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Information technology — Generic coding of moving pictures and associated audio information —

Part 6:
Extensions for DSM-CC

AMENDMENT 3: Transport buffer model in support of synchronized user-to-network download protocol

Technologies de l'information — Codage générique des images animées et des informations sonores associées —

Partie 6: Extensions pour DSM-CC

AMENDEMENT 3: Modèle de tampon de transport en support du protocole de chargement utilisateur-réseau synchronisé

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Foreword

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Amendment 3 to International Standard ISO/IEC 13818-6:1998 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Information technology — Generic coding of moving pictures and associated audio information — Part 6: Extensions for DSM-CC

AMENDMENT 3: Transport buffer model in support of synchronized user-to-network download protocol

Add the following new subclause:

9.2.9 T-STD buffer model for synchronized download protocol

9.2.9.1 Introduction

The MPEG-2 Transport System Target Decoder (T-STD) buffer model is defined for the Synchronized Download protocol. The buffer model includes a secondary multiplexing stage based on the table_id_extension field of the DSM-CC section structure. The secondary multiplexing stage allows multiple data modules of a single program element to be independently synchronized.

A secondary channel is referenced as a data module channel. The table_id_extension field conveys a copy of the moduleId of the data module. Each data module channel is identified by the moduleId value shared by all data modules conveyed in this data module channel.

The primary, conventional multiplexing stage uses the MPEG-2 Transport Stream packet's PID value to forward the packet payloads to their respective smoothing buffer. The payloads of the Transport Stream packets are all portions of DSM-CC sections of a program element of stream_type value 0x14. The DSM-CC sections convey Download Control messages or Download Data messages. Download control messages are conveyed in sections with table_id value 0x3B while Download Data messages are conveyed in sections with table_id value 0x3C. The section_number field identifies the block number of the data module conveyed in the section. The payloads of the DSM-CC section sharing the same table_id, table_id_extension and version_number field values are re-assembled in-order in the receiver to reconstruct the synchronized data modules.

9.2.9.2 Definitions

Table 9-7 below defines the DSM-CC section payload as the bytes between the section header bytes and the CRC32 or checksum bytes at the end of the section. The concept of DSM-CC section payload is used in the definition of the T-STD for the Synchronized Download protocol.

Table 9-7 DSM-CC Section Format

Syntax	No. of bits	Mnemonic
DSMCC_section(){		
table_id	**8**	**uimsbf**
section_syntax_indicator	**1**	**bslbf**
complement_indicator	**1**	**bslbf**
reserved	**2**	**bslbf**
section_length	**12**	**uimsbf**
table_id_extension	**16**	**uimsbf**
reserved	**2**	**bslbf**
version_number	**5**	**uimsbf**
current_next_indicator	**1**	**bslbf**
section_number	**8**	**uimsbf**
last_section_number	**8**	**uimsbf**
DSM-CC section payload		
if(section_syntax_indicator == '0') {		
checksum	**32**	**uimsbf**
}		
else {		
CRC_32	**32**	**rpchof**
}		
}		

DSM-CC section header bytes shall correspond to the first 8 bytes of the DSM-CC section (from the table_id field to the last_section_number field included) and the last 4 bytes of the section (checksum or CRC_32 field). The section payload bytes are the bytes starting immediately following the last_section_number field and up to the field immediately preceding the checksum or CRC_32 field.

A DSM-CC section payload includes a Download message header and a Download message. In the case of a Download Control message (table_id 0x3B), the message header is a dsmccMessageHeader structure. In the case of a Download Data message (table_id 0x3C), the message header is a dsmccDownloadDataHeader structure and the Download message is a DownloadDataBlock message. The payload of a DownloadDataBlock message shall be referenced as the Download data message payload. The payload of the DownloadDataBlock message shall not include the moduleId, moduleVersion, reserved and blockNumber fields at the beginning of the message. The Download Data Message payload represents a portion of a synchronized data module.

9.2.9.3 Data module channels

The secondary multiplexing/de-multiplexing stage operates on the table_id_extension fields of DSM-CC sections with table_id value 0x3C. DSM-CC sections conveying other messages (like the DownloadInfoIndication message) may be conveyed in the same program element. It is only in the case of table_id equal to 0x3C that the table_id_extension field values are used to identify the data module channels.

The Transport System Target Decoder buffer model for synchronized data elementary streams includes a Transport Buffer, a Smoothing Buffer and a Data Module Buffer. The purpose of the Data Module buffer is to allow for the re-assembly of the synchronized data modules before they are decoded and presented in the receiver.

9.2.9.4 Transport system target decoder buffer model

Complete Transport Stream packets containing data from program element n of stream_type 0x14 are passed to the transport buffer for program element n, TBn. The size of TBn is fixed and equal to 512 bytes. This includes duplicate Transport Stream packets and packets with no payloads. Transfer of any data from the System Target Decoder input to TBn is considered instantaneous. All data that enter TBn are removed from TBn at a rate RXn. When there are no data in TBn, the rate RXn is equal to 0.

Bytes that are part of a DSM-CC section are delivered to the Smoothing buffer SBn. Other bytes are not and may be used to control the system. Duplicate Transport Stream packets are not delivered to SBn. All bytes enter SBn

instantaneously upon leaving the buffer TBn. All bytes that enter the smoothing buffer SBn leave the smoothing buffer SBn.

The data module stream bytes in buffer SBn are all delivered to their associated data module buffer at the rate sb_leak_n. The value of sb_leak_n is either defined implicitly or listed explicitly in the ISO/IEC 13818-1 smoothing_buffer_descriptor. The value of the leak rate may follow the classification specified in Table 7-13 of Section 7.5.5 of this specification. The size of SBn, SBSn, is implicitly declared or listed explicitly in the ISO/IEC 13818-1 smoothing_buffer_descriptor. Only synchronized data module data bytes (bytes of a Download data message payload) in data module k of program element n enter the data module buffer DMBnk. If there is DSM-CC section data in SBn and buffer DMBnk is not full, the data is transferred from SBn to DMBnk at a rate defined by sb_leak_n. When there is no DSM-CC section data in SBn, no data is removed from SBn. Bytes from a DSM-CC section header are removed instantaneously and discarded and may be used to control the system. Bytes from a DSM-CC section CRC_32 field or checksum field that immediately follow the last data module byte in the DSM-CC section payload are removed instantaneously and discarded and may be used to verify the integrity of the data. Bytes from the dsmccDownloadDataHeader message header and the first 6 bytes of the DownloadDataBlock message (representing the moduleId, moduleVersion, reserved and blockNumber fields of the message) are discarded and may be used to control the system. Bytes from the payload of a DSM-CC section with a table_id value other than 0x3C are taken out of buffer SBn at rate sb_leak_n. These bytes are subsequently discarded and may be used to control the system. All bytes that enter the smoothing buffer SBn leave it. All data module bytes of data module stream n enter the data module de-multiplexer instantaneously upon leaving SBn.

The size of the buffer DMBnk is DMBSnk. The value of DMBSnk shall be at least equal to the largest size that synchronized module k can take in program element n. In buffer DMBnk, the synchronized data modules shall be reconstructed from the in-order concatenation of the DownloadDataBlock data message payloads as indicated by the section_number field of the DSM-CC section headers. The DSM-CC sections conveying a synchronized data module are identified by unique table_id, table_id_extension and version_number values.

For the Data Elementary Buffer DMBnk, all data for the data module that has been in the buffer longest are removed instantaneously at time td_nk. The Decoding time td_nk may be specified by the Presentation Time Stamp located in the adaptation field of the dsmccDownloadDataMessageHeader in the first section (section_number 0x00) conveying the synchronized data module and a Data Module Decode Time (DMDT) common to all data modules in the program element n. The value of DMDT may be signaled in the MPEG-2 Transport Stream (e.g., in the moduleInfoBytes in the DowloadInfoIndication message). Alternatively, the value of td_nk may be equal to the PTS of the previous data module in the data module channel when the value of DMDT is not specified. The presentation data unit resulting from decoding the data module is presented at the instant specified by the PTS field associated with the synchronized data module.

Buffer TBn shall not overflow. Buffer SBn shall not overflow. Buffer DMBnk shall not overflow nor underflow. Underflow of DMBnk occurs when one or more bits of the data module is not present in DMBnk at the Data Module Decode Time associated with the data module.

In the example shown in Figure 9-1 below, three synchronized or synchronous data elementary streams, nk, nj and nh, multiplexed within the same program element referenced by PID value 0x0FDA. To the right of the smoothing buffer SBn, a secondary de-multiplexing operates on the table_id_extension field to route the data module bytes to their respective data module channels. A collection of synchronized data streams is conveyed in MPEG sections where table_id is equal to 0x3C and table_id_extension is equal to 0xABCD, 0x9876 and 0x1122. Each value of the table_id_extension field identifies the secondary channel on which a data elementary sub-stream is being conveyed.

Figure 9-1 also shows three synchronized or synchronous data elementary streams mk, mj and mh multiplexed in the MPEG-2 program element referenced by PID value 0x1753 and in MPEG sections with table_id field value equal to 0x3C.

The following notation is used in Figure 9-1:

TB_n	is the transport buffer.
SB_n	is the smoothing buffer for program element n.
DMB_{nk}	is the data module buffer for data module channel k of program element n.
Rx_n	is the rate at which data is removed from TB_n.
sb_leak_n	is the rate at which data is removed from SB_n.
$A_{nk}(j)$	is the j^{th} access unit for data module channel k of program element n.
$td_{nk}(j)$	is the decoding time in the system target decoder of the jth access unit in data module channel k of program element n.

$tp_{nk}(j)$ is the presentation time in the system target decoder of the jth access unit in data module channel k of program element n.

t(i) indicates the time in seconds at which the i^{th} byte of the Transport Stream enters the system target decoder.

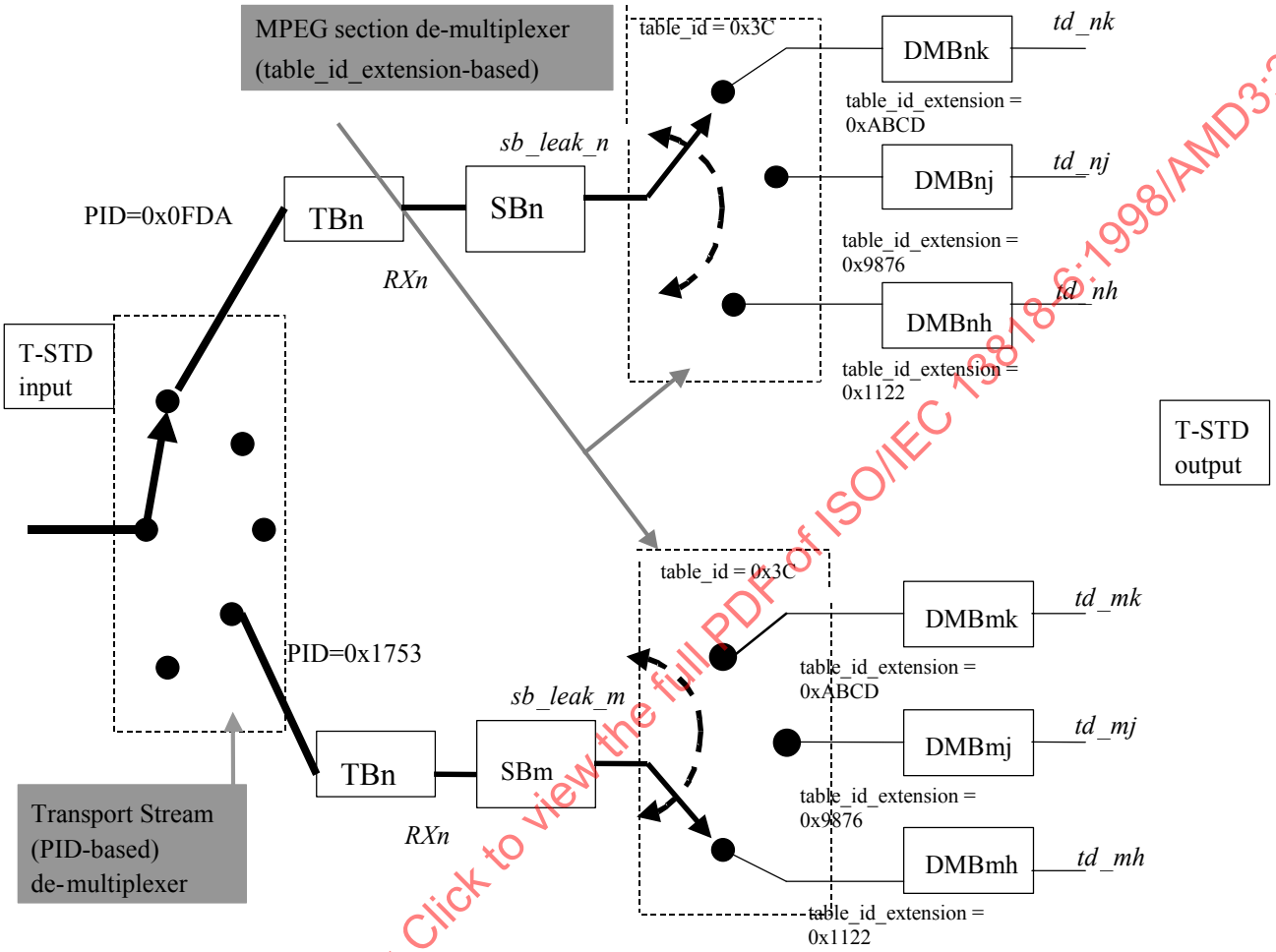

Figure 9-1 T-STD for DSM-CC Synchronized Download Protocol