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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Digital audio – Interface for non-linear PCM Encoded audio bitstreams applying IEC 60958 –
Part 1: General

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

Part 1: General

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61937-1:2007+AMD1:2011. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61937-1 has been prepared by technical area 20: Analogue and digital audio, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

This third edition cancels and replaces the second edition published in 2007, and amendment 1 published in 2011. This edition constitutes a technical revision.

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

a) Activation of Pe field;

b) Enhanced usage of channel status bits.

c) Addition of Annex B.

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

Draft	Report on voting
100/3447/CDV	100/3522/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The list of all the parts of IEC 61937, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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~~INTRODUCTION~~
~~(to Amendment 1)~~

~~The revision of IEC 61937-1 (2007) has become necessary to specify the additional definition of length-code. Amendment 1 contains the following significant technical changes with respect to the base publication (IEC 61937-1, second edition).~~

~~– New 8-bytes unit definition of length-code is added.~~

~~– An erratum in Clause 7 as for indication of the burst-payload type is corrected.~~

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

Part 1: General

1 Scope

This part of IEC 61937 applies to the digital audio interface using the IEC 60958 series for the conveying of non-linear PCM encoded audio bitstreams.

It describes the way in which this digital interface can be used in consumer applications.

The professional mode ~~(AES/EBU)~~ is not considered within the scope of this document.

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

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

IEC 60958-5, *Digital audio interface – Part 5: Consumer application enhancement*

~~IEC 61937 (all parts), *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958*~~

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

3 Terms, definitions, ~~abbreviations~~ and presentation

For the purposes of this document, the following terms, definitions, ~~abbreviations~~ and presentation convention 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 data-burst
data-burst with an encoded audio frame as burst-payload

3.1.2
audio data-word
16-bit data word

3.1.3
audio frame
fixed number of audio samples

Note 1 to entry: The number of samples in an audio frame is dependent on the particular encoding system that is used to encode the audio frame into the encoded audio frame.

3.1.4
audio gap
period in the sequence of baseband audio samples where valid samples of audio are not available

3.1.5
bitstream
non-linear PCM encoded audio source, represented in a sequence of bits

Note 1 to entry: In this interface, the bitstream consists of a sequence of data-bursts.

3.1.6
data-burst
packet of data, including the burst-preamble, to be transmitted across the interface

3.1.7
burst-payload
information content of the data-burst

3.1.8
burst-preamble
header for the data-burst, containing synchronization, and information about the data contained in the burst-payload

3.1.9
data-type
reference to the type of payload of the data-bursts

3.1.10
encoded audio frame
minimum decodable unit of an encoded data sequence

Note 1 to entry: Each encoded audio frame is the encoded representation of a fixed number of audio samples (for each original audio channel). The number of samples that are encoded into an encoded audio frame depends on the particular encoding system that is used to encode the audio frame into the encoded audio frame.

3.1.11
idle
state in which the interface is not used to convey any sequence of data-bursts or PCM data

Note 1 to entry: The channel status data is still active (bit b1 is set to '1' when further non-linear PCM encoded audio is anticipated; see Figure 7).

3.1.12
length-code
code indicating the length of the data-burst-payload in bits, bytes or ~~8-bytes unit~~ 8-byte units

3.1.13
repetition period
period between the reference point of the current data-burst and the reference point of the immediately following data-burst of the same data-type

3.1.14
sampling frequency
sampling frequency of the encoded PCM audio samples (i.e. before encoding and after decoding)

3.1.15
sampling period
time period related to the sampling frequency of the PCM audio samples, represented in the encoded bitstream

3.1.16
stuffing
occupying the unused data capacity of the interface

3.1.17
stuffing subframe
occupying the unused data capacity in 16-bit audio data words

3.1.18
stream gap
period within the encoded audio bitstream without any audio frame; a discontinuity in the bitstream

Note 1 to entry: Typically, a stream gap will occur between encoded audio frames.

~~**3.2 Abbreviations**~~

~~**3.2.1**~~
~~**MPEG**~~
~~Moving Pictures Expert Group, a joint committee of ISO and IEC~~

~~**3.2.2**~~
~~**SMPTE**~~
~~The Society of Motion Picture and Television Engineers~~

~~**3.2.3**~~
~~**ETSI**~~
~~European Telecommunication Standards Institute~~

~~**3.2.4**~~
~~**ATSC**~~
~~Advanced Television Standards Committee~~

3.2 Presentation convention

3.2.1
F872h
value 'F872' in hexadecimal format

4 General description

The format of the IEC 60958 interface consists of a sequence of IEC 60958 subframes. Each IEC 60958 subframe is normally used to carry one linear PCM sample, but may also be used to convey data. The non-linear PCM encoded audio bitstreams to be transported over this interface are formed into a sequence of data-bursts.

Each data-burst consists of a 64-bit burst-preamble, followed by the burst-payload. The burst-preamble consists of a sync-word, information about the burst-payload and a bitstream-number.

The interface may convey one or more bitstreams. Each type of bitstream may impose a particular requirement for the repetition period for the data-bursts that make up the bitstream (see Clause 7).

The 16 bits of a data-burst are placed in time-slots 12 to 27 of an IEC 60958 subframe. Both odd and even IEC 60958 subframes (channel 1, channel 2) are simultaneously used to carry 32 bits of data. This allows IEC 60958, in the consumer mode, to convey either two-channel linear PCM audio, or a set of non-linear PCM encoded bitstreams (alternating data words), but not both simultaneously.

5 Interface format

The interface format as defined in IEC 60958-1 and IEC 60958-3 is used.

6 Mapping of the audio bitstream on to IEC 60958

6.1 Coding of the bitstream

6.1.1 General

The non-linear PCM encoded audio bitstream is transferred using the basic 16-bit data area of the IEC 60958 subframes, i.e. in time-slots 12 to 27 (see Figure 1 and Table 1). Because the non-linear PCM encoded audio bitstream to be transported is at a lower data rate than that supported by the IEC 60958 interface, the audio bitstream is broken into a sequence of discrete data-bursts, and stuffing between the data-bursts is necessary (see 6.3).

Each data-burst contains data of an encoded audio frame that is the encoded representation of a fixed number of audio samples per PCM audio channel. The number of samples to be encoded into an encoded audio frame depends on the particular encoding system.

It is possible for this interface to simultaneously convey multiple non-linear PCM encoded audio bitstreams. One of the applications of this capability would be to convey both a main audio service and an associated audio service.

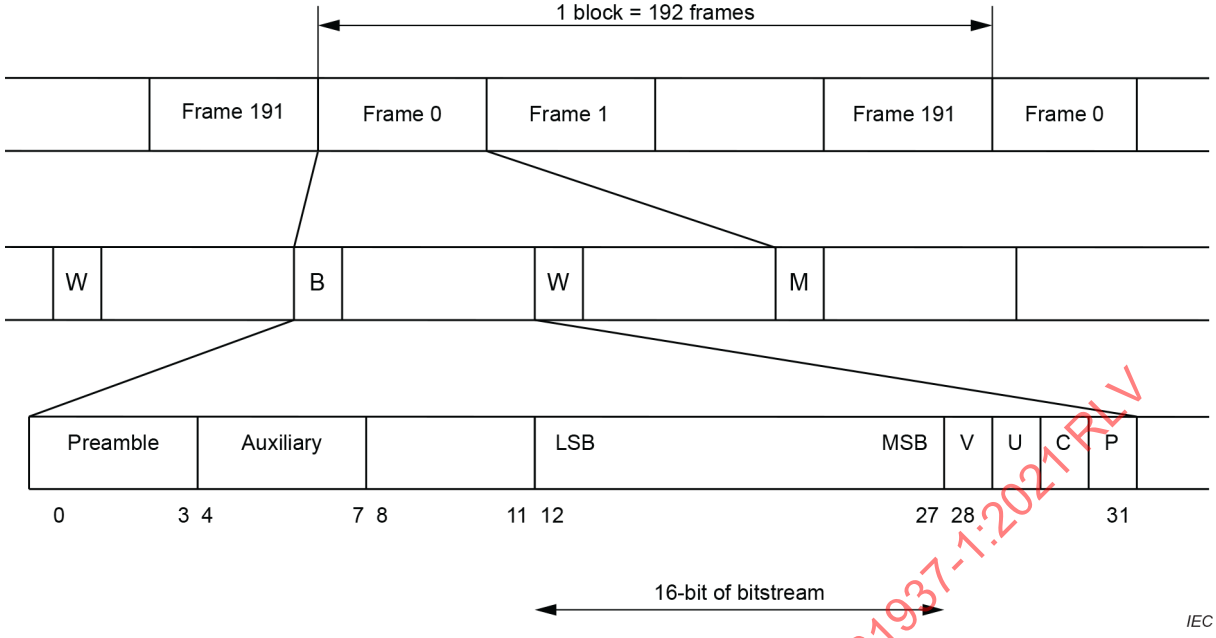


Figure 1 – IEC 60958 interface format

Table 1 – Bit allocation of the IEC 60958 frame

Field	IEC 60958 time-slot	Value
0 to 3	Preamble	IEC 60958 preamble
4 to 7	Auxiliary field	Not used, all "0" or partial of linear PCM
8 to 11	Unused data bits	Not used, all "0" or partial of linear PCM
12 to 27	16-bit data	Sections of the bitstream
28	Validity flag	According to IEC 60958
29	User data	According to IEC 60958
30	Channel status	According to IEC 60958
31	Parity bit	According to IEC 60958

6.1.2 Bit map of bitstream

The method of placing the data into the IEC 60958 bitstream is to format the data to be transmitted into data-bursts and to send each data-burst in a continuous sequence of IEC 60958 frames (see Table 2).

Table 2 – Bit allocation of data-burst in IEC 60958 subframes

Subframe	Bit of subframes				
	MSB				LSB
	b27	b26	b25 ..... b14	b13	b12
Frame 0; subframe B or M	0	1		14	15
Frame 0; subframe W	16	17		30	31
Frame 1; subframe B or M	32	33		46	47
Frame 1; subframe W	48	49		62	63
Frame 2; subframe B or M	64	65		78	79
----------			----------		
Last subframe B or M of data-burst	n – 32	n – 31		n – 18	n – 17
Last subframe W of data-burst	n – 16	n – 15		n – 2	n – 1

Considering the data within an IEC 60958 subframe as a 16-bit word out of a serial stream of bits, the first bit of the burst-payload in a data-burst would occupy the MSB of subframe 1 (time-slot 27), and the 32nd bit would occupy the LSB (or what would be the LSB for 16-bit PCM audio) of subframe 2 (time-slot 12). The next 32 bits of the burst-payload would occupy the next IEC 60958 frame. The last data bits of the audio data-burst might occupy only a fraction of the last frame. Any unused bits in the last frame will be ignored by the receiver. In the case where the audio data-burst contains a multiple of ~~16-bit~~ 16 bits, all used IEC 60958 sub-frames are completely filled. When it is not a multiple of ~~16-bit~~ 16 bits, the bits of the burst-payload to be conveyed in the last IEC 60958 subframe will be MSB aligned; the remaining bits shall be stuffed with zeros.

6.1.3 IEC 60958 validity flag

It is recommended to set the validity bit to a logical '1'. This is intended to prevent accidental decoding of non-audio data to analogue before a complete channel status block is received.

6.1.4 IEC 60958 channel status bit 1

The purpose of channel status bit 1 is to indicate if IEC 60958 is used to convey linear PCM or to indicate that the interface is used for other purposes (see Annex A). This bit shall be set to '1' when IEC 60958 is used to convey non-linear PCM encoded audio bitstreams.

6.1.5 Symbol frequency

When the IEC 60958 bitstream conveys linear PCM audio, the symbol frequency is 64 times the PCM sampling frequency (32 time-slots per PCM sample, times two channels). When a non-linear PCM encoded audio bitstream is conveyed by the interface, the symbol frequency is normally 64 times the sampling rate of the encoded audio within that bitstream, and other times should be referred to each parts of IEC 61937.

6.1.6 The format of the data-bursts

Each data-burst contains a burst-preamble consisting of four 16-bit words (Pa, Pb, Pc and Pd) followed by the burst-payload that contains data of an encoded audio frame (see Figure 2).

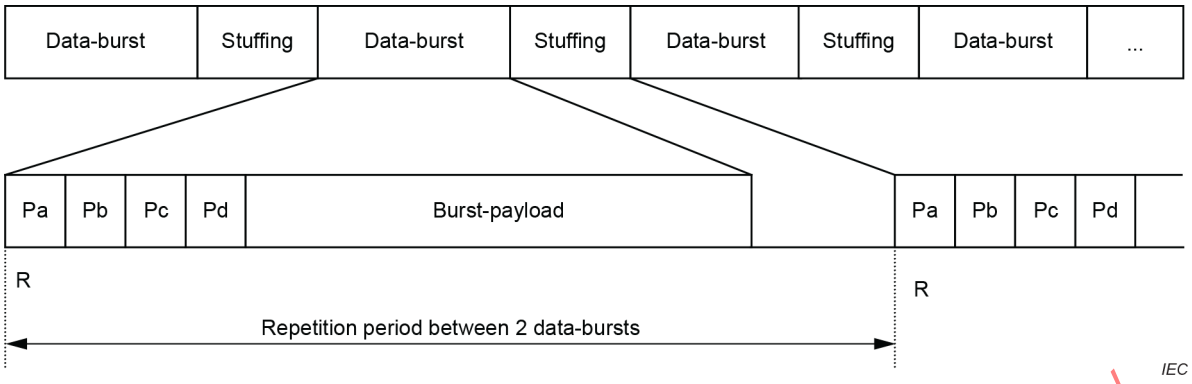


Figure 2 – Data-burst format

The repetition period of these bursts is defined as the length between the reference points R (measured in IEC 60958 frames) of one data-burst and the next data-burst (with the same bit-stream-number). The data representing each individual encoded audio frame is typically specified to be packaged into a single individual data-burst, with a repetition period (measured in IEC 60958 frames) for that data-burst equal to the number of encoded audio samples of each channel contained within that encoded audio frame.

It is possible for a number of data-bursts representing multiple bitstreams to be interleaved on the interface. When more than one non-linear PCM encoded audio bitstreams are transmitted through the same interface, the audio sampling rates of these bitstreams are identical to each other.

6.1.7 Burst-preamble

The burst-preamble consists of four mandatory fields. Pa and Pb represent a synchronization word. Pc gives information about the type of data, and some information/control for the receiver. ~~Pd gives the length of the burst-payload, limited to 65 535 bits in the case of Pd represent bits length, limited to 65 535 bytes in the case of Pd represent bytes length or limited to 524 280 bytes in the case of Pd represent 8-bytes unit length.~~ Pd gives the length of the burst-payload, limited to 65 535 bits if the length of Pd is given in bits, limited to 65 535 bytes if the length of Pd is given in bytes, or limited to 524 280 bytes if the length of Pd is given in 8-byte units.

The four preamble words are contained in two sequential IEC 60958 frames (see Figure 3). The frame beginning the data-burst contains preamble word Pa in subframe 1, and Pb in subframe 2. The next frame contains Pc in subframe 1 and Pd in subframe 2. When placed into an IEC 60958 subframe, the MSB of a 16-bit burst-preamble word is placed into time-slot 27 and the LSB is placed into time-slot 12 (see Table 3 and Table 4).

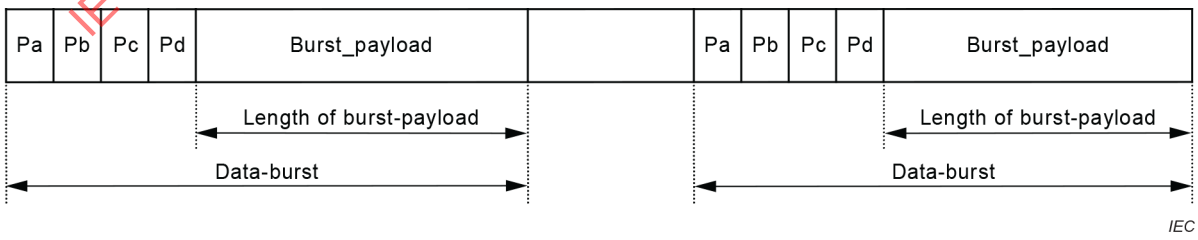


Figure 3 – Burst-preamble

Table 3 – Burst-preamble words

Preamble word	Length of field	Contents	Value MSB ... LSB
Pa	16-bit	Sync word 1	F872h
Pb	16-bit	Sync word 2	4E1Fh
Pc	16-bit	Burst-info	Table 5
Pd	16-bit	Length-code	Number of bits, number of bytes or number of ~~8-bytes unit~~ 8-byte units according to data-type

Table 4 – Bit map of burst-preambles

IEC 60958 time-slot bit-number	27															12
Preamble bit-number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Pa	1	1	1	1	1	0	0	0	0	1	1	1	0	0	1	0
Pb	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1	1
Pc	In accordance with Table 5, burst-info values Pc, bit 15 = MSB															
Pd	Length-code, bit 15 = MSB															

6.1.8 Burst-info

6.1.8.1 General

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

Table 5 – Fields of burst-info

Bits of Pc	Value	Contents	Remark
0 to 6		Data-type	See IEC 61937-2
7	0	Error flag indicating a valid burst-payload	
	1	Error flag indicating that ~~the burst-payload may contain errors~~ this burst-payload is not valid	
8 to 12		Data-type-dependent info	
13 to 15	0	Bitstream-number	
NOTE The repetition period of pause data-bursts depends on the application in which IEC 60958 is used to convey encoded audio bitstreams.			

6.1.8.2 Data-type

The 7-bit data-type is defined in bits 0 to 6 of the burst-preamble Pc (see Table 5), bit 6 is the MSB. This data-type field indicates the format of the burst-payload, which will be conveyed in the data-burst. Typical properties of a data-type are the reference point and repetition period of the burst, which is the number of sampling periods of the audio between the reference point of the current data-burst and the reference point of the next data-burst. The reference point is inherently defined for each data-type.

The allocation of data-types is defined in IEC 61937-2. The data-types themselves are specified in ~~each part of IEC 61937-3 and higher~~ the other parts of IEC 61937.

6.1.8.3 Extended data-type

6.1.8.3.1 General

When the burst-info Pc is equal to 1Fh (data-type = 31), the burst-preamble is extended with Pe and Pf. Figure 4 shows a burst-preamble with an extended preamble. Pe and Pf are included in the length of the burst-payload. The third frame of the IEC 60958 frames contains Pe in subframe 1 and Pf in subframe 2 (see Table 6, Table 7 and Table 8).

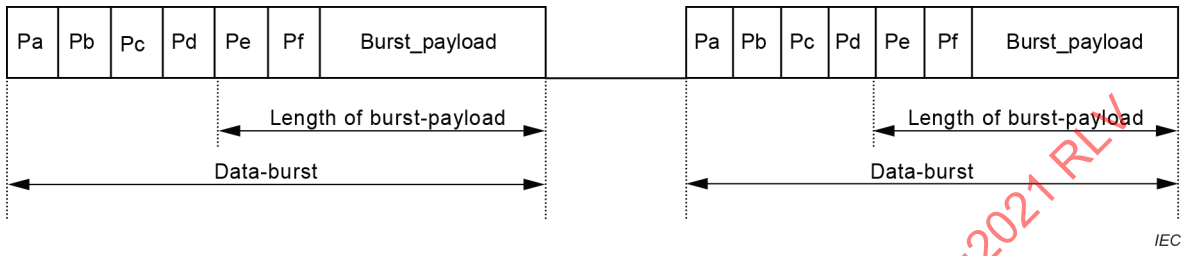


Figure 4 – Burst-preamble with extended preamble

Table 6 – Burst-preamble words

Preamble word	length of field	Contents	Value MSB ... LSB
Pa	16-bit	Sync word 1	F872h
Pb	16-bit	Sync word 2	4E1Fh
Pc	16-bit	Burst-info	Table 5
Pd	16-bit	Length-code	Number of bits, number of bytes or number of ~~8-bytes unit~~ 8-byte units according to data-type
Pe (conditional)	16-bit	Extended data-type	Table 7
Pf (conditional)	16-bit	Reserved for future use	Table 8

6.1.8.3.2 Fields of Pe

Table 7 – Fields of Pe (extended data-type)

~~Bits of Pe~~	~~Value~~	~~Contents~~	~~Reference point R~~	~~Repetition period of data-burst in IEC 60958 frames~~
~~0 – 65 535~~	~~0 – 65 535~~	~~Extended data-type~~		

Bits of Pe	Value	Contents	Remark
0 to 15	0 to 65 535	Extended data-type	See IEC 61937-2

~~The reference point and repetition period of data-bursts with extended data-type depend on the properties of the data-type selected in the extension.~~

The allocation of extended data-types is defined in IEC 61937-2. The extended data-types themselves are specified in the following parts of IEC 61937.

6.1.8.3.3 Fields of Pf

Table 8 – Fields of Pf

~~Bits of Pf~~	~~value~~	~~Contents~~
~~0 – 65 535~~	~~0 – 65 535~~	~~Reserved for future use~~

Bits of Pf	value	Contents
0 to 15	0 to 65 535	Reserved for future use

6.1.8.4 Error-flag

The error-flag bit is available to indicate if the contents of the data-burst contain data errors. If a data-burst is thought to be error-free, or if the data source does not know if the data contains errors, then the value of this bit is set to a '0'. If the data source does know that a particular data-burst contains some errors, this bit may be set to a '1'. The use of this bit by receivers is optional.

6.1.8.5 Data-type-dependent info

The meaning of the 5-bit data-type-dependent info depends on the value of the data-type (see 7.2).

6.1.8.6 Bitstream-number

The 3-bit bitstream-number indicates to which bitstream the data-burst belongs. Eight codes (0 to 7) are available so that up to eight independent bitstreams may be multiplexed in one bitstream in a time multiplex. Each independent bitstream shall use a unique bitstream-number. The MSB of the bit-stream-number is placed in bit number 15.

The following constraints apply. If a single bitstream is carried, the value of the bitstream-number is 0h. In the case where a main audio service and an associated audio service are placed into this interface, the main service audio data-burst has its bitstream number set to '0h'.

If a receiver is only capable of selecting and processing a single bitstream, it receives and processes bitstream-number 0h. The bitstream with bitstream-number 0h thus has the highest priority and should carry the most important data.

The data-type within a bitstream ~~may~~ can change, but the bitstream-number is constant for a bitstream. For example, the pause data-burst used to bridge a stream gap between the data-burst of an audio type contains the same bitstream-number.

6.1.9 Length-code

The length-code indicates the number of bits, bytes or ~~8-bytes unit~~ 8-byte units according to the data-type within the data-burst, from 0 to 65 535. The size of the Pa, Pb, Pc and Pd is not counted in the value of the length-code. In other words, the length-code indicates the number of bits of the burst-payload in bits, plus the conditional lengths of Pe and Pf (see Figure 4), or the number of bytes of the burst-payload in bytes, plus the conditional lengths of Pe and Pf, if they exist, or the number of ~~8-bytes unit~~ 8-byte units of the burst-payload in bytes, plus the conditional lengths of Pe and Pf if they exist.

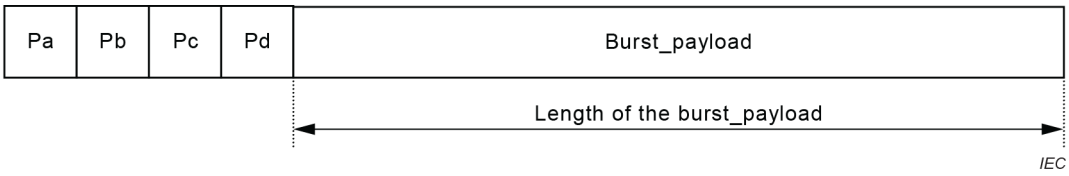


Figure 5 – Length of the burst-payload specified by Pd

6.2 Burst-payload

The format of the burst-payload is specified by means of the data-type in preamble Pc and is used to convey the information content. The data-bursts of several data-types are specified in IEC 61937-2.

6.3 Stuffing

6.3.1 General

Not all bits are occupied during the transfer of data-bursts (see Figure 2). In the case where the audio data-burst contains a multiple of ~~16-bit~~ 16 bits, all IEC 60958 subframes used are completely filled.

6.3.2 Stuffing within an IEC 60958 subframe

In the case where the audio data-burst does not contain a multiple of 16-bit, the bits of the burst-payload to be conveyed in the last 16-bit data word shall be MSB aligned, and the remaining bits of that subframe are set to '0' (stuffing).

6.3.3 Stuffing between data-bursts

An unoccupied space between two data-bursts shall be stuffed with 16-bit data words, which are set to all '0's.

6.3.4 Burst spacing

The following feature allows equipment reliably to detect whether the IEC 60958 signal is conveying PCM or non-linear PCM data without relying on bit 1 of the channel status (see Annex A). Four IEC 60958 subframes that have the contents of time slots 12 to 27 all set to '0' shall be inserted between every data-burst.

All these four '0' subframes with Pa and Pb will behave as an extended 96-bit sync code. In the case of PCM transmission, the false occurrence of the sync code will be extremely small. When the interface is not in the idle state, this requirement is automatically fulfilled unless there are sequences of data-bursts so tightly packed that there is never a sequence of all four '0' subframes preceding any ~~Pas~~ Pa (see Figure 6).

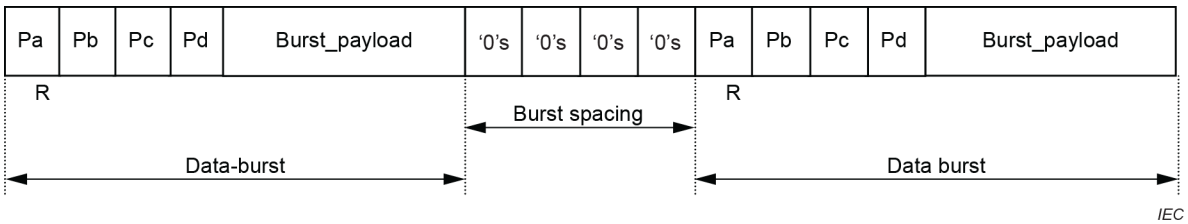


Figure 6 – Burst spacing

7 Format of data-bursts

7.1 General

Data-types are categorized into three classes: audio data-burst, pause data-burst and null data-burst. The type of the burst-payload is normally indicated by bits ~~0 to 4~~ 0 to 6 and 8 to 12 fields of Pc. Repetition periods apply to all data-types except for the null data-type.

In cases where the IEC 60958 interface is idle, i.e. it is not used to convey any data but is anticipating transmission of the non-linear PCM audio bitstream, channel status bit 1 is kept as '1' (see Annex A). Null data-bursts may be transferred to assist some receivers (which do not observe channel status bit 1) in switching from non-linear PCM mode to linear PCM mode unexpectedly (see 7.3).

In cases where the interface is used to convey non-linear PCM audio bitstreams, the bitstream is broken into discrete data-bursts and stuffing is necessary between the data-bursts (see 6.3.3). If gaps occur within the bitstreams, these stream gaps are filled with bursts of the pause data-type.

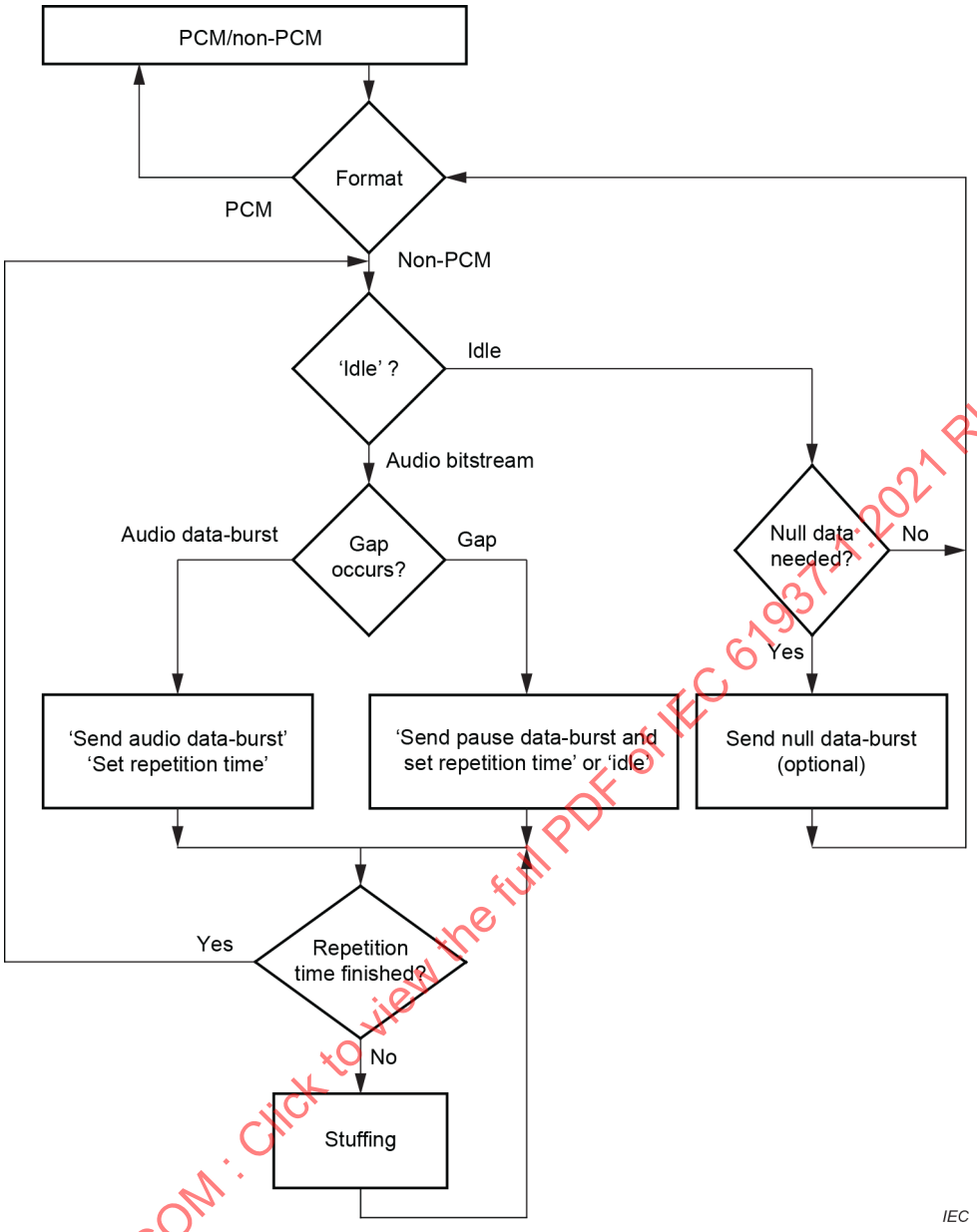


Figure 7 – Flow chart of transmission of a bitstream

7.2 Pause data-burst

Occasionally, ~~"~~stream gaps~~" (which means small discontinuities of the bitstream) may~~ can occur between two audio data-bursts of a non-linear PCM encoded audio ~~due~~ owing to switching between bitstreams in a transmitter. When a stream gap exists in the encoded audio bitstream, an audio gap will exist in the decoded audio signal. Pause data-bursts are intended to be used to fill the stream gaps. As indicated in Figure 8, pause data-bursts (Ps) are located with the repetition period of the pause data-burst. The reference point R of a pause data-burst is bit 0 of its Pa, and it follows immediately after the stuffing, which follows the previous audio data-burst. (The length of the audio data-burst with stuffing is the repetition period of the audio data-burst.) If an unoccupied space exists following a pause data-burst, it is stuffed with all '0's (see 6.3.3).

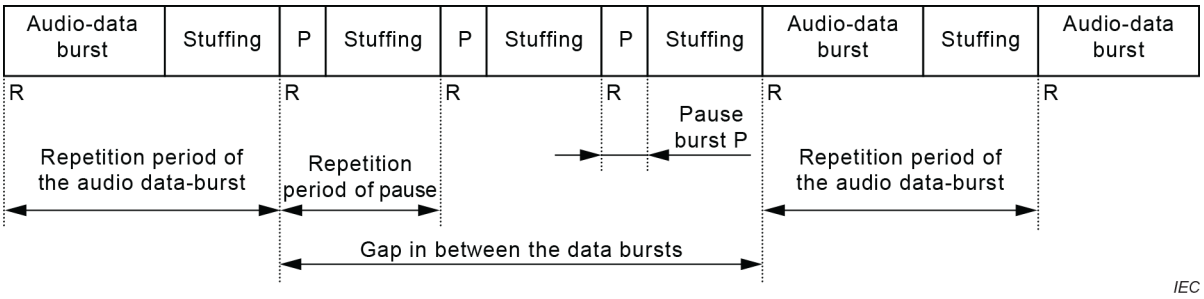


Figure 8 – Bridging gaps in-between data-bursts with three pause data-bursts

Pause data-bursts convey information to the audio decoder that a stream gap exists. The pause data-bursts may also ~~(optionally)~~ indicate either the actual length of the audio gap, or that the non-linear PCM audio data stream has stopped. This information ~~may~~ can be used by the audio decoder to minimize (or conceal) the existence of the audio gap, or in the case where the bitstream stops, to trigger a fade-out of the audio. A sequence of pause data-bursts can also assist decoder synchronization prior to the beginning of a non-linear PCM audio bitstream. A short sequence of pause data-bursts ~~may~~ can be sent immediately preceding the transmission of the first audio data-burst.

The pause data-burst shall be transferred with the same bitstream-number as the bitstream-number of the audio data stream which contains the stream gap to be filled with the pause data-bursts, or for which synchronization is being assisted. In the case where a main audio service bitstream and one or more associated audio service bitstreams are interleaved on the interface, the pause data-bursts shall have the same bit-stream-number as the main audio service. The pause data-burst is only used to fill the stream gaps between data-bursts of the main audio service bitstreams.

The pause data-burst contains the burst-preamble and a 32-bit payload (see Figure 9). The first 16-bit of the payload contains the audio gap-length parameter. The remaining bits are reserved and are all set to '0'. The audio gap-length parameter is an optional indication of the actual audio gap length. This is the length, measured in sampling periods of the audio, between the anticipated reference point of the next audio burst (based on the repetition period for that data-type – see Table 5), and the actual reference point of the next audio data-burst. In the case of audio with normal sampling rate, this length is equal to the number of PCM audio samples which would be missing in the decoded output signal (in the case of half sampling-rate audio, the number of PCM audio samples in the audio gap will be twice the value indicated by the gap-length parameter). For the data-types with Pa as a reference point, this length is equal to the length, measured in sampling periods of the audio, between the first bit of Pa of the first pause data-burst and the first bit of Pa of the next audio data-burst. The inclusion of non-zero values of gap-length is optional; data sources are not required to indicate the length of the audio gap.

The detailed use of the pause data-burst is dependent on the data-type of the audio data-burst. ~~For example, it is recommended that stream gaps between AC-3 data-bursts be filled with a sequence of very short pause bursts, while the repetition period of pause data-bursts between the data-burst of an MPEG type is related to the algorithm.~~ The gap-length parameter of the first pause data-burst of the sequence may ~~(optionally)~~ be used to indicate the length of the audio gap that will occur ~~due~~ owing to the stream gap. The pause data-bursts in the sequence that follows the first pause data-burst typically do not have a gap-length specified (gap-length = 0). ~~It should be noted that~~ For data-types that use Pa of the burst as the reference point, it is not necessary to differentiate between stream gaps and audio gaps; in this case, both are of the same length.

A gap may be filled with one single sequence of pause data-bursts with a single indication of audio gap-length. For example, a stream gap resulting from an audio gap of 768 samples long may be filled with one sequence of pause data-bursts with an indication of gap-length = 768 in the first pause data-burst.

If the data source does not have the information about the full audio gap length at the time the stream gap begins, it may signal an initial value for gap-length. If the data source then determines that the audio gap will be longer than the initial indication, another sequence of pause data-bursts may be initiated (following the first sequence by the repetition period) with another gap-length value to signal to the decoder that the audio gap is being extended. If the gap is further extended, additional sequences may be initiated. For example, a stream gap could be filled with a number of smaller sequences of pause data-bursts, with the first pause data-burst in each sequence indicating the gap-length bridged by that sequence (for example, one sequence with a gap-length of 256 samples, followed by a sequence with gap-length of 512, together bridging a gap of 768 sample periods).

The information about the full length of the audio gap in the first pause data-burst will allow the decoder the possibility to perform the best concealment.

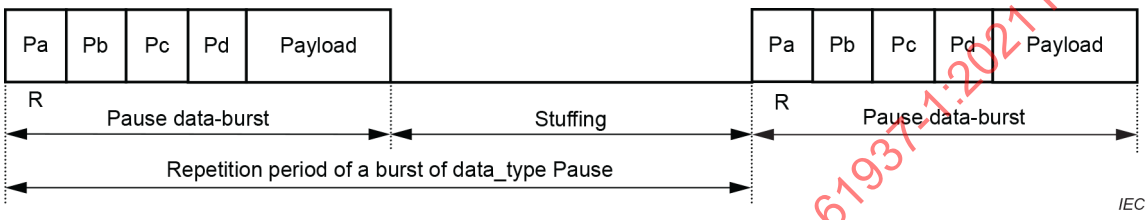


Figure 9 – Data-burst format of the data-type pause

The length of a gap is adjusted to be concealed completely with a sequence of pause data-bursts whose repetition periods are defined for each particular encoding system as indicated in ~~each~~ the other parts of IEC 61937. The repetition period of a pause data-burst gives the interval between Pa of a pause-burst and Pa of the next pause-burst.

The data-type-dependent info for pause data-bursts is given in Table 9 and Table 10.

Table 9 – Values of data-type-dependent info of the pause data-burst

Bits of Pc	Value	Contents
8 to 12	0	General use
	1	Stop, frame sequence discontinued
	2 to 31	Reserved
NOTE 1 A pause data-burst with data-type-dependent info set to 'general use' is used to fill a gap or preceding encoded audio bitstream. NOTE 2 Transmitters ~~may optionally~~ can use the STOP value to indicate that the transmission of the current encoded audio bitstream is interrupted. When stopped, the interface becomes idle.		

Table 10 – Burst-payload of pause data-burst

Bits of payload LSB ... MSB	Value	Contents	Remark
0 to 15	0	Not specified	Mandatory when data-type-dependent info = 1
	1	Reserved	
	2	Reserved	
	3 to 65 535	Gap-length	Gap length measured in number of IEC 60958 frames
16 to 31	0	Reserved	All '0'
NOTE Non-zero values for gap-length are optional.			

7.3 Audio data-bursts

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

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 the picture and the decoded audio.

The summary of the audio data-bursts is specified in IEC 61937-2.

7.4 Null data-burst

A null data-type is provided to be inserted occasionally if the interface is idle, to allow receivers that do not observe channel status bit 1 to determine if the interface is conveying PCM or non-linear PCM encoded audio. The contents of a data-burst with the data-type null are fixed (data-type = 00h). In a null data-burst, the length-code, error-flag, and data-type-dependent values are all set to '0h' (see Figure 10 and Table 11). The bit-stream-number is set to '7h'. When placed into an IEC 60958 subframe, the MSB of each burst-preamble word is placed into time-slot 27, the LSB into time-slot 12.

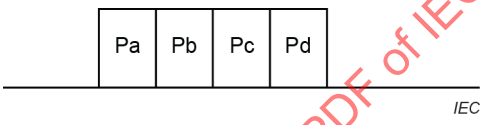


Figure 10 – Null data-burst

There is no requirement on the repetition period, but, when used, it is recommended that a null data-burst be inserted at least once every 4 096 sampling periods in case the interface is idle. This could potentially enhance reliable auto-detection of whether or not the subframe contents contain linear PCM audio or non-linear PCM bitstreams. The use of the null data-burst is optional.

Table 11 – Fields of a null data-burst

Burst-preamble word	Length of field	Contents	Value MSB … LSB
Pa	16-bit	Sync word 1	F872h
Pb	16-bit	Sync word 2	4E1Fh
Pc	16-bit	Burst-info	E000h
Pd	16-bit	Length-code	0000h

Annex A
(normative)

Channel status when IEC 60958 is used in consumer applications

The primary bit of interest in the channel status word is bit 1, which indicates whether the subframe contains PCM audio or data. This bit should be set to '1' to indicate non-linear PCM samples. Consumer applications may use this bit to determine if the IEC 60958 signal should be interpreted as stereo linear PCM audio or digital data. This bit can be used to protect audio devices from converting the non-linear PCM samples into audio.

The allocation of channel status bits of IEC 60958, when used to convey non-linear PCM encoded audio bitstreams, is shown in Table A.1.

Table A.1 – Allocation of the channel status bits

Bit number LSB ... MSB	Value LSB ... MSB	Comments
Bit 0	0	Consumer use
Bit 1	1	Audio sample word used for other purpose than linear PCM
Bit 2	0	Software for which copyright is asserted
	1	Software for which no copyright is asserted
Bit 3 to 5	000	Non-linear PCM audio samples, in accordance with IEC 60958
	010	Non-linear PCM audio samples, in accordance with IEC 60958 with simultaneous monaural linear PCM in accordance with Annex B
Bit 6 to 7	00	Mode 0
Bit 8 to 15	xxxxxxxL	Category code, Lbit
Bit 16 to 19	0000	Source number
Bit 20 to 23	0000	Channel number
~~Bit 24.. 31~~		~~Sampling frequency and clock accuracy (see IEC 60958-3)~~
~~Bit 32.. 191~~	~~All 0~~	~~As defined in IEC 60958-3~~
Bit 24 to 47		Sampling frequency, sampling frequency extension, clock accuracy, original sampling frequency, CGMS and audio sampling frequency coefficient (see IEC 60958-3)
Bit 48 to 60	All 0	As defined in IEC 60958-3 and IEC 60958-5
Bit 61 to 62	xx	Bitstream playback level (see Annex B)
Bit 63 to 191	All 0	As defined in IEC 60958-3 and IEC 60958-5

Some IEC 61937 data-types signal the IEC 60958 frame rate required for transmission using channel status bits 24 to 27 (sampling frequency) and bits 30 to 31 (sampling frequency extension) with valid level (I, II, or III) clock accuracy.

Annex B
(informative)

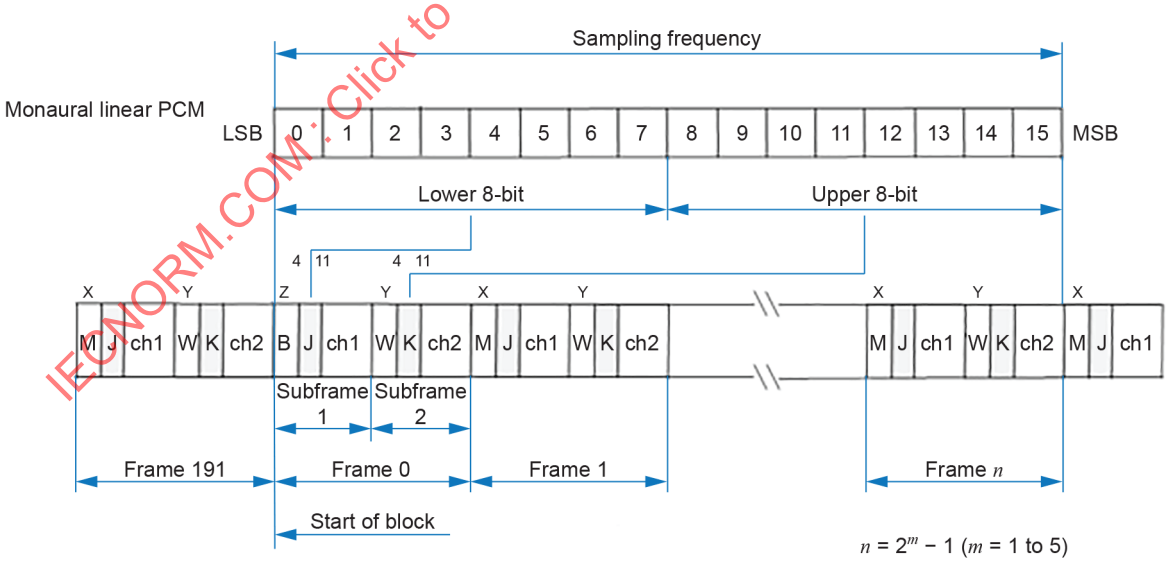
Monaural linear PCM audio sample simultaneous transferred with non-linear PCM encoded audio bitstream

This interface can usually only transfer the non-linear PCM encoded audio bitstreams. This interface can also transfer the monoaural linear PCM audio samples simultaneously transferred with the non-linear PCM encoded audio bitstreams, whose audio format is 1-ch (mono, centre channel) 16-bit linear PCM without pre-emphasis.

After transmission, the monaural linear PCM audio samples simultaneously transferred with a non-linear PCM encoded audio bitstream may be muted simultaneously when the non-linear PCM encoded audio bitstreams are muted. The decoded non-linear PCM encoded audio bitstream may be mixed with the simultaneously transmitted monaural linear PCM. Owing to unknown variations in decoder delay, the monaural linear PCM shall be treated as being asynchronous to the non-linear PCM encoded audio bitstream. The relationship between the audio sampling frequencies of the decoded compressed stream and the monaural linear PCM shall be an integer multiple of 2^i (i = 0 to 2).

The monaural linear PCM audio sample is transferred using time slots 4 to 11 (auxiliary field and unused data bits) of the IEC 60958 subframes. The least significant bit (LSB) of the monaural linear PCM audio sample is carried by time slot 4 of subframe 1. The most significant bit (MSB) of the monaural linear PCM audio sample is carried by time slot 11 of subframe 2.

A partial 8 bits of the monaural 16-bit linear PCM audio sample is carried by time slots 4 to 11. The lower 8-bit sample is carried by time slots 4 to 11 of subframe 1 in the first frame. The upper 8-bit sample is carried by time slots 4 to 11 of subframe 2 in the first frame; time slots 4 to 11 are not used because the monaural linear PCM audio sample is stuffed with zeros, as shown in Figure B.1.



J: time slots 4 to 11 (auxiliary field and unused data bits) of subframe 1
K: time slots 4 to 11 (auxiliary field and unused data bits) of subframe 2

IEC

Figure B.1 – Frame and block structure

In the case of the 48 kHz IEC 60958 frame rate, frame and block structure is shown in Figure B.2.

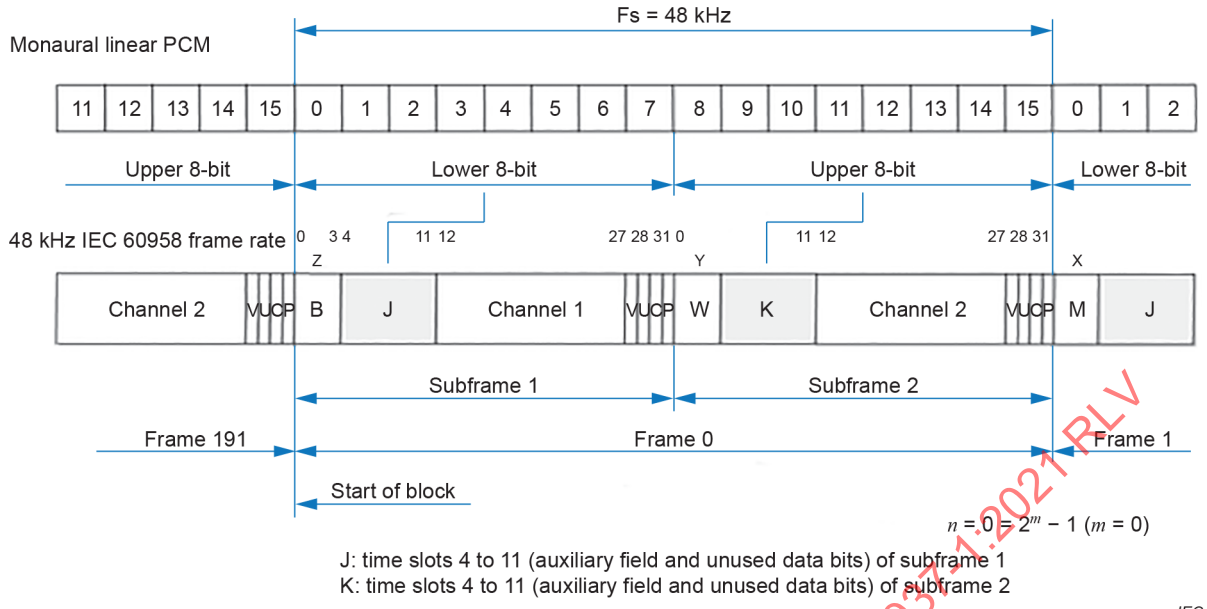


Figure B.2 – Example 1: frame and block structure at 48 kHz IEC 60958 frame rate

In the case of the 192 kHz IEC 60958 frame rate, frame and block structure is shown in Figure B.3.

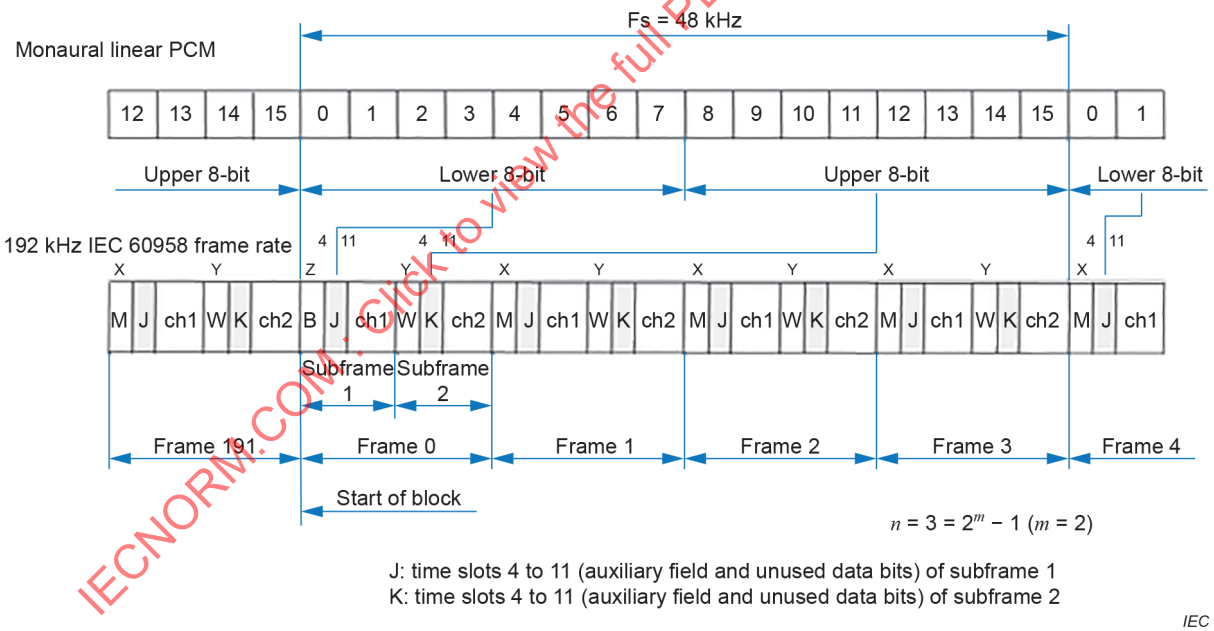


Figure B.3 – Example 2: frame and block structure at 192 kHz IEC 60958 frame rate

The sampling frequencies (f_s) for monaural linear PCM audio samples are 32 kHz, 44,1 kHz, or 48 kHz, the monaural linear PCM audio samples are transmitted at intervals in accordance with the IEC 60958 frame rate for the non-linear PCM encoded audio bitstreams. The embedded-frame interval (2^m, m = 0 to 5) is the IEC 60958 frame rate for the non-linear PCM audio bitstreams divided by the sampling frequency (f_s) for monaural linear PCM, so that the sampling frequency (f_s) for the monaural linear PCM transmitted simultaneously becomes the same frequency; the sampling frequency (f_s) for the monaural linear PCM audio samples corresponds to $1/2^m$ (m = 0 to 5) of the IEC 60958 frame rate for the non-linear PCM encoded audio bitstreams. Table B.1 indicates the relationship between the sampling frequency for the monaural linear PCM audio samples and the IEC 60958 frame rate for the non-linear PCM encoded audio bitstreams.

Table B.1 – Relationship between sampling frequency for monaural linear PCM and IEC 60958 frame rate for non-linear PCM

	Non-linear PCM (bitstream)		Monaural linear PCM (L-PCM)	
	IEC 60958 frame rate		Sampling frequency	Embedded-frame interval
m	$2^m \times f_s$ (m = 0 to 5)		f_s	2^m (m = 0 to 5)
0	f_s	32 kHz	32 kHz	1 frame
1	$2 \times f_s$	64 kHz		2 frames
2	$4 \times f_s$	128 kHz		4 frames
3	$8 \times f_s$	256 kHz		8 frames
4	$16 \times f_s$	512 kHz		16 frames
5	$32 \times f_s$	1 024 kHz		32 frames
0	f_s	44,1 kHz	44,1 kHz	1 frame
1	$2 \times f_s$	88,2 kHz		2 frames
2	$4 \times f_s$	176,4 kHz		4 frames
3	$8 \times f_s$	352,8 kHz		8 frames
4	$16 \times f_s$	705,6 kHz		16 frames
5	$32 \times f_s$	1 411,2 kHz		32 frames
0	f_s	48 kHz	48 kHz	1 frame
1	$2 \times f_s$	96 kHz		2 frames
2	$4 \times f_s$	192 kHz		4 frames
3	$8 \times f_s$	384 kHz		8 frames
4	$16 \times f_s$	768 kHz		16 frames
5	$32 \times f_s$	1 536 kHz		32 frames
The monaural linear PCM signal can require up-sampling by 2× or 4× to match the decoded non-linear PCM signal sampling frequency before mixing the two signals.				

It is recommended that the playback level of all the decoded bitstreams of the IEC 61937 audio channels compared to the embedded monoaural linear PCM be indicated by channel status bits 61 and 62.

Bits 61 to 62 bitstream playback level

Bit	61	62	
State	"0	0"	no information
	"1	0"	0 dB
	"0	1"	−10 dB playback to be attenuated
	"1	1"	replace the centre channel signal of the decoded IEC 61937 bitstream with the embedded monoaural linear PCM signal.

This bitstream playback level sometimes happens to be changed dynamically within a streaming content to temporarily draw attention to the reproduction of the monoaural linear PCM signal.

~~Bibliography~~

~~IEC 61603 (all parts), *Transmission of audio and/or video and related signals using infra-red radiation*~~

~~IEC 61883-6:2005, *Consumer audio/video equipment – Digital interface – Part 6: Audio and music data transmission protocol*~~

~~IEC 62105:1999, *Digital audio broadcast system – Specification of the receiver data interface (RDI)*~~

~~SMPTE 337M, *Format for Non-PCM Audio and Data in an AES3 Serial Digital Audio Interface*~~

~~SMPTE 339M, *Format for Non-PCM Audio and Data in an AES3 – Generic Data Types*~~

~~SMPTE 340M, *Format for Non-PCM Audio and Data in an AES3 – ATSC A/52 (AC-3) Data type*~~

~~ETSI TS 102 366, *Digital Audio Compression (AC-3, Enhanced AC-3) Standard*~~

~~ATSC Standard A/52B, *Digital Audio Compression Standard (AC-3, E-AC-3) Revision B*~~

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Digital audio – Interface for non-linear PCM Encoded audio bitstreams applying IEC 60958 – Part 1: General

Audionumérique – Interface pour les flux de bits audio à codage MIC non linéaire selon l'IEC 60958 – Partie 1: Généralités

IEC 61937-1:2021-02(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 1: General

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 61937-1 has been prepared by technical area 20: Analogue and digital audio, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

This third edition cancels and replaces the second edition published in 2007, and amendment 1 published in 2011. This edition constitutes a technical revision.

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

a) Activation of Pe field;
b) Enhanced usage of channel status bits.
c) Addition of Annex B.

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

Draft	Report on voting
100/3447/CDV	100/3522/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The list of all the parts of IEC 61937, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

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

Part 1: General

1 Scope

This part of IEC 61937 applies to the digital audio interface using the IEC 60958 series for the conveying of non-linear PCM encoded audio bitstreams.

It describes the way in which this digital interface can be used in consumer applications.

The professional mode is not considered within the scope of this document.

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

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

IEC 60958-5, *Digital audio interface – Part 5: Consumer application enhancement*

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

3 Terms, definitions, and presentation

For the purposes of this document, the following terms, definitions, and presentation convention 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 data-burst
data-burst with an encoded audio frame as burst-payload

3.1.2
audio data-word
16-bit data word

3.1.3
audio frame
fixed number of audio samples

Note 1 to entry: The number of samples in an audio frame is dependent on the particular encoding system that is used to encode the audio frame into the encoded audio frame.

3.1.4
audio gap
period in the sequence of baseband audio samples where valid samples of audio are not available

3.1.5
bitstream
non-linear PCM encoded audio source, represented in a sequence of bits

Note 1 to entry: In this interface, the bitstream consists of a sequence of data-bursts.

3.1.6
data-burst
packet of data, including the burst-preamble, to be transmitted across the interface

3.1.7
burst-payload
information content of the data-burst

3.1.8
burst-preamble
header for the data-burst, containing synchronization, and information about the data contained in the burst-payload

3.1.9
data-type
reference to the type of payload of the data-bursts

3.1.10
encoded audio frame
minimum decodable unit of an encoded data sequence

Note 1 to entry: Each encoded audio frame is the encoded representation of a fixed number of audio samples (for each original audio channel). The number of samples that are encoded into an encoded audio frame depends on the particular encoding system that is used to encode the audio frame into the encoded audio frame.

3.1.11
idle
state in which the interface is not used to convey any sequence of data-bursts or PCM data

Note 1 to entry: The channel status data is still active (bit b1 is set to '1' when further non-linear PCM encoded audio is anticipated; see Figure 7).

3.1.12
length-code
code indicating the length of the data-burst-payload in bits, bytes or 8-byte units

3.1.13
repetition period
period between the reference point of the current data-burst and the reference point of the immediately following data-burst of the same data-type

3.1.14
sampling frequency
sampling frequency of the encoded PCM audio samples (i.e. before encoding and after decoding)

3.1.15
sampling period
time period related to the sampling frequency of the PCM audio samples, represented in the encoded bitstream

3.1.16
stuffing
occupying the unused data capacity of the interface

3.1.17
stuffing subframe
occupying the unused data capacity in 16-bit audio data words

3.1.18
stream gap
period within the encoded audio bitstream without any audio frame; a discontinuity in the bitstream

Note 1 to entry: Typically, a stream gap will occur between encoded audio frames.

3.2 Presentation convention

3.2.1
F872h
value 'F872' in hexadecimal format

4 General description

The format of the IEC 60958 interface consists of a sequence of IEC 60958 subframes. Each IEC 60958 subframe is normally used to carry one linear PCM sample, but may also be used to convey data. The non-linear PCM encoded audio bitstreams to be transported over this interface are formed into a sequence of data-bursts.

Each data-burst consists of a 64-bit burst-preamble, followed by the burst-payload. The burst-preamble consists of a sync-word, information about the burst-payload and a bitstream-number.

The interface may convey one or more bitstreams. Each type of bitstream may impose a particular requirement for the repetition period for the data-bursts that make up the bitstream (see Clause 7).

The 16 bits of a data-burst are placed in time-slots 12 to 27 of an IEC 60958 subframe. Both odd and even IEC 60958 subframes (channel 1, channel 2) are simultaneously used to carry 32 bits of data. This allows IEC 60958, in the consumer mode, to convey either two-channel linear PCM audio, or a set of non-linear PCM encoded bitstreams (alternating data words), but not both simultaneously.

5 Interface format

The interface format as defined in IEC 60958-1 and IEC 60958-3 is used.

6 Mapping of the audio bitstream on to IEC 60958

6.1 Coding of the bitstream

6.1.1 General

The non-linear PCM encoded audio bitstream is transferred using the basic 16-bit data area of the IEC 60958 subframes, i.e. in time-slots 12 to 27 (see Figure 1 and Table 1). Because the non-linear PCM encoded audio bitstream to be transported is at a lower data rate than that supported by the IEC 60958 interface, the audio bitstream is broken into a sequence of discrete data-bursts, and stuffing between the data-bursts is necessary (see 6.3).

Each data-burst contains data of an encoded audio frame that is the encoded representation of a fixed number of audio samples per PCM audio channel. The number of samples to be encoded into an encoded audio frame depends on the particular encoding system.

It is possible for this interface to simultaneously convey multiple non-linear PCM encoded audio bitstreams. One of the applications of this capability would be to convey both a main audio service and an associated audio service.

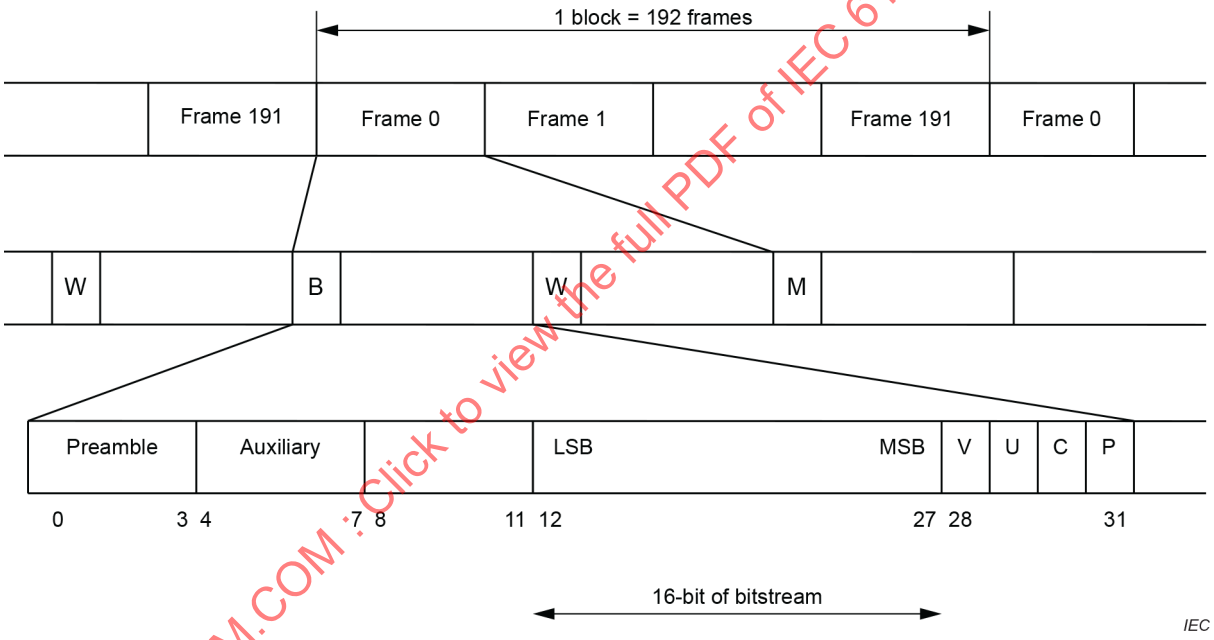

Figure 1 – IEC 60958 interface format

Table 1 – Bit allocation of the IEC 60958 frame

Field	IEC 60958 time-slot	Value
0 to 3	Preamble	IEC 60958 preamble
4 to 7	Auxiliary field	Not used, all "0" or partial of linear PCM
8 to 11	Unused data bits	Not used, all "0" or partial of linear PCM
12 to 27	16-bit data	Sections of the bitstream
28	Validity flag	According to IEC 60958
29	User data	According to IEC 60958
30	Channel status	According to IEC 60958
31	Parity bit	According to IEC 60958

6.1.2 Bit map of bitstream

The method of placing the data into the IEC 60958 bitstream is to format the data to be transmitted into data-bursts and to send each data-burst in a continuous sequence of IEC 60958 frames (see Table 2).

Table 2 – Bit allocation of data-burst in IEC 60958 subframes

Subframe	Bit of subframes				
	MSB				LSB
	b27	b26	b25 ..... b14	b13	b12
Frame 0; subframe B or M	0	1		14	15
Frame 0; subframe W	16	17		30	31
Frame 1; subframe B or M	32	33		46	47
Frame 1; subframe W	48	49		62	63
Frame 2; subframe B or M	64	65		78	79
----------			----------		
Last subframe B or M of data-burst	n – 32	n – 31		n – 18	n – 17
Last subframe W of data-burst	n – 16	n – 15		n – 2	n – 1

Considering the data within an IEC 60958 subframe as a 16-bit word out of a serial stream of bits, the first bit of the burst-payload in a data-burst would occupy the MSB of subframe 1 (time-slot 27), and the 32nd bit would occupy the LSB (or what would be the LSB for 16-bit PCM audio) of subframe 2 (time-slot 12). The next 32 bits of the burst-payload would occupy the next IEC 60958 frame. The last data bits of the audio data-burst might occupy only a fraction of the last frame. Any unused bits in the last frame will be ignored by the receiver. In the case where the audio data-burst contains a multiple of 16 bits, all used IEC 60958 sub-frames are completely filled. When it is not a multiple of 16 bits, the bits of the burst-payload to be conveyed in the last IEC 60958 subframe will be MSB aligned; the remaining bits shall be stuffed with zeros.

6.1.3 IEC 60958 validity flag

It is recommended to set the validity bit to a logical '1'. This is intended to prevent accidental decoding of non-audio data to analogue before a complete channel status block is received.

6.1.4 IEC 60958 channel status bit 1

The purpose of channel status bit 1 is to indicate if IEC 60958 is used to convey linear PCM or to indicate that the interface is used for other purposes (see Annex A). This bit shall be set to '1' when IEC 60958 is used to convey non-linear PCM encoded audio bitstreams.

6.1.5 Symbol frequency

When the IEC 60958 bitstream conveys linear PCM audio, the symbol frequency is 64 times the PCM sampling frequency (32 time-slots per PCM sample, times two channels). When a non-linear PCM encoded audio bitstream is conveyed by the interface, the symbol frequency is normally 64 times the sampling rate of the encoded audio within that bitstream, and other times should be referred to each parts of IEC 61937.

6.1.6 The format of the data-bursts

Each data-burst contains a burst-preamble consisting of four 16-bit words (Pa, Pb, Pc and Pd) followed by the burst-payload that contains data of an encoded audio frame (see Figure 2).

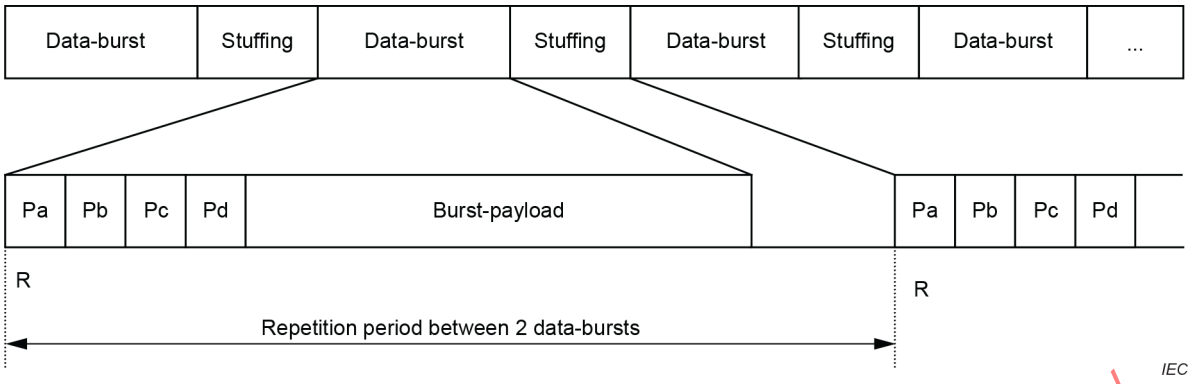

Figure 2 – Data-burst format

The repetition period of these bursts is defined as the length between the reference points R (measured in IEC 60958 frames) of one data-burst and the next data-burst (with the same bit-stream-number). The data representing each individual encoded audio frame is typically specified to be packaged into a single individual data-burst, with a repetition period (measured in IEC 60958 frames) for that data-burst equal to the number of encoded audio samples of each channel contained within that encoded audio frame.

It is possible for a number of data-bursts representing multiple bitstreams to be interleaved on the interface. When more than one non-linear PCM encoded audio bitstreams are transmitted through the same interface, the audio sampling rates of these bitstreams are identical to each other.

6.1.7 Burst-preamble

The burst-preamble consists of four mandatory fields. Pa and Pb represent a synchronization word. Pc gives information about the type of data, and some information/control for the receiver. Pd gives the length of the burst-payload, limited to 65 535 bits if the length of Pd is given in bits, limited to 65 535 bytes if the length of Pd is given in bytes, or limited to 524 280 bytes if the length of Pd is given in 8-byte units.

The four preamble words are contained in two sequential IEC 60958 frames (see Figure 3). The frame beginning the data-burst contains preamble word Pa in subframe 1, and Pb in subframe 2. The next frame contains Pc in subframe 1 and Pd in subframe 2. When placed into an IEC 60958 subframe, the MSB of a 16-bit burst-preamble word is placed into time-slot 27 and the LSB is placed into time-slot 12 (see Table 3 and Table 4).

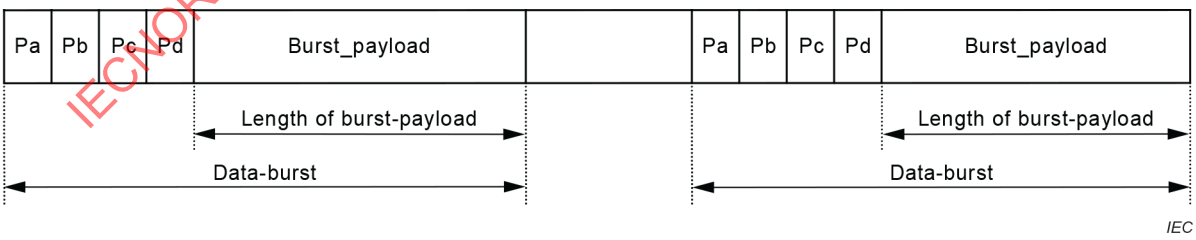

Figure 3 – Burst-preamble

Table 3 – Burst-preamble words

Preamble word	Length of field	Contents	Value MSB ... LSB
Pa	16-bit	Sync word 1	F872h
Pb	16-bit	Sync word 2	4E1Fh
Pc	16-bit	Burst-info	Table 5
Pd	16-bit	Length-code	Number of bits, number of bytes or number of 8-byte units according to data-type

Table 4 – Bit map of burst-preambles

IEC 60958 time-slot bit-number	27															12
Preamble bit-number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Pa	1	1	1	1	1	0	0	0	0	1	1	1	0	0	1	0
Pb	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1	1
Pc	In accordance with Table 5, burst-info values Pc, bit 15 = MSB															
Pd	Length-code, bit 15 = MSB															

6.1.8 Burst-info

6.1.8.1 General

The 16-bit burst-info contains information about the data that is found in the data-burst.

Table 5 – Fields of burst-info

Bits of Pc	Value	Contents	Remark
0 to 6		Data-type	See IEC 61937-2
7	0	Error flag indicating a valid burst-payload	
	1	Error flag indicating that this burst-payload is not valid	
8 to 12		Data-type-dependent info	
13 to 15	0	Bitstream-number	
NOTE The repetition period of pause data-bursts depends on the application in which IEC 60958 is used to convey encoded audio bitstreams.			

6.1.8.2 Data-type

The 7-bit data-type is defined in bits 0 to 6 of the burst-preamble Pc (see Table 5), bit 6 is the MSB. This data-type field indicates the format of the burst-payload, which will be conveyed in the data-burst. Typical properties of a data-type are the reference point and repetition period of the burst, which is the number of sampling periods of the audio between the reference point of the current data-burst and the reference point of the next data-burst. The reference point is inherently defined for each data-type.

The allocation of data-types is defined in IEC 61937-2. The data-types themselves are specified in the other parts of IEC 61937.

6.1.8.3 Extended data-type

6.1.8.3.1 General

When the burst-info Pc is equal to 1Fh (data-type = 31), the burst-preamble is extended with Pe and Pf. Figure 4 shows a burst-preamble with an extended preamble. Pe and Pf are included in the length of the burst-payload. The third frame of the IEC 60958 frames contains Pe in subframe 1 and Pf in subframe 2 (see Table 6, Table 7 and Table 8).

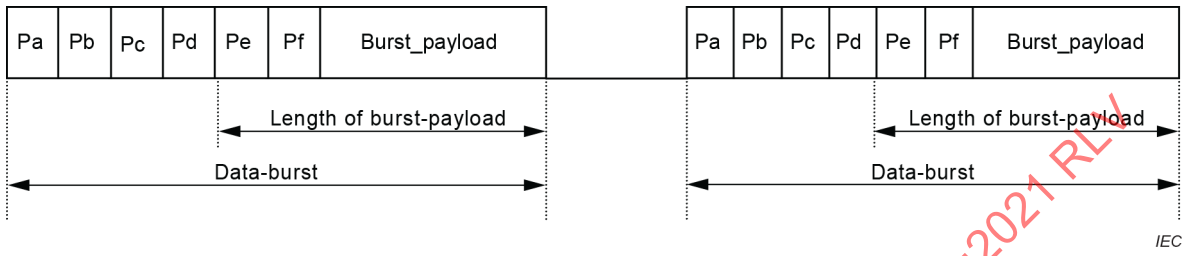

Figure 4 – Burst-preamble with extended preamble

Table 6 – Burst-preamble words

Preamble word	length of field	Contents	Value MSB ... LSB
Pa	16-bit	Sync word 1	F872h
Pb	16-bit	Sync word 2	4E1Fh
Pc	16-bit	Burst-info	Table 5
Pd	16-bit	Length-code	Number of bits, number of bytes or number of 8-byte units according to data-type
Pe (conditional)	16-bit	Extended data-type	Table 7
Pf (conditional)	16-bit	Reserved for future use	Table 8

6.1.8.3.2 Fields of Pe

Table 7 – Fields of Pe (extended data-type)

Bits of Pe	Value	Contents	Remark
0 to 15	0 to 65 535	Extended data-type	See IEC 61937-2

The allocation of extended data-types is defined in IEC 61937-2. The extended data-types themselves are specified in the following parts of IEC 61937.

6.1.8.3.3 Fields of Pf

Table 8 – Fields of Pf

Bits of Pf	value	Contents
0 to 15	0 to 65 535	Reserved for future use

6.1.8.4 Error-flag

The error-flag bit is available to indicate if the contents of the data-burst contain data errors. If a data-burst is thought to be error-free, or if the data source does not know if the data contains errors, then the value of this bit is set to a '0'. If the data source does know that a particular data-burst contains some errors, this bit may be set to a '1'. The use of this bit by receivers is optional.

6.1.8.5 Data-type-dependent info

The meaning of the 5-bit data-type-dependent info depends on the value of the data-type (see 7.2).

6.1.8.6 Bitstream-number

The 3-bit bitstream-number indicates to which bitstream the data-burst belongs. Eight codes (0 to 7) are available so that up to eight independent bitstreams may be multiplexed in one bitstream in a time multiplex. Each independent bitstream shall use a unique bitstream-number. The MSB of the bit-stream-number is placed in bit number 15.

The following constraints apply. If a single bitstream is carried, the value of the bitstream-number is 0h. In the case where a main audio service and an associated audio service are placed into this interface, the main service audio data-burst has its bitstream number set to '0h'.

If a receiver is only capable of selecting and processing a single bitstream, it receives and processes bitstream-number 0h. The bitstream with bitstream-number 0h thus has the highest priority and should carry the most important data.

The data-type within a bitstream can change, but the bitstream-number is constant for a bitstream. For example, the pause data-burst used to bridge a stream gap between the data-burst of an audio type contains the same bitstream-number.

6.1.9 Length-code

The length-code indicates the number of bits, bytes or 8-byte units according to the data-type within the data-burst, from 0 to 65 535. The size of the Pa, Pb, Pc and Pd is not counted in the value of the length-code. In other words, the length-code indicates the number of bits of the burst-payload in bits, plus the conditional lengths of Pe and Pf (see Figure 4), or the number of bytes of the burst-payload in bytes, plus the conditional lengths of Pe and Pf, if they exist, or the number of 8-byte units of the burst-payload in bytes, plus the conditional lengths of Pe and Pf if they exist.

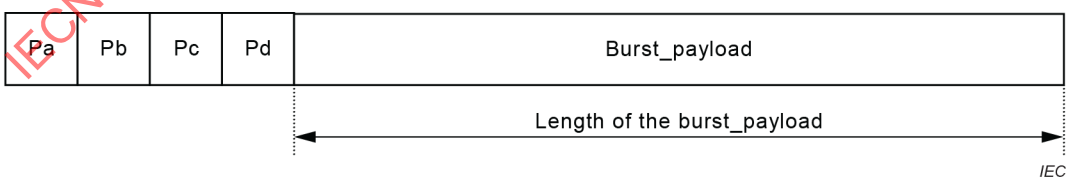

Figure 5 – Length of the burst-payload specified by Pd

6.2 Burst-payload

The format of the burst-payload is specified by means of the data-type in preamble Pc and is used to convey the information content. The data-bursts of several data-types are specified in IEC 61937-2.

6.3 Stuffing

6.3.1 General

Not all bits are occupied during the transfer of data-bursts (see Figure 2). In the case where the audio data-burst contains a multiple of 16 bits, all IEC 60958 subframes used are completely filled.

6.3.2 Stuffing within an IEC 60958 subframe

In the case where the audio data-burst does not contain a multiple of 16-bit, the bits of the burst-payload to be conveyed in the last 16-bit data word shall be MSB aligned, and the remaining bits of that subframe are set to '0' (stuffing).

6.3.3 Stuffing between data-bursts

An unoccupied space between two data-bursts shall be stuffed with 16-bit data words, which are set to all '0's.

6.3.4 Burst spacing

The following feature allows equipment reliably to detect whether the IEC 60958 signal is conveying PCM or non-linear PCM data without relying on bit 1 of the channel status (see Annex A). Four IEC 60958 subframes that have the contents of time slots 12 to 27 all set to '0' shall be inserted between every data-burst.

All these four '0' subframes with Pa and Pb will behave as an extended 96-bit sync code. In the case of PCM transmission, the false occurrence of the sync code will be extremely small. When the interface is not in the idle state, this requirement is automatically fulfilled unless there are sequences of data-bursts so tightly packed that there is never a sequence of all four '0' subframes preceding any Pa (see Figure 6).

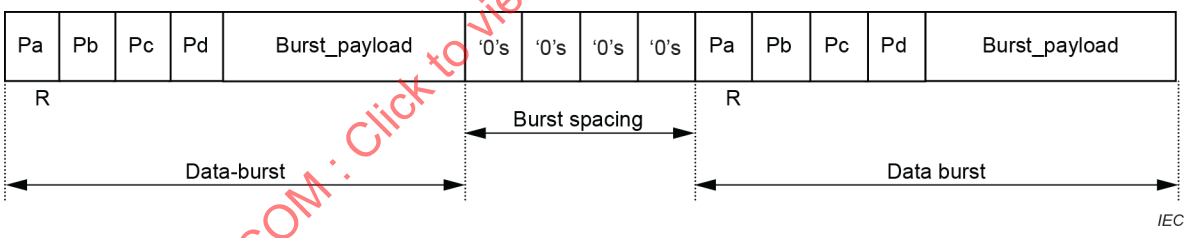

Figure 6 – Burst spacing

7 Format of data-bursts

7.1 General

Data-types are categorized into three classes: audio data-burst, pause data-burst and null data-burst. The type of the burst-payload is normally indicated by bits 0 to 6 and 8 to 12 fields of Pc. Repetition periods apply to all data-types except for the null data-type.

In cases where the IEC 60958 interface is idle, i.e. it is not used to convey any data but is anticipating transmission of the non-linear PCM audio bitstream, channel status bit 1 is kept as '1' (see Annex A). Null data-bursts may be transferred to assist some receivers (which do not observe channel status bit 1) in switching from non-linear PCM mode to linear PCM mode unexpectedly (see 7.3).

In cases where the interface is used to convey non-linear PCM audio bitstreams, the bitstream is broken into discrete data-bursts and stuffing is necessary between the data-bursts (see 6.3.3). If gaps occur within the bitstreams, these stream gaps are filled with bursts of the pause data-type.

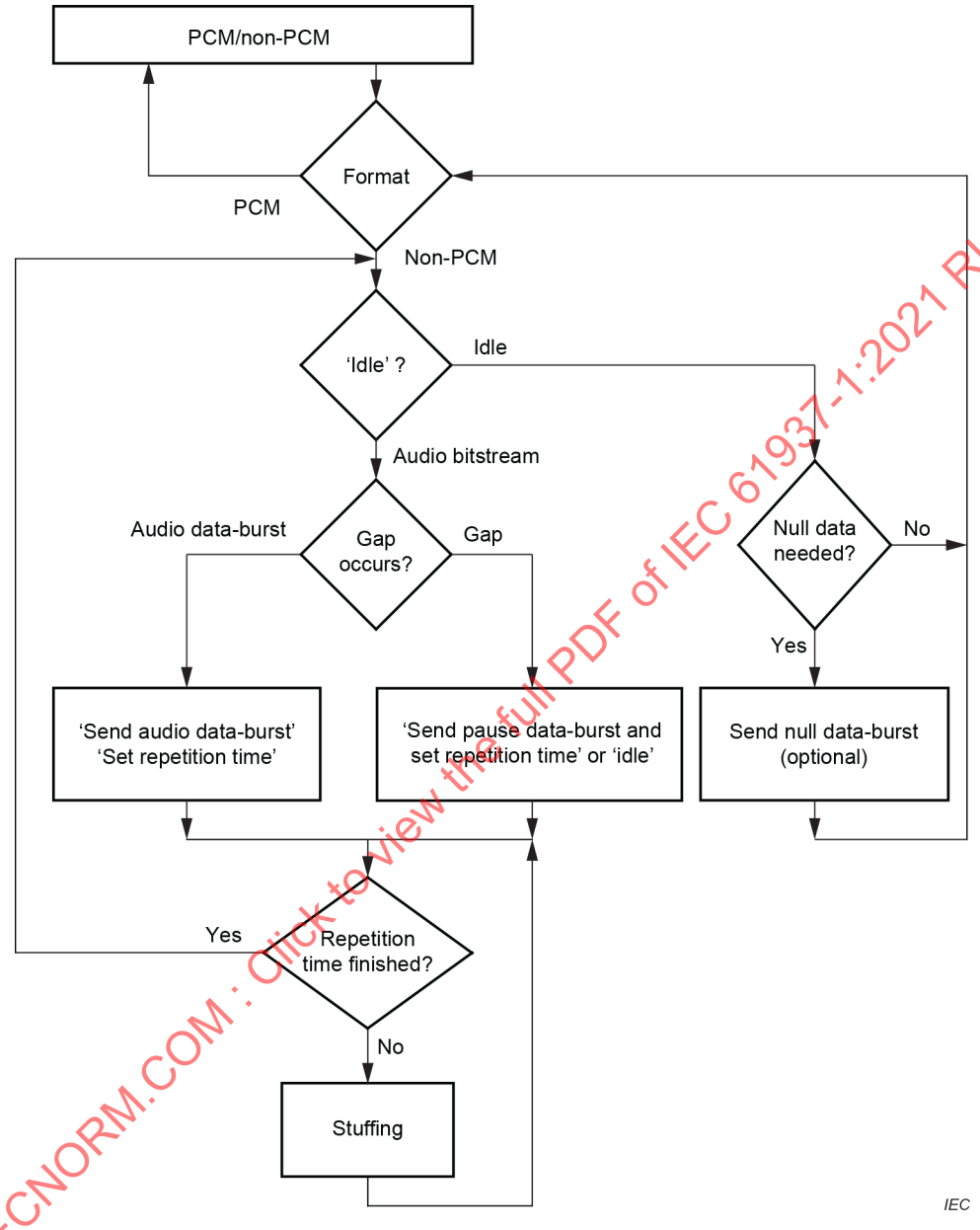

Figure 7 – Flow chart of transmission of a bitstream

7.2 Pause data-burst

Occasionally, stream gaps can occur between two audio data-bursts of a non-linear PCM encoded audio owing to switching between bitstreams in a transmitter. When a stream gap exists in the encoded audio bitstream, an audio gap will exist in the decoded audio signal. Pause data-bursts are intended to be used to fill the stream gaps. As indicated in Figure 8, pause data-bursts (Ps) are located with the repetition period of the pause data-burst. The reference point R of a pause data-burst is bit 0 of its Pa, and it follows immediately after the stuffing, which follows the previous audio data-burst. (The length of the audio data-burst with stuffing is the repetition period of the audio data-burst.) If an unoccupied space exists following a pause data-burst, it is stuffed with all '0's (see 6.3.3).

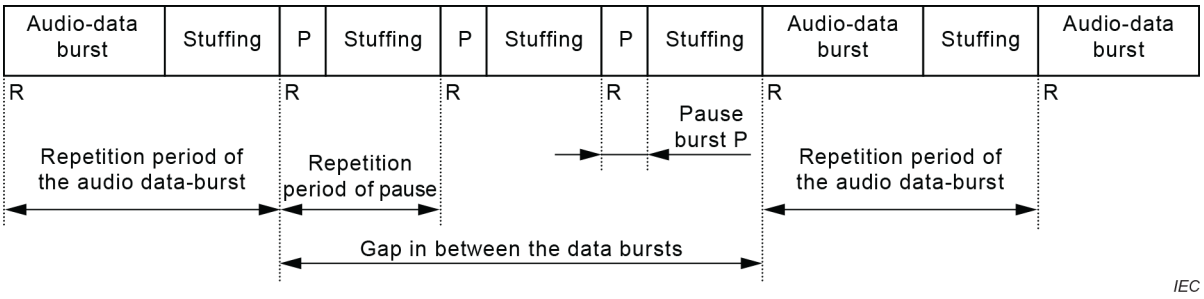

Figure 8 – Bridging gaps in-between data-bursts with three pause data-bursts

Pause data-bursts convey information to the audio decoder that a stream gap exists. The pause data-bursts may also indicate either the actual length of the audio gap, or that the non-linear PCM audio data stream has stopped. This information can be used by the audio decoder to minimize (or conceal) the existence of the audio gap, or in the case where the bitstream stops, to trigger a fade-out of the audio. A sequence of pause data-bursts can also assist decoder synchronization prior to the beginning of a non-linear PCM audio bitstream. A short sequence of pause data-bursts can be sent immediately preceding the transmission of the first audio data-burst.

The pause data-burst shall be transferred with the same bitstream-number as the bitstream-number of the audio data stream which contains the stream gap to be filled with the pause data-bursts, or for which synchronization is being assisted. In the case where a main audio service bitstream and one or more associated audio service bitstreams are interleaved on the interface, the pause data-bursts shall have the same bit-stream-number as the main audio service. The pause data-burst is only used to fill the stream gaps between data-bursts of the main audio service bitstreams.

The pause data-burst contains the burst-preamble and a 32-bit payload (see Figure 9). The first 16-bit of the payload contains the audio gap-length parameter. The remaining bits are reserved and are all set to '0'. The audio gap-length parameter is an optional indication of the actual audio gap length. This is the length, measured in sampling periods of the audio, between the anticipated reference point of the next audio burst (based on the repetition period for that data-type – see Table 5), and the actual reference point of the next audio data-burst. In the case of audio with normal sampling rate, this length is equal to the number of PCM audio samples which would be missing in the decoded output signal (in the case of half sampling-rate audio, the number of PCM audio samples in the audio gap will be twice the value indicated by the gap-length parameter). For the data-types with Pa as a reference point, this length is equal to the length, measured in sampling periods of the audio, between the first bit of Pa of the first pause data-burst and the first bit of Pa of the next audio data-burst. The inclusion of non-zero values of gap-length is optional; data sources are not required to indicate the length of the audio gap.

The detailed use of the pause data-burst is dependent on the data-type of the audio data-burst. The gap-length parameter of the first pause data-burst of the sequence may be used to indicate the length of the audio gap that will occur owing to the stream gap. The pause data-bursts in the sequence that follows the first pause data-burst typically do not have a gap-length specified (gap-length = 0). For data-types that use Pa of the burst as the reference point, it is not necessary to differentiate between stream gaps and audio gaps; in this case, both are of the same length.

A gap may be filled with one single sequence of pause data-bursts with a single indication of audio gap-length. For example, a stream gap resulting from an audio gap of 768 samples long may be filled with one sequence of pause data-bursts with an indication of gap-length = 768 in the first pause data-burst.

If the data source does not have the information about the full audio gap length at the time the stream gap begins, it may signal an initial value for gap-length. If the data source then determines that the audio gap will be longer than the initial indication, another sequence of pause data-bursts may be initiated (following the first sequence by the repetition period) with another gap-length value to signal to the decoder that the audio gap is being extended. If the gap is further extended, additional sequences may be initiated. For example, a stream gap could be filled with a number of smaller sequences of pause data-bursts, with the first pause data-burst in each sequence indicating the gap-length bridged by that sequence (for example, one sequence with a gap-length of 256 samples, followed by a sequence with gap-length of 512, together bridging a gap of 768 sample periods).

The information about the full length of the audio gap in the first pause data-burst will allow the decoder the possibility to perform the best concealment.

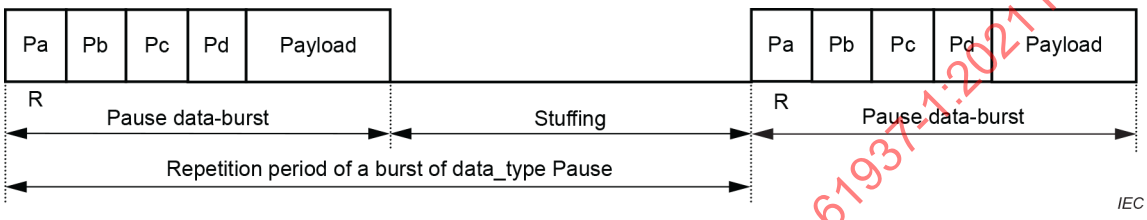

Figure 9 – Data-burst format of the data-type pause

The length of a gap is adjusted to be concealed completely with a sequence of pause data-bursts whose repetition periods are defined for each particular encoding system as indicated in the other parts of IEC 61937 The repetition period of a pause data-burst gives the interval between Pa of a pause-burst and Pa of the next pause-burst.

The data-type-dependent info for pause data-bursts is given in Table 9 and Table 10.

Table 9 – Values of data-type-dependent info of the pause data-burst

Bits of Pc	Value	Contents
8 to 12	0	General use
	1	Stop, frame sequence discontinued
	2 to 31	Reserved
NOTE 1 A pause data-burst with data-type-dependent info set to 'general use' is used to fill a gap or preceding encoded audio bitstream. NOTE 2 Transmitters can use the STOP value to indicate that the transmission of the current encoded audio bitstream is interrupted. When stopped, the interface becomes idle.		

Table 10 – Burst-payload of pause data-burst

Bits of payload LSB ... MSB	Value	Contents	Remark
0 to 15	0	Not specified	Mandatory when data-type-dependent info = 1
	1	Reserved	
	2	Reserved	
	3 to 65 535	Gap-length	Gap length measured in number of IEC 60958 frames
16 to 31	0	Reserved	All '0'
NOTE Non-zero values for gap-length are optional.			

7.3 Audio data-bursts

Specific properties such as reference points, repetition period, the method of filling stream gaps, and decoding latency are specified for each data-type.

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 the picture and the decoded audio.

The summary of the audio data-bursts is specified in IEC 61937-2.

7.4 Null data-burst

A null data-type is provided to be inserted occasionally if the interface is idle, to allow receivers that do not observe channel status bit 1 to determine if the interface is conveying PCM or non-linear PCM encoded audio. The contents of a data-burst with the data-type null are fixed (data-type = 00h). In a null data-burst, the length-code, error-flag, and data-type-dependent values are all set to '0h' (see Figure 10 and Table 11). The bit-stream-number is set to '7h'. When placed into an IEC 60958 subframe, the MSB of each burst-preamble word is placed into time-slot 27, the LSB into time-slot 12.

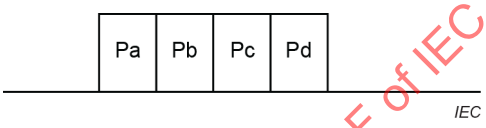

Figure 10 – Null data-burst

There is no requirement on the repetition period, but, when used, it is recommended that a null data-burst be inserted at least once every 4 096 sampling periods in case the interface is idle. This could potentially enhance reliable auto-detection of whether or not the subframe contents contain linear PCM audio or non-linear PCM bitstreams. The use of the null data-burst is optional.

Table 11 – Fields of a null data-burst

Burst-preamble word	Length of field	Contents	Value MSB ... LSB
Pa	16-bit	Sync word 1	F872h
Pb	16-bit	Sync word 2	4E1Fh
Pc	16-bit	Burst-info	E000h
Pd	16-bit	Length-code	0000h

Annex A
(normative)

Channel status when IEC 60958 is used in consumer applications

The primary bit of interest in the channel status word is bit 1, which indicates whether the subframe contains PCM audio or data. This bit should be set to '1' to indicate non-linear PCM samples. Consumer applications may use this bit to determine if the IEC 60958 signal should be interpreted as stereo linear PCM audio or digital data. This bit can be used to protect audio devices from converting the non-linear PCM samples into audio.

The allocation of channel status bits of IEC 60958, when used to convey non-linear PCM encoded audio bitstreams, is shown in Table A.1.

Table A.1 – Allocation of the channel status bits

Bit number LSB ... MSB	**Value** LSB ... MSB	**Comments**
Bit 0	0	Consumer use
Bit 1	1	Audio sample word used for other purpose than linear PCM
Bit 2	0	Software for which copyright is asserted
	1	Software for which no copyright is asserted
Bit 3 to 5	000	Non-linear PCM audio samples, in accordance with IEC 60958
	010	Non-linear PCM audio samples, in accordance with IEC 60958 with simultaneous monaural linear PCM in accordance with Annex B
Bit 6 to 7	00	Mode 0
Bit 8 to 15	xxxxxxxL	Category code, Lbit
Bit 16 to 19	0000	Source number
Bit 20 to 23	0000	Channel number
Bit 24 to 47		Sampling frequency, sampling frequency extension, clock accuracy, original sampling frequency, CGMS and audio sampling frequency coefficient (see IEC 60958-3)
Bit 48 to 60	All 0	As defined in IEC 60958-3 and IEC 60958-5
Bit 61 to 62	xx	Bitstream playback level (see Annex B)
Bit 63 to 191	All 0	As defined in IEC 60958-3 and IEC 60958-5

Some IEC 61937 data-types signal the IEC 60958 frame rate required for transmission using channel status bits 24 to 27 (sampling frequency) and bits 30 to 31 (sampling frequency extension) with valid level (I, II, or III) clock accuracy.

Annex B
(informative)

Monaural linear PCM audio sample simultaneous transferred with non-linear PCM encoded audio bitstream

This interface can usually only transfer the non-linear PCM encoded audio bitstreams. This interface can also transfer the monoaural linear PCM audio samples simultaneously transferred with the non-linear PCM encoded audio bitstreams, whose audio format is 1-ch (mono, centre channel) 16-bit linear PCM without pre-emphasis.

After transmission, the monaural linear PCM audio samples simultaneously transferred with a non-linear PCM encoded audio bitstream may be muted simultaneously when the non-linear PCM encoded audio bitstreams are muted. The decoded non-linear PCM encoded audio bitstream may be mixed with the simultaneously transmitted monaural linear PCM. Owing to unknown variations in decoder delay, the monaural linear PCM shall be treated as being asynchronous to the non-linear PCM encoded audio bitstream. The relationship between the audio sampling frequencies of the decoded compressed stream and the monaural linear PCM shall be an integer multiple of 2^i (i = 0 to 2).

The monaural linear PCM audio sample is transferred using time slots 4 to 11 (auxiliary field and unused data bits) of the IEC 60958 subframes. The least significant bit (LSB) of the monaural linear PCM audio sample is carried by time slot 4 of subframe 1. The most significant bit (MSB) of the monaural linear PCM audio sample is carried by time slot 11 of subframe 2.

A partial 8 bits of the monaural 16-bit linear PCM audio sample is carried by time slots 4 to 11. The lower 8-bit sample is carried by time slots 4 to 11 of subframe 1 in the first frame. The upper 8-bit sample is carried by time slots 4 to 11 of subframe 2 in the first frame; time slots 4 to 11 are not used because the monaural linear PCM audio sample is stuffed with zeros, as shown in Figure B.1.

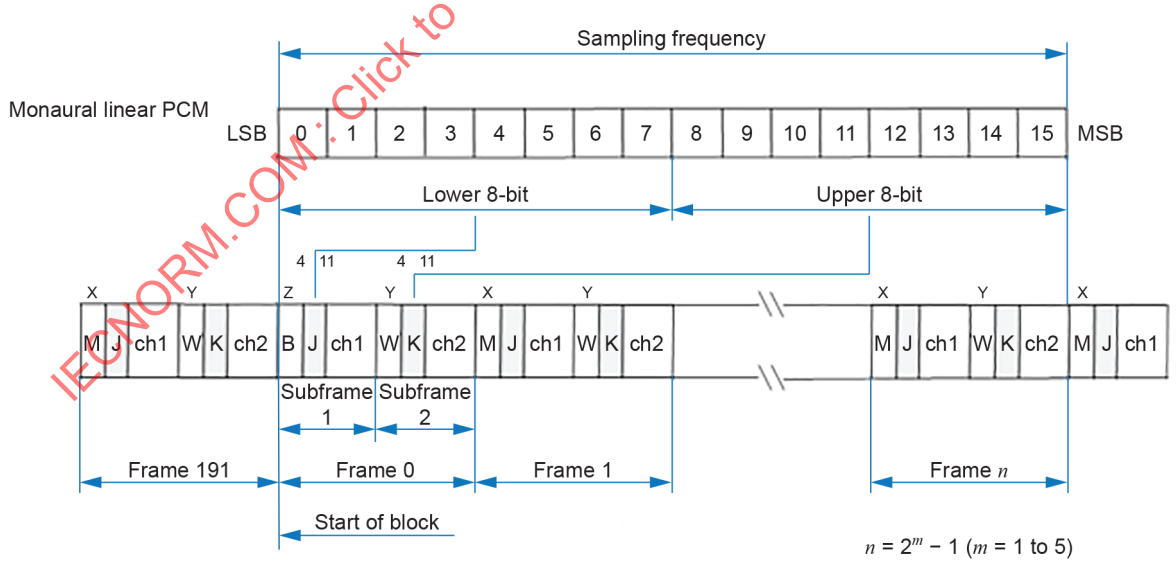

Figure B.1 – Frame and block structure

In the case of the 48 kHz IEC 60958 frame rate, frame and block structure is shown in Figure B.2.

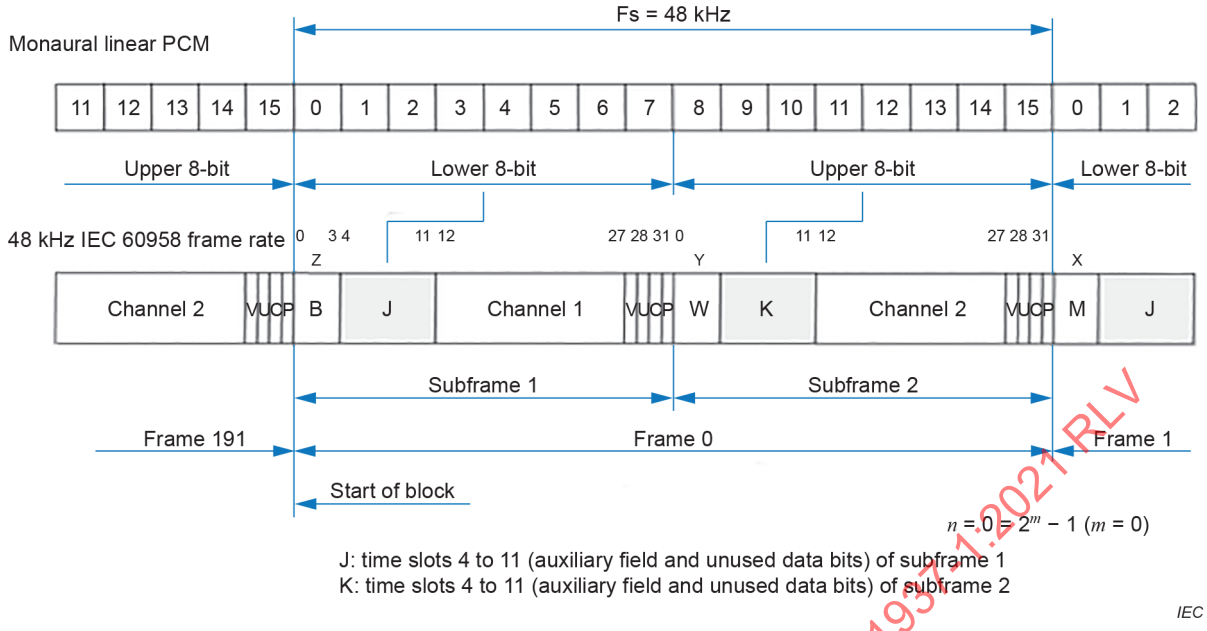

Figure B.2 – Example 1: frame and block structure at 48 kHz IEC 60958 frame rate

In the case of the 192 kHz IEC 60958 frame rate, frame and block structure is shown in Figure B.3.

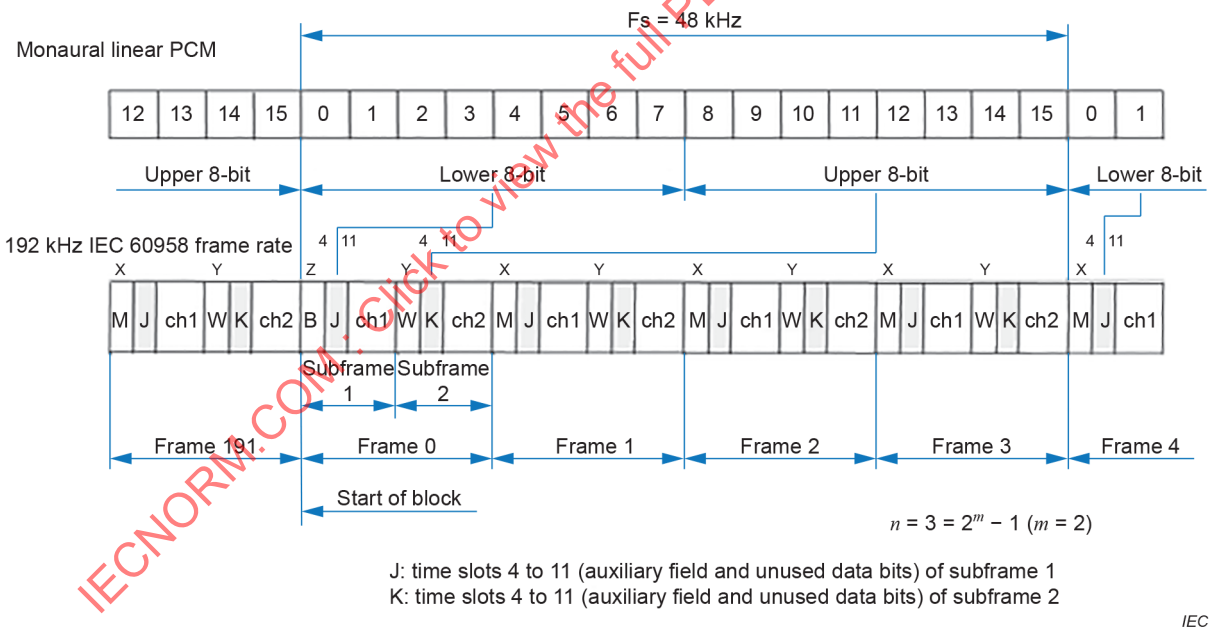

Figure B.3 – Example 2: frame and block structure at 192 kHz IEC 60958 frame rate

The sampling frequencies (f_s) for monaural linear PCM audio samples are 32 kHz, 44,1 kHz, or 48 kHz, the monaural linear PCM audio samples are transmitted at intervals in accordance with the IEC 60958 frame rate for the non-linear PCM encoded audio bitstreams. The embedded-frame interval (2^m, m = 0 to 5) is the IEC 60958 frame rate for the non-linear PCM audio bitstreams divided by the sampling frequency (f_s) for monaural linear PCM, so that the sampling frequency (f_s) for the monaural linear PCM transmitted simultaneously becomes the same frequency; the sampling frequency (f_s) for the monaural linear PCM audio samples corresponds to $1/2^m$ (m = 0 to 5) of the IEC 60958 frame rate for the non-linear PCM encoded audio bitstreams. Table B.1 indicates the relationship between the sampling frequency for the monaural linear PCM audio samples and the IEC 60958 frame rate for the non-linear PCM encoded audio bitstreams.

Table B.1 – Relationship between sampling frequency for monaural linear PCM and IEC 60958 frame rate for non-linear PCM

	Non-linear PCM (bitstream)		Monaural linear PCM (L-PCM)	
	IEC 60958 frame rate		Sampling frequency	Embedded-frame interval
m	$2^m \times f_s$ (m = 0 to 5)		f_s	2^m (m = 0 to 5)
0	f_s	32 kHz	32 kHz	1 frame
1	$2 \times f_s$	64 kHz		2 frames
2	$4 \times f_s$	128 kHz		4 frames
3	$8 \times f_s$	256 kHz		8 frames
4	$16 \times f_s$	512 kHz		16 frames
5	$32 \times f_s$	1 024 kHz		32 frames
0	f_s	44,1 kHz	44,1 kHz	1 frame
1	$2 \times f_s$	88,2 kHz		2 frames
2	$4 \times f_s$	176,4 kHz		4 frames
3	$8 \times f_s$	352,8 kHz		8 frames
4	$16 \times f_s$	705,6 kHz		16 frames
5	$32 \times f_s$	1 411,2 kHz		32 frames
0	f_s	48 kHz	48 kHz	1 frame
1	$2 \times f_s$	96 kHz		2 frames
2	$4 \times f_s$	192 kHz		4 frames
3	$8 \times f_s$	384 kHz		8 frames
4	$16 \times f_s$	768 kHz		16 frames
5	$32 \times f_s$	1 536 kHz		32 frames
The monaural linear PCM signal can require up-sampling by 2× or 4× to match the decoded non-linear PCM signal sampling frequency before mixing the two signals.				

It is recommended that the playback level of all the decoded bitstreams of the IEC 61937 audio channels compared to the embedded monoaural linear PCM be indicated by channel status bits 61 and 62.

Bits 61 to 62	bitstream playback level	
Bit	61 62	
State	"0 0"	no information
	"1 0"	0 dB
	"0 1"	−10 dB playback to be attenuated
	"1 1"	replace the centre channel signal of the decoded IEC 61937 bitstream with the embedded monoaural linear PCM signal.

This bitstream playback level sometimes happens to be changed dynamically within a streaming content to temporarily draw attention to the reproduction of the monoaural linear PCM signal.

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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AUDIONUMÉRIQUE – INTERFACE POUR LES FLUX DE BITS AUDIO À CODAGE MIC NON LINÉAIRE SELON L'IEC 60958 –

Partie 1: Généralités

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L'IEC 61937-1 a été établie par le domaine technique 20: Audio analogique et numérique, du comité d'études 100 de l'IEC: Systèmes et équipements audio, vidéo et services de données. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2007 et l'Amendement 1:2011. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) activation du champ Pe;

b) utilisation élargie de la voie de signalisation;

c) ajout de l'Annexe B.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
100/3447/CDV	100/3522/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 61937, publiées sous le titre général *Audionumérique – Interface pour les flux de bits audio à codage MIC non linéaire selon l'IEC 60958*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. A cette date, le document sera

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- remplacé par une édition révisée, ou
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AUDIONUMÉRIQUE – INTERFACE POUR LES FLUX DE BITS AUDIO À CODAGE MIC NON LINÉAIRE SELON L'IEC 60958 –

Partie 1: Généralités

1 Domaine d'application

La présente partie de l'IEC 61937 s'applique à l'interface audionumérique conforme à la série IEC 60958 pour l'acheminement des flux de bits audio à codage MIC non linéaire.

Elle décrit comment cette interface numérique peut être utilisée dans les applications grand public.

Le domaine d'application du présent document ne couvre pas le mode professionnel.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60958-1, *Interface audionumérique – Partie 1: Généralités*

IEC 60958-3, *Digital audio interface – Part 3: Consumer applications* (disponible en anglais seulement)

IEC 60958-5, *Interface audionumérique – Partie 5: Amélioration de l'application grand public*

IEC 61937-2, *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 2: Burst-info* (disponible en anglais seulement)

3 Termes, définitions et présentation

Pour les besoins du présent document, les termes, les définitions ainsi que la convention de présentation suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1 Termes et définitions

3.1.1
salve de données audio
salve de données associée à une trame audio codée qui représente la charge utile de la salve

3.1.2
mot de données audio
mot de données de 16 bits

3.1.3
trame audio
nombre défini d'échantillons audio

Note 1 à l'article: Le nombre d'échantillons dans une trame audio dépend du système de codage particulier utilisé pour coder la trame audio en une trame audio codée.

3.1.4
intervalle audio
intervalle de temps dans la séquence des échantillons audio en bande de base, où aucun échantillon audio valide n'est disponible

3.1.5
flux de bits
source audio à codage MIC non linéaire représentée par une séquence de bits

Note 1 à l'article: Dans cette interface, le flux de bits se compose d'une séquence de salves de données.

3.1.6
salve de données
paquet de données, y compris le préambule de la salve, à émettre par l'interface

3.1.7
charge utile de la salve
contenu des informations de la salve de données

3.1.8
préambule de la salve
en-tête de la salve de données qui comprend la synchronisation et les informations sur les données contenues dans la charge utile de la salve

3.1.9
type de données
référence au type de charge utile des salves de données

3.1.10
trame audio codée
unité décodable minimale d'une séquence de données codées

Note 1 à l'article: Chaque trame audio codée est une représentation codée d'un nombre défini d'échantillons audio (pour chaque voie audio d'origine). Ce nombre d'échantillons codés dans une trame audio codée dépend du système de codage particulier utilisé pour coder la trame audio en une trame audio codée.

3.1.11
au repos
état dans lequel l'interface n'est pas utilisée pour l'acheminement de séquences de salves de données ou de données MIC

Note 1 à l'article: Les données de la voie de signalisation sont toujours actives (le bit b1 est défini sur "1" lorsque d'autres bits audio à codage MIC non linéaire sont attendus; voir Figure 7).

3.1.12
code de longueur
code qui indique la longueur de la charge utile de la salve de données en bits, en octets ou en unités de 8 octets

3.1.13
période de répétition
période comprise entre le point de référence de la salve de données actuelle et le point de référence de la salve de données qui suit immédiatement (pour le même type de données)

3.1.14
fréquence d'échantillonnage
fréquence d'échantillonnage des échantillons audio à codage MIC (c'est-à-dire avant codage et après décodage)

3.1.15
période d'échantillonnage
période de temps qui correspond à la fréquence d'échantillonnage des échantillons audio MIC, représentée dans le flux de bits codés

3.1.16
bourrage
occupation de la capacité de données inutilisée de l'interface

3.1.17
sous-trame de bourrage
occupation de la capacité de données inutilisée dans les mots de données audio de 16 bits

3.1.18
intervalle entre flux
période au cours de laquelle le flux de bits audio codés ne comporte pas de trame audio; discontinuité dans le flux de bits

Note 1 à l'article: Habituellement, un intervalle entre flux se produit entre des trames audio codées.

3.2 Convention de présentation

3.2.1
F872h
Valeur "F872" au format hexadécimal

4 Description générale

Le format de l'interface IEC 60958 se compose d'une séquence de sous-trames IEC 60958. Chaque sous-trame IEC 60958 est habituellement utilisée pour l'acheminement d'un échantillon MIC linéaire, mais elle peut également être utilisée pour acheminer des données. Les flux de bits audio à codage MIC non linéaire à acheminer sur cette interface sont constitués d'une séquence de salves de données.

Chaque salve de données comporte un préambule de salve de 64 bits, suivi de la charge utile de la salve. Le préambule de la salve est composé d'un mot de synchronisation, d'informations relatives à la charge utile de la salve et d'un numéro de flux de bits.

L'interface peut acheminer un ou plusieurs flux de bits. Chaque type de flux de bits peut imposer une exigence particulière en ce qui concerne la période de répétition des salves de données qui forment le flux de bits (voir Article 7).

Les 16 bits d'une salve de données sont placés dans les intervalles temporels 12 à 27 d'une sous-trame IEC 60958. Les sous-trames IEC 60958 paires et impaires (voie 1 et voie 2) sont utilisées simultanément pour acheminer les 32 bits de données. En mode grand public, cette caractéristique permet à l'interface IEC 60958 d'acheminer des flux de bits audio à deux voies en codage MIC linéaire ou un ensemble de flux de bits audio à codage MIC non linéaire (en alternant les mots de données), mais pas les deux simultanément.

5 Format d'interface

Le format d'interface défini dans l'IEC 60958-1 et l'IEC 60958-3 est utilisé.

6 Mapping du flux de bits audio sur l'interface IEC 60958

6.1 Codage du flux de bits

6.1.1 Généralités

Le flux de bits audio à codage MIC non linéaire est transféré en utilisant la zone de données élémentaire à 16 bits des sous-trames IEC 60958, c'est-à-dire dans les intervalles temporels 12 à 27 (voir Figure 1 et Tableau 1). Comme le flux de bits audio à codage MIC non linéaire à acheminer possède un débit de données inférieur à celui pris en charge par l'interface IEC 60958, le flux de bits audio est divisé en une séquence de salves de données distinctes, ce qui nécessite un bourrage entre les salves (voir 6.3).

Chaque salve de données contient des données d'une trame audio codée, qui est la représentation codée d'un nombre défini d'échantillons audio par voie audio MIC. Le nombre d'échantillons à coder pour former une trame audio codée dépend du système de codage particulier utilisé.

Cette interface peut acheminer simultanément plusieurs flux de bits audio à codage MIC non linéaire. L'une des applications de cette propriété de l'interface est l'acheminement d'un service audio principal et d'un service audio secondaire.

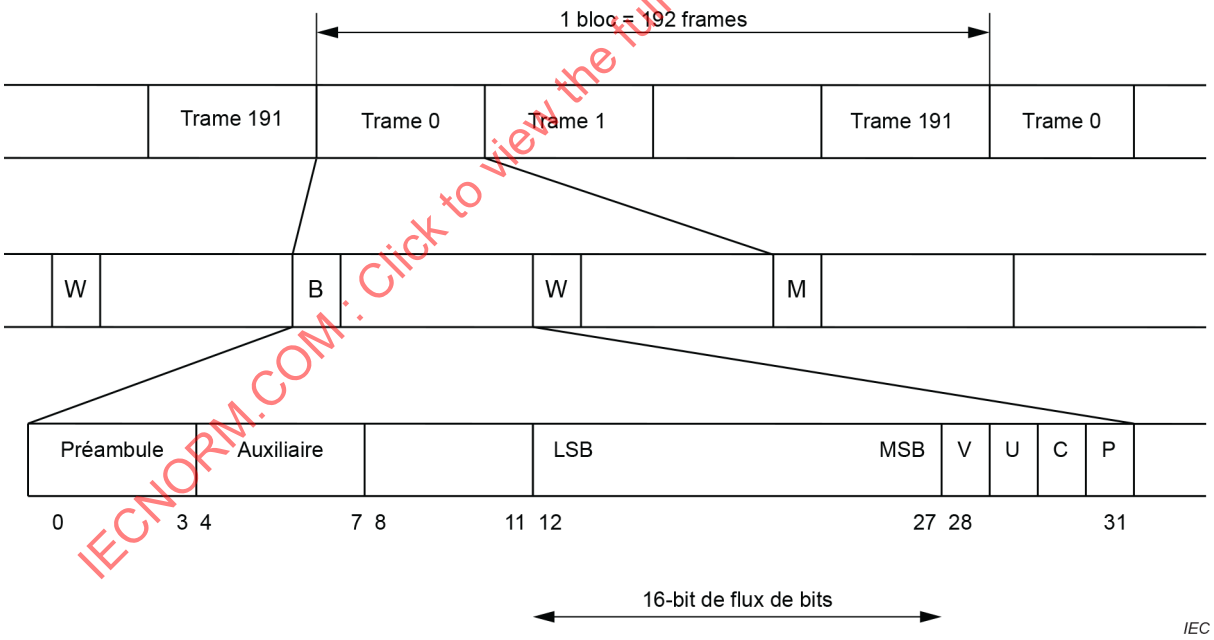

Figure 1 – Format de l'interface IEC 60958

Tableau 1 – Attribution des bits de la trame IEC 60958

Champ	Intervalle temporel IEC 60958	Valeur
0 à 3	Préambule	Préambule IEC 60958
4 à 7	Champ auxiliaire	Inutilisé, tous les bits sont définis sur "0" ou seuls les bits partiels de l'échantillon MIC linéaire
8 à 11	Bits de données inutilisés	Inutilisé, tous les bits sont définis sur "0" ou seuls les bits partiels de l'échantillon MIC linéaire
12 à 27	Données de 16 bits	Sections du flux de bits
28	Indicateur de validité	Selon l'IEC 60958
29	Données utilisateur	Selon l'IEC 60958
30	Voie de signalisation	Selon l'IEC 60958
31	Bit de parité	Selon l'IEC 60958

6.1.2 Table des bits dans le flux de bits

Pour insérer les données dans le flux de bits IEC 60958, les données à transmettre sont formatées en salves de données et chaque salve de données est transmise au sein d'une séquence continue de trames IEC 60958 (voir Tableau 2).

Tableau 2 – Attribution des bits d'une salve de données dans des sous-trames IEC 60958

Sous-trame	Bit des sous-trames				
	MSB				LSB
	b27	b26	b25 ..... b14	b13	b12
Trame 0; sous-trame B ou M	0	1		14	15
Trame 0; sous-trame W	16	17		30	31
Trame 1; sous-trame B ou M	32	33		46	47
Trame 1; sous-trame W	48	49		62	63
Trame 2; sous-trame B ou M	64	65		78	79
----------			----------		
Dernière sous-trame B ou M de la salve de données	n - 32	n - 31		n - 18	n - 17
Dernière sous-trame W de la salve de données	n - 16	n - 15		n - 2	n - 1

Si les données d'une sous-trame IEC 60958 sont par hypothèse un mot de 16 bits issu d'un flux de bits en série, le premier bit de la charge utile de la salve occupe la place du bit de poids fort (MSB, *Most Significant Bit*) de la sous-trame 1 (intervalle temporel 27) et le 32^{e} bit occupe la place du bit de poids faible (LSB, *Least Significant Bit*) (ou du bit qui est le bit de poids faible dans le cas d'une interface audio MIC 16 bits) de la sous-trame 2 (intervalle temporel 12). Les 32 bits suivants de la charge utile de la salve occupent la trame IEC 60958 suivante. Les derniers bits de données la salve de données audio peuvent occuper uniquement une partie de la dernière trame. Tous les bits inutilisés dans la dernière trame sont ignorés par le récepteur. Lorsque la salve de données audio contient un multiple de 16 bits, toutes les sous-trames IEC 60958 utilisées sont totalement remplies. Lorsque la salve de données audio ne correspond pas à un multiple de 16 bits, les bits de la charge utile de la salve à acheminer dans la dernière sous-trame IEC 60958 sont alignés sur le bit de poids fort (MSB) et les bits restants doivent être remplis de zéros (bourrage).

6.1.3 Indicateur de validité IEC 60958

Il est recommandé de définir le bit de validité sur un "1" logique. Cela permet d'éviter une conversion accidentelle des données non audio en analogique tant que la totalité d'un bloc de signalisation n'a pas été reçue.

6.1.4 Bit 1 de la voie de signalisation IEC 60958

L'objet du bit 1 de la voie de signalisation est d'indiquer si l'IEC 60958 est utilisée pour l'acheminement de flux de bits audio à codage linéaire MIC ou à d'autres fins (voir Annexe A). Ce bit doit être défini sur "1" lorsque l'IEC 60958 est utilisée pour l'acheminement de flux de bits audio à codage MIC non linéaire.

6.1.5 Fréquence des symboles

Lorsque le flux de bits IEC 60958 achemine des données audio MIC linéaires, la fréquence des symboles est égale à 64 fois la fréquence d'échantillonnage MIC (32 intervalles temporels par échantillon MIC multiplié par deux voies). Lorsqu'un flux de bits audio à codage MIC non linéaire est acheminé par l'interface, la fréquence des symboles est normalement égale à 64 fois la fréquence d'échantillonnage des données audio codées dans ce flux de bits et il convient de rattacher les autres temps à chaque partie de l'IEC 61937.

6.1.6 Format des salves de données

Chaque salve de données comporte un préambule de salve constitué de quatre mots de 16 bits (Pa, Pb, Pc et Pd), suivi de la charge utile de la salve qui contient les données d'une trame audio codée (voir Figure 2).

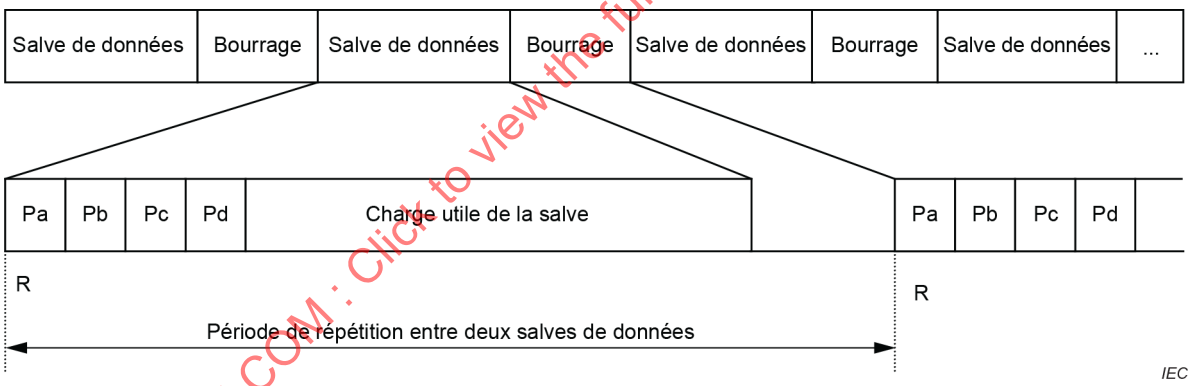

Figure 2 – Format d'une salve de données

La période de répétition de ces salves est définie comme la longueur (mesurée au sein de trames IEC 60958) entre les points de référence R d'une salve de données et la salve de données suivante (avec le même numéro de flux de bits). Les données qui représentent chacune des trames audio codées sont habituellement spécifiées afin d'être contenues dans une seule salve de données, avec une période de répétition (mesurée au sein de trames IEC 60958) égale au nombre d'échantillons audio codés de chaque voie contenue dans cette trame audio codée.

Plusieurs salves de données qui représentent plusieurs flux de bits peuvent être entrelacées à l'interface. Lorsque plusieurs flux de bits audio à codage MIC non linéaire sont transmis par la même interface, les fréquences d'échantillonnage audio de ces flux de bits sont identiques d'un flux de bits à l'autre.

6.1.7 Préambule de la salve

Le préambule de la salve comporte quatre champs obligatoires. Pa et Pb représentent un mot de synchronisation. Pc fournit des informations sur le type de données et certaines

informations/commandes destinées au récepteur. Pd indique la longueur de la charge utile de la salve; elle est limitée à 65 535 bits si la longueur de Pd est exprimée en bits, à 65 535 octets si la longueur de Pd est exprimée en octets ou à 524 280 octets si la longueur de Pd est exprimée en unités de 8 octets.

Les quatre mots du préambule sont contenus dans deux trames IEC 60958 consécutives (voir Figure 3). La trame qui commence la salve de données contient le mot de préambule Pa dans la sous-trame 1 et Pb dans la sous-trame 2. La trame suivante contient Pc dans la sous-trame 1 et Pd dans la sous-trame 2. Lorsque la trame se trouve dans une sous-trame IEC 60958, le bit de poids fort (MSB) d'un mot de 16 bits du préambule de la salve est placé dans l'intervalle temporel 27 et le bit de poids faible (LSB) est placé dans l'intervalle temporel 12 (voir Tableau 3 et Tableau 4).

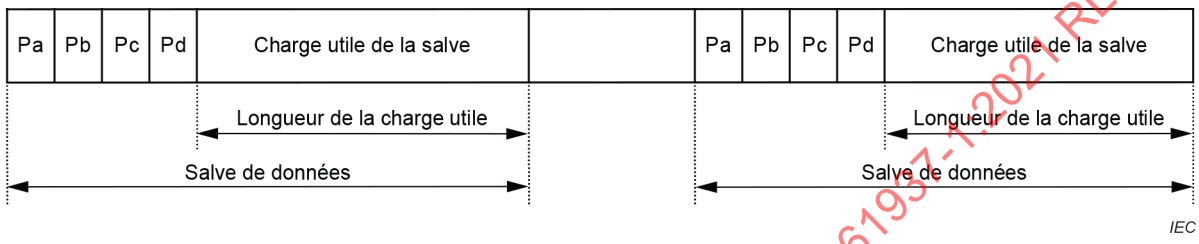

Figure 3 – Préambule de la salve

Tableau 3 – Mots du préambule de la salve

Mot de préambule	Longueur du champ	Contenu	Valeur MSB ... LSB
Pa	16 bits	Mot de synchronisation 1	F872h
Pb	16 bits	Mot de synchronisation 2	4E1Fh
Pc	16 bits	Informations relatives à la salve	Tableau 5
Pd	16 bits	Code de longueur	Nombre de bits, nombre d'octets ou nombre d'unités de 8 octets selon le type de données considéré

Tableau 4 – Table des bits des préambules de salve

Numéro de bit de l'intervalle temporel IEC 60958	27															12
Numéro de bit du préambule	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Pa	1	1	1	1	1	0	0	0	0	1	1	1	0	0	1	0
Pb	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1	1
Pc	Conformément au Tableau 5, valeurs des informations relatives à la salve Pc, bit 15 = MSB															
Pd	Code de longueur, bit 15 = MSB															