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Digital audio –
**Interface for non-linear PCM encoded
audio bistreams applying IEC 60958 –**

**Part 5:
Non-linear PCM bitstreams according to
the DTS (Digital Theater Systems) format(s)**

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**DIGITAL AUDIO –
INTERFACE FOR NON-LINEAR PCM ENCODED
AUDIO BITSTREAMS APPLYING IEC 60958 –**

**Part 5: Non-linear PCM bitstreams according to
the DTS (Digital Theater Systems) format(s)**

FOREWORD

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International Standard IEC 61937-5 has been prepared by Technical Area 4: Digital system interfaces and protocols, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

a) References to the company name Digital Theater Systems have been changed to DTS which is consistent with the official change of the company name.

b) DTS type IV has been added to Table 1 and 5.3.4 describing type IV has been added.

c) Annex A, which provides examples of the use of the repetition period parameter introduced in subclause 5.3.4, has been added.

The text of this standard is based on the following documents:

CDV	Report on voting
100/974/CDV	100/1055/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61937 consists of the following parts, under the general title *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958:*

Part 1: General

Part 2: Burst-info

Part 3: Non-linear PCM bitstreams according to the AC-3 format

Part 4: Non-linear PCM bistreams according to the MPEG audio formats

Part 5: Non-linear PCM bitstreams according to the DTS (Digital Theater Systems) format(s)

Part 6: Non-linear PCM bitstreams according to the ATRAC, ATRAC2/3 and ATRAC-X formats

Part 8: Non-linear PCM bitstreams according to the Windows Media Audio Professional[1]

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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[1] To be published.

**DIGITAL AUDIO –
INTERFACE FOR NON-LINEAR PCM ENCODED
AUDIO BITSTREAMS APPLYING IEC 60958 –**

**Part 5: Non-linear PCM bitstreams according to
the (Digital Theater Systems) DTS format(s)**

1 Scope

This part of IEC 61937 describes audio bitstreams encoded according to the Digital Theater Systems (DTS) format data-types I, II, III, and IV.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60958-1, *Digital audio interface – Part 1: General*

IEC 60958-3, *Digital audio interface – Part 3: Consumer applications*

IEC 60958-4, *Digital audio interface – Part 4: Professional applications*

IEC 61937-1, *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 1: General*

IEC 61937-2*, Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 2: Burst Information*

3 Terms, definitions, abbreviations and presentation convention

For the purposes of this document, the following terms, definitions, abbreviations and presentation convention apply.

3.1 Definitions

**3.1.1
latency**
delay time of an external audio decoder to decode a DTS data-burst, defined as the sum of two values of the receiving delay time and the decoding delay time

3.2 Abbreviations

IEC   International Electrotechnical Commission

ISO/IEC MPEG   The Moving Pictures Expert Group, a joint committee of ISO and IEC

3.3 Presentation convention

F872h   Value 'F872' in hexadecimal format

4 Mapping of the audio bitstream on to IEC 61937-1

The coding of the bitstream and data-burst is in accordance with IEC 61937-1 and 61937-2.

4.1 DTS burst-info

The 16-bit burst-info contains information about the data which will be found in the data-burst.

Table 1 – Fields of burst-info

Bits of Pc	Value	Contents	Reference point R	Repetition period of data-burst in IEC 60958 frames
0-4		Data-type		
	0-10	According to IEC 61937		
	11	DTS type I	Bit 0 of Pa	512
	12	DTS type II	Bit 0 of Pa	1 024
	13	DTS type III	Bit 0 of Pa	2 048
	14-16	According to IEC 61937		
	17	DTS type IV		Dependent on bits 8-10
	14-31	According to IEC 61937	Bit 0 of Pa	
5, 6		Reserved		
7		According to IEC 61937		
8-10		Reserved for DTS types I, II and III		
		For the repetition period for DTS type IV, see Table 6		
11, 12		Reserved		
13-15		According to IEC 61937		

5 Format of DTS data-bursts

This clause specifies the audio data-bursts DTS type I, DTS type II, DTS type III and DTS type IV. Specific properties such as reference points, repetition period, the method of filling stream gaps, and decoding latency are specified for each data-type.

5.1 General

The decoding latency (or delay), indicated for the data-types, should be used by the transmitter to schedule data-bursts as necessary to establish synchronization between picture and decoded audio.

5.2 Pause data-burst

Pause data-burst for DTS type I, DTS type II, DTS type III and DTS type IV is given in Table 2.

Table 2 – Repetition period of the pause data-bursts

| Data-type of audio data-burst	Repetition period of pause data-burst	
	Mandatory	Recommended
DTS type I	-	3 IEC 60958 frames
DTS type II	-	3 IEC 60958 frames
DTS type III	-	3 IEC 60958 frames
DTS type IV	-	3 IEC 60958 frames

5.3 Audio data-bursts

5.3.1 DTS type I

The DTS bitstream consists of sequences of DTS frames. The data-type of a DTS data-burst type I is 0Bh. The data-burst is headed with a burst-preamble, followed by the burst-payload, and stuffed with stuffing bits. The burst-payload of each data-burst of DTS type I data shall contain one complete DTS-frame and represents 512 samples for each encoded channel.

NOTE 1 The length of the DTS type I data-burst depends on the encoded bit rate (which determines the DTS-frame length).

NOTE 2 The reference to the specification for the DTS bitstream, representing 512 samples of encoded audio per frame, is given in the bibliography.
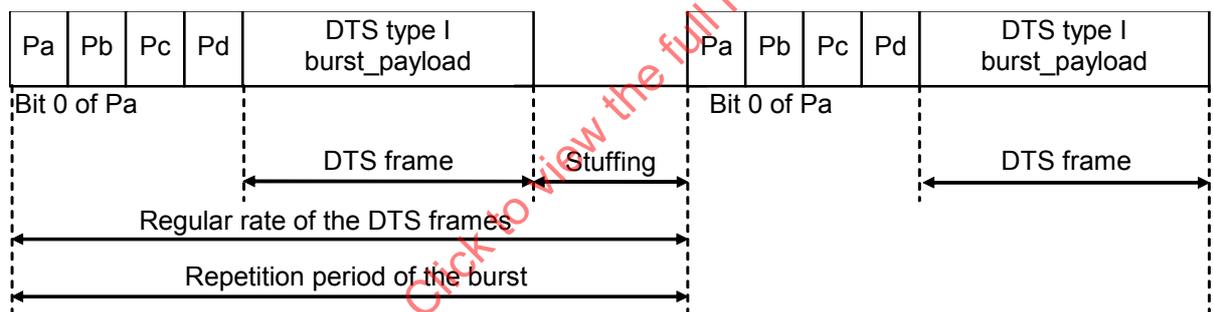
IEC   2671/05

Figure 1 – DTS type I data-burst

The data-type-dependent information for DTS type I is given in Table 3.

Table 3 – Data-type-dependent when DTS type I

Bits of Pc LSB..MSB	Value	Contents
8-12	00h	Reserved, shall be set to '0'

The reference point of a DTS type I data-burst is bit 0 of Pa and occurs exactly once every 512 sampling periods. The data-burst containing DTS type I frames occurs at a regular rate, with the reference point of each DTS type I data-burst beginning 512 IEC 60958 frames after the reference point of the preceding DTS type I data-burst (of the same bit-stream-number).

It is recommended that pause data-bursts be used to fill stream gaps in the DTS type I bitstream, as described in IEC 61937, and that pause data-bursts be transmitted with a repetition period of 3 IEC 60958 frames, except when other repetition periods are necessary to fill the precise stream gap length (which may not be a multiple of 3 IEC 60958 frames), or to meet the requirement on burst spacing (see IEC 61937).

When a stream gap in a DTS type I stream is filled by a sequence of pause data-bursts, the Pa of the first pause data-burst shall be located 512 sampling periods following the Pa of the previous DTS type I frame. It is recommended that the sequence(s) of pause data-bursts which fill the stream gap should continue from this point up to (as close as possible considering the 3 IEC 60958 frame length of the pause data-burst) the Pa of the first DTS type I data-burst which follows the stream gap.

NOTE 3   The gap-length parameter contained in the pause data-burst is intended to be interpreted by the DTS decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap).
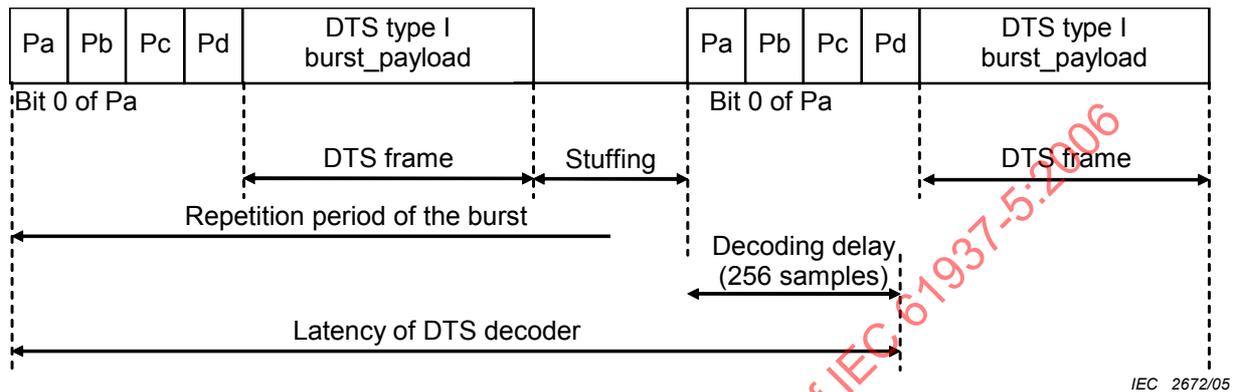

IEC   2672/05

Figure 2 – Latency of DTS type II decoding

NOTE 4   The latency of a DTS decoder is defined as a delay measured from the reference point and equal to one frame (10,67 ms) plus 5,33 ms (equivalent to 256 samples). This is 768 PCM samples or 16 ms at 48 kHz sampling frequency.

5.3.2   DTS type II

The DTS bitstream consists of sequences of DTS frames. The data-type of a DTS data-burst type II is 0Ch. The data-burst is headed with a burst-preamble, followed by the burst-payload, and stuffed with stuffing bits. The burst-payload of each data-burst of DTS type II data shall contain one complete DTS-frame and represents 1 024 samples for each encoded channel.

NOTE 1   The length of the DTS type II data-burst depends on the encoded bit rate (which determines the DTS-frame length).

NOTE 2   The reference to the specification for the DTS bitstream, representing 1 024 samples of encoded audio per frame, is given in the bibliography.
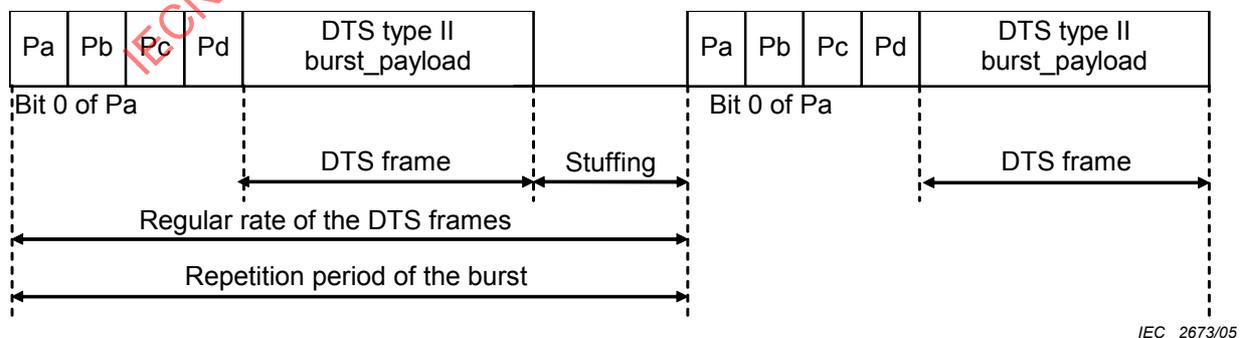

IEC   2673/05

Figure 3 – DTS type II data-burst

The data-type-dependent information for DTS type II is given in Table 4.

Table 4 – Data-type-dependent when DTS type II

Bits of Pc LSB..MSB	Value	Contents
8-12	00h	Reserved, shall be set to '0'

The reference point of a DTS type II data-burst is bit 0 of Pa and occurs exactly once every 1 024 sampling periods. The data-burst containing DTS type II frames shall occur at a regular rate, with the reference point of each DTS type II data-burst beginning 1 024 IEC 60958 frames after the reference point of the preceding DTS type II data-burst (of the same bit-stream-number).

It is recommended that pause data-bursts be used to fill stream gaps in the DTS type II bitstream, as described in IEC 61937, and that pause data-bursts be transmitted with a repetition period of 3 IEC 60958 frames, except when other repetition periods are necessary to fill the precise stream gap length (which may not be a multiple of 3 IEC 60958 frames), or to meet the requirement on burst spacing (see IEC 61937).

When a stream gap in a DTS type II stream is filled by a sequence of pause data-bursts, the Pa of the first pause data-burst shall be located 1 024 sampling periods following the Pa of the previous DTS type II frame. It is recommended that the sequence(s) of pause data-bursts which fill the stream gap should continue from this point up to (as close as possible considering the 3 IEC 60958 frame length of the pause data-burst) the Pa of the first DTS type II data-burst which follows the stream gap.

NOTE 3   The gap-length parameter contained in the pause data-burst is intended to be interpreted by the DTS decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap).
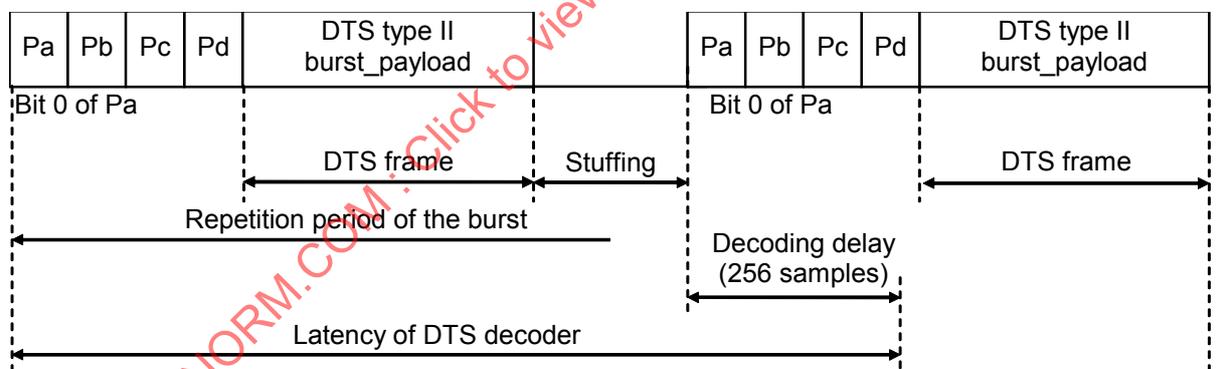
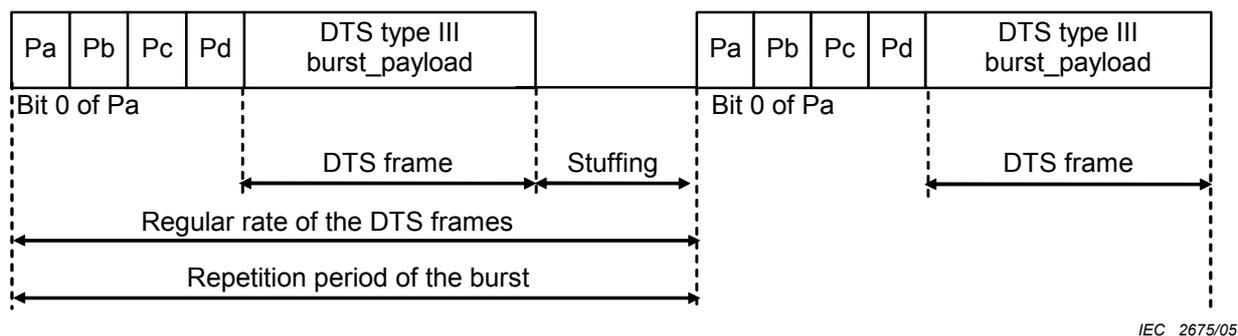**Figure 4 – Latency of DTS type II decoding**

NOTE 4   The latency of a DTS decoder is defined as a delay measured from the reference point and equal to one frame (21,34 ms) plus 5.33 ms (equivalent to 256 samples). This is 1 280 PCM samples or 26,67 ms at 48 kHz sampling frequency.

5.3.3   DTS type III

The DTS bitstream consists of sequences of DTS frames. The data-type of a DTS data-burst type III is 0Dh. The data-burst is headed with a burst-preamble, followed by the burst-payload and stuffed with stuffing bits. The burst-payload of each data-burst of DTS type III data shall contain one complete DTS-frame and represents 2 048 samples for each encoded channel.

NOTE 1   The length of the DTS type III data-burst depends on the encoded bit rate (which determines the DTS-frame length).

NOTE 2   The reference to the specification for the DTS bitstream, representing 2 048 samples of encoded audio per frame, is given in the bibliography.

| Pa | Pb | Pc | Pd | DTS type III
burst_payload | | Pa | Pb | Pc | Pd | DTS type III
burst_payload |

Bit 0 of Pa — DTS frame — Stuffing — Bit 0 of Pa — DTS frame

Regular rate of the DTS frames

Repetition period of the burst

Figure 5 – DTS type III data-burst

The data-type-dependent information for DTS type III is given in Table 5.

**Table 5 – Data-type-dependent when DTS type III**

Bits of Pc LSB..MSB	Value	Contents
8-12	00h	Reserved, shall be set to '0'

The reference point of a DTS type III data-burst is bit 0 of Pa and occurs exactly once every 2 048 sampling periods. The data-burst containing DTS type III frames shall occur at a regular rate, with the reference point of each DTS type III data-burst beginning 2 048 IEC 60958 frames after the reference point of the preceding DTS type III data-burst (of the same bit-stream-number).

It is recommended that pause data-bursts be used to fill stream gaps in the DTS type III bitstream as described in IEC 61937, and that pause data-bursts be transmitted with a repetition period of 3 IEC 60958 frames, except when other repetition periods are necessary to fill the precise stream gap length (which may not be a multiple of 3 IEC 60958 frames), or to meet the requirement on burst spacing (see IEC 61937).

When a stream gap in a DTS type III stream is filled by a sequence of pause data-bursts, the Pa of the first pause data-burst shall be located 2 048 sampling periods following the Pa of the previous DTS type III frame. It is recommended that the sequence(s) of pause data-bursts which fill the stream gap should continue from this point up to (as close as possible considering the 3 IEC 60958 frame length of the pause data-burst) the Pa of the first DTS type III data-burst which follows the stream gap.

NOTE 3 The gap-length parameter contained in the pause data-burst is intended to be interpreted by the DTS decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap).
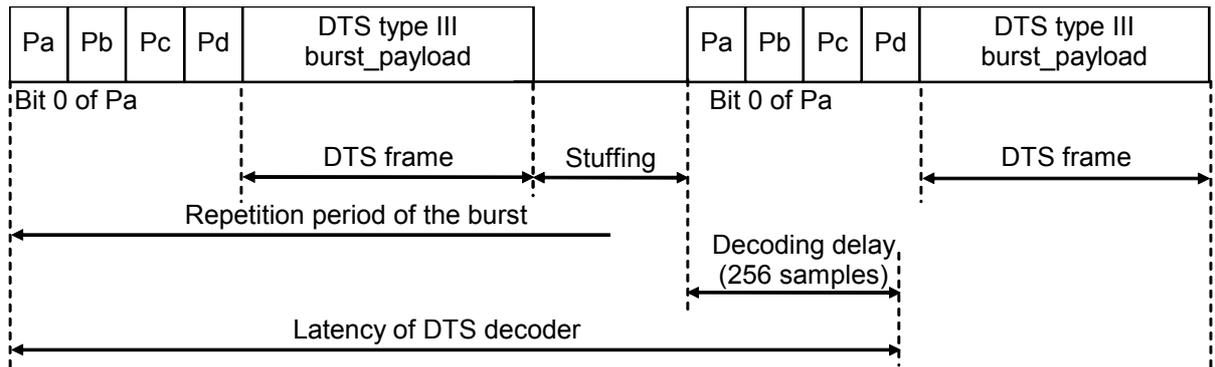
IEC 2676/05

Figure 6 – Latency of DTS type III decoding

NOTE 4   The latency of a DTS decoder is defined as a delay measured from the reference point and equal to one frame (42,67 ms) plus 5,33 ms (equivalent to 256 samples). This is 2 304 PCM samples or 48 ms at 48 kHz sampling frequency.
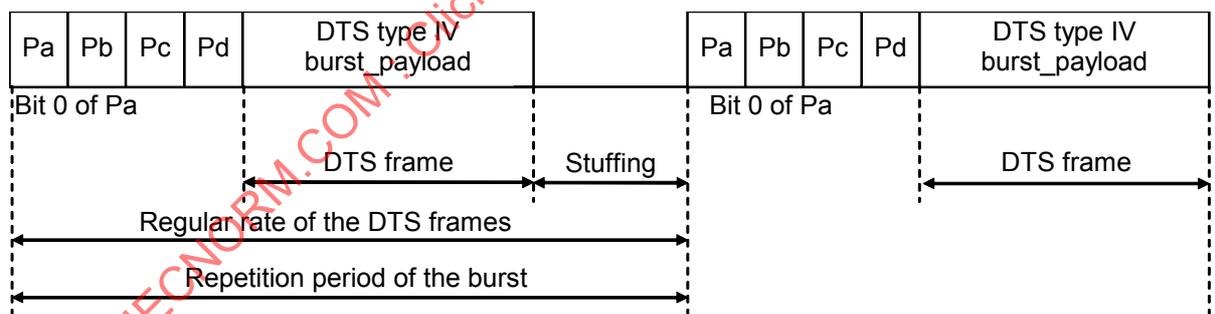
5.3.4   DTS type IV

The DTS bitstream consists of sequences of DTS frames. The data-type of a DTS data-burst type IV is 11h. The data-burst is headed with a burst-preamble, followed by the burst-payload, and stuffed with stuffing bits.

The frame duration is the period of each complete audio frame and is relative to the base sample rate. In theory, any supported base sample rate may be applied. The nominal base sample rate for DTS Type IV is 48 kHz.

NOTE 1   The length of the DTS type IV data-burst depends on the encoded bit rate and the duration of the burst.

NOTE 2   The reference to the specification for the DTS-HD bitstream is given in the bibliography.

IEC 2677/05

Figure 7 – DTS type IV data-burst

The units of **burst_length** shall be in bytes. This means the maximum size of a burst is 65 535 bytes.

The data-type-dependent information for DTS Type IV is given in Table 6.

Table 6 – Data-type-dependent when DTS type IV

Bits of Pc	Value	Meaning	
0-4	17	DTS Type IV	
5, 6		Reserved	
7		According to IEC 61937	
8-10	0	Repetition period of data-burst in IEC 60958 frames	512
	1		1 024
	2		2 048
	3		4096
	4		8 192
	5		16 384
	6		Reserved
	7		Reserved
11-12		Reserved	
13-15		According to IEC 61937	

The reference point of a DTS type IV data-burst is bit 0 of Pa. The data-burst containing DTS type IV frames shall occur at a regular rate, with the reference point of each DTS type IV data-burst beginning 1 audio frame period after the reference point of the preceding DTS type IV data-burst.

It is recommended that pause data-bursts be used to fill stream gaps in the DTS type IV bitstream as described in IEC 61937, and that pause data-bursts be transmitted with a repetition period of 3 IEC 60958 frames, except when other repetition periods are necessary to fill the precise stream gap length (which may not be a multiple of 3 IEC 60958 frames), or to meet the requirement on burst spacing (see IEC 61937).

When a stream gap in a DTS type IV stream is filled by a sequence of pause data-bursts, the Pa of the first pause data-burst shall be located one audio frame period following the Pa of the previous DTS type IV frame. It is recommended that the sequence(s) of pause data-bursts which fill the stream gap should continue from this point up to (as close as possible considering the 3 IEC 60958 frame length of the pause data-burst) the Pa of the first DTS type IV data-burst which follows the stream gap.

NOTE 3   The gap-length parameter contained in the pause data-burst is intended to be interpreted by the DTS decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap).