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Edition 1.0 2019-09

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Universal serial bus interfaces for data and power –
Part 1-7: Common components – USB Audio 3.0 device class definition data formats

Interfaces de bus universel en série pour les données et l'alimentation électrique –
Partie 1-7: Composants communs – Définition de classes de dispositifs USB Audio 3.0 pour formats de données

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UNIVERSAL SERIAL BUS INTERFACES FOR DATA AND POWER –

Part 1-7: Common components – USB Audio 3.0 device class definition data formats

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

CDV	Report on voting
100/3159/CDV	100/3229/RVC

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The IEC 62680 series is based on a series of specifications that were originally developed by the USB Implementers Forum (USB-IF). These specifications were submitted to the IEC under the auspices of a special agreement between the IEC and the USB-IF.

This standard is the USB-IF publication USB Device Class Definition for Audio Data Formats Release 3.0.

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UNIVERSAL SERIAL BUS
DEVICE CLASS DEFINITION
FOR
AUDIO DATA FORMATS

Release 3.0

September 22, 2016

SCOPE OF THIS RELEASE

This document is the Release 3.0 of this device class definition.

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3.0	Sep. 22, 16	Frmts30.pdf	Release 3.0

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1 INTRODUCTION

The intention of this document is to describe in detail all the Audio Data Formats that are supported by the Audio Device Class. This document is considered an integral part of *the Audio Device Class Specification*, although subsequent revisions of this document are independent of the revision evolution of the main *USB Audio Specification*. This is to easily accommodate the addition of new Audio Data Formats without impeding the core *USB Audio Specification*.

1.1 RELATED DOCUMENTS

- *Universal Serial Bus Specification*, Revision 2.0 (referred to in this document as the *USB Specification*). In particular, see Chapter 5, “USB Data Flow Model” and Chapter 9, “USB Device Framework.”
- Universal Serial Bus Device Class Definition for Audio Devices (referred to in this document as USB Audio Device Class).
- Universal Serial Bus Device Class Definition for Terminal Types (referred to in this document as USB Audio Terminal Types).
- ANSI S1.11-1986 standard.
- MPEG-1 standard ISO/IEC 111172-3 1993. (available from http://www.iso.ch)
- MPEG-2 standard ISO/IEC 13818-3 Feb. 20, 1997. (available from http://www.iso.ch)
- Digital Audio Compression Standard (AC-3), ATSC A/52A Aug. 20, 2001. (available from http://www.atsc.org)
- Windows Media Audio (WMA) specification. (available from http://www.microsoft.com)
- ANSI/IEEE-754 floating-point standard.
- ISO/IEC 60958 International Standard: *Digital Audio Interface and Annexes.*
- ISO/IEC 61937 standard.
- ITU G.711 standard.
- ETSI Specification TS 102 114, “DTS Coherent Acoustics; Core and Extensions”. (Available from http://webapp.etsi.org/action%5CPU/20020827/ts_102114v010101p.pdf)

1.2 TERMS AND ABBREVIATIONS

This section defines terms used throughout this document. For additional terms that pertain to the Universal Serial Bus, see Chapter 2, “Terms and Abbreviations,” in the *USB Specification*.

AC-3	Audio compression standard from Dolby Labs.
Audio Slot	A collection of audio subslots, each containing a PCM audio sample of a different physical audio channel, taken at the same moment in time.
Audio Stream	A concatenation of a potentially very large number of audio slots ordered according to ascending time.
Audio Subslot	Holds a single PCM audio sample.
DTS	Acronym for Digital Theater Systems.
DVD	Acronym for Digital Versatile Disc.
Encoded Audio Bit Stream	A concatenation of a potentially very large number of encoded audio frames, ordered according to ascending time.

Encoded Audio Frame	A sequence of bits that contains an encoded representation of audio samples from one or more physical audio channels taken over a fixed period of time.
MPEG	Acronym for Moving Pictures Expert Group.
PCM	Acronym for Pulse Coded Modulation.
Service Interval	A grouping of USB (micro)frames or Bus Intervals that are related.
Service Interval Packet	A packet that contains all the audio slots that are transferred over the bus during a Service Interval.
Transfer Delimiter	A unique token that indicates an interruption in an isochronous data packet stream. Can be either a zero-length data packet or the absence of an isochronous transfer in a certain USB frame.
WMA	Acronym for Windows Media Audio.

2 AUDIO DATA FORMATS

Audio Data formats can be divided in two main groups:

- Simple Audio Data Formats
- Extended Audio Data Formats

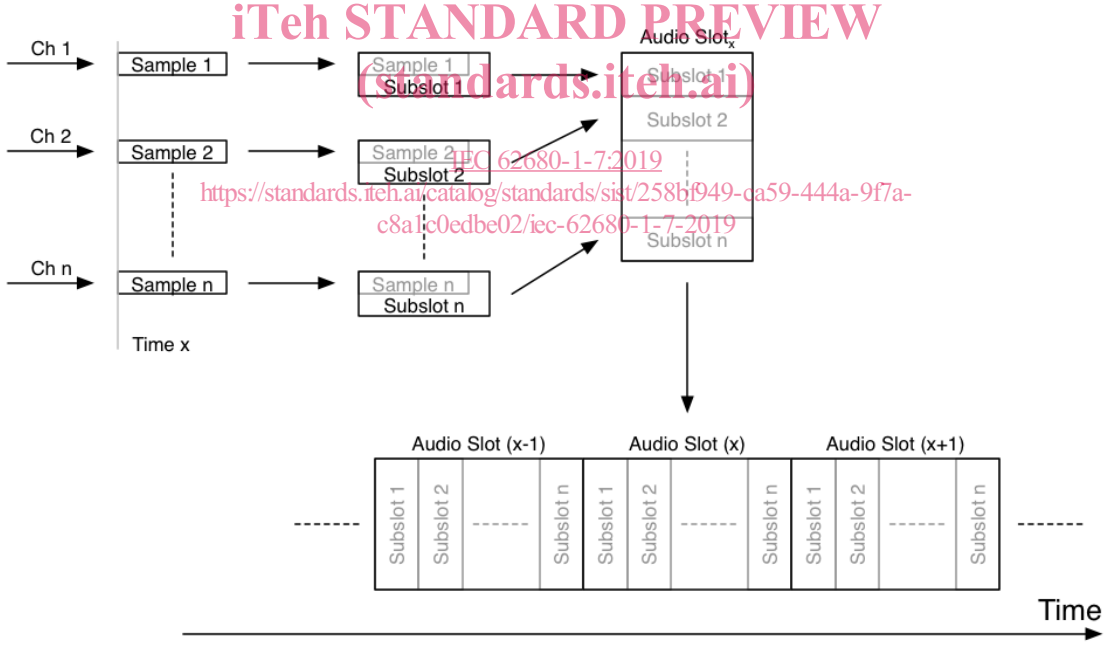
Simple Audio Data Formats can then be subdivided into three groups according to type.

The first group, Type I, deals with audio data streams that are transmitted over USB and are constructed on a sample-by-sample basis. Each audio sample is represented by a single independent symbol, contained in an audio subslot. Different compression schemes may be used to transform the audio samples into symbols.

Note: This is different from encoding. Compression is considered to take place on a per-audio-sample base. Each audio sample generates one symbol (e.g. A-law compression where a 16-bit audio sample is compressed into an 8-bit symbol).

If multiple physical audio channels are formatted into a single audio channel cluster, then samples at time *x* of subsequent channels are first contained into audio subslots. These audio subslots are then interleaved, according to the cluster channel ordering as described in the main *USB Audio Specification*, and then grouped into an audio slot. The audio samples, taken at time *x*+1, are interleaved in the same fashion to generate the next audio slot and so on. The notion of physical channels is explicitly preserved during transmission. A typical example of Type I formats is the standard PCM audio data. The following figure illustrates the concept.

Figure 2-1: Type I Audio Stream



The second group, Type III, contains Audio Data Formats that use encapsulation as described in the ISO/IEC 61937 standard before being sent over USB. One or more non-PCM encoded audio data streams are packed into “pseudo-stereo samples” and transmitted as if they were real stereo PCM audio samples. The sampling frequency of these pseudo samples (transport sampling frequency, as reported by the Clock Frequency Control of the associated Clock Source Entity) either matches the sampling frequency of the original non-encoded PCM audio data streams (native sampling frequency) or there is an integer ratio relationship between them. Therefore, clock recovery at the receiving end is relatively easy. The drawback is that unless multiple non-PCM encoded streams are packed into one pseudo stereo stream, more bandwidth than necessary is consumed.

The third group, Type IV, deals with audio streams that are not transmitted over USB. Instead, they interface with the Audio Function through an AudioStreaming interface that does not contain a USB isochronous IN or OUT endpoint. These streams typically connect via a digital interface like S/PDIF (or some other means of connectivity) and may require interaction from the Host before they enter or leave the Audio Function. A