MISB MOTION IMAGERY STANDARDS BOARD	MISB ST 1108.3
STANDARD **Interpretability and Quality Local Set**	**23 October 2019**

1 Scope

This document defines metadata for documenting image metrics and compression characteristics within a Motion Imagery stream or file. Such metadata facilitates documenting the quality of Motion Imagery along the imaging workflow with objective metrics or subjective interpretability criteria providing valuable information to the end user. Encoding the metadata as binary KLV (Key Length Value) supports encapsulation in MISP-approved containers. Metric computation is area based defined by a starting Frame and an ending Frame.

2 References

[1] MISB ST 0107.4 KLV Metadata in Motion Imagery, Feb 2019.

[2] MISB ST 0807.24 MISB KLV Metadata Registry, Oct 2019.

[3] MISB ST 0603.5 MISP Time System and Timestamps, Oct 2017.

[4] MISB ST 0901.3 Video-National Imagery Interpretability Rating Scale, Oct 2017.

[5] IEEE 754-2008 Standard for Floating-Point Arithmetic [and Floating-Point formats].

[6] MISB MISP-2020.1 Motion Imagery Standards Profile, Oct 2019.

[7] MISB MISP-2020.1: Motion Imagery Handbook, Oct 2019.

3 Revision History

Revision	Date	Summary of Changes
ST 1108.3	10/23/2019	• Changed document name • Document revised to generalize implementation • Deprecated requirements 02-05 • Added requirements 06-16

4 Acronyms / Definitions

DLP Defined Length Pack
KLV Key Length Value
ST Standard
VNIIRS Video National Imagery Interpretability Rating Scale

Interpretability

The potential of an analyst to extract specific intelligence data for an intelligence task

Quality

Measures the overall appearance of Motion Imagery

5 Introduction

MISB ST 1108 defines the content and structure for Motion Imagery Interpretability and Quality metadata that documents imagery metrics and image compression parameters for a Motion Imagery stream or file. The intent and principles for this standard include:

- Agnostic to metric type
  - Support VNIIRS predictive metric and other image-based metrics
- Document location in data lifecycle of metric calculation
  - Include ability to identify various forms of the same algorithm calculated at the same location over time
- Document Motion Imagery stream characteristics at time of metric calculation
  - Include Motion Imagery timestamps and encoding information for metric comparisons during data lifecycle

6 Interpretability and Quality Local Set

MISB ST 0107 [1] provides a set of baseline requirements for using KLV in Motion Imagery.

Requirement	
ST 1108.2-01	All metadata shall be in accordance with MISB ST 0107.

The Interpretability and Quality Local Set 16-Byte Universal Label (key) registered in MISB ST 0807 [2] is:

06.0E.2B.34.02.03.01.01.0E.01.03.03.1C.00.00.00 (CRC 6633)

Table 1 summarizes the Interpretability and Quality Local Set with the columns defined as:

- **Tag** indicates the KLV Local Set tag number for the item. The tag is a one-byte integer encoded as a BER-OID value.
- **Item Name** is the name of the dictionary item
- **Key** is the KLV registry Universal Label associated with the item
- **Type** specifies the data type when encoding the value into binary. Note: generalizing the Types uint and int allow the application to define the number of bytes needed for a values representation.
- **Length** is the number of bytes used by the elements value; lengths denoted as “V” are variable and computed at runtime.
- **M/O** indicates if the Local Set item is Mandatory (M) or Optional (O)

- **Notes** provide additional details about the value

Table 1: Interpretability and Quality Local Set

Local Set Key			Name			
06.0E.2B.34.02.03.01.01.0E.01.03.03.1C.00.00.00 (CRC 6633)			**Interpretability and Quality Local Set**			
Constituent Items						
Tag	**Item Name**	**Key**	**Type**	**Length**	**M/O**	**Notes**
1	Assessment Point	06.0E.2B.34.01.01.01.01.0E.01.05.01.00.00.00.00 (CRC 8498)	enum	1	M	Location in workflow metric evaluated specified as an enum (see Table 2)
2	Metric Period Pack	06.0E.2B.34.02.05.01.01.0E.01.05.02.00.00.00.00 (CRC 39736)	dlp	12	M	Period within metric calculated (see Table 3)
3	Window Corners Pack	06.0E.2B.34.02.05.01.01.0E.01.03.02.01.01.00.00 (CRC 22365)	dlp	V	O	Image sub-region upper left, lower right row/column positions (see Table 4). Full image assumed when not present.
4	Metric Local Set	06.0E.2B.34.02.03.01.01.0E.01.05.01.00.00.00.00 (CRC 33822)	Set	V	M	Metric Name; Metric Version; Metric Parameters, Metric Time and Metric Value (see Table 5)
5	Compression Type	06.0E.2B.34.01.01.01.01.0E.01.05.02.00.00.00.00 (CRC 53216)	enum	1	M	0 = uncompressed 1 = H.262 2 = H.264 3 = H.265 4 = JPEG2000 5-255 Reserved
6	Compression Profile	06.0E.2B.34.01.01.01.01.0E.01.05.03.00.00.00.00 (CRC 26033)	enum	1	M	0 = N/A (uncompressed) 1 = Main (H.264) 2 = Main 10 (H.265) 3 = Constrained Baseline (H.264) 4 = High (H.264) 5 = Main 4:2:2 12 (H.265) 6 = Main 4:4:4 12 (H.265) 7 = High 4:2:2 (H.264) 8 = High 4:4:4 Predictive (H.264) 9-255 = Reserved
7	Compression Level	06.0E.2B.34.01.01.01.01.0E.01.05.04.00.00.00.00 (CRC 613)	utf8	3	M	"N/A" for uncompressed Expressed as a String; ex: "5", "4.2", "5.1"
8	Compression Ratio	06.0E.2B.34.01.01.01.01.0E.01.05.05.00.00.00.00 (CRC 43060)	float	V	M	Source-to-compressed size; ex: 25.2 means 25.2:1. Set to 1.0 for uncompressed
9	Stream Bitrate	06.0E.2B.34.01.01.01.01.0E.01.05.06.00.00.00.00 (CRC 18150)	uint	2	M	Expressed in kilobits/sec

10	Document Version	06.0E.2B.34.01.01.01.01. 0E.01.02.05.05.00.00.00 (CRC 56368)	uint	1	M	Version number of this standard
11	CRC-16-CCITT	06.0E.2B.34.01.01.01.01. 0E.01 02.03.5E.00.00.00 (CRC 31377)	uint	2	M	Two-byte checksum on Local Set

6.1 Assessment Point

An Assessment Point is a physical location along the imaging workflow. The Assessment Point item documents the calculation of one or more metrics at this location. The Assessment Point is an enum; Table 2 enumerates the allowed values for Assessment Point. This Local Set item is mandatory.

Requirement	
ST 1108.3-06	An Assessment Point item shall be present in a Interpretability and Quality Local Set.

Table 2: Assessment Point Identifier

Assessment Point	Description	Value
Sensor	Output directly from sensor	1
Sensor Encoder	Output from Motion Imagery encoder (if applicable)	2
GCS Received	Platform to ground station reception point	3
GCS Transmit	GCS transmission point	4
Library/Archive	Receipt at archival location	5

6.2 Metric Period Pack

The Metric Period Pack documents the time period over which a calculated metric applies indicated by a beginning image Frame timestamp (i.e. Start Time) and an ending period image Frame time offset (i.e. Time Offset). This Local Set item is mandatory and encoded as a defined length pack (DLP) (see Figure 1) where the beginning Frame timestamp is a Precision Time Stamp as specified in MISB ST 0603 [3] and the ending Frame timestamp calculated as a positive offset added to the beginning Frame timestamp. Thus, the difference in the two numbers is the period defined for the metric calculation.

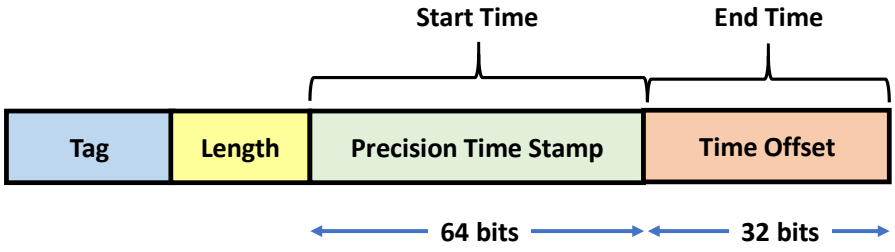

Figure 1: Metric Period Pack

Requirement	
ST 1108.3-07	A Metric Period Pack shall be present in a Interpretability and Quality Local Set.

Table 3 defines the elements of the Metric Period Pack. The Key indicates the KLV Dictionary Universal Label. The Element Name is the identifier associated with the value. The Data Type specifies the bit representation of the value. The Units specify the units of the value. The Notes provide additional information about the value.

Table 3: Metric Period Pack Elements

Metric Period Pack					
Key (hex)	**Element Name**	**Data Type**	**Length (Bytes)**	**Units**	**Notes**
06.0E.2B.34.01.01.01.03.07.02.01.01.01.05.00.00 (CRC 64827)	Time Start	uint	8	µs	Timestamp marking the beginning of the metric calculation
06.0E.2B.34.01.01.01.01.0E.01.05.0C.00.00.00.00 (CRC 72)	Time Offset	uint	4	µs	Timestamp offset from Precision Time Stamp marking the end of the metric calculation

6.3 Window Corners Pack

The Window Corners Pack, which is a defined length pack (DLP), describes a sub-image region within an image Frame for the metric calculation bounded by Frame Line[start] to Frame Line [end] and Frame Row[start] to Frame Row[end]. Figure 2 illustrates a window extracted as a sub-region within an image. C_1 denotes Frame Line[start] and Frame Row[start], while C_2 denotes Frame Line[end] and Frame Row[end]. This enables defining a local region within an image to calculate image metrics rather than over the entire image.

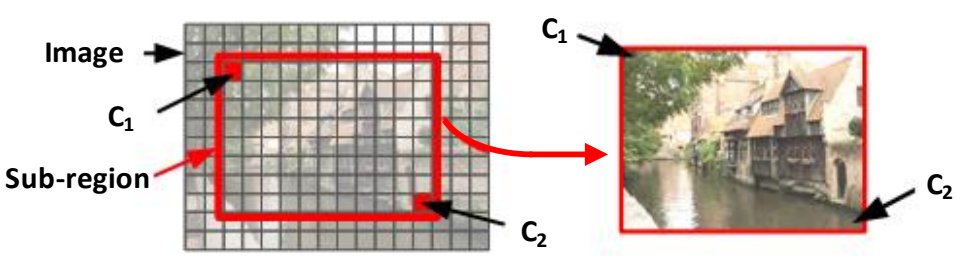

Figure 2: Window as sub-region of an image

Table 4 defines the Window Corners Pack used to encode the corner information of a sub-region or "window" within an image Frame. The Element Name is the identifier for the value. The Type specifies the bit representation of the value; values start at zero. The Length is the number of bytes used for the value. Since all values in the Window Corners Pack are BER, the length is variable and is determined during pack construction or parsing. The Units specify the units of the value. In the Window Corners Pack, the units are coordinates in the image Frame, so each value is in units of Pixels. All four values of rows or columns in the Window Corners Pack are zero based, i.e. each value starts at zero. The Window Corners Pack item is optional.

Table 4: Window Corners Pack Elements

Window Corners Pack					
Key (hex)	**Element Name**	**Type**	**Length**	**Units**	**Notes**
06.0E.2B.34.01.01.01.01. 0E.01.01.03.3F.01.00.00 (CRC 44071)	C_1 Row	BER-OID	V	Pixels	Row for the upper left corner of the window. First row starts at zero.
06.0E.2B.34.01.01.01.01. 0E.01.01.03.3F.02.00.00 (CRC 62839)	C_1 Column	BER-OID	V	Pixels	Column for the upper left corner of the window. First column starts at zero.
06.0E.2B.34.01.01.01.01. 0E.01.01.03.3F.01.00.00 (CRC 44071)	C_2 Row	BER-OID	V	Pixels	Row for the lower right corner of the window. First row starts at zero.
06.0E.2B.34.01.01.01.01. 0E.01.01.03.3F.02.00.00 (CRC 62839)	C_2 Column	BER-OID	V	Pixels	Column for the lower right corner of the window. First column starts at zero.

The full size of the image Frame is assumed in the absence of the Window Corners Pack.

Requirement	
ST 1108.3-08	Where a metric represents a sub-region of an image Frame, the Window Corners Pack shall be present in the Interpretability and Quality Local Set.

6.4 Metric Local Set

The Metric Local Set consists of five metric parameters: 1) Metric Name, 2) Metric Version, 3) Metric Parameters, 4) Metric Time, and 5) Metric Value.

Table 5 summarizes the Metric Local Set with the columns defined as:

- **Tag** indicates the KLV Local Set tag number for the item. The tag is a one-byte integer encoded as a BER-OID value.
- **Item Name** is the name of the dictionary item
- **Key** is the KLV registry Universal Label associated with the item
- **Type** specifies the data type when encoding the value into binary. Note: generalizing the Types uint and int allow the application to define the number of bytes needed for a values representation.
- **Length** is the number of bytes used by the elements value; lengths denoted as “V” are variable and computed at runtime. Note: recommended to use the fewest number of bytes for efficiency.
- **M/O** indicates if the Local Set item is Mandatory (M) or Optional (O)
- **Notes** provide additional details about the value

Table 5: Metric Local Set Items

Metric Local Set						
Tag	**Item Name**	**Key**	**Type**	**Length**	**M/O**	**Notes**
1	Metric Name	06.0E.2B.34.01.01.01.01. 0E.01.05.07.00.00.00.00 (CRC 60599)	utf8	V	M	Examples "VNIIRS"; "RER" (Relative Edge Response)
2	Metric Version	06.0E.2B.34.01.01.01.01. 0E.01.05.08.00.00.00.00 (CRC 35150)	utf8	V	M	Alphanumeric denoting calculated values; Alpha "Human" for observed
3	Metric Implementer	06.0E.2B.34.01.01.01.01. 0E.01.05.09.00.00.00.00 (CRC 8991)	utf8	V	M	Identifies organization responsible for how metric is calculated
4	Metric Parameters	06.0E.2B.34.01.01.01.01. 0E.01.05.0A.00.00.00.00 (CRC 52685)	utf8	V	O	Additional information necessary for repeatability
5	Metric Time	06.0E.2B.34.01.01.01.03. 07.02.01.01.01.05.00.00 (CRC 64827)	uint	8	M	Time of metric assessment (defined with MISP Precision Time Stamp)
6	Metric Value	06.0E.2B.34.01.01.01.01. 0E.01.05.0B.00.00.00.00 (CRC 26524)	float	V	M	Numeric value of calculation (IEEE format [5])

At least one instance of the Metric Local Set is required per Interpretability and Quality Local Set; however, the Metric Local Set may be used multiple times. This enables defining multiple metrics within the timeframe defined by the Metric Period Pack.

Requirement	
ST 1108.3-09	At least one (1) Metric Local Set shall be present in a Interpretability and Quality Local Set.

Figure 3 shows an example of an Interpretability and Quality Local Set with two metrics "VNIIRS" and "PSNR" included as two instances of Tag 4 – Metric Local Set. Note: mandatory items only shown.

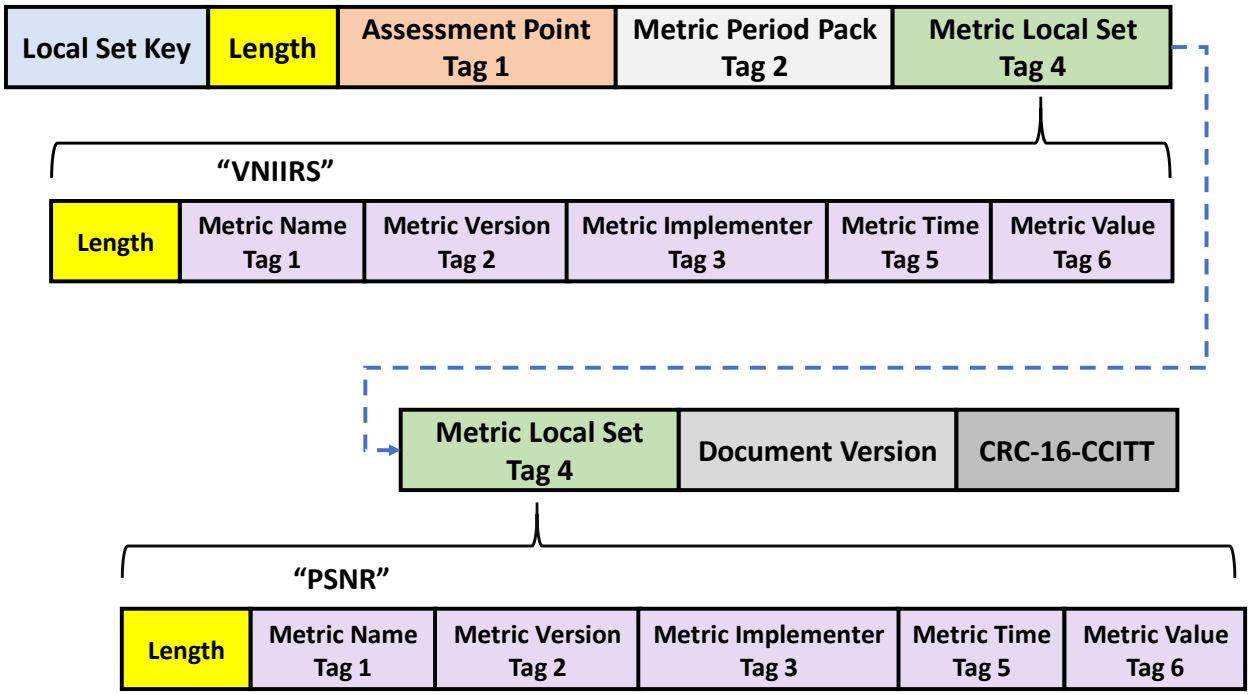

Figure 3: Example: repeated use of Metric Local Set tag for VNIIRS and PSNR metrics.

6.4.1 Metric Name

The Metric Name is the name of the metric calculated. Although its type is a string MISB defines the following strings for consistency (see Table 6).

Table 6: Metric Assigned Names

Metric Name	Meaning
GSD	Ground Sample Density
MSSIM	Multi-Scale Structural Similarity Index
PSNR	Peak Signal-to-Noise Ratio
RER	Relative Edge Response
SNR	Signal-to-Noise Ratio
SSIM	Structural Similarity Index
VNIIRS	Video-National Imagery Interpretability Rating Scale (MISB ST 0901 [4])

Metrics other than those listed in Table 6 are allowed as long as the string does not exceed the maximum length for the item as given in Table 5.

6.4.2 Metric Version

The Metric Version mandatory item serves a dual role. Firstly, it indicates how the method used to calculate the metric, and secondly, it provides configuration management information. When

generated by a human observer, the value is "human". When generated by an algorithm, the value is an alphanumeric configuration management identifier for the algorithm.

Requirement(s)	
ST 1108.3-10	Where the Metric Version is produced by a human, the value of the Metric Version shall be "human".
ST 1108.3-11	Where the Metric Version is produced by an algorithm, the value of the Metric Version shall be an alphanumeric composed of characters and numbers.

6.4.3 Metric Implementer

The Metric Implementer mandatory item identifies the organization responsible for how a metric is calculated. This enables various versions of the same metric without having to maintain an active registry. The string should be Name of Company/Organization[ASCII Code 30]Subgroup. ASCII Code 30 is Record Separator and used here to separate two meaningful strings with a default separator. For example: "Company XYZ[ASCII Code 30]Imaging Dept."

Requirement	
ST 1108.3-12	The format for the value of the Metric Implementer shall be Name of Company/Organization[ASCII Code 30]Subgroup, where ASCII Code 30 designates Record Separator.

6.4.4 Metric Parameters

Metric Parameters optional item is a user-defined string for specifying any unique conditions used in the computation. For example, within the period of calculation are all Frames used and averaged, are several Frames skipped, etc. This information ensures repeatable calculations, or the same process applied downstream for like-metric comparisons.

6.4.5 Metric Time

Metric Time mandatory item is the time of metric assessment, which with respect to the Metric Time pack may be a future value. Metric Time is a microsecond Precision Time Stamp as defined in MISB ST 0603.

6.4.6 Metric Value

The Metric Value mandatory item is a floating-point numeric based on the resultant calculation. The length field of the Metric Value KLV item dictates the length of the corresponding Metric Value.

6.5 Compression Type

The Compression Type mandatory item is a MISP-approved [6] type such as H.264, H.265 etc. specified using an unsigned 8-bit integer enumeration indicated in Table 1. For no compression (i.e., uncompressed) specify a value of zero (0).

6.6 Compression Profile

The Compression Profile mandatory item is a valid MISP-approved level for MPEG-2, H.264 and H.265 specified using an unsigned 8-bit integer enumeration value indicated in Table 1. For no compression (i.e., uncompressed) specify a value of zero (0).

6.7 Compression Level

The Compression Level mandatory item is a valid MISP-approved level for H.262, H.264 and H.265 specified as a string value. Example typical values for a compression level are 4, 4.1, 4.2, 5 for H.264/H.265 and ML, HL for H.262. Thus, the string length for this item is three characters or less. See the MISP for allowed levels. For no compression (i.e., uncompressed) specify a value of "N/A".

6.8 Compression Ratio

The Compression Ratio mandatory item, expressed as an IEEE floating point value, is the ratio of source to compressed signal data quantity. For no compression (i.e., uncompressed) specify a value of 1.0.

6.9 Stream Bitrate

The Stream Bitrate mandatory item is the measured or known bitrate of the stream at the metric calculation time. Stream Bitrate is a 16-bit unsigned integer measuring kilobits per second. For example, 2200 Kbits/sec represents a stream bit rate of 2.2 Mbits/sec.

6.10 Document Version

The Document Version item indicates the numeric version of this document. For example, ST 1108.3 is version 3, ST 1108.4 is version 4, etc.

Requirement	
ST 1108.3-13	A Document Version item shall be present in a Interpretability and Quality Local Set.

6.11 CRC-16-CCITT

To detect erroneous metadata post transmission, the Local Set includes a two-byte CRC as the last item computed across the entire Local Set starting with the 16-byte Local Set key and ending with the length field of the CRC data element. If the calculated CRC of the received Local Set packet does not match the CRC stored in the packet, the packet is invalid and discarded.

The Motion Imagery Handbook [7] Appendix D provides the algorithm for calculating the CRC.

Requirement(s)	
ST 1108.3-14	The Interpretability and Quality Local Set shall contain a CRC-16-CCITT.
ST 1108.3-15	The calculation of the CRC-16-CCITT shall be in accordance with the MISB Motion Imagery Handbook.

ST 1108.3-16	The CRC-16-CCITT shall be the last element in the Interpretability and Quality Local Set.

7 Appendix A – Deprecated Requirements

Requirement(s)	
ST 1108.2-02 (Deprecated)	The Interpretability and Quality (IQ) metadata set shall use Local Data Set 16-byte Universal Key 06.0E.2B.34.02.03.01.01.0E.01.03.03.1C.00.00.00 (CRC 6633) for its implementation.
ST 1108.2-03 (Deprecated)	Chip sizes shall be 32, 64 or 128.
ST 1108.2-04 (Deprecated)	For a given image Frame only one chip shall be allowed.
ST 1108.2-05 (Deprecated)	The Chip Frequency Ratio shall have a cut-off frequency of 0.15.