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What is the Motion Imagery Standards Board (MISB)?
The Motion Imagery Standards Board (MISB) was established in accordance with DoD Directive 5105.60 “to formulate, review, and recommend standards for Motion Imagery, associated Metadata, Audio, and other related systems” for the Department of Defense (DoD), Intelligence Community (IC), and National System for Geospatial-Intelligence (NSG). The MISB exists under the Geospatial Intelligence Standards Working Group (GWG) which is operated by the GEOINT Standards Center of Excellence division at NGA.
The MISB meets three times a year (typically February, June and October) in the Washington D.C. metropolitan area. The MISB is comprised of working groups that address different functional areas regarding Motion Imagery.

**Where do MISB requirements apply?**

Any Motion Imagery (MI) System subject to the DoD IT Standards Registry (DISR) is subject to MISB standards and requirements. In the production of a Motion Imagery System, or components for use within the DoD/IC communities, such systems and components are subject to MISB standards and requirements.

**What constitutes a Motion Imagery System (as defined by the MISB)?**

Any imaging system that provides the functionality of collecting, encoding, processing, controlling, exploiting, viewing, and/or storing Motion Imagery as defined in MISP-2015.1 or later. This explicitly includes, but is not limited to, phenomenologies such as Electro-optical (EO), Infrared (IR), Synthetic Aperture Radar (SAR), Multi-spectral (MSI), and Hyper-spectral (HSI). Video Teleconference (VTC), Video Telemedicine, and Video Support Services applications DO NOT fall within the purview of the MISB and are not subject to its requirements.

**What is the difference between Motion Imagery and Full Motion Video?**

Motion Imagery is a sequence of Images, that when viewed (e.g. with a media player) must have the potential for providing informational or intelligence value. This implies the Images composing the Motion Imagery are: (1) generated from sensed data, and (2) related to each other both in time and in space. Some sensed data, such as Visible Light and Infrared, can be used directly to form Images, while others, such as SAR and LIDAR, require a conversion to a viewable Image. To satisfy the time and space relationship the capture time (i.e. the time the Image was taken) of each successive Image must be sequentially in order and the space relationship between each successive Image must have some recognizable visual overlap with the previous Image.

Full Motion Video (FMV) is a term used within the military and intelligence communities. As used, FMV implies a very narrow subset of Motion Imagery; one that assumes geo-spatial metadata, commercial image formats and playback rates. FMV has no formal definition and conveys different meanings to different communities; therefore, the term FMV should not be used in any contractual language.

**What does it mean to be MISB conformant?**

To be MISB conformant, a Motion Imagery System must:

1. Once Motion Imagery is in digital form, it must remain digital within the workflow
2. Produce a conformant MPEG-2 Transport Stream (TS); this does not apply to JPEG 2000 based systems or RTP/RTCP-based systems
3. Use MPEG-2, H.264/AVC, H.265/HEVC (provisional use) or JPEG 2000 image compression
4. Produce non-destructive (not “burned in”) metadata
5. Comply with the MISB ST 0902 minimum metadata set
6. Add metadata elements as needed for the task (e.g., MISB ST 0601, MISB ST 0801, etc.)

Older systems used MISB EG 0104, which has been deprecated. The Motion Imagery Standards Profile (MISP) codifies all MISB requirements, Standards and Recommended Practices. The MISP is found on the MISB website, and is cited in the DISR.

**What is to be avoided in building a Motion Imagery System?**

Do not build systems with any of the following:
1. Analog image capture/processing
2. Systems with interlaced scanning formats
3. Destructive ("burned in") metadata
4. MISB EG 0104
5. Systems that utilize file formats, metadata encodings and compression algorithms not cited in the MISP.

What is the MISB website URL, and what information is found there?
The MISB website is http://www.gwg.nga.mil/misb. The MISP (Motion Imagery Standards Profile) and all Standards (STs), Recommended Practices (RPs), and Technical Reference Material (TRMs) can be found there. A good starting point is to review the Motion Imagery Handbook, which provides fundamentals on Motion Imagery and sets the stage for a better understanding of the MISP. The MISP defines requirements which programs can use in the acquisition phase; it also includes references to all MISB STs, RPs and TRMs. For access to draft documents, test files, and other support documentation follow the instructions on the website to apply for an account to access the MISB protected website.

What is the difference between a Standard and a Recommended Practice?
A document is eligible to be a Standard when it meets at least one of the following criteria:
- Facilitates interoperability and consistency
- Defines metadata elements

Where the MISP term Standard (ST) is used, the MISP item mandates binding technical implementation policy, and as such, should be identified in Government procurement actions as a mandatory conformance item in order for vendor offerings to be accepted by the Government.

A document begins the standards process as “Developing”, where it is authored and presented for community review and approval. Once adopted the developing Standard moves to an “Approved” status. Standards that are obsolete or replaced are declared “Deprecated”, while those no longer in use are “Retired”.

A document is considered a RP when it:
- Provides guidance that facilitates the implementation of a Standard
- Is not required for interoperability, but when used states requirements for its usage

Recommended Practices should be considered technical implementation policy. They may be identified in Government procurement actions as a mandatory conformance item in order for vendor offerings to be accepted by the Government.

Additional information on document initiation, review and adoption processes can be found on the MISB website under MISB PROCEDURES.

What viewer will play both Motion Imagery and Metadata?
There are several GOTS and COTS tools available from a variety of government contracting companies as well as a few commercial companies. The MISB cannot make recommendations regarding software and hardware solutions.

What is the process to certify a Motion Imagery System?
NGA is responsible for overseeing conformance testing to GEOINT standards.
• Results from conformance testing are submitted to the NSG GEOINT Functional Manager Standards Assessment (GFMSA) program, which ultimately provides NGA’s recommendations on GEOINT conformance to JITC’s Interoperability Certification process on a per program basis.
• NGA oversees the process whereby a Motion Imagery System achieves and sustains conformance through the NGA Conformance Program for Motion Imagery.
• The Motion Imagery Standards Board (MISB), acting as NGA’s delegate for Motion Imagery, is instituting the NGA Conformance Program for Motion Imagery. The NGA Conformance Program for Motion Imagery defines the testing policies and procedures to meet conformance to the (MISP) as issued by the MISB.
• The MISP states requirements and specifies standards for maximizing interoperability in the production, exchange and use of Motion Imagery.

The NGA Conformance Program for Motion Imagery prescribes test policies, defines the roles and responsibilities of participating organizations, outlines test processes, and identifies artifact repositories for test reports and certificates of conformance. A companion document, the NGA Conformance Test Plan for Motion Imagery, defines the baseline suite of tests, test procedures, test equipment and test report templates to document results of conformance testing. The NGA Conformance Test Plan for Motion Imagery is specifically tailored to measure conformance to the MISP issued by the MISB.

Of the approved compression algorithms (MPEG-2, H.264 and JPEG2000), which is recommended?
H.264 yields the best image quality for bandwidth-constrained applications with data rates approximately one-half that of MPEG-2. This improvement comes with increased complexity in the encoder and decoder; however, with H.264 widely adopted in the commercial world this is nearly a non-issue. DISA advocates H.264 over MPEG-2 throughout their networks. For High Definition on-platform applications, H.264 is the recommended choice given the bandwidth-constrained realities of the communications links.

JPEG2000 is an intra-frame compression technology, and produces 2-3 times the data of MPEG-2. However, JPEG2000 accommodates large frame (Gpixels) sizes and offers low (1 frame) latency. This makes JPEG 2000 useful in Large Volume Motion Imagery (LVMI) applications. For more information regarding LVMI systems see the section below.

What is the status of H.265 within MISB?
H.265 is a successor compression technology to H.264 offering an approximate 50% reduction in data for a given level of image quality. The MISB has endorsed H.265 for provisional use.

Why is MISB EG 0104 no longer recommended?
MISB EG 0104: Predator UAV Basic Universal Metadata Set was the first step in moving away from the analog metadata used by the initial RQ-1’s. Although still supported by the MISB for legacy systems, there is no reason to use it in a new system. Any information conveyed with MISB EG 0104 can be conveyed with MISB ST 0601 with greater precision and bit-efficiency.

What is KLV metadata?
KLV stands for Key-Length-Value. KLV metadata comes in self-contained binary units. The Key describes the metadata element, the Length defines the data in number of bytes, and the Value contains the actual data. KLV metadata is very bit-efficient. The Society of Motion Picture and Television Engineers (SMPTE) standard, SMPTE ST 336: Data Encoding Protocol Using Key-Length-Value, defines KLV data encoding.

KLV metadata isn’t human readable! Why not use XML?
KLV is expressed in binary bits, which provide a very efficient representation of data. XML contains a great deal of padding, and although "human readable", it wastes precious bandwidth. KLV metadata can be translated into human-readable XML (and vice versa) without loss of information, if necessary.

**Where are the definitions for KLV keys?**
The structure and encoding of KLV metadata is defined in *SMPTE ST 336*. The metadata dictionaries are *SMPTE RP 210* and *MISB ST 0807*.

**Why are there two metadata dictionaries?**
SMPTE developed the standard for KLV encoding of metadata. SMPTE produces and maintains a KLV metadata dictionary (*SMPTE RP 210*). Various organizations are allowed to buy part of the KLV domain name-space to maintain private metadata dictionaries. The DoD was the first organization to take advantage of this offer. Initially, most of the metadata keys used by the MISB were registered in *SMPTE RP 210*, but, over time, several issues became apparent. First, it can take 12-24 months to get a new KLV metadata key approved by SMPTE. Second, SMPTE does not give tight definitions to their metadata elements. *MISB ST 0807* is the metadata dictionary for elements in the DoD private domain space. The MISB can assign keys quickly if necessary (a week is common), and can define their meaning and usage to whatever exactitude is necessary. Finally, because the keys in *MISB ST 0807* are not published to the general public, it is possible to maintain classified keys.

**Which metadata dictionary (MISB or SMPTE) has precedence?**
*MISB ST 0807* has precedence over *SMPTE RP 210*.

**How can I tell if a key is in *SMPTE RP 210* or *MISB ST 0807***?
All KLV keys are 16 bytes long. All SMPTE keys (including the DoD private keys in *MISB ST 0807*) begin with the 4-byte sequence 06 0E 2B 34 (in hexadecimal). Keys from *MISB ST 0807* have the ninth byte set to 0E and the tenth byte set to 01, 02, or 03. A MISB key will, therefore, have the form 06 0E 2B 34 xx xx xx xx 0E [01, 02, or 03] xx xx xx xx xx. As a general rule, older MISB documents have *SMPTE RP 210* keys, and newer MISB documents have their keys registered in *MISB ST 0807*.

**If I need new keys registered, should I go to SMPTE or the MISB?**
Go to the MISB. Keys can be created faster and their usage defined unambiguously.

**What KLV metadata do I need to use?**
*MISB ST 0902: Motion Imagery Sensor Minimum Metadata Set* is a required metadata set. Depending on your mission requirements and CONOPS, you may need to support more than the baseline elements from *MISB ST 0902* defined in other MISB documents.

**What is timestamping?**
A timestamp is a value derived from a known time scale specified to a certain resolution and known format. Timestamping aids the search and discovery process. Timestamps provide a means to align metadata with collected Motion Imagery for event analysis and exploitation. It is not uncommon for platform metadata to be collected earlier, later or at a different rate than the Motion Imagery. For example, platform elevation, heading and speed might be collected at 7 Hz (frame per second), while the Motion Imagery might be collected at 30 Hz. Timestamping both the Motion Imagery and metadata allows for interpolation of the metadata, if needed, for processing or exploiting a given Motion Imagery frame.

**Why is timestamping mandatory?**
All Motion Imagery and metadata are required to have a timestamp. The MISB standards define the format and location of timestamps in Motion Imagery and metadata. MISB ST 0603: MISP Time System and Timestamps, specifies the MISP Time System, which is an absolute time scale from which a Precision Time Stamp is derived. MISB ST 0605: Encoding and Inserting Time Stamps and KLV Metadata in Class 0 Motion Imagery, describes how to insert timestamps into uncompressed Motion Imagery, while MISB ST 0604: Timestamps for Class 1/Class 2 Motion Imagery describes how to insert timestamps into compressed Motion Imagery.

**What is the difference between asynchronous and synchronous metadata?**

In general, asynchronous metadata is not registered to a particular frame in the Motion Imagery (MI). Units of metadata travel in close proximity to corresponding events in the MI, but this proximity can vary depending on how the MI and metadata information is processed. If the asynchronous metadata has a timestamp, the metadata can be correlated with a MI frame (some interpolation of the metadata may also be required).

Synchronous metadata is registered in temporal alignment with MI frames. Events in the imagery can then be accurately associated with the corresponding metadata. It is preferred that all future MI systems employ synchronous metadata.

MISB ST 1402: MPEG-2 Transport of Compressed Motion Imagery and Metadata details how to add metadata using either method with Motion Imagery.

**Why is the MPEG-2 Transport Stream container recommended for Motion Imagery?**

MPEG-2 Transport Stream (TS) was designed originally for digital television transmission. As an international standard, it is widely supported and many tools are available for testing and compliance. The value in Motion Imagery is greatly increased when augmented with metadata, and MPEG-2 TS provides an excellent vehicle to deliver Motion Imagery and Metadata as a unified package.

**What are RTP/RTCP/RTSP used for?**

Real-time Transport Protocol (RTP) is designed to deliver real time media, such as video and audio, over internet protocol (IP). Specifically, RTP addresses the public internet, where quality-of-service (QoS) is not guaranteed. RTP is a protocol layer added (typically) on top of UDP that adds a timestamp and count to every data packet to aid the receiver in reconstructing the stream when packets suffer latency, become reordered, or are lost in the network. MPEG-2 transport stream does not do as well in such environments, because it was designed for constant delay networks like broadcast. Some systems do use RTP to carry MPEG-2 Transport Stream at the expense of additional data overhead, where robustness of signal delivery is critical.

RTP generally is accompanied with the bi-directional server/client protocol RTCP (RTP Control Protocol). RTCP provides network and timing information between video senders (servers) and receivers (clients). Clients and servers use this information to determine QoS operating points and to maintain real-word time synchronization. Finally, RTSP (Real Time Streaming Protocol) provides information that allows clients and servers to describe and establish video streaming sessions and it gives clients TiVo-like control for the client to record, rewind, stop, play, and fast-forward the stream. MISB ST 0804: Real-Time Protocol for Motion Imagery and Metadata addresses the use of RTP.

**What is JPIP used for?**

JPIP (JPEG2000 Interactive Protocol) is similar in spirit to RTP and RTSP (there currently is no RTCP equivalent within JPIP). JPIP is a client/server streaming protocol that provides interactive delivery of JPEG2000 compressed imagery. It allows a client to specify a region-of-interest within a larger image at a desired
resolution and image quality, and have the data streamed to a client. Using JPEG2000 and JPIP together it is possible to browse very large images (1 Gpixel and up) on lightweight clients (PDAs). This is possible because only small portions of the compressed image are streamed from the server to the client. As the client changes its viewing region, the server streams new information to the client to update the image display. The MISB anticipates that JPIP will find use in LVMI applications.

**What are the differences between file transfer, progressive download, and streaming?**

File transfer is based on FTP, a protocol that guarantees delivery of a file to a receiver. FTP operates over TCP/IP, and therefore all packets are assured they will be received as transmitted. Because of this the download of a file using FTP can take a long time, and the user must wait for the content to be delivered in its entirety prior to viewing. Progressive download helps this by invoking a buffer in the receiver that will display the content after sufficient data has been received; the user must still wait, however.

Streaming is designed to accommodate real time delivery of content and is appropriate for live events and time-sensitive applications. Streaming over IP typically uses UDP/IP (although MPEG-DASH is a streaming technology that uses TCP/IP), and for this reason there is no guarantee all packets transmitted will be received. Because of this, the quality of content received via streaming may fluctuate as the server/client attempt to deliver the stream as fast as possible to meet real time delivery. Image size, frame rate, and compression factor are adjustments made to meet the channel bandwidth. See *MISB TRM 0803: Delivery of Low Bandwidth Motion Imagery* and *MISB TRM 0703: Low Bandwidth Motion Imagery - Technologies* for more information.

**What is the best container to store/archive Motion Imagery?**

At this time, the MISB advocates the MPEG-2 Transport Stream (TS), AAF (Advanced Authoring Format) and MXF (Material eXchange Format) as file containers. MPEG-2 TS is a delivery format that also serves as a storage container. AAF can accommodate historical editing and updates of content as it moves through its production. MXF is emerging as a format that can manage complex content and metadata, and is also designed for exchange of Motion Imagery. The "best" container to choose is application dependent.

**What is Large Volume Motion Imagery (LVMI)?**

LVMI systems typically collect very high, pixel-density imagery (100 Mpx to a 10 Gpx per frame) using arrays of cameras or multiple focal plane sensors, which are then composited into one single image. LVMI systems may incorporate multiple sensor modalities, for example, an HD MI (i.e. 24-60 Hz frame rate) camera in conjunction with a large focal plane array sensor. LVMI systems typically collect large volumes of data (terabytes to petabytes during a collection), and may provide Motion Imagery streaming services off platform during data collects.