 ISO/IEC JTC 1/SC 29/WG 3 N1062

**ISO/IEC JTC 1/SC 29/WG 03  
MPEG Systems   
Convenorship: KATS (Korea, Republic of)**

**Document type:** Output Document

**Title:** Text of ISO/IEC 23001-17 CDAM 1 High Precision Time Tagging and Other Improvements

**Status:** Approved

**Date of document:** 2023-10-19

**Source:** ISO/IEC JTC 1/SC 29/WG 03

**No. of pages:** 11 (with cover page)

**Email of Convenor:** young.L @ samsung . com

**Committee URL:** <https://isotc.iso.org/livelink/livelink/open/jtc1sc29wg3>

**INTERNATIONAL ORGANISATION FOR STANDARDISATION**

**ORGANISATION INTERNATIONALE DE NORMALISATION**

**ISO/IEC JTC 1/SC 29/WG 3**

**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC 1/SC 29/WG 3 N** **1062**

**Hanover, Germany – October 2023**

|  |  |
| --- | --- |
| **Title** | **Text of ISO/IEC 23001-17 CDAM 1 High Precision Time Tagging and Other Improvements** |
| **Source** | **WG 03, MPEG Systems** |
| **Status** | **Approved** |
| **Serial Number** | **23215** |

This document contains the initial Committee Draft of Amendment 1 to ISO/IEC 23001-17 Uncompressed video and images in ISO Base Media File Format

**ISO/IEC 23001-17:2023/CD AMD 1(E)**

ISO/IEC JTC 1/SC 29/WG 3

Date: 2023-10-20

**Information technology — MPEG Systems technologies — Part17: Uncompressed video and images in ISO Base Media File Format**

**Committee Draft of ISO/IEC 23001-17 AMENDMENT 1: High Precision Time Tagging and Other Improvements**

**Warning**

This document is not an ISO International Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an International Standard.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

CD stage

**Copyright notice**

This ISO document is a working draft or committee draft and is copyright-protected by ISO. While the reproduction of working drafts or committee drafts in any form for use by participants in the ISO standards development process is permitted without prior permission from ISO, neither this document nor any extract from it may be reproduced, stored or transmitted in any form for any other purpose without prior written permission from ISO.

Requests for permission to reproduce this document for the purpose of selling it should be addressed as shown below or to ISO's member body in the country of the requester:

ISO copyright office

Case postale 56 • CH-1211 Geneva 20

Tel. + 41 22 749 01 11

Fax + 41 22 749 09 47

E-mail copyright@iso.org

Web www.iso.org

Reproduction for sales purposes may be subject to royalty payments or a licensing agreement.

Violators may be prosecuted.

# Scope

This committee draft for 23001-17 Amendment 1 includes text for supporting:

1. High precision time tagging.
2. An update to the text of 23001-17 concerning the use of signed integers.

# Additional text concerning high precision time tagging

*The following terms and definitions are to be added to the existing list in 23001-17.*

# Terms and definitions

## **3.12 Temps Atomique International (TAI)**

A high-precision time scale derived from hundreds of precise atomic clocks from around the world and maintained as closely as possible to the Système International (SI) second. Current practice achieves a maximum deviation of approximately one second every 100 million years. The English version is International Atomic Time.

## **3.13 TAI clock**

A clock capable of synchronizing to a source of TAI time and generating TAI timestamps.

*The following text adds a section to the standard for labeling samples and items in general and with High Precision Time Tagging via section 8.1.*

# 8 Labeling of Samples and Items

## **8.1 High Precision Time Tagging**

To support applications requiring high resolution and high accuracy time labeling of media items and track samples, a method based on International Atomic Time (TAI) is provided. A TAI timestamp is defined as an integer number of nanoseconds since the TAI epoch of 1958-01-01T00:00:00.0Z. Additionally, this standard defines TAI timestamp quality status metadata included with each timestamp.

TAI timestamps are measurements from a TAI clock which reports timestamp values relative to the TAI epoch. TAI clocks are “receptor clocks”, typically receiving synchronization data with one or more external remote clocks (e.g., GPS system) which are sources of TAI time. Different types of receptor clocks have different levels of quality when synchronizing with remote clocks, therefore this standard defines metadata for describing the TAI clock, its capabilities, and its state when sampling a timestamp.

Two data structures support TAI timestamps:

1) TAIClockInfoBox: describes the TAI clock generating timestamps.

2) TAITimestampPacket: contains a timestamp and quality status for the timestamp.

**8.1.1 TAI clock information box**

**8.1.1.1 Definition**

Box Type: 'taic'

Container: SampleEntry, ItemPropertyContainerBox

Mandatory: Yes, when TAI Timestamps are present

Quantity: Zero, or one per sample entry or associated item

The TAIClockInfoBox provides metadata about TAI clocks. This metadata provides information about the type, quality, and status of the TAI clock, enabling readers to fully analyze information in measured items, such as an image item.

When TAI timestamps apply to an allocated media item, the TAIClockInfoBox is a descriptive item property. When the TAI timestamps apply to track samples, the writer includes a TAIClockInfoBox in the SampleEntry. The TAIClockInfoBox must be present when a TAI timestamp is present.

For systems and situations where a TAI clock does not synchronize with a remote clock, the TAIClockInfoBox is able to indicate this status condition.

**8.1.1.2 Syntax**

aligned(8) class TAIClockInfoBox extends FullBox('taic', 0, 0) {{

unsigned int(64) time\_uncertainty;

signed int(64) correction\_offset;

float(32) clock\_drift\_rate;

unsigned int(8) clock\_type;

}

**8.1.1.3 Semantics**

time\_uncertainty is the standard deviation measurement uncertainty for the timestamp generation process. It is expressed as an unsigned integer number of nanoseconds. Calibration testing of a device determines the time\_uncertainty value relative to the true TAI time of a measuring event. When the time\_uncertainty is unknown, the value is set to the maximum value (0xFFFF FFFF FFFF FFFF). Readers shall interpret the maximum value as being an unknown time\_uncertainty.

correction\_offset is the difference between the clock’s reported timestamp and true time value of the measurement event, e.g., a difference due to circuitry delay. The correction\_offset is a signed integer number of nanoseconds, coded using the two’s-complement representation. Positive values indicate the reported time has a delay relative to true time. Negative numbers indicate the reported time is ahead of true time. Calibration testing of a device determines the correction\_offset of the timestamp generation process. When the correction\_offset is unknown, the value shall be set to the maximum positive value (0x7FFF FFFF FFFF FFFF). Readers shall interpret the maximum positive value as being unknown. When the correction\_offset is known, applications add the correction\_offset value to the TAI\_timestamp to remove the offset resulting in a corrected timestamp:

corrected\_TAI\_timestamp = TAI\_timestamp + correction\_offset

clock\_drift\_rate is an IEEE 754 binary32 floating point value needed when the receptor and remote clocks are not in synchronization, e.g., receptor clock losing communication with remote clock. Drift rate is the difference between the synchronized reported time and the unsynchronized reported time, over a period of one second. The clock\_drift\_rate is the maximum drift rate in nanoseconds/second, given from either a clock’s specification information or laboratory testing and measurement. When the clock\_drift\_rate is unknown, the value shall be set to an IEEE 754 quiet NaN value of 0x7FC0 0000. Readers shall interpret the quiet NaN value of 0x7FC0 0000 as being unknown.

clock\_type is an enumeration value indicating the style of clock generating the timestamps. The enumeration values are:

|  |  |
| --- | --- |
| 0 | Clock type is unknown |
| 1 | The clock does not synchronize to an atomic source of absolute TAI time (ex: unsynchronized CPU clock) |
| 2 | The clock can synchronize to an atomic source of absolute TAI time (ex: synchronized GPS timing card) |
| 3-255 | Reserved – DO NOT USE |

**8.1.2 TAI timestamp packet**

**8.1.2.1 Definition**

The TAITimestampPacket supports the carriage of a TAI time value from a TAI clock along with real-time TAI clock status information. The TAI\_timestamp provides temporal context and attaches to samples and items within a file.

To attach TAI\_timestamps to track samples, writers include TAITimestampPackets as sample auxiliary information. To attach TAI timestamps to items, writers implement them as a descriptive item property. The TAITimestampPacket carries a TAI\_timestamp, along with per-sample status information for each track sample or item.

For media captured in real-time, TAI\_timestamps for the media monotonically increase. TAI is not the same at UTC time and therefore TAI\_timestamp values do not include leap seconds. The TAI\_timestamp for an individual frame is immutable, does not change once written, and remains with its sample or item to provide a record of the original measurement time of the sample or item. Subsequent processing, like editing to change the order of the media samples, may alter the overall monotonic nature within the structure of a track.

The TAIClockInfoBox must be present when a TAI timestamp is present.

**8.1.2.2 Syntax**

aligned(8) class TAITimestampPacket {

unsigned int(64) TAI\_timestamp;

unsigned int(8) status\_bits;

}

**8.1.2.3 Symantics**

TAI\_timestampis a 64-bit unsigned integer representing the number of nanoseconds since the TAI epoch of 1958-01-01T00:00:00.0Z. Each nanosecond is one billionth of a Standard International (SI) Second. The timestamp is associated with the beginning of a physical measurement, such as the start of exposure for an imaging sensor. When a TAI clock does not report a timestamp or produces an invalid or corrupt timestamp, the writer assigns the TAI timestamp a value equal to the maximum value (0xFFFF FFFF FFFF FFFF) and sets the timestamp\_validity bit to 0. Readers are to interpret the maximum value as an invalid timestamp.

status\_bits indicate the state of the timestamp generation process. The TAI clock reporting the TAI\_timestampmust synchronize with a remote clock when possible. When the remote clock is in synchronization with the receptor clock the state of the receptor clock is synchronized. When the remote clock is unavailable the state of the receptor clock is unsynchronized. This table defines the meaning of the bits and bit values:

|  |  |
| --- | --- |
| **Value** | **Status Parameter** |
| Bit 0 (lsb) | synchronization\_status |
| = 0 | Unsynchronized to remote clock during measurement |
| = 1 | Synchronized to remote clock time during measurement |
| Bit 1 | timestamp\_validity |
| = 0 | Timestamp is invalid, corrupt, or missing |
| = 1 | Timestamp generation was nominal |
| Bit 2 through Bit 7 (msb) | Reserved – DO NOT USE |
| = b000000 | *Set reserved bits to zero* |

synchronization\_status indicates the remote clock and receptor clock were in the synchronous state when generating the TAI\_timestamp. When the remote clock and receptor clock are not in a synchronous state the bit ‘0’ flag is set to 0. When the remote clock and receptor clock are in a synchronous state, the bit ‘0’ flag is set to 1. When the clock\_type value in the companion TAIClockInfoBox is set to something other than ‘2’, this bit is set to ‘0’.

timestamp\_validity When a system determines the timestamp is invalid, corrupt, or missing, bit ‘1’ is set to 0. When a system determines the timestamp is valid, bit ‘1’ is set to 1.

When a clock is not traceable to a remote TAI clock (e.g., GPS) the synchronization\_status is set to ‘0’, since the clock is not synchronized to TAI and the timestamp\_validity is set to ‘1’ when the timestamp is valid. For example, a system using a CPU clock without a remote TAI clock.

**8.1.3 Sample TAI Timestamps**

**8.1.3.1 Definition**

Aux Info Type: 'stai'

Container: Sample auxiliary information

Mandatory: No

Quantity: Zero, or one per sample when present

A timestamp\_packet is a sample auxiliary information payload for each sample in a track. The companion TAIClockInfoBox is stored in the sample entry and carries clock source information for the sample timestamps.

**8.1.3.2.Syntax**

TAITimestampPacket timestamp\_packet;

**8.1.3.3 Semantics**

timestamp\_packet is an instance of the TAITimestampPacket. See the TAITimestampPacket class declaration in Section 8.1.2 for details.

aux\_info\_type (‘saiz’ and ‘saio’ box parameter) This parameter is set to ‘stai’, which indicates sample TAI timestamps.

aux\_info\_type\_parameter (‘saiz’ and ‘saio’ box parameter) This parameter is currently unused for the aux\_info\_type of ‘stai’. The aux\_info\_type\_parameter is reserved, and all 32-bits of the unsigned word shall be set to ‘0’.

Remaining ‘saiz’ and ‘saio’ box parameters are implemented as per ISO/IEC 14496-12 box specification.

**8.1.4 Item TAI Timestamps**

**8.1.4.1 Definition**

Box Type: 'itai'

Property Type: Descriptive item property

Container: ItemPropertyContainerBox

Mandatory: No

Quantity: Zero, or one per item

The TAITimestampBox allows associating a TAI\_timestamp to an allocated item. This box may be present when deriving the item contents from a measured process, such as an image item or a metadata item containing measured sensor data. This box has a required companion TAIClockInfoBox property holding clock information. The TAI timestamps and TAI clock information are two separate properties so clock information, when identical across multiple items, can be generated once and associated to multiple items.

**8.1.4.2.Syntax**

aligned(8) class TAITimestampBox extends ItemFullProperty('itai', 0, 0) {

TAITimestampPacket timestamp\_packet;

}

**8.1.4.3 Semantics**

timestamp\_packet is an instance of the TAITimestampPacket class (see declaration for details).

# Clarification on the use of signed variables

*The FDIS text of ISO/IEC 23001-17 ed1 was published at MPEG #143 (N 990). The specification makes uses of signed integers for two syntax elements. The binary representation associated with signed integers is currently not defined by ISO/IEC 14496-12 or ISO/IEC 14496-1. As a result, the following changes clarify the binary representation of the signed integers. Changes are highlighted in yellow below.*

**6.1.4 Component Reference Level**

**6.1.4.1 Definition**

Box Type: 'clev'   
Container: Video sample entry, ItemPropertyContainerBox  
Mandatory: No  
Quantity: Zero or one

The ComponentReferenceLevelBox allows describing the minimum and maximum values for components present in the image data.

When this box is present, there shall be an associated ComponentDefinitionBox present.

When this box is absent or a component type is not listed in this box, reference white and black values for this component type are derived from the ColourInformationBox present in the sample entry of the track or associated with the image item. If the ColourInformationBox is absent, the levels for the desired component type are derived as follows:

* For components of type Y, U or V with 8 bits depth, reference black is 16 and reference white is 235
* For components of type Y, U or V with 10 bits depth, reference black is 64 and reference white is for 940
* Otherwise, reference black is 0 and reference white is maximum value for component bit depth.

When ComponentReferenceLevelBox and ColourInformationBox are both present and document reference levels for the same component types, information from the ColourInformationBox shall be used.

NOTE If the ColourInformationBox is present with unspecified matrix\_coefficients and has full\_range\_flag set to 1, full range is assumed.

Reference levels shall be ignored for non-integer component types.

If clip\_range is set to 1, black\_level (resp. white\_level) indicates the minimum (resp. maximum value) for the component; readers shall clip any value less than black\_level (resp. greater than white\_level) to black\_level (resp. white\_level).

If clip\_range is set to 0, readers shall transform the value *N* coded on *k* bits (as read from the sample data) to the value black\_level+*N*\*(white\_level-black\_level)/(2*k*-1) before display or interpretation.

**6.1.4.2 Syntax**

aligned(8) class ComponentReferenceLevelBox extends FullBox('clev', 0, 0) {  
 unsigned int(32) level\_count;

{  
 unsigned int(32) component\_index;  
 unsigned int(1) clip\_range;  
 bits(7) reserved = 0;  
 signed int(32) black\_level;   
 signed int(32) white\_level;   
 } [level\_count];  
}

**6.1.4.3 Semantics**

level\_count indicates the number of components for which levels are described

component\_index indicates the index of the Nth component listed in the associated ComponentDefinitionBox.

clip\_range indicates if the levels indicate a clip range or an affine transformation of the Nth component values

black\_level indicates the black level for the Nth component. This value shall be coded using the two’s-complement representation.

white\_level indicates the white level for the Nth component; this value shall be greater than the black\_level value and shall be coded using the two’s-complement representation.