format_identifier field for this application is specified as 0x474A 3934.

System A further specifies that a registration_descriptor is required in conjunction with audio elementary streams in the PMT. The format_identifier field in this case is 0x4143 2D33.

#### 3.3.6.2 ISO 639 language descriptor

System B allows use of both ISO 639.2/B and /T language codes. For compatibility with future standards derived from the System A specification (Appendix 1 [ATSC, 1995b and 1996a]), it is recommended that only ISO 639.2/B codes be used. It is further recommended that all audio Elementary Streams in the PMT include an associated ISO_639_language_descriptor.

#### 3.3.6.3 Smoothing buffer descriptor

System A specification specifies that the PMT of each program shall include an MPEG-2 smoothing_buffer_descriptor in accordance with ISO/IEC Standard 13818-1 § 2.6.30. For compatibility with System A, therefore, Transport Streams compliant with dual SI must include a smoothing_buffer_descriptor in the PMT of each program.

#### 3.3.6.4 Other MPEG-defined descriptors

Other MPEG-defined descriptors may appear in the PMT without restriction. Their function and use is specified in ISO/IEC Standard 13818-1.

#### 3.3.6.5 System B SI-defined descriptors

The following System B-defined descriptors may be present in the PMT and may be ignored by equipment processing the TS according to the System A standard: the mosaic_descriptor (tag value 0x51), the stream_identifier_descriptor (tag value 0x52), the teletext_descriptor (tag value 0x56), the subtitling_descriptor (tag value 0x59), and the service_move_descriptor (tag value 0x60).

#### 3.3.6.6 System A-defined descriptors

The System A Digital Television Standard defines one descriptor, the audio_stream_descriptor, tag value 0x81 (see System A specification (Appendix 1 [ATSC, 1995a])). The audio_stream_descriptor may be present in the PMT and may be ignored by equipment not supporting the System A audio standard. Note that inclusion of a registration_descriptor for System A audio in the PMT is optional in System A specification (Appendix 1 [ATSC, 1995a]).

Annex A of System A specification (Appendix 1 [ATSC, 1996a]) (informative) indicates that descriptor tag values in the range 0x40 through 0xAF are reserved for future extensions to the System A standard. These extensions should avoid the range of tag values reserved for System B, therefore these extensions should use tags in the range 0x80 through 0xAF (0x81 already having been used).

APPENDIX 1

## System A Standard

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APPENDIX 2

## System B Standard

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