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

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

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

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

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

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

The following are working draft amendments for inclusion into ISO/IEC 23001-17.

[1. High Precision Time Tagging 4](#_Toc140831129)

# High Precision Time Tagging

This amendment material describes a mechanism to include 64-bit nanosecond time stamps, for media items and media track samples based on International Atomic Time (TAI). This approach defines the following:

1. TAIClockInfoBox: describes the clock source generating the time stamps. It is carried in the sample entry when annotating track media samples, or as an item property when annotating items
2. TAITimeStampPacket: contains the time stamps and synchronization status for each time stamp. It is carried as sample auxiliary information for track media samples, or as an item property when annotating items

These two data structures carry the necessary information enabling the annotation of high precision TAI timestamps with uncompressed video and images in ISOBMFF and HEIF files.

**6.1.12 TAI Clock Info**

**6.1.12.1 Definition**

Box Type: 'taic'

Container: Video sample entry, ItemPropertyContainerBox

Mandatory: Yes, when TAI Time Stamps are present

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

Applications requiring high precision, high accuracy time stamps on measured samples in a track may annotate samples with International Atomic Time standard (TAI) time stamps having nanosecond precision. These time stamps include metadata about the clock source providing reader applications with information related to the type, quality, and status of the clock used to measure time. The TAIClockInfoBox is used to carry metadata associated with the TAI clock source. Time stamps and per sample status data are carried in a TAITimeStampPacket as sample auxiliary information for track samples and as an item property for items. The need for this type of time stamp is driven by uncompressed video and image collection, but this capability may be used with other forms of measured sample data and items, including compressed imagery, when appropriate.

When carried as an item property, the TAI Clock Info is a descriptive item property.

When media is captured in real-time, the TAI time stamps for the media are monotonically increasing. With subsequent processing, like editing and other operations on the media, the order of time stamps in a track may get modified and may not stay monotonically increasing. The TAI time stamp 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. For systems and situations where a synchronized TAI clock source is not available, an unsynchronized local clock may be used, which then diminishes the utility of the time stamps. The instant in time for the time stamps is the start of exposure for an image frame and the beginning of physical measurement for metadata and audio signals.

**6.1.12.2 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) reference\_source\_type;

}

**6.1.12.3 Semantics**

time\_uncertainty is the one standard deviation measurement uncertainty of the time stamp generation process, relative to the true TAI time of the beginning of media sample exposure. The units are nanoseconds. When the time\_uncertainty is unknown, it shall be set to 0xFFFFFFFFFFFFFFFF. Readers shall interpret the “all ones” value as being unknown.

Correction\_offset accounts for a fixed offset in the time stamps from the estimated true value. If the time stamp generation process results in an offset, due to circuitry delays, a known offset in the source clock, etc. this value can be used to signal an offset value to be applied to the individual time stamps. When this value is non-zero, applications may add this value to the TAI\_time\_stampto remove the estimated offset. Corrections are applied as

Corrected\_TAI\_time\_stamp = TAI\_time\_stamp + Correction\_offset

A negative offset occurs when the time stamp is measured later than the measurement of the sample begins. The units are nanoseconds and when the value is unknown, it shall be set to 0x7FFFFFFFFFFFFFFF. Readers shall interpret the 0x7FFFFFFFFFFFFFFF value as being unknown.

clock\_drift\_rate is the maximum drift rate of the source clock when not in synchronization (i.e. free-running) with the timing source (e.g., GPS) and free running. This parameter allows for estimating time stamp drift over time after synchronization with a timing source is lost. The clock\_drift\_rate is determined from a specification for the timing source or via laboratory testing and measurement. The units are nanoseconds/second. When the clock\_drift\_rate is unknown, it shall be set to zero (‘0.0’). Readers shall interpret the zero value as being unknown.

reference\_source\_type indicates the type of the source of time generating the time stamps. The following enumerated values are defined:

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

**6.1.13 Sample TAI Time Stamps**

**6.1.13.1 Definition**

Aux Info Type: 'stai'

Container: Sample auxiliary information

Mandatory: No

Quantity: Zero, or one per sample when present

TAI time stamps are utilized when precise and accurate time stamps are required on measured samples. Metadata defining the clock source and its capabilities are carried in the companion TAIClockInfoBox, which is required to be present when TAI time stamps are present. To attach TAI time stamps to track samples, they are implemented as sample auxiliary information. The TAITimeStampPacket is the sample auxiliary information payload for each sample in a track. It carries TAI nanosecond precision time stamps, along with per sample status information for each track sample.

**6.1.13.2 Syntax**

aligned(8) class TAITimeStampPacket {

unsigned int(64) TAI\_time\_stamp;

unsigned int(8) status\_bits;

}

**6.1.13.3 Semantics**

TAI\_time\_stampis a 64-bit time stamp for an item. The units are nanoseconds since the epoch of the TAI time format, which is defined as 1958-01-01T00:00:00.0Z. TAI time does not include leap seconds.

status\_bits are coded to indicate the state of the time stamp generation process. The clock reporting the TAI\_time\_stampmust synchronize with a TAI source when possible. When the TAI source is in sync with the reporting clock the state of the reporting clock is synchronized. When the TAI source is unavailable the state of the reporting clock is unsynchronized. The following values are defined:

|  |  |
| --- | --- |
| **Value** | **Status Parameter** |
| Bit 0 (lsb) | synchronization\_status |
| = 0 | Unsynchronized to TAI time during measurement |
| = 1 | Synchronized to TAI time during measurement |
| Bit 1 | time\_stamp\_validity |
| = 0 | Time stamp is invalid, corrupt, or missing |
| = 1 | Time stamp generation was nominal |
| Bit 2 through Bit 7 (msb) | Reserved |
| = b000000 | *Set reserved bits to zero* |

synchronization\_status indicates the reporting clock generating the TAI\_time\_stamp is synchronized with a TAI clock source. When the reporting clock system is not synchronized to TAI time and is ‘coasting’, the bit ‘0’ flag is set to 0. When the reporting clock system is synchronized to a source of TAI time, the bit ‘0’ flag is set to 1. When the reference\_source\_type value in the companion TAIClockInfoBox is set to other than ‘2’, this bit shall be set to ‘0’.

time\_stamp\_validity When a time stamp is determined to be invalid, corrupt or missing, bit ‘1’ is set to 0. When a time stamp for a specific frame is missing, the time stamp value shall be coded to 0xFFFFFFFFFFFFFFFF. Readers shall interpret the “all ones” value as being invalid. For a particular media sample, when the time stamp is measured in a nominal manner, bit ‘1’ is set to 1. When a clock not traceable to TAI time is used to capture a time stamp, such as a free-running CPU clock, the time\_stamp\_validity is set to ‘1’ during normal reads, and the synchronization\_status is set to ‘0’, since the clock is not synchronized to TAI.

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

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 box specification.

**6.3.2 Item TAI Time Stamps**

**6.3.2.1 Definition**

Box Type: 'itai'

Property Type: Descriptive item property

Container: ItemPropertyContainerBox

Mandatory: No

Quantity: Zero or one per item

The TAITimeStampBox allows associating a time stamp based on International Atomic Time to an allocated item. This box may only be present when the item contents are derived from a measured process, such as an image item or a metadata item containing measured sensor data. The time stamp is associated with the beginning of a physical measurement, such as the start of exposure for an imaging sensor. This box has a required companion TAIClockInfoBox property holding clock source information. The TAI time stamps and TAI clock information are separated into two properties so source information, when identical across multiple items, can be generated once and associated to the multiple items.

**6.1.2.2 Syntax**

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

TAITimeStampPacket time\_stamp\_packet;

}

**6.1.2.3 Semantics**

time\_stamp\_packet carries the TAI time stamp, synchronization\_status, and time\_stamp\_validity. See the TAITimeStampPacket class declaration for details.