

BS EN 61883-6:2014



BSI Standards Publication

Consumer audio/video equipment — Digital interface

Part 6: Audio and music data transmission protocol

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National foreword

This British Standard is the UK implementation of EN 61883-6:2014. It is identical to IEC 61883-6:2014. It supersedes BS EN 61883-6:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

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English Version

**Consumer audio/video equipment - Digital interface -
Part 6: Audio and music data transmission protocol
(IEC 61883-6:2014)**

Matériel audio/vidéo grand public - Interface numérique -
Partie 6: Protocole de transmission de données audio et
musicales
(CEI 61883-6:2014)

Audio-Video-Geräte der Unterhaltungselektronik - Digitale
Schnittstelle - Teil 6: Übertragungsprotokoll für Ton- und
Musikdaten
(IEC 61883-6:2014)

This European Standard was approved by CENELEC on 2014-10-08. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 100/2341/FDIS, future edition 3 of IEC 61883-6, prepared by Technical Area 4 "Digital system interfaces and protocols" of IEC/TC 100 "Audio, video and multimedia systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61883-6:2014.

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- latest date by which the national (dow) 2017-10-08
standards conflicting with the
document have to be withdrawn

This document supersedes EN 61883-6:2005.

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Endorsement notice

The text of the International Standard IEC 61883-6:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60958-4	NOTE	Harmonized as EN 60958-4.
IEC 61883-6:2002	NOTE	Harmonized as EN 61883-6:2002 (not modified).

Annex ZA
(normative)**Normative references to international publications
with their corresponding European publications**

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60958	Series	Digital audio interface	EN 60958	Series
IEC 60958-3	-	Digital audio interface - Part 3: Consumer applications	EN 60958-3	-
IEC 61883-1	-	Consumer audio/video equipment - Digital interface - Part 1: General	EN 61883-1	-
IEEE 754	1985 ¹⁾	IEEE Standard for Binary Floating-Point Arithmetic	-	-
IEEE 1394	-	IEEE Standard for a High-Performance Serial Bus	-	-
IEEE 1394a	-	Standard for a High Performance Serial Bus - Amendment 1	-	-

¹⁾ Superseded by IEEE 754:2008.

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CONSUMER AUDIO/VIDEO EQUIPMENT – DIGITAL INTERFACE –

Part 6: Audio and music data transmission protocol

1 Scope

This part of IEC 61883 describes a protocol for the transmission of audio and music data employing IEEE 1394 and specifies essential requirements for the application of the protocol.

This protocol can be applied to all modules or devices that have any kind of audio and/or music data processing, generation and conversion function blocks. This standard deals only with the transmission of audio and music data. The control, status and machine-readable description of these modules or devices should be defined outside of this standard according to each application area.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60958-3, *Digital audio interface – Part 3: Consumer applications*

IEC 61883-1, *Consumer audio/video equipment – Digital interface – Part 1: General*

IEEE 754:1985, *Standard for Binary Floating-Point Arithmetic*

IEEE 1394, *Standard for a High Performance Serial Bus*

IEEE 1394A, *Standard for a High Performance Serial Bus – Amendment 1*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61883-1, together with the following, apply.

3.1.1

32-bit floating-point data

data type which is defined in IEEE 754

3.1.2

AM824 data

32-bit data consisting of an 8-bit label and 24-bit data

3.1.3**A/M protocol**

protocol for the transmission of audio and music data over IEEE 1394

Note 1 to entry: IEEE 1394 describes the Audio and Music Data Transmission Protocol.

3.1.4**embedded synchronization clock**

signal that carries information that is used by a sampling device to derive a sample clock

Note 1 to entry: In the context of A/M protocol, this synchronization clock is embedded in the SYT field of the CIP and carries timing information that refers to local CYCLE_TIME register values.

3.1.5**non-sampling device**

devices that do not use clock timing in a way that may modify the analogue or digital audio signal

Note 1 to entry: Any clocks that the non-sampling devices use do not affect the accuracy of that data in normal operation. (See also 3.1.9, sampling device.)

3.1.6**reserved**

keyword used to describe objects or the code values assigned to these objects

Note 1 to entry: Objects are: bit, byte, quadlet, octet, and field.

Note 2 to entry: The object or the code value are set aside for future standardization by the IEC.

3.1.7**sample clock**

reference used at a sampling device to define the instant at which an audio data sample word is valid

Note 1 to entry: For over-sampled conversion systems, the sample clock is multiplied up to the over-sampling rate. Inside an asynchronous sampling frequency converter (ASFC), one sample clock is represented numerically by the relationship it has to another sample clock.

3.1.8**sample clock timing transfer**

mechanism by which the sample clock of one device can be derived from a clock on another device such as by using an embedded synchronization clock

3.1.9**sampling device**

device that depends on the timing of a sample clock to modify an audio signal in some way as it is being converted between the analogue and digital domains, or between two independent sampling frequencies

Note 1 to entry: Examples of a sampling device are an analogue-to-digital converter (ADC), a digital-to-analogue converter (DAC) and an ASFC.

3.1.10**sampling frequency**

F_s

frequency of the sample clock

3.1.11**stream**

uni-directional data transmission

3.1.12**synchronization clock frequency** F_{sync}

embedded synchronization clock frequency using the A/M protocol has to be less than the isochronous cycle rate of 8 kHz

Note 1 to entry: The rate is defined as follows:

$$F_{\text{sync}} = F_s / \text{SYT_INTERVAL}$$

The SYT_INTERVAL value is defined in the CIP header for each sampling frequency.

3.1.13**synchronization clock source**

device that supplies an embedded synchronization clock that another device uses to derive a sample clock

Note 1 to entry: A synchronization clock source does not need to be a source device for audio data.

3.1.14**synchronization clock destination****3.1.15.1****clock jitter definition**

deviation in the timing of clock transitions when compared to an ideal clock

Note 1 to entry: The ideal clock can be considered to have a frequency of exactly the same long-term average frequency and aligned for zero mean phase offset from the real clock. For a sample clock, the jitter amplitude defined in this way is directly related to the amplitude of the jitter modulation products produced in a sampling device.

3.1.15.2**embedded synchronization clock jitter**

jitter in the embedded synchronization clock includes the effect of errors (including limited precision) in the embedded SYT data and jitter in the CYCLE_TIME register used to decode the SYT

3.1.15**time stamp**

quantized timing in which an event occurs based on a reference clock

Note 1 to entry: The reference clock is CYCLE_TIME unless otherwise specified in this standard.

3.2 Abbreviations

ASID Audio Software Information Delivery
See <http://ria-japan-music.or.jp/tech/asid/e.html>

AV/C Audio Video Control

DVD Digital Versatile Discs
See <http://www.dvdforum.org/index.htm>

MIDI Musical Instrument Digital Interface

NOTE The complete MIDI 1.0 detailed specification, Version 96.1, March 1996, is a specification for the interconnection of digital music processing devices (for example, keyboards and signal processors) and computers.

SACD SACD Super Audio CD
See <http://www.licensing.philips.com/>

4 Reference model for data transmission

4.1 General

This clause describes a reference model for data transmission.

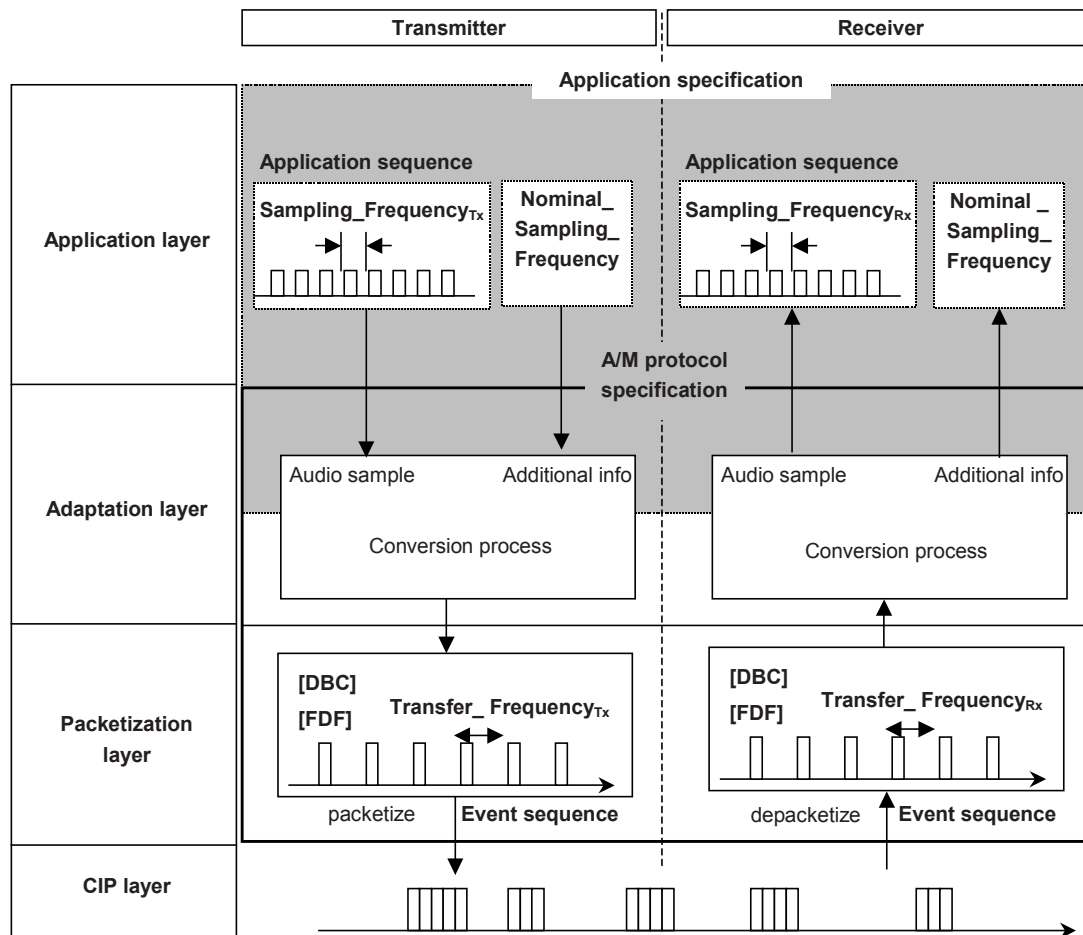


Figure 1 – Reference model for audio and music data transmission

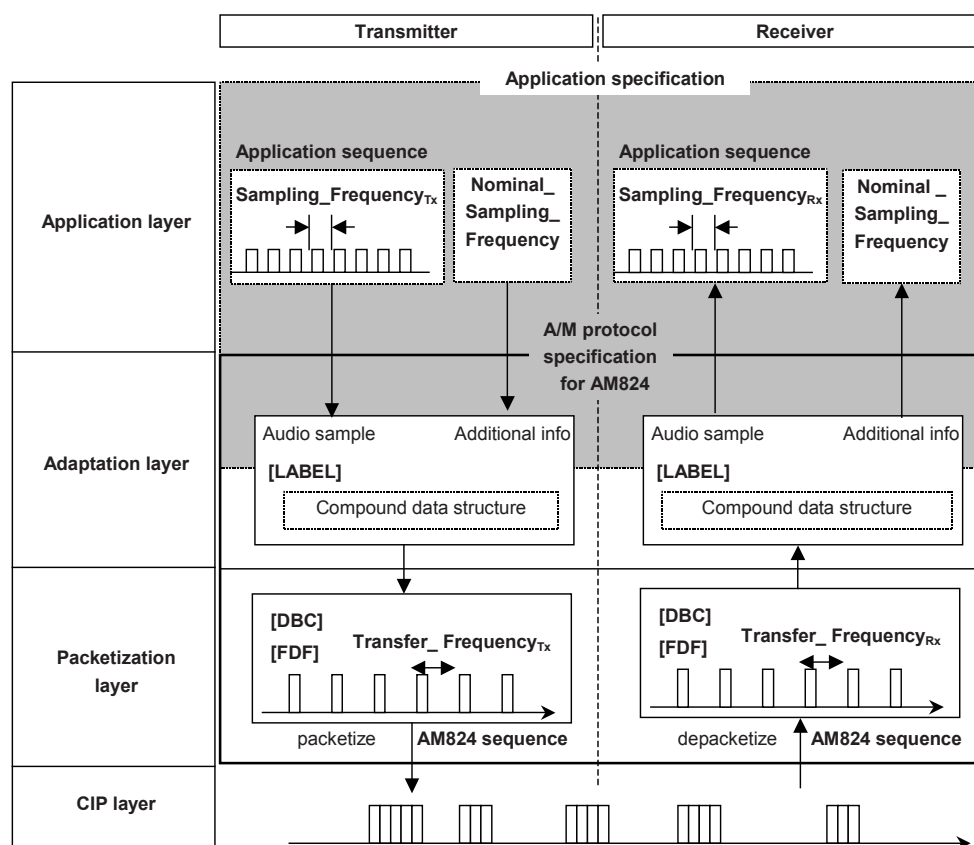


Figure 2 – Reference model for AM824 data transmission

Figure 1 gives an outline for audio data transmission from a transmitter to a receiver. It has four major layers denoted as CIP (common isochronous packet) layer, packetization layer, adaptation layer and application layer.

4.2 Application layer

Each application defines its own application sequence and the interface to the adaptation layer. The application sequence in Figure 1 is data in a format such as an audio signal format. The Nominal_Sampling_Frequency is the ideal sampling frequency for the application sequence. The range of Sampling_Frequency should be defined by the application. The audio signal at Nominal_Sampling_Frequency can be reproduced at the actual rate of Sampling_Frequency in operation. This means that the value of Sampling_Frequency may have some deviation and/or may vary in time in contrast with Nominal_Sampling_Frequency.

Additional information in Figure 1 is any information other than events of a sequence (audio samples) being transmitted at a given rate.

4.3 Adaptation layer

The adaptation layer defines a process to convert an application sequence to an event sequence and vice versa. The conversion process may not be required if an application sequence and an event sequence have the same structure. If an event sequence consists of events of 24-bit payload, such as AM824 data defined in 8.2, and if the bit length of an audio sample of the application sequence is not 24-bit, some conversion between Sampling_Frequency and Transfer_Frequency may be required (see Figure 2 and Clause 11). The Transfer_Frequency represents the frequency of occurrence of a data block, which is equivalent to a cluster event. The Transfer_Frequency is used for describing a conceptual transmission model.

The transfer rate of an event sequence is $24 \times \text{Transfer_Frequency}$ [bit/s] in the case of AM824.

Generally, the adaptation layer is designed in such a way that both the application sequence at $\text{Sampling_Frequency}$ and its $\text{Nominal_Sampling_Frequency}$ are carried. In this specification, $\text{Nominal_Sampling_Frequency}$, which would usually be one of the ancillary data items, is carried by SFC (sampling frequency code) which is defined in Clause 10. The information in $\text{Nominal_Sampling_Frequency}$ is necessary for using command based rate control or making a copy. On the other hand, $\text{Sampling_Frequency}$ is necessary for clock-based rate control. Although $\text{Sampling_Frequency}$ is not explicitly transmitted, it can be estimated from SYT_INTERVAL and time stamps by the algorithm specified for the AM824 data type.

An application specification defines the process (shown in the grey shaded area of Figure 1) to convert the application's signal (application sequence) to an event sequence. This standard assumes that the application specification is an external document using the definition of an event sequence for the adaptation process. For several generic data types this standard also defines the adaptation layer.

The adaptation to an event sequence is the point at which the packetization process interfaces to the application. The packetization process can be described as IEEE 1394 adaptation from the point of view that the data stream utilizes IEEE 1394 as its transport.

More details of this layer are described in Clause 12.

4.4 Packetization layer

The AM824 sequence is directly packetized to CIP or depacketized from CIP in the packetization layer.

The $\text{Transfer_Frequency}$ can be implicitly expressed by the output of a locked PLL circuit, as shown in Figure 3, instead of being explicitly denoted in the packetization layer.

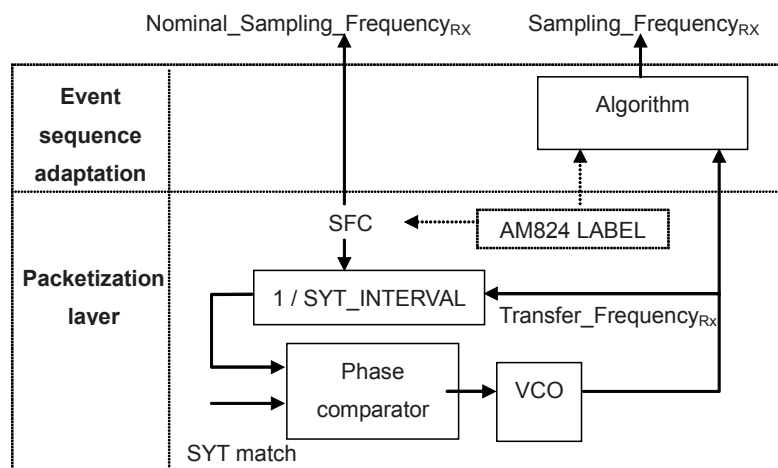


Figure 3 – Implementation example of receiver

5 Transport requirements

5.1 Arbitrated short bus reset

All modules or devices which implement this A/M protocol should have the capability of "arbitrated short-bus reset" in order to prevent the interruption of audio and music data transmission when a bus reset occurs.

5.2 Bit, byte, and quadlet ordering

This standard adopts the ordering of bit, byte, and quadlet for bus packets in accordance with IEEE 1394.

6 Packet header for audio and music data

6.1 General

This clause defines the packet format in the CIP layer described in Figure 1.

6.2 Isochronous packet header format

The header for an isochronous packet which conforms to the A/M protocol shall have the same format given in Figure 4, which is part of the isochronous packet format defined in IEEE 1394.

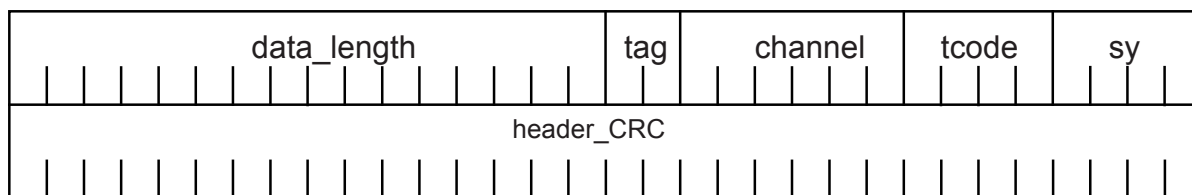


Figure 4 – Isochronous packet header

The isochronous packet header fields are defined with unique values that are specified in Table 1.

Table 1 – Isochronous packet header fields

Field	Value	Comments
Tag	01 ₂	This value indicates that a CIP header is included in the packet.
Tcode	A ₁₆	This value indicates that this is an isochronous data packet.
Sy	xx	This field is reserved. The transmitter shall set this field to 0 ₁₆ unless specified by another application.

6.3 CIP header format

IEC 61883-1 defines a two-quadlet CIP header for a fixed length source packet with SYT field, repeated here for clarity as in Figure 5. The CIP header format for an isochronous packet, which conforms to the audio and music data transmission protocol, shall use the CIP header.

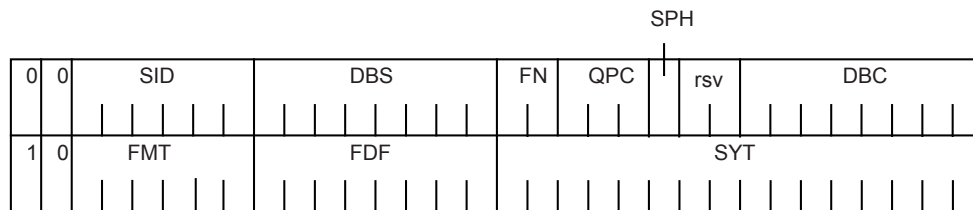


Figure 5 – Common isochronous packet (CIP) format

Table 2 defines the fields with unique values that are specified by this protocol.

Table 2 – CIP fields

Field	Value	Comments
FMT	10 ₁₆	This value indicates that the format is for audio and music
FN	0 ₁₆	
QPC	0 ₁₆	
SPH	0 ₁₆	
SYT	xx	This field shall contain the time when the specified event shall be presented at a receiver
FDF	xx	This field is defined in Clause 10.

7 Packetization

7.1 Packet transmission method

When a non-empty CIP is ready to be transmitted, the transmitter shall transmit it within the most recent isochronous cycle initiated by a cycle start packet. The behaviour of packet transmission depends on the definition of the condition in which “a non-empty CIP is ready to be transmitted”. There are two situations in which this condition is defined.

- In order to minimize TRANSFER_DELAY, the condition of a non-empty CIP being ready for transmission is defined to be true if one or more data blocks have arrived within an isochronous cycle. This transmission method is called non-blocking transmission and is described in detail in 7.4.
- The condition of “non-empty CIP ready” can also be defined as true when a fixed number of data blocks have arrived. This transmission method is called blocking transmission and is described in Annex A.

7.2 Transmission of timing information

A CIP without a source packet header (SPH) has only one time stamp in the SYT field. If a CIP contains multiple data blocks, it is necessary to specify which data block of the CIP corresponds to the time stamp.

The transmitter prepares the time stamp for the data block which meets this condition:

$$\text{mod}(\text{data block count}, \text{SYT_INTERVAL}) = 0 \quad (1)$$

where

data block count is the running count of transmitted data blocks;

SYT_INTERVAL denotes the number of data blocks between two successive valid SYTs, which includes one of the data blocks with a valid SYT. For example, if

there are three data blocks between two valid SYTs, then the SYT_INTERVAL would be 4.

The receiver can derive the index value from the DBC field of a CIP with a valid SYT using the following formula:

$$\text{index} = \text{mod}((\text{SYT_INTERVAL} - \text{mod}(\text{DBC}, \text{SYT_INTERVAL})), \text{SYT_INTERVAL}) \quad (2)$$

where

index is the sequence number;

SYT_INTERVAL denotes the number of data blocks between two successive valid SYTs, which includes one of the data blocks with a valid SYT;

DBC is the data block count field of a CIP.

The receiver is responsible for estimating the timing of data blocks between valid time stamps. The method of timing estimation is implementation-dependent.

7.3 Time stamp processing

A data block contains all data arriving at the transmitter within an audio sample period. The data block contains all data which make up an “event”.

The transmitter shall specify the presentation time of the event at the receiver. A receiver for professional use shall have the capability of presenting events at the time specified by the transmitter. A consumer-use or cost-sensitive receiver is not required to support this presentation-time adjustment capability.

If a function block receives a CIP, processes it and subsequently re-transmits it, the SYT of the outgoing CIP shall be the sum of the incoming SYT and the processing delay.

The transmitter shall add TRANSFER_DELAY to the quantized timing of an event to construct the SYT. The TRANSFER_DELAY value is initialized with the DEFAULT_TRANSFER_DELAY value. For professional use, TRANSFER_DELAY may be changed to achieve a shorter TRANSFER_DELAY value, according to the bus configuration. Products for consumer use are not required to support the modification of TRANSFER_DELAY.

The DEFAULT_TRANSFER_DELAY value is $(354,17 + 125)\mu\text{s}$, which accommodates the maximum latency time of CIP transmission through an arbitrated short bus reset.

7.4 Transmission control

7.4.1 Non-blocking transmission method

Figure 6 illustrates the non-blocking transmission method.

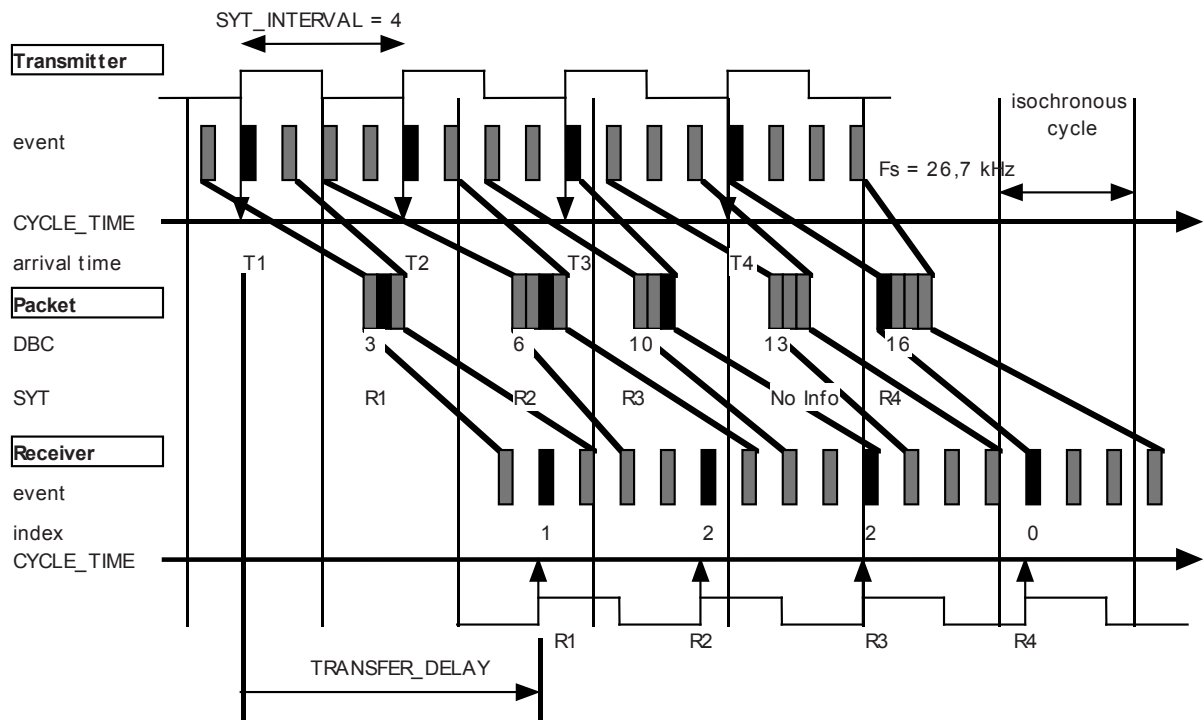


Figure 6 – Non-blocking transmission method

The transmitter shall construct a packet in every nominal isochronous cycle. Each packet shall comply with the following constraint:

$$0 \leq N \leq \text{SYT_INTERVAL} \quad (3)$$

where N is the number of events in the packet.

In normal operation the transmitter shall not transmit events late and shall not transmit packets early. The resulting conditions may be expressed as follows:

$$\text{Packet_arrival_time_L} \leq \text{Event_arrival_time}[0] + \text{TRANSFER_DELAY} \quad (4)$$

$$\text{Event_arrival_time}[N-1] \leq \text{Packet_arrival_time_F} \quad (5)$$

where

Packet_arrival_time_F is the time (measured in μs) when the first bit of the packet arrives at the receiver;

Packet_arrival_time_L is the time (measured in μs) when the last bit of the packet arrives at the receiver;

Event_arrival_time[M] is the time (measured in μs) of the arrival at the transmitter of event M of the packet. The first event of the packet has $M = 0$.

Figure 7 illustrates the transmission control rules as described in Clause 7.

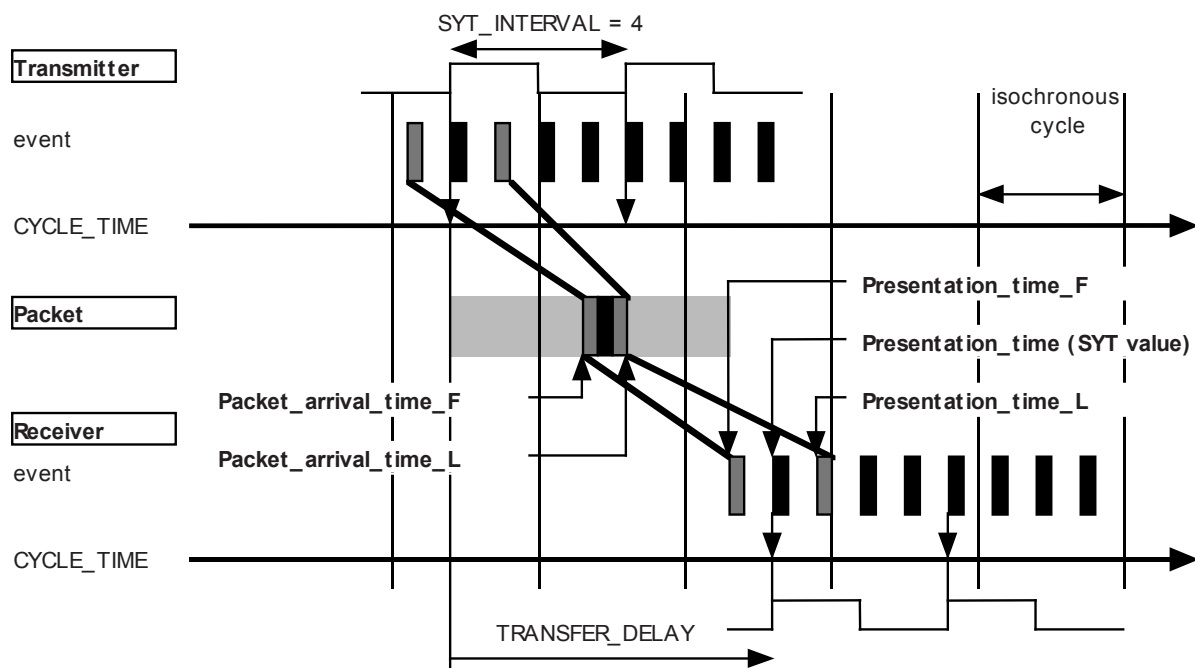


Figure 7 – Transmission parameters

In the event of lost opportunities to transmit non-blocking packets, a method of catching up may be provided (refer to Annex C).

7.4.2 Blocking transmission method

Figure 8 shows a diagram of a blocking transmission method.

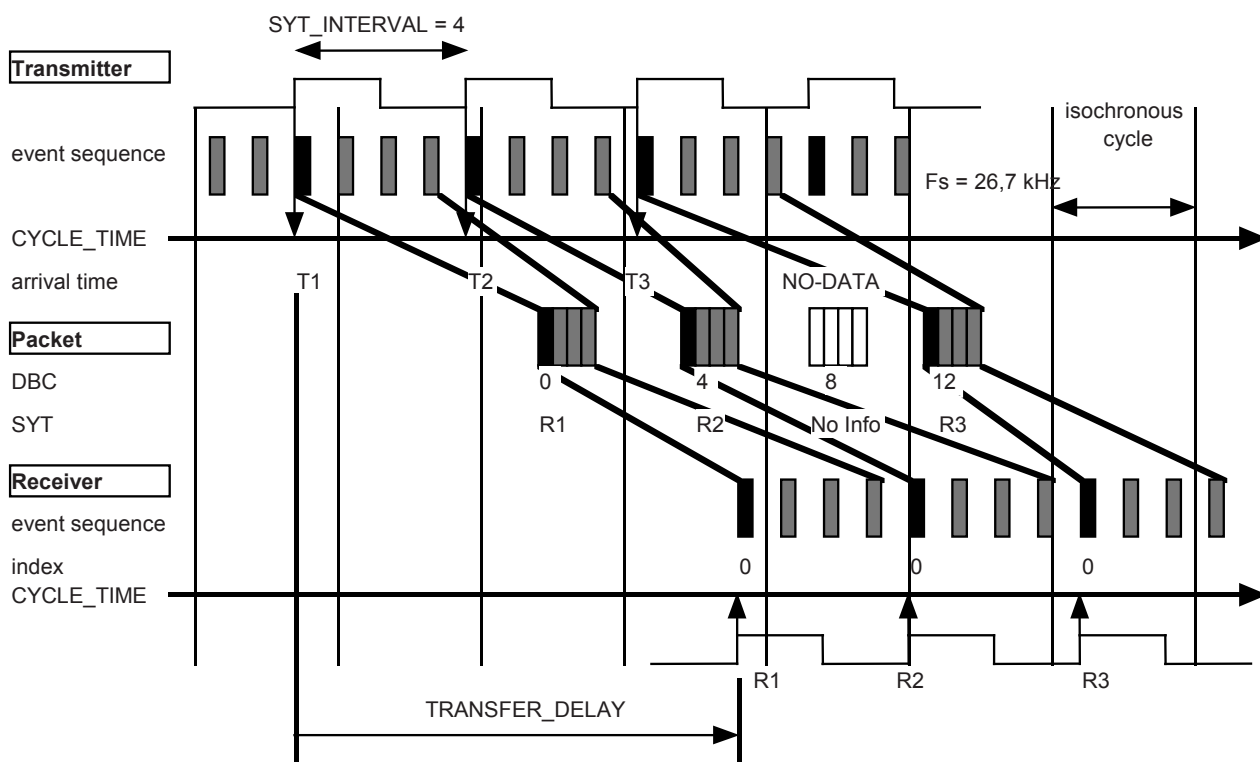


Figure 8 – Blocking transmission method

The blocking method may be used by a transmitter, which has only the ability to transmit packets of the same size. In order to indicate "no data", the transmitter may transmit an empty packet or a special non-empty packet which has the "NO-DATA" code in its FDF and has the same size of dummy data as a non-empty packet. The transmitter shall set the time stamp of the first data block in a packet.

For blocking, the duration of the successive events in a CIP have to be added to DEFAULT_TRANSFER_DELAY.

If a CIP contains N audio samples of a stream at Sampling Transmission Frequency (STF), then:

$$\text{TRANSFER_DELAY} \geq \text{DEFAULT_TRANSFER_DELAY} + 1/\text{STF} \times N \times 1\,000$$

where

TRANSFER_DELAY is the latency of transmission;

DEFAULT_TRANSFER_DELAY is the initialized value of TRANSFER_DELAY;

STF is the sampling transmission frequency;

N is the number of audio samples in a CIP.

The TRANSFER_DELAY for each STF when DEFAULT_TRANSFER_DELAY = 479,17 μs (= 354,17 μs + 125 μs) is defined in Table 21.

It is recommended that the receiver have 250 μs of extra buffer.

8 Event types

8.1 General

All the subformats described in this standard shall use only 32-bit aligned events.

If multiple event sequences are synchronized, it is possible to convert the sequences into a single event which consists of an ordered collection of those sequences which occurred at the same time. The ordered collection is called a cluster. A cluster consists of ordered units. In the case of data, a unit consists of a single sequence. In the case of a pack, the unit may consist of several sequences packed together. The number of units in a single cluster is called the dimension, and is denoted by CLUSTER_DIMENSION. Figure 9 illustrates these concepts.

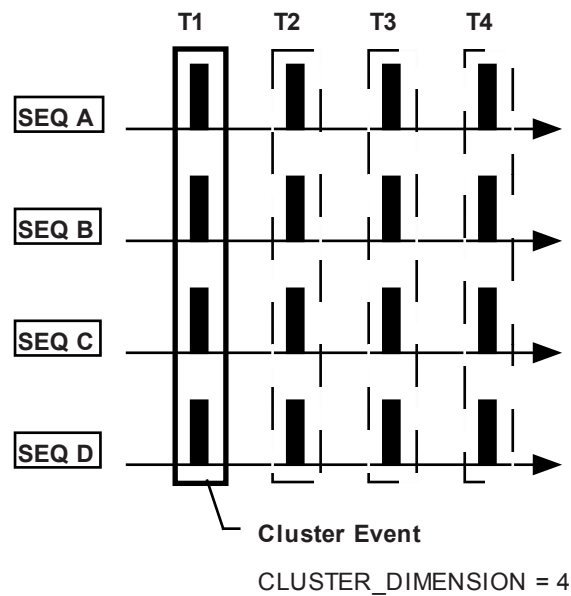


Figure 9 – Cluster events

In order to efficiently cluster non-32-bit aligned sequences which occur at the same time, the pack event type is defined. For example, four events of 24-bit data can be collected into a pack of three quadlets.

An event which is neither a cluster nor a pack is simply called data.

Only the pack and data types can be combined into units to make a cluster. All events in a cluster shall be of the same type.

UNIT_SIZE is the number of quadlets in a unit.

UNIT_DIMENSION is the number of sequences in a unit.

The UNIT_DIMENSION of data is always 1.

Figure 10 illustrates pack and cluster events.

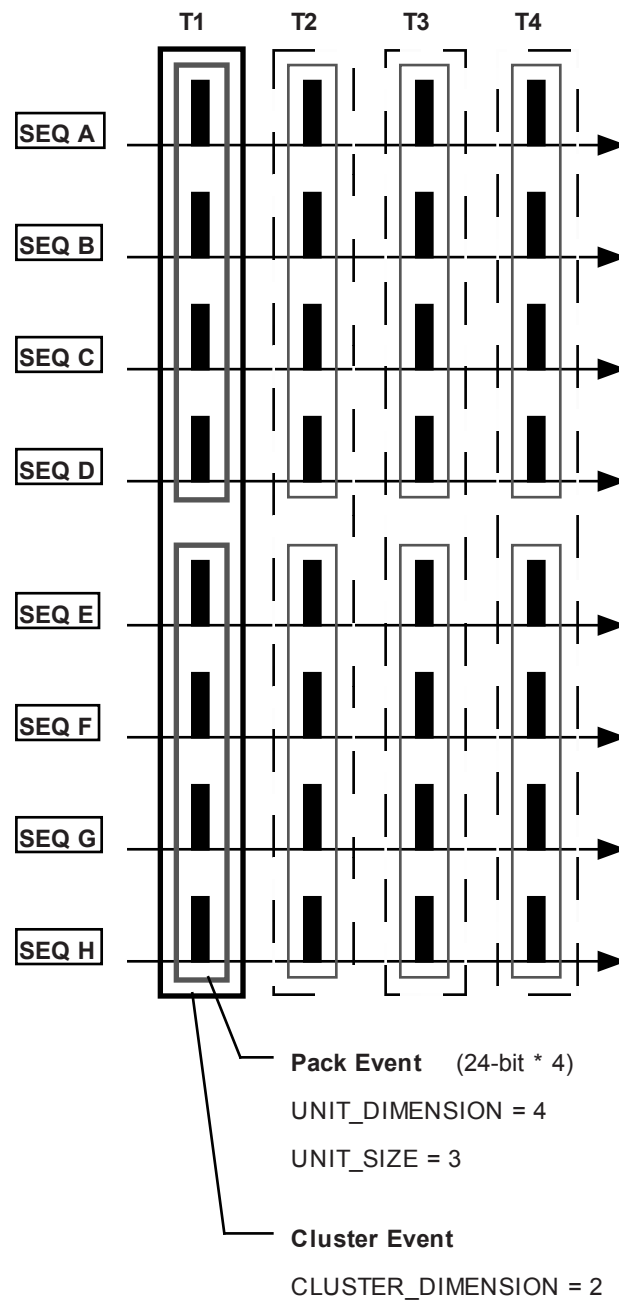


Figure 10 – Pack and cluster events

Figure 11 illustrates the structure of a pack which consists of four 24-bit event sequences (UNIT_DIMENSION = 4, UNIT_SIZE = 3).

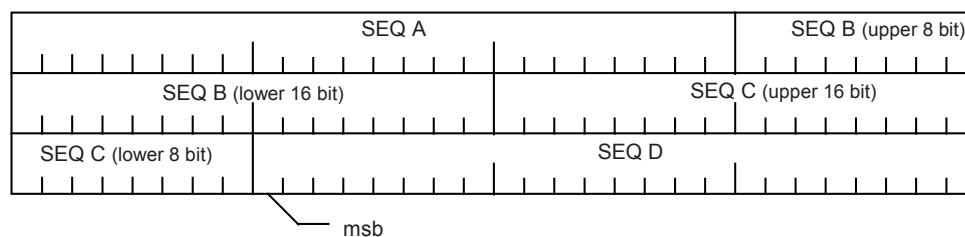


Figure 11 – Pack event with 24-bit event sequence

Since the cluster is an abstract event, only pack or data shall be specified as an event type for a subformat. However, the DBS shall reflect the size in quadlets of all cluster events in a data block. In the case of a clustered sequence:

$$DBS = \sum_{n=0}^{(clusters-1)} (Unit_Size_n \times CLUSTER_DIMENSION_n) \quad (6)$$

where

clusters is the number of clusters in the event;

Unit_Size_n is the number of quadlets per unit of the *n*th cluster;

CLUSTER_DIMENSION_n is the number of units per cluster of the *n*th cluster.

Generally, the number of elementary sequences in a CIP is given by the following:

$$\text{number of sequences} = DBS \times UNIT_DIMENSION / UNIT_SIZE \quad (7)$$

For the pack illustrated in Figure 9 and Figure 10, DBS = 6, CLUSTER_DIMENSION = 2, UNIT_DIMENSION = 4, UNIT_SIZE = 3.

The number of successive events in a CIP is equal to the number of data blocks in a CIP and given by

$$NEVENTS_SUCCESSIVE = (data_length / 4 - CIPH_SIZE) / DBS \quad (8)$$

where

data_length is the size of the payload of an isochronous packet (in bytes);

CIPH_SIZE is the size of the CIP header (in quadlets).

The ordering of sequences in an event is application-specific and is not within the scope of this standard. For example, the identification of audio channels in a multichannel transmission will be defined elsewhere.

8.2 AM824 data

8.2.1 Generic format

Figure 12 shows the AM824 format that is used in the following conditions and Table 3 provides a LABEL definition.

NOTE A 32-bit data consisting of an 8-bit label and 24-bit data are called AM824 data.

UNIT_SIZE = 1 quadlet/unit

UNIT_DIMENSION = 1 sequence/unit



Figure 12 – Generic AM824 format

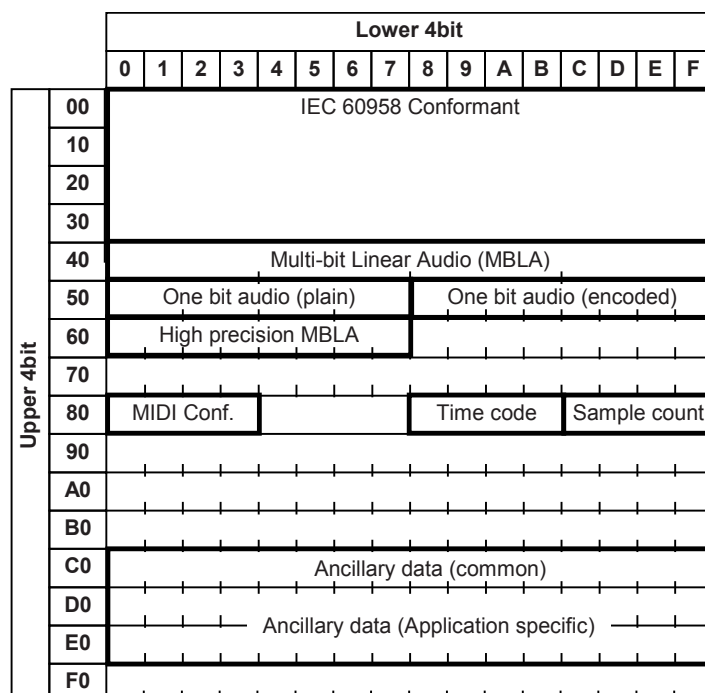
A receiver capable of processing AM824 data shall check the label for each AM824 data in a sequence being received.

**Figure 13 – AM824 data with SUB LABEL**

If an application requires many data types, SUB LABEL, as shown in Figure 13, may be used to extend the number of data types defined by LABEL, see Table 3. An application map representation for Table 3 is shown in Figure 14.

Table 3 – LABEL definition

Value	Description
00 ₁₆ – 3F ₁₆	IEC 60958 conformant
40 ₁₆ – 4F ₁₆	Multi-bit linear audio
50 ₁₆ – 57 ₁₆	One-bit audio (plain)
58 ₁₆ – 5F ₁₆	One-bit audio (encoded)
60 ₁₆ – 67 ₁₆	High-precision multi-bit linear audio
70 ₁₆ – 7F ₁₆	Reserved
80 ₁₆ – 83 ₁₆	MIDI conformant
84 ₁₆ – 87 ₁₆	Reserved
88 ₁₆ – 8B ₁₆	SMPTE time code conformant
8C ₁₆ – 8F ₁₆	Sample count
90 ₁₆ – BF ₁₆	Reserved
C0 ₁₆ – EF ₁₆	Ancillary data
F0 ₁₆ – FF ₁₆	Reserved

**Figure 14 – AM824 LABEL allocation map**

8.2.2 IEC 60958 conformant data

IEC 60958 conformant data format is shown in Figure 15.

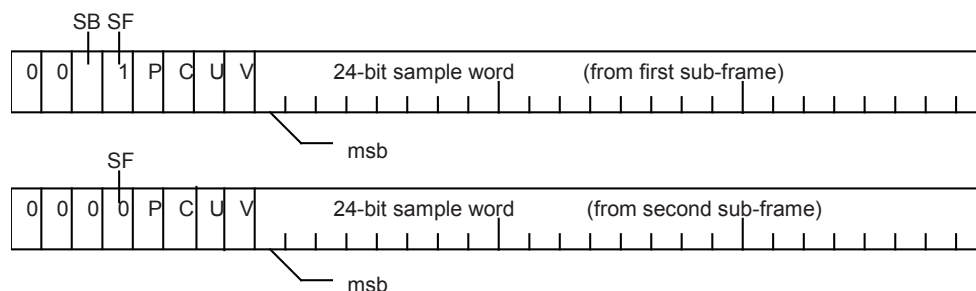


Figure 15 – IEC 60958 conformant data format

Table 4 – SB and SF definitions

SB (start-of-block) and SF (start-of-frame) definitions				
LABEL	SB	SF	Description	Equivalent IEC 60958 preamble codes
$00_{16} - 0F_{16}$	0	0	Second subframe of IEC 60958 frames 0 to 191	W,Y
$10_{16} - 1F_{16}$	0	1	First subframe of IEC 60958 frames 1 to 191	M,X
$20_{16} - 2F_{16}$	1	0	Reserved	–
$30_{16} - 3F_{16}$	1	1	First subframe of IEC 60958 frame 0	B,Z

All information defined in IEC 60958 is mapped into the data format shown in Figure 14 and Table 4. For each IEC 60958 frame, both sub-frames shall be transmitted together in the same event. The corresponding quadlet may be consecutive or non-consecutive. If multiple IEC 60958 streams are transmitted, then their sub-frames shall not be interleaved. Applications which use this data type shall follow IEC 60958.

8.2.3 Multi-bit linear audio (MBLA)

Multi-bit linear audio (MBLA) is shown in Figure 16.



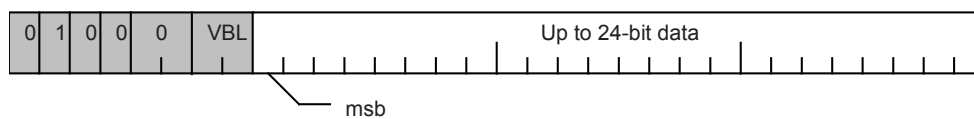
Figure 16 – MBLA data

The label field of MBLA has two fields for ASI (application-specific information). The definition of ASI2 depends on the ASI1 value described in Table 5.

Table 5 – ASI1 definition

Value	Description
00 ₂	Raw audio. The sample word can be fed directly to a D/A converter. Ancillary data may accompany. The definition of ASI2 is identical to VBL (valid bit length) defined in IEC 61883-6:2002. ^a
01 ₂ – 11 ₂	Application-specific information. The sample word may be fed directly to a D/A converter but, in some processing, required according to the application identified by application-specific ancillary data which shall appear in the same data block. The definition of the ASI2 field also shall be given by the application such as DVD-Audio described in 12.2.
^a This information is given for the convenience of VBL system users.	

Figure 17 shows raw audio format and Table 6 provides a VAL definition.

**Figure 17 – Raw audio data****Table 6 – VBL (valid bit length code) definition**

Value	Description
00 ₂	24 bit
01 ₂	20 bit
10 ₂	16 bit
11 ₂	Reserved

The audio data shall be expressed in 24-bit 2's complement format. If the data active word length is less than 24 bit, the correct number of zero bit shall be padded below the least significant bit to make a 24-bit data structure.

For example, a 20-bit audio data shall be placed in a 24-bit field as shown in Figure 18 (note the four zero pad bit at the right end of the structure).

**Figure 18 – Alignment of 20-bit data in 24-bit field**

For audio data word lengths of less than 24 bit the VBL indication can be used by receivers to determine if the data can be truncated to less than 24 bit without changing the value. If the word length is not known or variable the data should be aligned at the most significant bit and the VBL code for 24-bit indication should be used.

8.2.4 One-bit audio

One-bit audio defines its own sampling frequency code (SFC). Table 7 and Table 8 provide LABEL definitions for one-bit audio (plain) and one-bit audio (encoded), respectively.

Table 7 – LABEL definition for one-bit audio (plain)

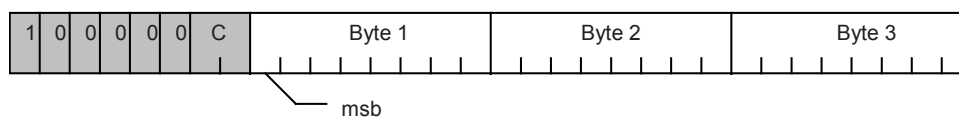
Value	Description
50 ₁₆	One-bit audio stream: multi-channel cluster start data
51 ₁₆	One-bit audio stream: multi-channel cluster continuation data
52 ₁₆ – 57 ₁₆	Reserved

Table 8 – LABEL definition for one-bit audio (encoded)

Value	Description
58 ₁₆	DST: Encoded one-bit audio stream
59 ₁₆ – 5F ₁₆	Reserved

8.2.5 MIDI conformant data

Figure 19 illustrates a MIDI conformant data format and Table 9 provides a C definition.

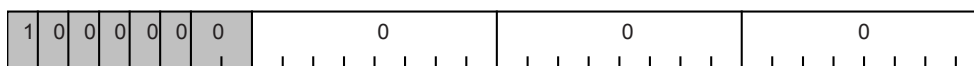
**Figure 19 – MIDI conformant data format****Table 9 – C (counter) definition**

C (counter) definition	
Value (decimal)	Description
0	No data (Byte 1 = Byte 2 = Byte 3 = 0)
1	Byte 1 is valid
2	Byte 1 and 2 are valid
3	Byte 1, 2 and 3 are valid

If the CIP carries only MIDI conformant data or cluster, and there are no MIDI data to be packed into a CIP, the packet should be an empty packet rather than a packet of all no-data codes.

The no-data code defined in MIDI conformant data may be used as no data for other AM824 data types if necessary. The usage of no data described above should be applied to the AM824 data types which use no data.

Figure 20 illustrates the no-data structure.

**Figure 20 – No-data format**

Successful implementation of MIDI conformant data may require additional information. Attention is drawn to MMA/AMEI Recommended Practice 027.

8.2.6 SMPTE time code data

The SMPTE time code is defined in 1394 Trade Association document 1999024, SMPTE Time Code and Sample Count Transmission Protocol Version 1.0.

8.2.7 Sample count data

The Sample count transmission is defined in 1394 Trade Association document 1999024, SMPTE Time Code and Sample Count Transmission Protocol Version 1.0.

8.2.8 High-precision multi-bit linear audio

The multi-bit linear audio (MBLA) is limited to sample words up to 24 bit length. Linear PCM audio data longer than 25 bit length and up to 196 bit length can be transmitted with high-precision multi-bit linear audio, see Figure 21.



Figure 21 – High-precision multi-bit linear audio data

The high-precision multi-bit linear audio data use the LABEL from 60_{16} to 67_{16} . The label field of the high-precision multi-bit linear audio has Num. (slot number) field. The definition of Num. field is given in Table 10.

Table 10 – Num. (slot number) definition

Value	Description
000_2	1st slot number (Num. = 0)
001_2	2nd slot number (Num. = 1)
010_2	3rd slot number (Num. = 2)
...	...
111_2	8th slot number (Num. = 7)

The high-precision multi-bit linear audio data longer than 25 are divided into more than 2 quadlet sequence slots. The Num. (slot number) shall start with Num. = 0 (LABEL = 60_{16}) and be sequential. Figure 22 shows generic quadlet sequence for the high-precision multi-bit linear audio data.

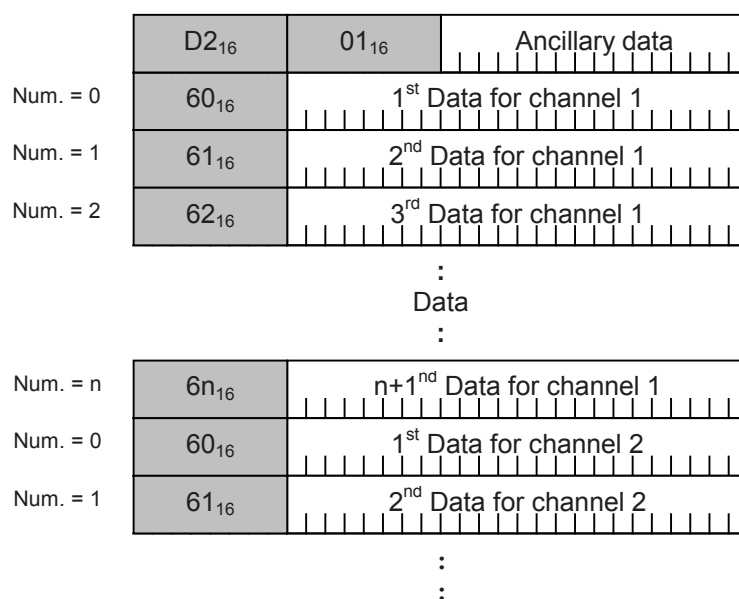


Figure 22 – Generic high-precision quadlet sequence

8.2.9 Ancillary data

8.2.9.1 Generic ancillary data

Generic ancillary data is illustrated in Figure 23 and the definition of LABEL is provided in Table 11. The definition of Byte 1, Byte 2, Byte 3 and transmission method, timing accuracy and interval, for instance, should be given by each instance of ancillary data. It is recommended that all information carried by ancillary data should be transmitted repeatedly in a reasonably short interval of time while the information is valid so that the receiver does not have to wait for the information. It is recommended that Byte 1 is defined as a SUB LABEL that specifies Byte 2 and Byte 3.

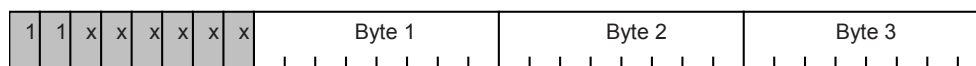


Figure 23 – Generic ancillary data

Table 11 – LABEL definition for ancillary data type

Value	Description
$C0_{16} - CF_{16}$	Common ancillary data
$D0_{16} - EF_{16}$	Application-specific ancillary data

8.2.9.2 Common ancillary data

8.2.9.2.1 General

Common ancillary data carries information common to all applications under a category of such as copyright information. The usage of these data are described in 11.4.2.3. Table 12 provides LABEL definition for common ancillary data.

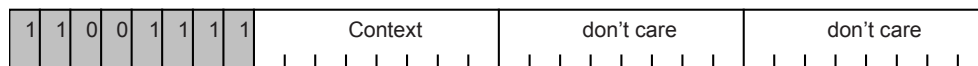
Table 12 – LABEL definition for common ancillary data

Value	Description
$C0_{16}$	ASID
$C1_{16} - CE_{16}$	Reserved
CF_{16}	Ancillary no-data

8.2.9.2.2 Ancillary no data

Ancillary no-data, shown in Figure 24, provides a no-data event only for AM824 data that does not define its own no data. Table 13 provides a CONTEXT definition. AM824 data types that define their own no data shall not use this ancillary no data.

In order to determine whether the AM824 data type carries valid information, it is required that no data specifies the AM824 data type to which it belongs. For this reason, the AM824 data type derived from a given no data should be identical to the AM824 data that carries valid information. Subclause 8.2.5 allows the use of no data defined in MIDI conformant data.

**Figure 24 – Ancillary no data****Table 13 – CONTEXT definition**

Value	Description
00_{16}	No-data for IEC 60958 conformant
$01_{16} - 3F_{16}$	Reserved
40_{16}	No-data for multi-bit linear audio
$41_{16} - 4F_{16}$	Reserved
50_{16}	No-data for one-bit audio (plain)
$51_{16} - 57_{16}$	Reserved
58_{16}	No-data for one-bit audio (encoded)
$59_{16} - 5F_{16}$	Reserved
60_{16}	No-data for high-precision multi-bit linear audio
$61_{16} - 7F_{16}$	Reserved
$80_{16} - 83_{16}$	Reserved
$84_{16} - 87_{16}$	Reserved
$88_{16} - 8F_{16}$	Reserved
$C0_{16} - CE_{16}$	No-data for each 7 different common ancillary data
CF_{16}	No-data for unspecified type. This shall be used only for the purpose described in 11.3.
$D0_{16} - EF_{16}$	No-data for each 32 different application specific ancillary data
$F0_{16} - FF_{16}$	Reserved

8.2.9.2.3 ASID

ASID (Audio Software Information Delivery) defines transmission methods of ISRC, UPC/EAN and content usage (copyright assertion) information carried by the AM824 data.

The general format for ASID is shown in Figure 25.

**Figure 25 – General format for ASID**

The second byte SUB LABEL following the LABEL identifies the particular type of ASID data as shown in Table 14.

Table 14 – SUB LABEL definition for ASID

SUB LABEL	Description
00 ₁₆ – 0F ₁₆	UPC/EAN and ISRC
10 ₁₆ – 1F ₁₆	Content Usage Information
20 ₁₆ – FF ₁₆	Reserved

For details, see the ASID specification.

8.2.10 Application specific ancillary data

Application specific ancillary data carries information specific to an application, which is transmitted along with the audio and music data. Examples are mapping of sequence of a compound data block to speaker location, microphone location, or signal name.

Table 15 – LABEL definition for application specific ancillary data

Value	Description
D0 ₁₆	DVD-Audio
D1 ₁₆	SACD
D2 ₁₆	High-precision multi-bit linear audio
D3 ₁₆	Blu-ray Disc
D4 ₁₆	Multi-bit Linear Audio (MBLA)
D5 ₁₆ – EF ₁₆	Reserved

The general format for the application-specific ancillary data is shown in Figure 26.

**Figure 26 – General format for application-specific ancillary data**

The first byte ("LABEL") indicates that these data are for the application specific ancillary data of the type shown in Table 15. The second byte ("SUB LABEL") further identifies the particular data that follows. For details, refer to 12.2 for DVD-Audio, 12.3 for SACD, 12.4 for Blu-ray and 12.5 for Multi-bit Linear Audio (MBLA).

8.3 32-bit floating-point data

This data type carries 32-bit floating-point data defined in IEEE 754-1985, Standard for Binary Floating-Point Arithmetic.

UNIT_SIZE = 1 quadlet/unit

UNIT_DIMENSION = 1 sequence/unit

Figure 27 illustrates the structure of 32-bit floating-point data.