Burst data description for the Immersive Audio Model and Formats (IAMF)

1 Scope

This AOM document specifies the method of conveying non-linear PCM bitstreams applying IEC 60958 encoded according to the Immersive Audio Model and Formats (IAMF) 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 61937-1:2007+AMD1:2011 CSV, *Digital audio – interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 1: General*

IEC 61937-2:2007+AMD1:2011+AMD2:2018 CSV, *Digital audio interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 2: Burst Information*

AOM *Immersive Audio Model and Formats v.1.1.0* (IAMF)

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

IAMF audio data frame

bit stream generated by an IAMF encoder containing audio data and metadata representing a block of linear PCM samples according to the IAMF specification.

3.2

frame length

number of linear PCM audio samples per IAMF audio data frame. The IAMF specification allows for multiple codecs, sampling rates and frame sizes. This burst specification constrains the use case to IAMF streams only employing codecs at a sampling rate of 48 kHz and an analysis data frames (update rate) of 20 ms, which corresponds to a frame rate of 960 samples.

4 Mapping of the audio bitstream on IEC 61937-1

4.1 General

The coding of the bitstream and data-burst is in accordance with IEC 61937-1 ED3:2021 and IEC 61937-2, including field names such as "Pa", "Pc", "Pe", "Pf", and "R".

4.2 IAMF burst-info

Pc bits 0 to 7 shall indicate extended data-type according to IEC 61937-1 clause 6.1.8.3 As all bits are used in the preamble word of Pc, the value of data-type in Pc bits 0 to 4 is set to be 0x1F and the value of data-type bits 5 to 6 are set to 0. The extended data-type burst preamble Pe is used and the value is set to 0x0003. The 32-bit burst-info contains information about the data which will be found in the data-burst. (see Table 1).

Table 1 – Fields of burst-info

Extended Data-type	Data-type			Data-type-dependent-info	Contents	Reference point R	Repetition period of data-burst measured in IEC 60958 frames
Value of Pe bits 0-15	Value of Pc bits 0-4	Value of Pc bits 5-6	Value of Pc bits 8-9	Value of Pc bits 10-11			
0x0003	0x1F	0	0	0	IAMF	bit 0 of Pa	960, i.e. IEC 60958 frame rate is 1x of the audio sample rate
				1-3	Reserved for future use		
			1	0	IAMF HBR	bit 0 of Pa	1920, i.e. IEC 60958 frame rate is 2x of the audio sample rate
				1		bit 0 of Pa	3840, i.e. IEC 60958 frame rate is 4x of the audio sample rate
				2		bit 0 of Pa	7680, i.e. IEC 60958 frame rate is 8x of the audio sample rate
				3		bit 0 of Pa	15360, i.e. IEC 60958 frame rate is 16x of the audio sample rate
			2-3	Reserved for future use			

Bits 0 to 6 of the burst-info (Pc) and bits 0 to 15 of the burst-info (Pe) signal the data-type used for

transmission. For IAMF, the signalled extended data-type is 0x0003.

The Pc bits 8 to 9 indicate the IAMF bitstream mode. The repetition periods of data bursts in IEC 60958 frames shall be determined from the data-type-dependent information specified in Table 1.

5 Format of IAMF data-burst

5.1 General

This clause specifies the IAMF data-burst. 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 used by the transmitter to schedule data-bursts as necessary to establish synchronization between picture and decoded audio.

5.2. Pause data-burst

The pause data-bursts for IAMF are defined in Table 2

Table 2 – Repetition period of pause data-burst

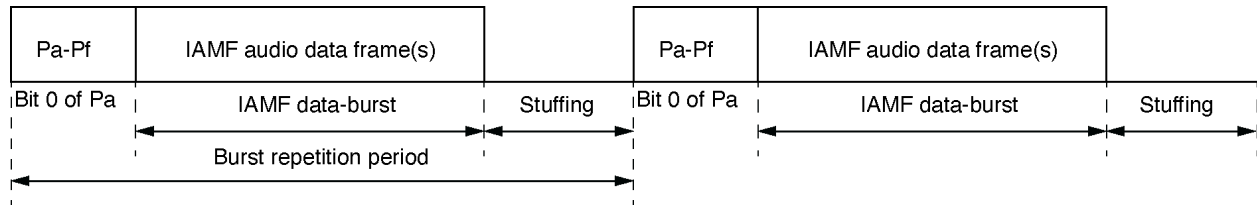| Data-type of audio data-burst	Repetition period of pause data-burst	
	Mandatory	Recommended
IAMF	-	3 IEC 60958 frames
IAMF HBR	-	4 IEC 60958 frames

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 IAMF audio data-frame length in conjunction with the data-type-dependent information from Table 3. 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 IAMF 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-burst

5.3.1 The IAMF data

An IAMF bit stream consists of a sequence of IAMF audio data frames. The IAMF data-burst is headed with a burst-preamble, followed by the burst-payload. The structure of the IAMF data-burst is shown in Figure 1. The extended data-type Pe bits 0 to 15 of an IAMF data-burst is 0x0003h, and the data-type Pc bits 8 to 9 is 0. When IAMF data is being transmitted, the transmission device shall ensure that both the extended data-type Pe bits 0 to 15 and data-type Pc bits 8 to 9 values are set correctly. Additionally, the receiving device shall utilize both the extended data-type Pe bits 0 to 15 and data-type Pc bits 8 to 9 values to ensure that the content of the data-burst is correctly identified as IAMF.

| Pa-Pf | IAMF audio data frame(s) | | Pa-Pf | IAMF audio data frame(s) | |

Bit 0 of Pa   IAMF data-burst   Stuffing   Bit 0 of Pa   IAMF data-burst   Stuffing

Burst repetition period

Figure 1. IAMF data-burst structure

The IEC 60958 frame rate for data-type IAMF shall be equal to the audio sample rate. The repetition period of data-bursts in IEC 60958 frames shall be determined from the IAMF audio data frame length in accordance with Table 1 (Pc bits 10-11). The maximum data-burst payload size in bits is determined from $2 \times 16 \times Rp - (Paf + Bs)$, where

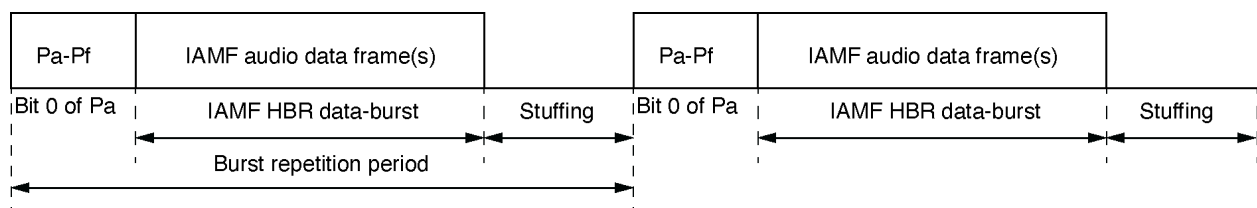*Rp*   is the repetition period of data-bursts in IEC 60958 frames

Paf   is the size of preamble words Pa-Pf in bits

Bs   is the burst spacing in bits

With a repetition period according to Table 1, the maximum data-burst payload size is then $2*16*960 - (6*16+4*16) = 30560$ bits. It is allowed for the size of the IAMF audio data frames to exceed the maximum data-burst payload size. In this case the IAMF audio data frames will overlap with the next burst payload.

5.3.2 The IAMF HBR data

When the required transmission rate for IAMF audio data exceeds the maximum data rate supported by an IAMF audio data burst, an IAMF HBR data-burst is used instead. An IAMF HBR data-burst is headed with a burst-preamble, followed by the burst-payload. The structure of the IAMF HB data-burst is shown in Figure 1. The extended data-type Pe bits 0 to 15 of an IAMF data-burst is 0x0001h, and the data-type Pc bits 8 to 9 is 1. When IAMF data is being transmitted, the transmission device shall ensure that both the extended data-type Pe bits 0 to 15 and data-type Pc bits 8 to 9 values are set correctly. Additionally, the receiving device shall utilize both the extended data-type Pe bits 0 to 15 and data-type Pc bits 8 to 9 values to ensure that the content of the data-burst is correctly identified as IAMF HBR.

| Pa-Pf | IAMF audio data frame(s) | | Pa-Pf | IAMF audio data frame(s) | |

Bit 0 of Pa   IAMF HBR data-burst   Stuffing   Bit 0 of Pa   IAMF HBR data-burst   Stuffing

Burst repetition period

Figure 2. IAMF HBR data-burst structure

The IEC 60958 frame rate for data-type IAMF HBR shall be equal to two, four, eight, or sixteen times the audio sample rate. Pc bits 10 to 11 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 IAMF audio data frame length and the IEC 60958 frame rate in accordance with Table 1 (Pc bits 10-11). The maximum data-burst payload size in bits is determined from $2 \times 16 \times Rp - (Paf + Bs)$, where

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

Paf is the size of preamble words Pa-Pf in bits

Bs is the burst spacing in bits

With repetition periods according to Table 1, the maximum data-burst payload size can then be calculated and be found in Table 3.

Table 3 – Maximum burst-length values per IAMF and IAMF HBR data-burst repetition period

Data-type	Data-type-dependent-info	Contents	Repetition period of data-burst in IEC 60958 frames	Maximum burst-length of data-burst in bits
Value of Pc bits 8-9	Value of Pc bits 10-11			
0	0	IAMF	960	30560
1	0	IAMF HBR	1920	61280
	1		3840	122720
	2		7680	245600
	3		15360	491360

5.3.3. Latency of IAMF decoding

The latency of an external audio decoder to decode IAMF is defined as the sum of the receiving time of one IAMF audio data frame in one or more data-bursts and the time used for decoding of one IAMF audio data frame.

Each data-burst contains a minimum of 4 mandatory fields (Pa, Pb, Pc, and Pd) and an extended field of Pe and Pf of length 16 bits each. The repetition period of data-bursts in IEC 60958 frames is computed according to information from Table 3 and Table X. The reception delay for one IAMF audio data frame is calculated as the time elapsed counting from the first bit of the data-burst until the last bit of the actual audio payload inside the data-burst received. Subsequent stuffing is not considered. After a complete IAMF audio data frame is received immediate decoding and subsequent rendering of the audio frame is not recommended as the size of the next audio frame and therefore time required for receiving it completely cannot be determined accurately.

The maximum size of an IAMF audio data frame is dependent on certain parameters of the IAMF bit stream, for example, the number of encoded channels. Details are specified in the IAMF specification.

In order to simplify the timing mechanism for receiving and decoding of content of IAMF audio data bursts, the receiving delay should be calculated as the time necessary to receive the complete data-burst including the stuffing. The maximum time available to decode (the decoding delay) should be selected to correspond to the length of one full IAMF audio data-burst at the IEC 60958b frame rate.

If the HBR mode is used it is recommended to set the relationship between the IEC 60958 frame rate and the audio sample rate (bits 10 and 11 of Pc, see Table 1) so that the resulting maximum data-burst payload size is greater than the maximum size of an IAMF audio data frame.