

 <p>STANDARD</p> <p>Time Stamping Compressed Motion Imagery</p>	<p>MISB ST 0604.3</p> <p>27 February 2014</p>
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1 Scope

This Standard defines guidance and requirements for time stamping MPEG-2 and H.264 compressed motion imagery streams. This Standard does not address metadata time stamping specifically, but assumes that timestamps are properly inserted into metadata as specified per MISB metadata-specific documents.

2 References

2.1 Normative References

The following references and the references contained therein are normative.

- [1] MISB ST 0603.2 Common Time Reference for Digital Motion Imagery using Coordinated Universal Time (UTC), Feb 2014
- [2] ISO/IEC 13818-2:2000, Information technology - Generic coding of moving pictures and associated audio information: Video
- [3] ITU-T Rec. H.264 (04/2013), Advanced Video Coding for Generic Audiovisual Services
- [4] MISB ST 0605.4 Time Stamping and Metadata Transport in High Definition Uncompressed Motion Imagery, Feb 2014
- [5] SMPTE ST 309:2012, Transmission of Date and Time Zone Information in Binary Groups of Time and Control Code
- [6] SMPTE ST 328:2000, Television - MPEG-2 Video Elementary Stream Editing Information

Informative References

- [7] SMPTE EG 40:2002, Conversion of Time Values Between SMPTE 12M Time Code, MPEG-2 PCR Time Base and Absolute Time

3 Revision History

Revision	Date	Summary of Changes
0604.3	02/27/2014	<ul style="list-style-type: none"> Revised for time stamping only; transport information moved to new standard ST 1402 Removed requirement for Commercial Time Stamp Included material from ST 9708

4 Definitions

Commercial Time Stamp: relative “time-of-day” time stamp derived from UTC. (see MISB ST 0603 [1]).

Precision Time Stamp: absolute “microseconds Since 1970” timestamp derived from UTC. (see MISB ST 0603 [1]).

5 Acronyms

ES	Elementary Stream
GOP	Group of Pictures
PES	Packetized Elementary Stream
SEI	Supplemental Enhancement Information
ST	Standard
UTC	Coordinated Universal Time
VANC	Vertical Ancillary Data Space
VITC	Vertical Interval Time Code

6 Time Information

Time stamps, when applied to both the motion imagery and the metadata provide a means for correlating the two data types. MISB ST 0603[1] identifies UTC as a deterministic common time reference for time stamping. ST 0603 defines two types of time stamps used in the MISB community: a Precision Time Stamp and a Commercial Time Stamp.

This Standard provides guidance on how to apply the Precision Time Stamp and the Commercial Time Stamp to MPEG-2 and H.264 compressed motion imagery.

6.1 Precision Time Stamp

Both MPEG-2 [2] and H.264/AVC [3] allocate space within the elementary stream for user defined data. This user defined data space shall be used to carry the Precision Time Stamp. Three components comprise the Precision Time Stamp information that is inserted into a motion imagery elementary stream: a Time Stamp Identifier, a Time Stamp Status, and a Precision Time Stamp (modified).

6.1.1 Time Stamp Identifier

The Time Identifier is a 16-byte Identification string that represents the ASCII string “MISPMicrosecond” and signals that the Precision Time Stamp is in the motion imagery elementary stream. Table 1 provides the mapping of this ASCII string to their byte equivalent.

Table 1: Byte Assignment for ASCII String MISPMicrosecond

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
M	I	S	P	m	i	c	r
0x4D	0x49	0x53	0x50	0x6D	0x69	0x63	0x72
Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
o	s	e	c	t	i	m	e
0x6F	0x73	0x65	0x63	0x74	0x69	0x6D	0x65

6.1.2 Time Stamp Status

The Time Stamp Status is a 1-byte word that indicates whether the time stamp source is synchronized to UTC. This status byte is defined in MISB ST 0603 [1].

6.1.3 Precision Time Stamp - modified

The Precision Time Stamp is an 8-byte value as specified in MISB ST 0603 [1]. For use within a motion imagery elementary stream this 8-byte value is modified to prevent false interpretation of the data by a decoder; the practice is known as Start Code Emulation Prevention. The Precision Time Stamp is therefore modified as two-byte values spaced by hex 0xFF (see Table 2). Table 2 shows the byte assignment for the one-byte Time Stamp Status followed by the 11-byte modified Precision Time Stamp, where Byte 18 is the most significant byte of the Precision Time Stamp. The Time Stamp Status plus modified Precision Time Stamp collectively form a 12-byte value.

Table 2: Byte Assignment for 64-bit Precision Time Stamp

Byte 17	Time Stamp Status (see MISB ST 0603 [1])	} Modified Precision Time Stamp
Bytes 18, 19	Byte 1 and 2 (Most significant bytes) of Precision Time Stamp	
Byte 20	<i>Start Code Emulation Prevention Byte (0xFF)</i>	
Bytes 21,22	Byte 3 and 4 of Time Stamp	
Byte 23	<i>Start Code Emulation Prevention Byte (0xFF)</i>	
Byte 24, 25	Byte 5 and 6 of Time Stamp	
Byte 26	<i>Start Code Emulation Prevention Byte (0xFF)</i>	
Byte 27, 28	Byte 7 and 8 (Least significant bytes) of Precision Time Stamp	

Note: The 8-byte Precision Time Stamp is embedded with Start Code Emulation Prevention bytes to form an 11-byte value.

6.1.4 Precision Time Stamp Sources

The Precision Time Stamp can originate from two possible sources (see Figure 1): 1) the Vertical Ancillary Data Space (VANC) [4] of an uncompressed motion imagery stream, if inserted at the sensor, or 2) generated from a local time reference.

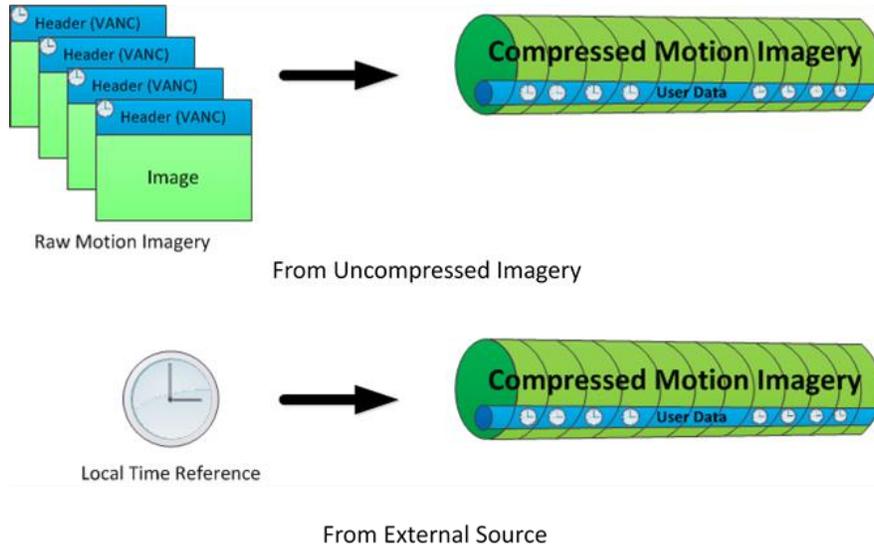


Figure 1: Sources of Precision Time Stamp

Requirement	
ST 0604.3-01	When an uncompressed motion imagery signal contains a Precision Time Stamp in the VANC (Vertical Ancillary Data Space) (MISB ST 0605 [4]), the Precision Time Stamp shall be extracted from the VANC and used as the Precision Time Stamp in the compressed motion imagery.
ST 0604.3-02	If an uncompressed motion imagery signal does not contain a Precision Time Stamp, but contains a Commercial Time Stamp in the VANC (Vertical Ancillary Data Space) (MISB ST 0605 [4]), the Commercial Time Stamp shall be extracted from the VANC and used to calculate the Precision Time Stamp in the compressed motion imagery.
ST 0604.3-03	If an uncompressed motion imagery signal does not contain a Precision Time Stamp and a UTC time reference is available, then that time reference shall be used to generate the Precision Time Stamp for the compressed motion imagery.

Note that for Requirement ST 0604.3-02, additional time since 1970 information must be provided in order to derive the Precision Time Stamp, since the Commercial Time Stamp only contains time-of-day information.

6.2 Commercial Time Stamp

The Commercial Time Stamp can originate from one or more sources: 1) the Vertical Ancillary Data Space (VANC)[4], or the Vertical Interval of an uncompressed motion imagery stream, if

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inserted at the source; 2) generated from the local clock reference; or 3) generated in a downstream process (such as the ground station). The Commercial Time Stamp is expressed as HH:MM:SS:FF as specified in MISB ST 0603 [1].

Requirement	
ST 0604.3-04	When an uncompressed motion imagery signal contains a Precision Time Stamp in the VANC (Vertical Ancillary Data Space) (MISB ST 0605 [4]), the Precision Time Stamp shall be extracted from the VANC and used to calculate the Commercial Time Stamp in the compressed motion imagery.
ST 0604.3-05	If an uncompressed motion imagery signal does not contain a Precision Time Stamp, but contains a Commercial Time Stamp in the VANC (Vertical Ancillary Data Space) (MISB ST 0605 [4]), the Commercial Time Stamp shall be extracted from the VANC and used as the Commercial Time Stamp in the compressed motion imagery.
ST 0604.3-06	If an uncompressed motion imagery signal does not contain either a Precision Time Stamp or a Commercial Time Stamp and a UTC time reference is available, then that time reference shall be used to generate a Commercial Time Stamp.

There are reserved data fields within the MPEG-2 and H.264/AVC elementary streams where Commercial Time Code is inserted.

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7.1 Common Requirements

Requirement	
ST 0604.3-07	The Precision Time Stamp as defined in MISB ST 0603 [1] shall be inserted in every motion imagery frame.

7.2 MPEG-2 Compressed Elementary Stream

7.2.1 Precision Time Stamp Information

MPEG-2 (ISO 13818-2 [2]) allocates a *user data field* (*user_data_start_code* = 0xB2) in a MPEG-2 compressed elementary stream for user defined data. The 16-byte Time Stamp Identifier, the one-byte Time Stamp Status and the 11-byte start-code emulation modified Precision Time Stamp form 28 bytes that are inserted into the *user data field* located between the picture header and the picture data, so that it relates to a specific frame of motion imagery.

Requirement	
ST 0604.3-08	A Precision Time Stamp consisting of Time Stamp Identifier, a Time Stamp Status and a start-code emulation-modified Precision Time Stamp shall be inserted into the MPEG-2 <i>user data field</i> located between the picture header and the picture data.

7.2.2 Commercial Time Stamp Information

The MPEG-2 video layer includes the definition of a 25-bit field time code (*time_code*) within the “group of pictures” (GOP) header. This time code is of the form HH:MM:SS:FF in a format specified in [1].

Requirement	
ST 0604.3-09	When a Commercial Time Stamp is available, it shall be inserted into every Group-of-Pictures (GOP) of a MPEG-2 elementary stream.

7.3 H.264 Compressed Elementary Stream

7.3.1 Precision Time Stamp Information

ITU-T Rec. H.264 [3] provides a Supplemental Enhancement Information (SEI) message portion of the H.264 elementary stream data field – designated the *user data unregistered SEI Message field* (*user_data_unregistered*) – to include user-defined data and time code in a H.264 compressed elementary stream. The *uuid_iso_iec_11578* is a 16-byte field (value set as a UUID), and the *user_data_payload_byte* is a variable length field.

Requirement	
ST 0604.3-10	A Precision Time Stamp consisting of Time Stamp Identifier, a Time Stamp Status and a start-code emulation-modified Precision Time Stamp shall be inserted into the H.264 elementary stream user data unregistered SEI Message field <i>uuid_iso_iec_11578</i> , so that it relates to a specific frame.

7.3.2 Commercial Time Stamp Information

The H.264 standard provides for an optional time code to be inserted into the *picture timing SEI message*. The picture timing SEI message (*pic_timing*) specifies this time code format as HH:MM:SS:FF. The time code reflects the time of frame capture, contains flags to specify whether the video is drop-frame, and whether there is a discontinuity in the video time-line.

Requirement	
ST 0604.3-11	When a Commercial Time Stamp is available, it shall be inserted into the H.264 <i>pic_timing</i> SEI message in every frame.