

# INTERNATIONAL STANDARD



**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)**



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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 33.160.60

ISBN 978-2-8322-6483-6

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## REDLINE VERSION



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## 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)

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**IEC 61937-5 edition 2.1 contains the second edition (2006-01) [documents 100/974/CDV and 100/1055/RVC] and its amendment 1 (2019-01) [documents 100/3101/CDV and 100/3163/RVC].**

**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.**

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 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.

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 bitstreams 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<sup>1</sup>

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- reconfirmed,
- withdrawn
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<sup>1</sup> 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,<br>For the Repetition period for DTS Type IV, see Table 6 |                   |                                                     |
| 11 – 12    | 0 – 3   | Reserved Profile                                                                                |                   |                                                     |
| 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 |

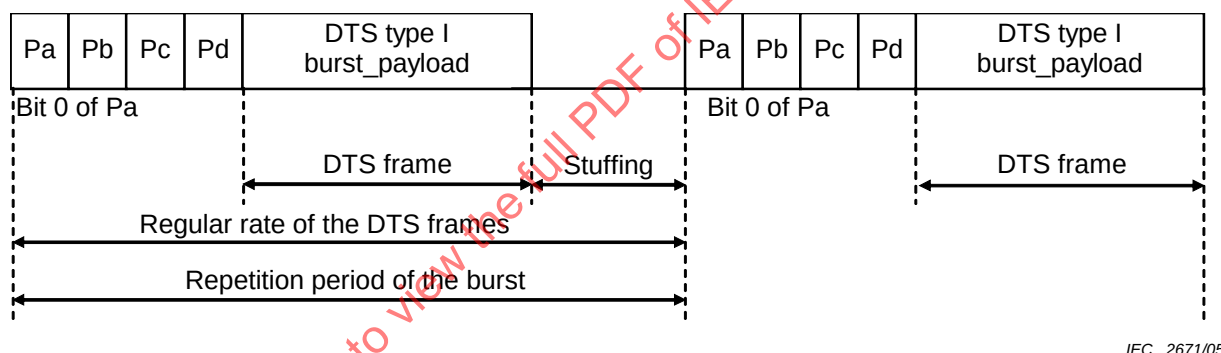
## 5.3 Audio data-bursts

### 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<br>LSB..MSB | Value | Contents                      |
|------------------------|-------|-------------------------------|
| 8-12                   | 00h   | Reserved, shall be set to '0' |

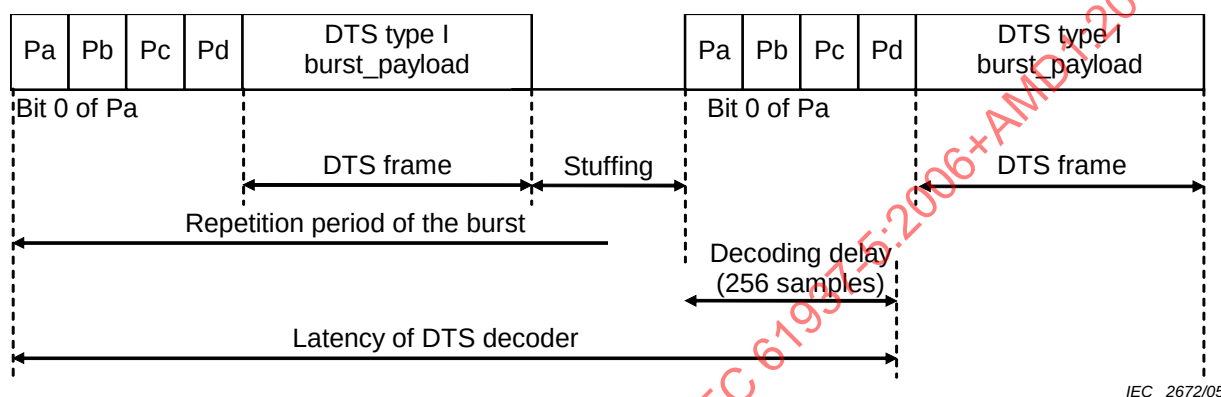
The reference point of a DTS type I data-burst is bit 0 of Pa and occurs exactly once every 512 sampling periods. The data-burst containing DTS type I frames occurs at a regular rate, with the reference point of each DTS type I data-burst beginning 512 IEC 60958 frames after the reference point of the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

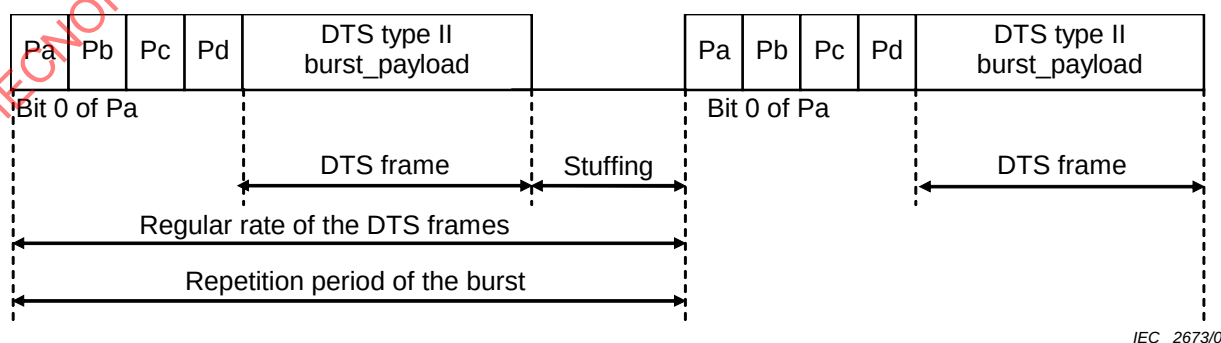
NOTE 4 The latency of a DTS decoder is defined as a delay measured from the reference point and equal to one frame (10,67 ms) plus 5,33 ms (equivalent to 256 samples). This is 768 PCM samples or 16 ms at 48 kHz sampling frequency.

### 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**

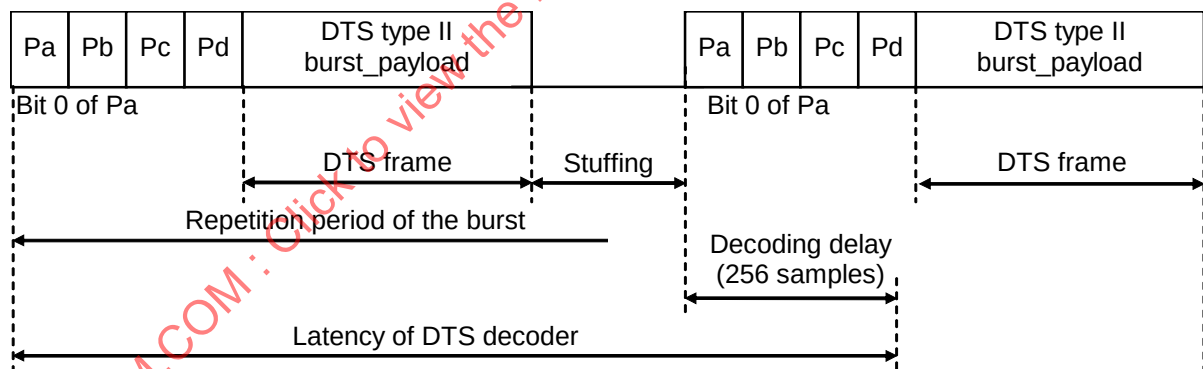
| Bits of Pc<br>LSB..MSB | Value | Contents                      |
|------------------------|-------|-------------------------------|
| 8-12                   | 00h   | Reserved, shall be set to '0' |

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).



IEC 2674/05

**Figure 4 – Latency of DTS type II decoding**

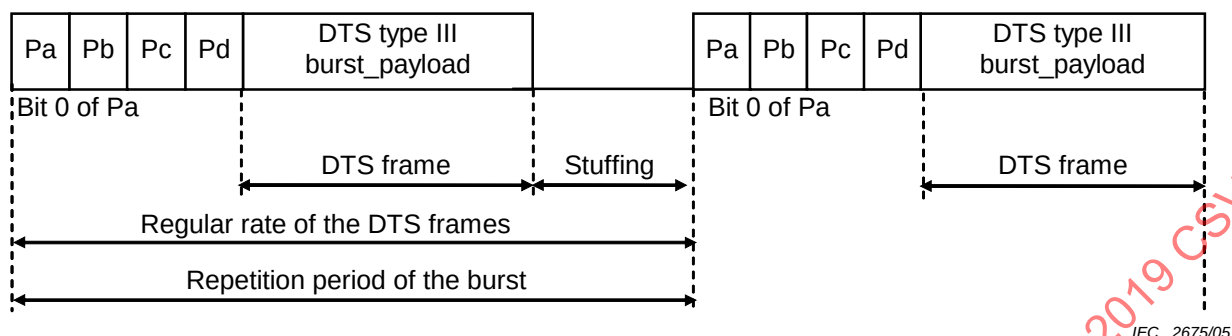
NOTE 4 The latency of a DTS decoder is defined as a delay measured from the reference point and equal to one frame (21,34 ms) plus 5,33 ms (equivalent to 256 samples). This is 1 280 PCM samples or 26,67 ms at 48 kHz sampling frequency.

### 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.



**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<br>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).

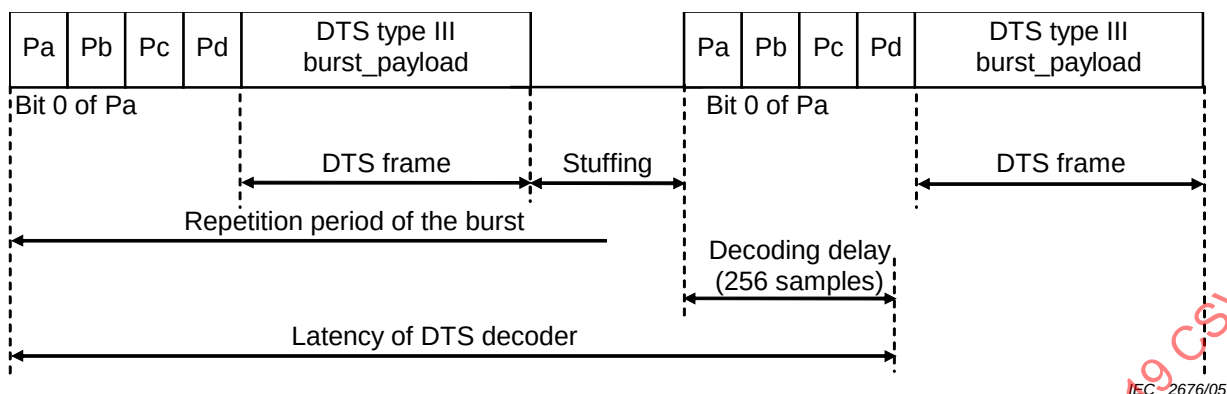


Figure 6 – Latency of DTS type III decoding

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

~~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 burst repetition period is set in bits 8 – 10 of Pc (see Table 6). The IEC 60958 frame rate has an integer relationship to the base sample rate of the compressed audio being delivered. 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.~~

Bits 11 and 12 are used to indicate a profile of DTS type IV.

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 information for 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     |                                                     | 4 096             |
|            | 4     |                                                     | 8 192             |
|            | 5     |                                                     | 16 384            |
|            | 6     |                                                     | Reserved          |
|            | 7     |                                                     | Reserved          |
| 11 – 12    | 0     | <del>Reserved</del> Type IV profile                 | Single Burst Mode |
|            | 1     |                                                     | Multi-Burst Mode  |
|            | 2     |                                                     | Profile 2         |
|            | 3     |                                                     | Profile 3         |
| 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 one 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 that fill the stream gap ~~should continue~~ be continued 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 that 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 that are missing (due to the resulting audio gap).

**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 one subframe (256 samples at 48 kHz or 5,33 ms), equivalent to 16 ms.~~

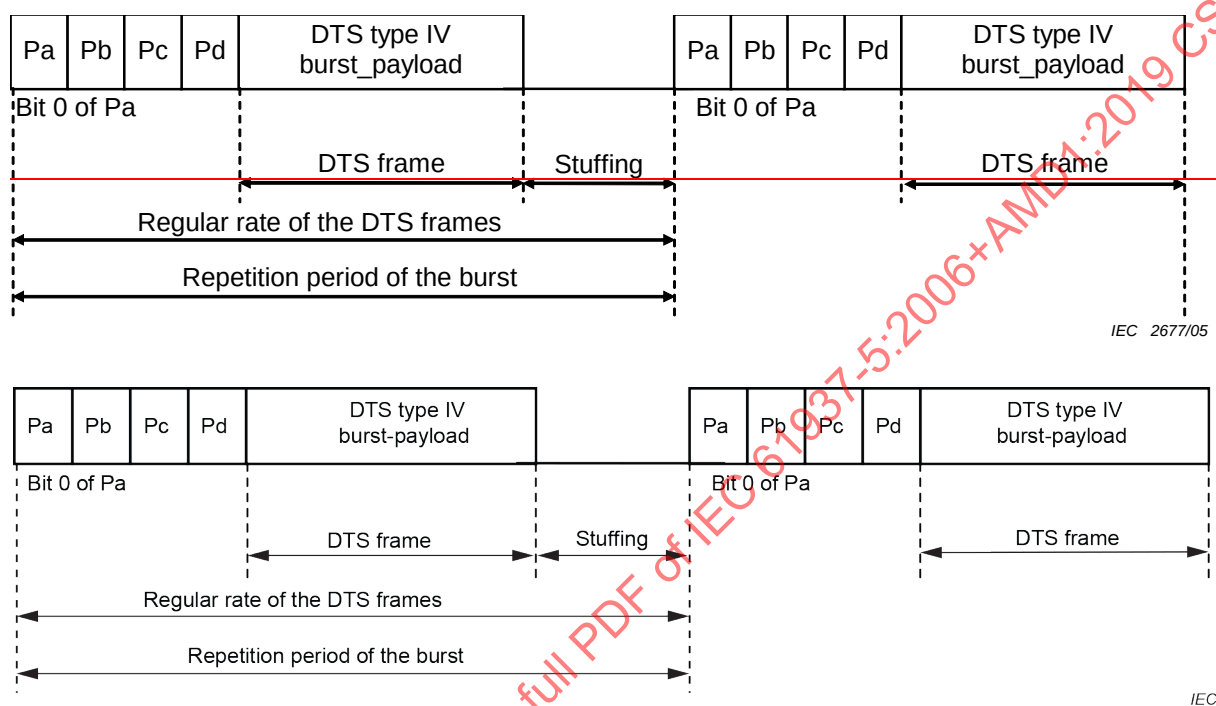


### 5.3.5 DTS type IV profile definitions

#### 5.3.5.1 Type IV profile = 0: single burst mode

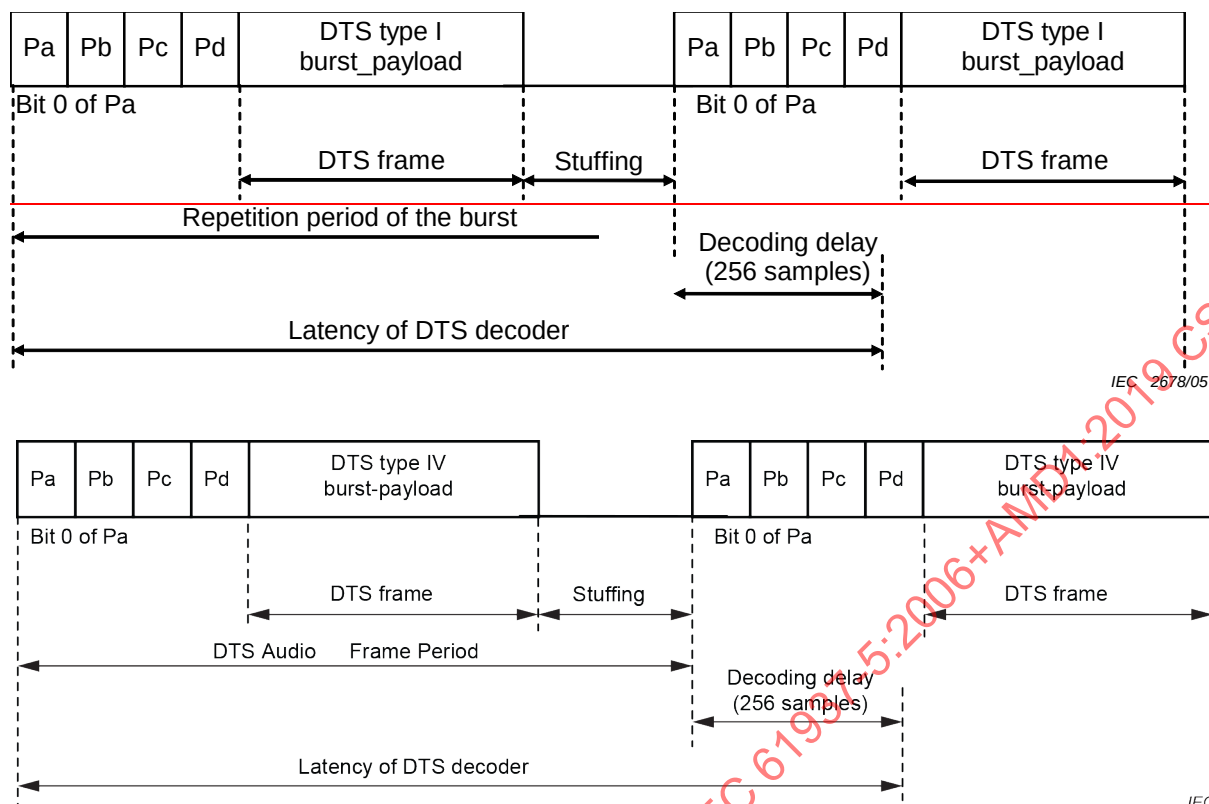
DTS type IV profile 0 shall deliver a DTS audio frame in a each burst. The burst repetition period, indicated with bits 8 – 10 of Pc, is relative to the period of the IEC 60958 frame. Figure 7 provides a representation of the repetition period of the burst.

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



**Figure 7 – DTS type IV single data-burst mode**

The decoder latency of a DTS stream delivered using DTS type IV single burst mode is shown in Figure 8.



**Figure 8 – Decoder latency of DTS type IV decoding single burst mode**

NOTE 2 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 one subframe (256 samples at 48 kHz, or 5,33 ms), equivalent to 16 ms.

### 5.3.5.2 Type IV profile = 1: multi-burst mode

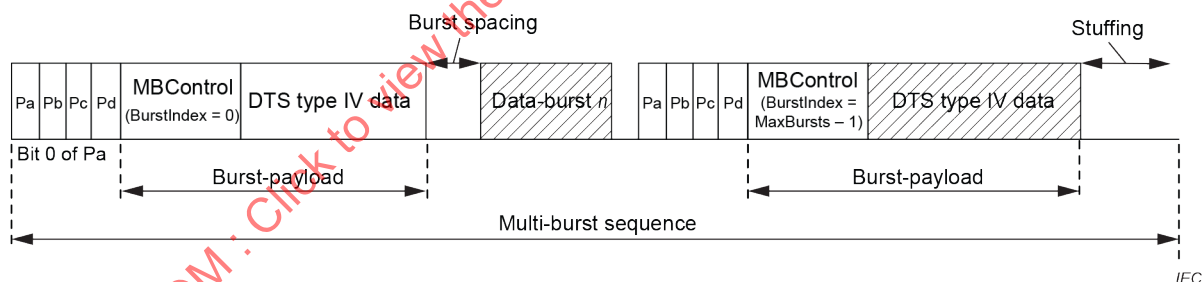
DTS type IV profile 1 delivers a DTS audio frame in a multi-burst sequence, which consists of 1, 2, 4, or 8 bursts. The burst repetition period, indicated with bits 8 – 10 of Pc, is relative to the period of the IEC 60958 frame. The repetition period of the multi-burst sequence shall be equal to the DTS audio-frame period.

The first byte of each burst-payload is the multi-burst control byte (MBControl). The multi-burst control byte is defined in Table 7.

**Table 7 – Bits of multi-burst control byte**

| Bits of ControlByte | Coded value | Interpretation | Parameter name |
|---------------------|-------------|----------------|----------------|
| 7 (MSB)             | 0           | 0              | Reserved       |
| 6, 5                | 0           | 1              | MaxBursts      |
|                     | 1           | 2              |                |
|                     | 2           | 4              |                |
|                     | 3           | 8              |                |
| 4, 3, 2             | 0           | 0              | BurstIndex     |
|                     | 1           | 1              |                |
|                     | 2           | 2              |                |
|                     | 3           | 3              |                |
|                     | 4           | 4              |                |
|                     | 5           | 5              |                |
|                     | 6           | 6              |                |
|                     | 7           | 7              |                |
| 1, 0                | 0           | 8              | DelayFactor    |
|                     | 1           | 4              |                |
|                     | 2           | 2              |                |
|                     | 3           | 1              |                |

A representation of a multi-burst sequence is shown in Figure 9. This representation assumes the case of 2 or more data-bursts per multi-burst sequence, and any data-bursts between the first and last data-burst are represented as data-burst  $n$ .



**Figure 9 – DTS type IV multi-burst mode**

**MaxBursts** – indicates the number of data-bursts in a multi-burst sequence. The valid values of MaxBursts are 1, 2, 4 or 8 data-bursts per multi-burst sequence. Note that

$$P_{\text{dts}} = P_{\text{burst}} * \text{MaxBursts}$$

where:

$P_{\text{dts}}$  is the period of the DTS audio frame, and

$P_{\text{burst}}$  is the period of the data burst according to bits 8 – 10 of Pc (see Table 6).

To convert  $P_{\text{dts}}$  into units of seconds, divide this value by the IEC 60958 frame rate in Hz.

**BurstIndex** – indicates the index of current burst within the multi-burst sequence. The first data-burst in a multi-burst sequence shall have *BurstIndex* = 0. A multi-burst sequence shall align the DTS audio frame to begin in the first data-burst of the multi-burst sequence. Subsequent bursts in the multi-burst sequence shall have *BurstIndex* increment monotonically, with the multi-burst sequence terminating when *BurstIndex* = (*MaxBursts* – 1).

**DelayFactor** – This parameter is used to determine the total decoder latency of the transmitted elementary bitstream. Decoder delay is defined as follows:

$$D_{\text{decoder}} = \frac{P_{\text{dts}}}{\text{DelayFactor}}$$

and

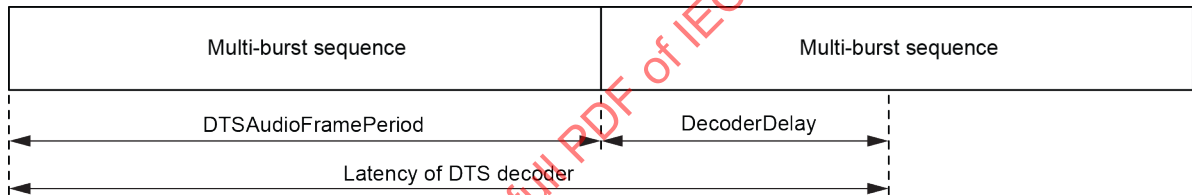
$$L_{\text{total}} = P_{\text{dts}} + D_{\text{decoder}}$$

where

$D_{\text{decoder}}$  is the delay of the decoder, and

$L_{\text{total}}$  is the total latency of the DTS decoder expressed in IEC 60958 frame periods. To convert latency into units of seconds, divide this value by the IEC 60958 frame rate in Hz.

Decoder latency for audio delivered using multi-burst mode is illustrated in Figure 10.



IEC

**Figure 10 – Decoder latency for DTS type IV multi-burst mode**

### 5.3.5.3 Type IV profile = 2

DTS type IV profile 2 is reserved for future definition.

### 5.3.5.4 Type IV profile = 3

DTS type IV profile 3 is reserved for future definition.

## Annex A (informative)

### Effect of repetition period of data burst and $F_s$ on frame period and maximum data rate in DTS type IV

#### A.1 Selection of DTS type IV mode

The DTS type IV mode selected will depend on the data rate required by the payload. Table A.1 shows IEC 60958 frame rates and repetition period and payload capacity in Mbps for the symbol rates shown.

**Table A.1 – DTS type IV payload and frame repetition: some examples**

| Frame repetition period | IEC 60958 frame rate<br>$F_s$ | Frame period<br>ms | Maximum data rate |
|-------------------------|-------------------------------|--------------------|-------------------|
| 512                     | 48 kHz                        | 10,67              | 1,524 Mbps        |
| 1 024                   | 96 kHz                        | 10,67              | 3,060 Mbps        |
| 2 048                   | 192 kHz                       | 10,67              | 6,132 Mbps        |
| 4 096                   | 384 kHz                       | 10,67              | 12,276 Mbps       |
| 8 192                   | 768 kHz                       | 10,67              | 24,564 Mbps       |
| 16 384                  | 1 536 kHz                     | 10,67              | 49,140 Mbps       |
| 16 384                  | 768 kHz                       | 21,33              | 24,570 Mbps       |
| 16 384                  | 384 kHz                       | 42,67              | 12,285 Mbps       |
| 16 384                  | 192 kHz                       | 85,33              | 6,1425 Mbps       |

The maximum data rates in Table A.1 assume a provision for two 60 958 frames for pad between bursts. Specific implementations may have additional restrictions.

## Bibliography

The following documents have served as references for the specification of the related data-type.

DTS DTS-HD     *Please contact DTS consumer licensing for the latest specifications for DTS and DTS-HD* <sup>2</sup>

IECNORM.COM : Click to view the full PDF of IEC 61937-5:2006+AMD1:2019 CSV

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<sup>2</sup> DTS, Inc. 5171 Clareton Drive, Agoura Hills, CA 91301 email: [consumerlicensing@ds.com](mailto:consumerlicensing@ds.com)

## FINAL VERSION



**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)**

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## 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

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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**IEC 61937-5 edition 2.1 contains the second edition (2006-01) [documents 100/974/CDV and 100/1055/RVC] and its amendment 1 (2019-01) [documents 100/3101/CDV and 100/3163/RVC].**

**This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.**

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 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.

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 bitstreams 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<sup>1</sup>

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability 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 may be issued at a later date.

---

<sup>1</sup> 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, Repetition period for DTS Type IV. See Table 6 |                   |                                                     |
| 11 – 12    | 0 – 3   | Profile                                                                              |                   |                                                     |
| 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 |

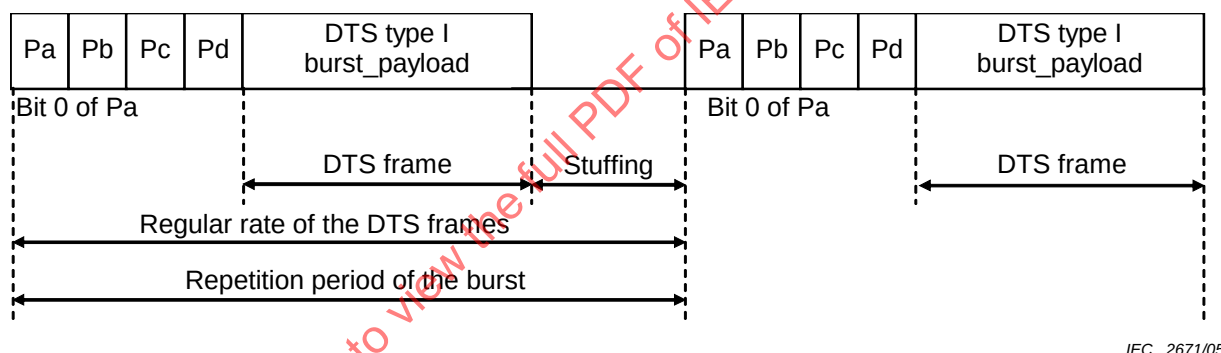
## 5.3 Audio data-bursts

### 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<br>LSB..MSB | Value | Contents                      |
|------------------------|-------|-------------------------------|
| 8-12                   | 00h   | Reserved, shall be set to '0' |

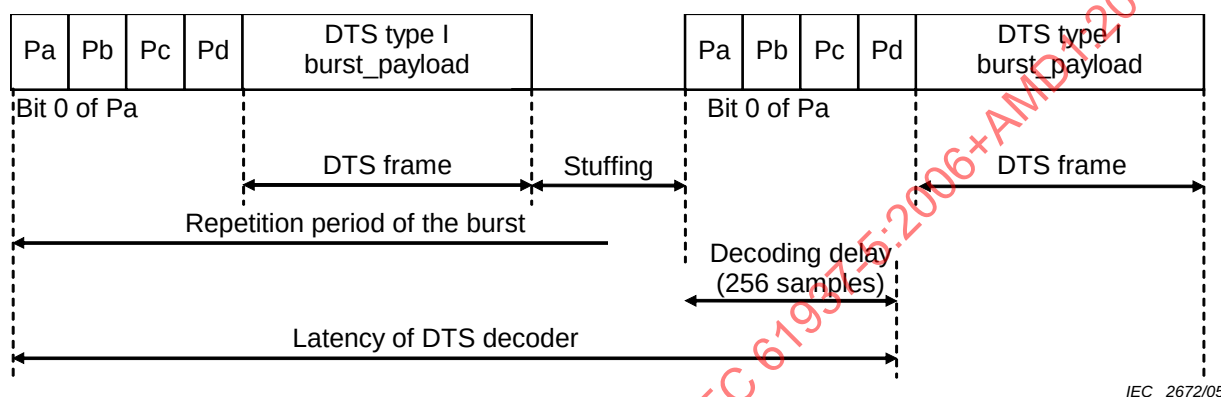
The reference point of a DTS type I data-burst is bit 0 of Pa and occurs exactly once every 512 sampling periods. The data-burst containing DTS type I frames occurs at a regular rate, with the reference point of each DTS type I data-burst beginning 512 IEC 60958 frames after the reference point of the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

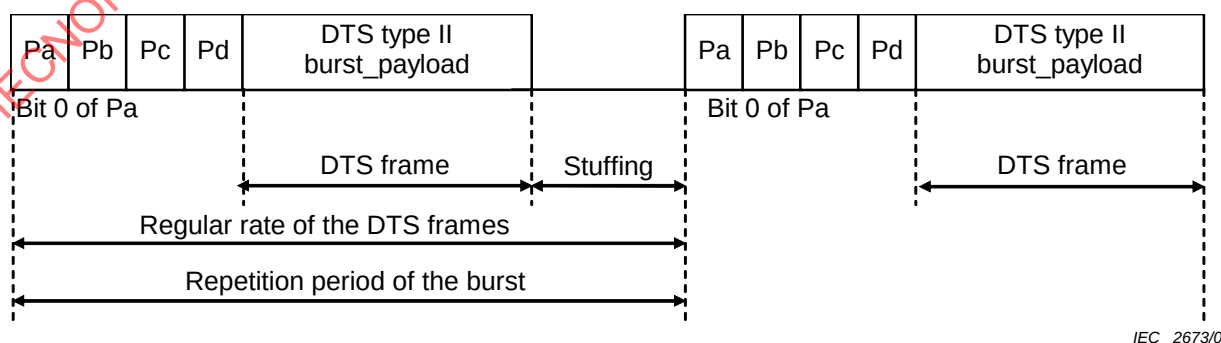
NOTE 4 The latency of a DTS decoder is defined as a delay measured from the reference point and equal to one frame (10,67 ms) plus 5,33 ms (equivalent to 256 samples). This is 768 PCM samples or 16 ms at 48 kHz sampling frequency.

### 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**

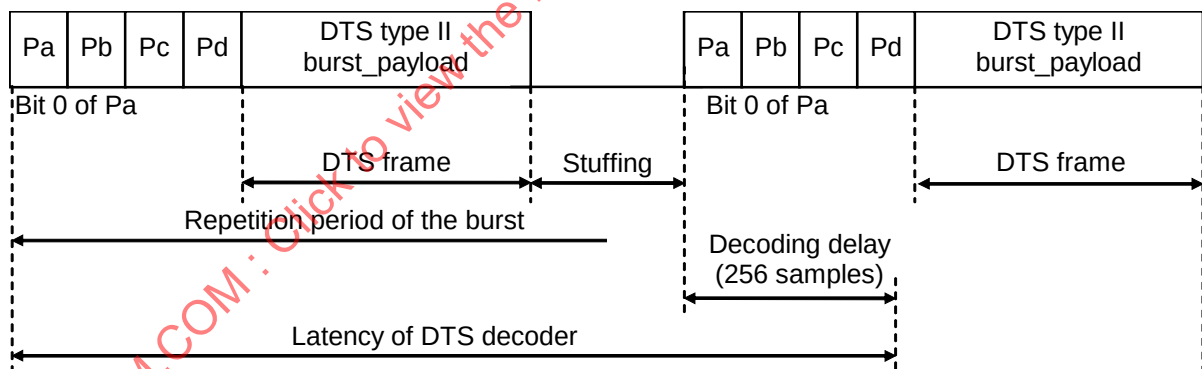
| Bits of Pc<br>LSB..MSB | Value | Contents                      |
|------------------------|-------|-------------------------------|
| 8-12                   | 00h   | Reserved, shall be set to '0' |

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).



IEC 2674/05

**Figure 4 – Latency of DTS type II decoding**

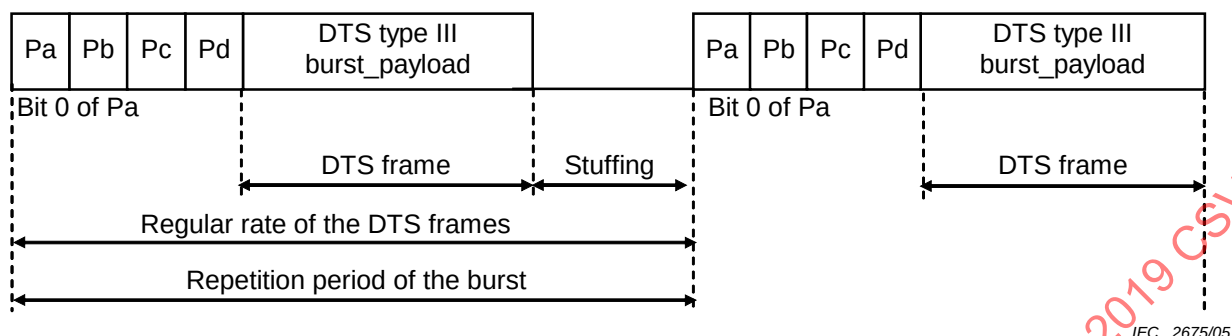
NOTE 4 The latency of a DTS decoder is defined as a delay measured from the reference point and equal to one frame (21,34 ms) plus 5.33 ms (equivalent to 256 samples). This is 1 280 PCM samples or 26,67 ms at 48 kHz sampling frequency.

### 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.



**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<br>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).



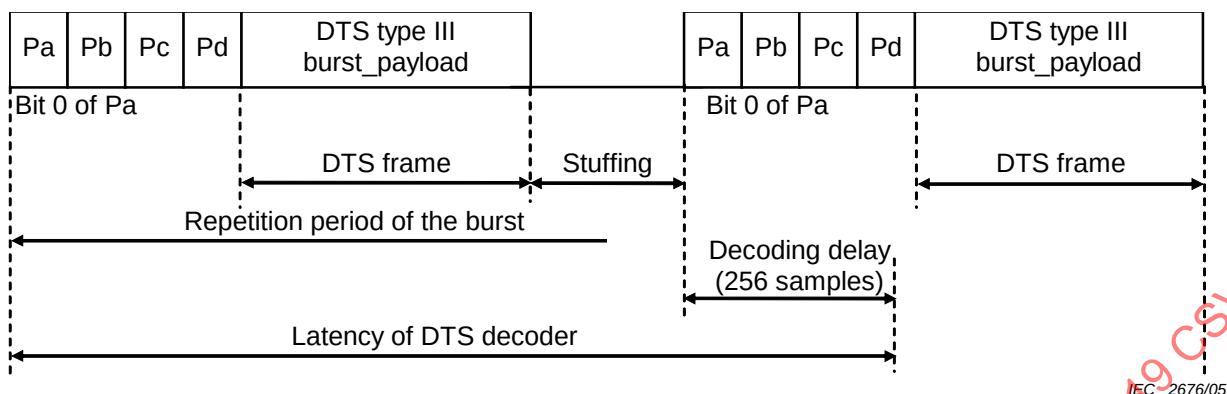


Figure 6 – Latency of DTS type III decoding

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

The burst repetition period is set in bits 8 – 10 of Pc (see Table 6). The IEC 60958 frame rate has an integer relationship to the base sample rate of the compressed audio being delivered. Any supported base sample rate may be applied. The nominal base sample rate for DTS Type IV is 48 kHz.

Bits 11 and 12 are used to indicate a profile of DTS type IV.

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