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Methods for Isochronous Data Services Transport

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1.0 SCOPE

This document defines a transmission format for the carriage of isochronous data services compatible with digital multiplex bitstreams constructed in accordance with ISO/IEC 13818-1 (MPEG-2 Systems). Bit rates for the data services extend from 19.2 kbps to 9.0 Mbps.

2.0 NORMATIVE REFERENCES

2.1 The following documents contain provisions, which, through reference in this text, constitute provisions of the standard. At the time of Subcommittee approval, the editions indicated were valid. All standards are subject to revision; and while parties to any agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents may not be compatible with the referenced version.

[1] ITU-T Rec. H. 222.0 | ISO/IEC 13818-1:2007, Information Technology—Coding of moving pictures and associated audio—Part 1: Systems.

3.0 COMPLIANCE NOTATION

“SHALL”	This word or the adjective “REQUIRED” means that the item is an absolute requirement of this specification.
“SHALL NOT”	This phrase means that the item is an absolute prohibition of this specification.
“SHOULD”	This word or the adjective “RECOMMENDED” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
“SHOULD NOT”	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
“MAY”	This word or the adjective “OPTIONAL” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

4.0 ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this standard.

bps	bits per Second
bslbf	bit sequence, leftmost bit first
CRC	Cyclic Redundancy Check
DDS	Direct Digital Synthesis
Hz	Hertz
ISO	International Standards Organization
k	kilo
M	Mega
MPEG	Moving Picture Experts Group
PCR	Program Clock Reference
PES	Packetized Elementary Stream
PID	Packet Identifier
ppm	parts per million
PTS	Presentation Time Stamp
rpchof	remainder polynomial coefficients, highest order first
SI	System Information
uimsbf	unsigned integer, most significant bit first
µ	micro

5.0 ISOCHRONOUS DATA SERVICE SPECIFICATION

5.1 Isochronous Data Rate Specification

Isochronous data services support rates ranging from 19.2 kbps to 9.0 Mbps. Since the syntax is biased towards a Direct Digital Synthesis (DDS) implementation, jitter is better than T1 specifications at rates below 2 Mbps.

5.2 Syntax Conventions and Definitions

5.2.1 Methods of Describing Bitstream Syntax

The method of describing isochronous data bitstream syntax is the same as that used in IEC/ISO 13818-1. [1] The bitstream retrieved by the decoder is specified by the syntax definitions given in Section 5.3 of this standard.

As exemplified in Table 1, each data item in the bitstream appears in bold type.

Table 1 – Bitstream Data Elements and Conditions

while (condition) {	If the condition is true, then the group of data elements occurs next in the data stream. This repeats until the condition is not true.
data_element	
. . .	
}	
do {	
data_element	The data element always occurs at least once.
. . .	
} while (condition)	The data element is repeated until the condition is not true.
if (condition) {	If the condition is true, then the first group of data elements occurs next in the data stream.
data_element	
. . .	
} else {	If the condition is not true, then the second group of data elements occurs next in the data stream.
data_element	
. . .	
}	
for (i = 0; i < n; i++) {	The group of data elements occurs n times. Conditional constructs within the group of data elements may depend on the value of the loop control variable i, which is set to zero for the first occurrence, incremented to one for the second occurrence, and so forth.
data_element	
. . .	
}	
/* comment ... */	Explanatory comment that may be deleted entirely without in any way altering the syntax.

Each data item is described by its name, its length in bits, and a mnemonic for its type and order of transmission. The action caused by a decoded data element in a bitstream depends on the value of that data element and on data elements previously decoded. The constructs in normal type in the table are used to express the conditions when data elements are present.

5.2.2 Abbreviations & Symbols

The mathematical operators used to describe this specification are similar to those used in the C programming language. Numbering and counting loops generally begin from zero.

5.2.2.1 Relational Operators

>	Greater than.
>=	Greater than or equal to.
<	Less than.
<=	Less than or equal to.
==	Equal to.
!=	Not equal to.

5.2.2.2 Bitwise Operators

&	AND
|	OR

5.2.2.3 Assignment

=	Assignment operator.

5.2.2.4 Mnemonics

The following mnemonics are defined to describe the different data types used in the coded bitstream:

bslbf Bit string, left bit first, where “left” is the order in which bit strings are written in the specification. Bit strings are written as a string of 1s and 0s within single quote marks, e.g. ‘1000 0001’. Blanks within a bit string are for ease of reading and have no significance.

uimsbf Unsigned integer, most significant bit first.

5.3 Isochronous Data Bitstream Syntax

Isochronous data is carried as a Packetized Elementary Stream (PES). The PES payload, which follows the PES header specified by MPEG-2, begins with an isochronous data header, which is followed by isochronous data access units. The isochronous data header is present even when the PES header does not include a Presentation Time Stamp (PTS). Each isochronous data access unit is 16 bits (2 bytes; 1 word). Additionally, isochronous data access units are aligned with the PES syntax in that the first byte of the isochronous data header immediately follows the last byte of the PES header. Finally, isochronous data access units are aligned with transport packet payloads such that the first payload byte of an isochronous data transport packet is the first byte of an isochronous data access unit (following any adaptation, PES header, and isochronous data header fields), and the last byte of an isochronous data transport packet is the last byte of an isochronous data access unit. Stuffing bytes in the adaptation or PES header may be included to accomplish this. The syntax of isochronous data is as specified in the following paragraphs.

5.3.1 Isochronous Data Sequence

The syntax for isochronous data sequences is specified in Figure 1.

isochronous_data_sequence {	**No. of bits**	**Mnemonic**
isochronous_data_header( ) {		
for (i=0 ; i<N ; i++) {		
isochronous_data_access_unit	16	bslbf
}		
}		

Figure 1 – Isochronous Data Sequence Syntax

5.3.2 Isochronous Data Header

To constrain each isochronous data sequence to an even number of bytes, the last reserved field in the isochronous data header, if present, is required to be an even number of bytes.   The syntax for isochronous data headers is specified in Figure 2.

isochronous_data_header {	No. of bits	Mnemonic
pts_ext8	8	bslbf
data_rate_flag	1	bslbf
reserved	3	bslbf
isochronous_data_header_length	4	uimsbf (H)
if (data_rate_flag) {		
reserved	4	bslbf
increment	28	uimsbf
reserved	16*(H-2)	bslbf
} else {		
reserved	16*H	bslbf
}		
}		

Figure 2 – Isochronous Data Header Syntax

5.4 Isochronous Data Bitstream Semantics

5.4.1 Reserved Fields

reserved—Fields in this standard marked “reserved” are reserved for future use. Decoders shall disregard reserved fields for which no definition exists that is known to the unit. Fields marked “reserved” shall be set to a value of zero until such time as they are defined and supported.

5.4.2 Isochronous Data Sequence

isochronous_data_access_unit—A 16 bit access unit of isochronous data where the first (left) bit is presented (output) before the second bit, etc.

5.4.3 Isochronous Data Header

pts_ext8—An 8-bit field extending the PTS conveyed in the PES header of this PES as defined in ISO/IEC 13818-1. This field is the 8 most significant bits of the 9 bit Program Clock Reference (PCR) extension defined in ISO/IEC 13818-1 that extends the time resolution of isochronous data PTSs from the MPEG-2 standard resolution of 11.1 μseconds (90 kHz) to 74 nanoseconds (13.5 MHz) for unambiguous determination of the correct access unit presentation time referenced by an isochronous data PTS. This unambiguous determination of presentation time supports each recovery without “bit slips”.

data_rate_flag—A one bit flag which, when set to “1”, indicates that an increment field is present in the isochronous data header.

isochronous_data_header_length—A 4 bit field indicating the number of words (16 bits) of isochronous data header which follow this field including the reserved words, (units of 16 bits forces the isochronous data header to be an even number of bytes which, coupled with isochronous data access units, adaptation fields, and PES headers also being an even number of bytes, allows isochronous data transport packets to be generated without any padding bytes and thus higher efficiency)

increment—A 28 bit unsigned even integer which indicates the isochronous data clock increment value and takes on values that describe the ratio of the isochronous data rate to a 27 MHz reference. Specifically, increment is:

increment = isochronous data rate *536,868,000/system_clock_frequency

where

system_clock_frequency is specified in ISO/IEC 13818-1 as 27 MHz ± 30 ppm.

5.5 Stream Type Assignment

The stream type code for isochronous data conforming to this specification shall be 0xC2.

6.0 DECODER MODEL

The following decoder model does not specify a required architecture for the isochronous data decoder. It is used to ensure that data streams are constructed with similar minimum buffer parameters in order to ensure interoperability between devices. The model is similar to the one used in the construction of MPEG 2 streams detailed in ITU-T Rec. H. 222.0 | ISO/IEC 13818-1. [1]

The model is divided into two parts to allow less costly implementation at low bit rates. Each of the models can be described with the following diagram. Encoders should only assume the High Bit Rate Model if the data service exceeds 64 K bits per second.

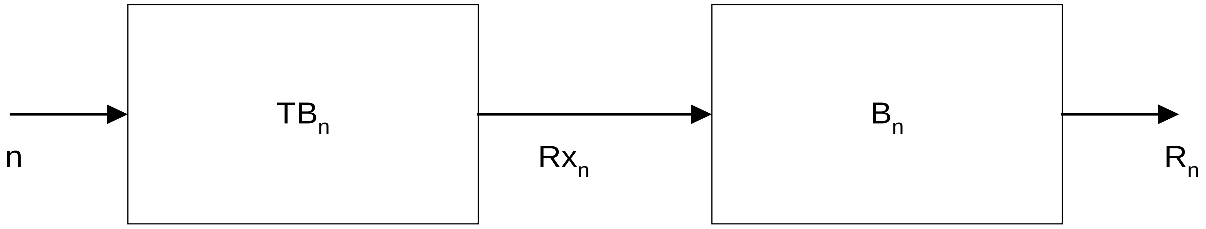

Figure 3 – Decoder Buffer Model

6.1 Low Bit Rate Model

This model is used where the data service is less than or equal to 64 K bits S-1.

Table 2 – Low Bit Rate Model

Parameter	Name	Value
n	nth stream from a transport multiplex	
TB_{low}	Transport Buffer size	512 bytes
Rx_{low}	Transport Buffer Leak Rate	10 M bits S^{-1}
B_{low}	Smoothing Buffer	1562 bytes
R_{low}	Removal Rate	as specified in service

6.2 High Bit Rate Model

This model is used where the data service is greater than 64 K bits S-1.

Table 3 – High Bit Rate Model

Parameter	Name	Value
n	nth stream from a transport multiplex	
TB_{high}	Transport Buffer size	512 bytes
Rx_{high}	Transport Buffer Leak Rate	10 M bits S^{-1}
B_{high}	Smoothing Buffer	4500 bytes
R_{high}	Removal Rate	as specified in service

6.3 Smoothing Buffer Descriptor

A smoothing buffer descriptor in the Program Map Table can be specified which allows the modification of the Rx and B parameters for future enhanced services or non-standard variations in the buffer model. Data Services that use the standard buffer models above need not include the smoothing buffer descriptor and may use the default values. However, for future compatibility the use of the descriptor is recommended.