

INTERNATIONAL STANDARD

**Digital audio – Interface for non-linear pcm encoded audio bitstreams applying
IEC 60958 –
Part 13: MPEG-H 3D Audio**

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IEC 60958 –
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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 35.040.40

ISBN 978-2-8322-5534-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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The text of this International Standard is based on the following documents:

CDV	Report on voting
100/2943/CDV	100/3068/RVC

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

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

A list of all parts in the IEC 61937 series, published under the general title *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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INTRODUCTION

Modern digital video standards, such as ATSC and DVB, are preparing for next-generation TV broadcast systems. The latest evolutions in audio introduce fundamental changes to the way audio is produced, and may well revolutionize the user experience. The new MPEG-H audio standard offers not only immersive 3D Audio, but it also introduces the concept of audio objects that can be used to personalize the user experience.

The MPEG-H 3D Audio standard is the next generation MPEG audio codec, and it requires a framing format that supports more flexible signalling and delivery mechanisms than were needed for earlier systems. Therefore, the MPEG-H 3D Audio Transport Stream (MHAS) framing format was specified for use with the MPEG-H 3D Audio codec.

In order to be able to pass the MPEG-H 3D Audio bit stream from a set-top box to an A/V receiver connected via the IEC 60958 interface, this part of IEC 61937 employs the MHAS framing format.

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

Part 13: MPEG-H 3D Audio

1 Scope

This part of IEC 61937 specifies the method to convey non-linear PCM bitstreams encoded according to the MPEG-H 3D Audio format.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 (all parts), *Digital audio interface*

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-info*

ISO/IEC 23008-3:2015, *Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 3: 3D audio*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 61937-1, IEC 61937-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Terms and definitions

3.1.1

audio sample rate

sampling frequency of the linear PCM audio samples before encoding and after decoding

3.1.2

frame length

number of linear PCM audio samples per MPEG-H 3D Audio data frame

Note 1 to entry: MPEG-H 3D Audio can operate in several modes using any of 1 024, 2 048, 4 096, 768, 1 536 or 3 072 linear PCM audio samples per MPEG-H 3D Audio data frame.

3.1.3

latency

delay time of an external audio decoder to decode an MPEG-H 3D Audio data-burst defined as the sum of two values – the receiving delay time and the decoding delay time

3.1.4

MHASPacketLabel

field in an MPEG-H 3D Audio stream packet that provides an indication on which packets belong together

3.1.5

MHASPacketLength

field in an MPEG-H 3D Audio stream packet that indicates the length of the MHASPacketPayload in bytes

3.1.6

MHASPacketPayload

payload of the MHASPacket

3.1.7

MHASPacketType

field in an MPEG-H 3D Audio stream packet that specifies the payload type in the packet given in ISO/IEC 23008-3:2015, 14.3.1

3.1.8

MPEG-H 3D Audio data frame

sequence of one or more MPEG-H 3D Audio stream packets (MHAS packets), as defined in ISO/IEC 23008-3:2015, Clause 14 that represents frame length (or fewer) linear PCM audio samples

3.1.9

MPEG-H 3D Audio stream packet

building blocks of an MPEG-H 3D audio stream that comprises an MHASPacketType field, an MHASPacketLabel field, an MHASPacketLength field, and an MHASPacketPayload

3.1.10

MPEG-H 3D Audio Stream

self-contained stream format to transport ISO/IEC 23008-3 (MPEG-H 3D Audio) data as defined in ISO/IEC 23008-3:2015, Clause 14

3.1.11

PACTYP_MPEGH3DACFG

MHASPacketType registration for an MHAS Packet that embeds an MPEG-H 3D audio configuration structure in the MHASPacketPayload as defined in ISO/IEC 23008-3:2015, 14.4

3.1.12

PACTYP_MPEGH3DAFRAME

MHASPacketType registration for an MHAS Packet that embeds a frame of MPEG-H 3D audio in the MHASPacketPayload as defined in ISO/IEC 23008-3:2015, 14.4

3.1.13

PACTYP_AUDIOSCENEINFO

MHASPacketType registration for an MHAS Packet that embeds an MPEG-H 3D audio scene information structure in the MHASPacketPayload as defined in ISO/IEC 23008-3:2015, 14.4

3.1.14

PACTYP_AUDIOTRUNCATION

MHASPacketType registration for an MHAS Packet that indicates a potential truncation as defined in ISO/IEC 23008-3:2015, 14.4

Note 1 to entry: Truncation in this context means the removal of audio samples from the decoded PCM samples. Audio samples are removed either before or after a truncation point as signaled in the truncation packet.

3.1.15

truncated MPEG-H 3D Audio data frame

MPEG-H 3D Audio data frame that represents fewer than frame length linear PCM audio samples

Note 1 to entry: A truncated MPEG-H 3D Audio data frame contains at least one MHAS packet with MHASPacketType PACTYP_AUDIOTRUNCATION.

Note 2 to entry: Truncation in this context means the removal of audio samples from the decoded PCM samples.

3.2 Abbreviated terms

HBR high bit rate

MHAS MPEG-H 3D Audio stream

4 Mapping of the audio bit stream on to IEC 61937-1

4.1 General

Coding of the bit stream and data-burst is in accordance with IEC 61937-1 and IEC 61937-2.

4.2 Burst-info for MPEG-H 3D Audio

The 16-bit burst-info contains information about the data that will be found in the data-burst. See Table 1.

Table 1 – Values of data-type for MPEG-H 3D Audio

Data-type bits 0-4 according to IEC 61937-2 Value of Pc bits 0-4	Data-type bits 5-6 Value of Pc bits 5-6	Contents	Reference point R	Repetition period of data-burst measured in IEC 60958 frames
0-24	0-3	In accordance with IEC 61937-2		
25	0	MPEG-H 3D Audio	Bit 0 of Pa	See Table 5
	1	MPEG-H 3D Audio HBR	Bit 0 of Pa	See Table 8, Table 9, Table 10 and Table 11
	2, 3	According to IEC 61937-2		
26-31	0-3	In accordance with IEC 61937-2		

Bits 0 to 4 of the burst-info (Pc) signal the data-type used for transmission. For MPEG-H 3D Audio, the signalled data-type is 25.

The Pc bits 5 to 6 indicate the MPEG-H 3D Audio mode. The repetition periods of data-bursts in IEC 60958 frames shall be determined from the data-type-dependent information specified in Table 4 and Table 7.

5 Format of data-burst for MPEG-H 3D Audio

5.1 General

Clause 5 specifies the data-burst for MPEG-H 3D Audio. Specific properties such as reference points, repetition period, the method of filling stream gaps, and decoding latency are specified.

The decoding latency (or delay) should be taken into account by the transmitter to schedule data-bursts as necessary to establish synchronization between picture and decoded audio.

5.2 Pause data-bursts for MPEG-H 3D Audio

Pause data-bursts for MPEG-H 3D Audio are defined in Table 2.

Table 2 – Repetition period of pause data-bursts for MPEG-H 3D Audio

Data-type of audio data-burst	Repetition period of pause data-burst	
	Mandatory	Recommended
MPEG-H 3D Audio	–	3 IEC 60958 frames
MPEG-H 3D Audio HBR	–	4 IEC 60958 frames

If regular audio data-bursts are not being transmitted due to, for example, a pause condition, it is recommended to use pause data-bursts to fill such stream gaps. The repetition period of the pause data-bursts should be selected according to Table 2. If other repetition periods are necessary to precisely fill the stream gap length, or to meet the requirement on audio data-burst spacing (see IEC 61937-1), pause data-bursts may have other lengths.

When a stream gap in an audio stream is filled by a sequence of pause data-bursts, the Pa of the first pause data-burst shall occur after exactly that number of IEC 60958 frames as indicated by the MPEG-H 3D Audio data-frame length in conjunction with the data-type-dependent information from Table 4. It is recommended that the sequence of pause data-bursts that fills the stream gap should continue from this point until the Pa of the first audio data-burst that follows the stream gap, or as close as possible to that point, considering the specific IEC 60958 frame length of the pause data-burst with respect to the MPEG-H 3D Audio data frame length. The repetition-period-length parameter contained in the pause data-burst is intended to be interpreted by the receiver as an indication of the number of decoded PCM samples that are missing (due to the resulting audio gap).

5.3 Audio data-bursts

5.3.1 MPEG-H 3D Audio

An MPEG-H 3D Audio bit stream consists of a sequence of MPEG-H 3D Audio data frames. Each data-burst is headed with a preamble followed by payload and stuffing, as shown in Figure 1. The value of data-type bits 0 to 4 of an MPEG-H 3D Audio data-burst according to this document is 25 and the value of data-type bits 5 to 6 is 0.

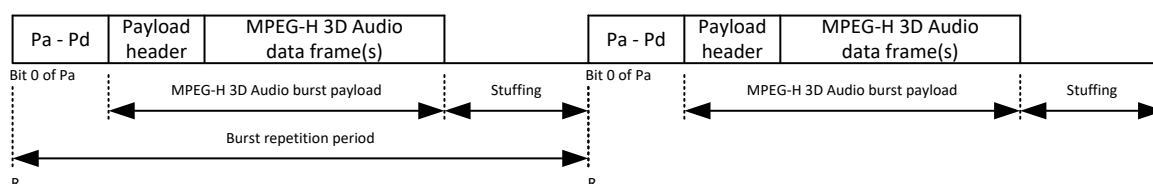


Figure 1 – MPEG-H 3D Audio data-burst structure

The burst payload of each data burst of MPEG-H 3D Audio data shall contain one MPEG-H 3D Audio burst payload header structure and the number of MPEG-H 3D Audio data frames that are indicated in the MPEG-H 3D Audio burst payload header.

An MPEG-H 3D Audio burst payload header structure consists of one or more entries as defined in Table 3.

Table 3 – MPEG-H 3D Audio burst payload header structure entry

Name	Size	Meaning
Data offset	2 bytes (unsigned 16 bit word)	Start offset of MPEG-H 3D Audio data frame in bytes with respect to the reference point
Data size	2 bytes (unsigned 16 bit word)	Size of MPEG-H 3D Audio data frame in bytes
PCM offset	2 bytes (signed 16 bit word)	Temporal offset of first decoded PCM sample of MPEG-H 3D Audio data frame in PCM samples with respect to the reference point

An MPEG-H 3D Audio burst payload header structure entry with all-zero values indicates the end of the MPEG-H 3D Audio burst payload header structure. The fields "data offset", "data size", and "PCM offset" shall be transmitted in big-endian byte order, i.e., high byte first. It is allowed for the combined size of the MPEG-H 3D Audio burst payload header structure plus the MPEG-H 3D Audio data frames to exceed the maximum data-burst payload size. In this case, the MPEG-H 3D Audio data frames will overlap with the next burst payload.

Each MPEG-H 3D Audio data frame shall contain exactly one MHAS packet with MHASPacketType PACTYP_MPEGH3DAFRAME and MHASPacketLabel in the range between 1 and 16. An MPEG-H 3D Audio data frame may contain zero or more MHAS Packets with MHASPacketType PACTYP_MPEGH3DAFRAME and MHASPacketLabel greater than 16. An MPEG-H 3D Audio data frame may contain additional MHAS packets of other types; if present, an MHAS Packet with MHASPacketType PACTYP_MPEGH3DACFG, PACTYP_AUDIOSCENEINFO, or PACTYP_AUDIOTRUNCATION shall precede the MHAS Packet of type PACTYP_MPEGH3DAFRAME.

Table 4 – Data-type-dependent information for data-type MPEG-H 3D Audio

Bits of Pc LSB..MSB	Value	Meaning
8-10	0	1 024 MPEG-H 3D Audio data frame length
	1	2 048 MPEG-H 3D Audio data frame length
	2	4 096 MPEG-H 3D Audio data frame length
	3	768 MPEG-H 3D Audio data frame length
	4	1 536 MPEG-H 3D Audio data frame length
	5	3 072 MPEG-H 3D Audio data frame length
	6-7	Reserved
11-12	0-3	Reserved

The IEC 60958 frame rate for data-type MPEG-H 3D Audio shall be equal to the audio sample rate. The repetition period of data-bursts in IEC 60958 frames shall be determined from the MPEG-H 3D Audio data frame length in accordance with Table 4 (Pc bits 8-10).

The maximum data-burst payload size in bits is determined from $2 \times 16 \times R_p - (P_{AD} + B_S)$, where

R_p is the repetition period of data-bursts in IEC 60958 frames,

$P_{AD} = 4 \times 16$ is the size of preamble words Pa-Pd in bits,

$B_S = 4 \times 16$ is the burst spacing in bits.

For data-type MPEG-H 3D Audio, the repetition period of data-bursts in IEC 60958 frames, and maximum data-burst payload size is specified in Table 5. The size of the data-burst payload is indicated by the Pd preamble word and is measured in bytes.

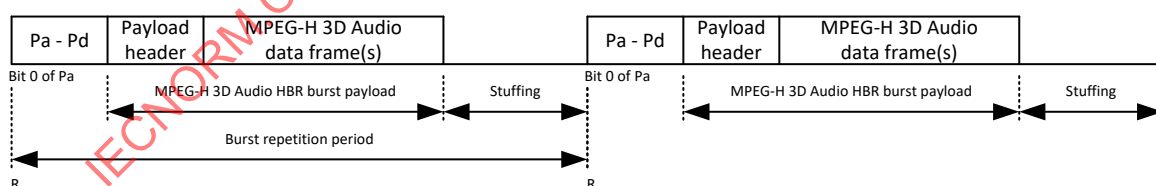
Table 5 – Repetition period and maximum data-burst payload size for data type MPEG-H 3D Audio

MPEG-H 3D Audio data frame length according to Pc bits 8-10	Repetition period of data-bursts in IEC 60958 frames	Maximum data-burst payload size in bytes
1 024	1 024	4 080
2 048	2 048	8 176
4 096	4 096	16 368
768	768	3 056
1 536	1 536	6 128
3 072	3 072	12 272

The reference point of a data-burst is bit 0 of Pa and occurs exactly once every number of IEC 60958 sampling periods that is computed using the information from Table 5. The data-burst containing one MPEG-H 3D Audio data frame shall occur at a constant rate.

5.3.2 MPEG-H 3D Audio HBR

When the required transmission rate for MPEG-H 3D Audio data exceeds the maximum data rate supported by an MPEG-H 3D Audio data-burst, an MPEG-H 3D Audio HBR data burst is used instead. Each HBR data-burst is headed with a preamble followed by payload and stuffing, as shown in Figure 2. The value data-type bits 0 to 4 of an MPEG-H 3D Audio HBR data-burst according to this document is 25 and the value of data-type bits 5 to 6 is 1.



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Figure 2 – MPEG-H 3D Audio HBR data-burst structure

The burst payload of each data burst of MPEG-H 3D Audio data shall contain one MPEG-H 3D Audio HBR burst payload header structure and the number of MPEG-H 3D Audio data frames that are indicated in the MPEG-H 3D Audio HBR burst payload header.

An MPEG-H 3D Audio HBR burst payload header structure consists of one or more entries as defined in Table 6.

Table 6 – MPEG-H 3D Audio HBR burst payload header structure entry

Name	Size	Meaning
Data offset	3 bytes (unsigned 24 bit word)	Start offset of MPEG-H 3D Audio data frame in bytes with respect to the reference point
Data size	3 bytes (unsigned 24 bit word)	Size of MPEG-H 3D Audio data frame in bytes
PCM offset	2 bytes (signed 16 bit word)	Temporal offset of first decoded PCM sample of MPEG-H 3D Audio data frame in PCM samples with respect to the reference point

An MPEG-H 3D Audio HBR burst payload header structure entry with all-zero values indicates the end of the MPEG-H 3D Audio burst payload header structure. The fields "data offset", "data size" and "PCM offset" shall be transmitted in big endian byte order, i.e., high byte first. It is allowed for the combined size of the MPEG-H 3D Audio burst payload header structure plus the MPEG-H 3D Audio data frames to exceed the maximum data-burst payload size. In this case, the MPEG-H 3D Audio data frames will overlap with the next burst payload.

Each MPEG-H 3D Audio data frame shall contain exactly one MHAS Packet with MHASPacketType PACTYP_MPEGH3DAFRAME and MHASPacketLabel in the range between 1 and 16. An MPEG-H 3D Audio data frame may contain zero or more MHAS Packets with MHASPacketType PACTYP_MPEGH3DAFRAME and MHASPacketLabel greater than 16. An MPEG-H 3D Audio data frame may contain additional MHAS packets of other types; if present, an MHAS packet with MHASPacketType PACTYP_MPEGH3DACFG, PACTYP_AUDIOSCENEINFO, or PACTYP_AUDIOTRUNCATION shall precede the MHAS packet of type PACTYP_MPEGH3DAFRAME.

Table 7 – Data-type-dependent information for data-type MPEG-H 3D Audio HBR

Bits of Pc LSB..MSB	Value	Meaning
8-10	0	1 024 MPEG-H 3D Audio data frame length
	1	2 048 MPEG-H 3D Audio data frame length
	2	4 096 MPEG-H 3D Audio data frame length
	3	768 MPEG-H 3D Audio data frame length
	4	1 536 MPEG-H 3D Audio data frame length
	5	3 072 MPEG-H 3D Audio data frame length
	6-7	Reserved
11-12	0	IEC 60958 frame rate is two times the audio sample rate
	1	IEC 60958 frame rate is four times the audio sample rate
	2	IEC 60958 frame rate is eight times the audio sample rate
	3	IEC 60958 frame rate is sixteen times the audio sample rate

The IEC 60958 frame rate for data-type MPEG-H 3D Audio HBR shall be equal to two, four, eight, or sixteen times the audio sample rate. Pc bits 11 to 12 indicate the relationship between the IEC 60958 frame rate and the audio sample rate. The repetition period of data-bursts in IEC 60958 frames shall be determined from the MPEG-H 3D Audio data frame length (Pc bits 8 to 10) and IEC 60958 frame rate (Pc bits 11 to 12) according to Table 7.

The maximum data-burst payload size in bits is determined from $2 \times 16 \times R_p - (P_{AD} + B_S)$, where

R_p is the repetition period of data-bursts in IEC 60958 frames,

$P_{AD} = 4 \times 16$ is the size of preamble words Pa-Pd in bits,

$B_S = 4 \times 16$ is the burst spacing in bits.

For data-type MPEG-H 3D Audio HBR, the repetition period of data-bursts in IEC 60958 frames, and maximum data-burst payload size are specified in Table 8, Table 9, Table 10 and Table 11. The size of the data-burst payload is indicated by the Pd preamble word and is measured in 8-byte units.

Table 8 – Repetition period and maximum data-burst payload size for value 0 of Pc bits 11 and 12 ($2 \times$ audio sample rate)

MPEG-H 3D Audio data frame length according to Pc bits 8 to 10	Repetition period of data-bursts in IEC 60958 frames	Maximum data-burst payload size in 8-byte units
1 024	2 048	1 022
2 048	4 096	2 046
4 096	8 192	4 094
768	1 536	766
1 536	3 072	1 534
3 072	6 144	3 070

Table 9 – Repetition period and maximum data-burst payload size for value 1 of Pc bits 11 and 12 ($4 \times$ audio sample rate)

MPEG-H 3D Audio data frame length according to Pc bits 8 to 10	Repetition period of data-bursts in IEC 60958 frames	Maximum data-burst payload size in 8-byte units
1 024	4 096	2 046
2 048	8 192	4 094
4 096	16 384	8 190
768	3 072	1 534
1 536	6 144	3 070
3 072	12 288	6 142

Table 10 – Repetition period and maximum data-burst payload size for value 2 of Pc bits 11 and 12 ($8 \times$ audio sample rate)

MPEG-H 3D Audio data frame length according to Pc bits 8 to 10	Repetition period of data-bursts in IEC 60958 frames	Maximum data-burst payload size in 8-byte units
1 024	8 192	4 094
2 048	16 384	8 190
4 096	32 768	16 382
768	6 144	3 070
1 536	12 288	6 142
3 072	24 576	12 286

Table 11 – Repetition period and maximum data-burst payload size for value 3 of Pc bits 11 and 12 (16 × audio sample rate)

MPEG-H 3D Audio data frame length according to Pc bits 8 to 10	Repetition period of data-bursts in IEC 60958 frames	Maximum data-burst payload size in 8-byte units
1 024	16 384	8 190
2 048	32 768	16 382
4 096	65 536	32 766
768	12 288	6 142
1 536	24 576	12 286
3 072	49 152	24 574

The reference point of a data-burst is bit 0 of Pa and occurs exactly once every number of IEC 60958 sampling periods that is computed using the information from Table 8, Table 9, Table 10 and Table 11. The data-burst containing one MPEG-H 3D Audio data frame shall occur at a constant rate.

5.3.3 Burst payload use cases

This section gives additional details on the usage of MPEG-H 3D Audio burst payload header structures and MPEG-H 3D Audio HBR burst payload header structures.

5.3.3.1 Simple use case

In the case of a MPEG-H 3D Audio data frame fitting completely into one MPEG-H 3D Audio burst payload, the corresponding IEC 61937-13 stream is constructed as shown in Figure 3 and Table 12.

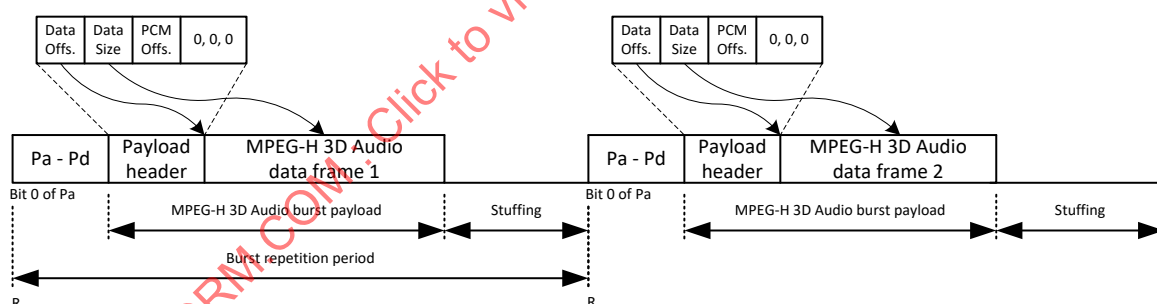


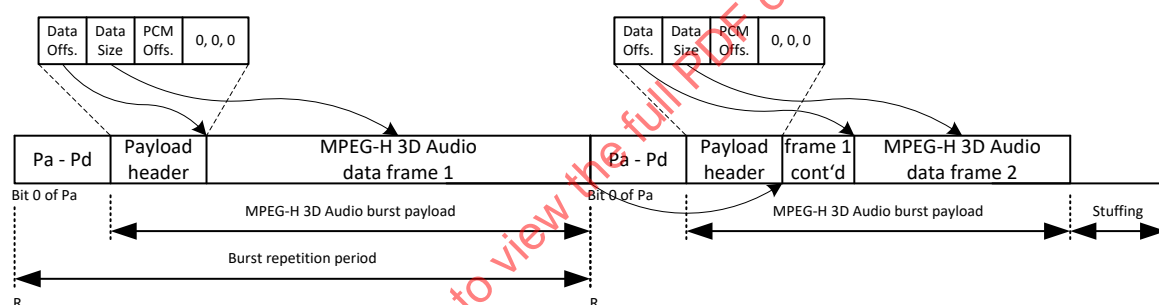
Figure 3 – MPEG-H 3D Audio burst payload

Table 12 – MPEG-H 3D Audio burst payload header structure entries

Header structure entry	Value in normal structure	Value in HBR structure	Notes
Data offset 1	20	24	8 bytes Pa-Pd + header structure + stop header structure (0, 0, 0)
Data size 1	Size of MPEG-H 3D Audio data frame 1	Size of MPEG-H 3D Audio data frame 1	
PCM offset 1	0	0	
Data offset 2	20	24	8 bytes Pa-Pd + header structure + stop header structure (0, 0, 0)
Data size 2	Size of MPEG-H 3D Audio data frame 2	Size of MPEG-H 3D Audio data frame 2	
PCM offset 2	0	0	

5.3.3.2 Overlapping burst payload

An MPEG-H 3D Audio data frame may be larger than a single MPEG-H 3D Audio burst payload. This can occur even if the average bitrate of the MPEG-H 3D Audio bitstream is lower than the channel capacity of the IEC 60958 channels. In this case, an MPEG-H 3D Audio data frame is continued in subsequent MPEG-H 3D Audio burst payloads as shown in Figure 4 and Table 13.



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Figure 4 – MPEG-H 3D Audio burst payload for overlapping data frame**Table 13 – MPEG-H 3D Audio burst payload header structure entries for overlapping data frame**

Header structure entry	Value in normal structure	Value in HBR structure	Notes
Data offset 1	20	24	8 bytes Pa-Pd + header structure + stop header structure (0, 0, 0)
Data size 1	Size of MPEG-H 3D Audio data frame 1	Size of MPEG-H 3D Audio data frame 1	
PCM offset 1	0	0	
Data offset 2	20 + size of overlapping part of data frame 1	24 + size of overlapping part of data frame 1	8 bytes Pa-Pd + header structure + stop header structure (0, 0, 0) + size of overlapping part of data frame 1
Data size 2	Size of MPEG-H 3D Audio data frame 2	Size of MPEG-H 3D Audio data frame 2	
PCM offset 2	0	0	