MOTION IMAGERY STANDARDS PROFILE

Department of Defense/Intelligence Community/
National System for Geospatial Intelligence
(DoD/IC/NSG)
Motion Imagery Standards Board

MISB

MISP Version 6.4

4 October 2012

This Page Left Intentionally Blank

Changes since MISP 6.3 – Full Change Log in Appendix K

Added this "Changes since last version" section

Promoted STD 0807.8 to STD 0807.10

Added EG 1203.2 - Video Interpretability and Quality Measurement and Prediction

Added RP 1204 - Motion Imagery Identification System (MIIS)

Promoted RP 0903.2 to STD 0903.3 (VMTI)

Added EG 1205 – Video Test Sequences

Promoted RP 0901 to RP 0901.1 (Video NIIRS)

FastPass to Key Items

MISP Compliance

Overview of Current Motion Imagery Profile

MISB Compliant Standards for High Definition FMV

MISM Tables – Motion Imagery System Matrix

IRSM Tables – Infrared Motion Imagery System Matrix

LVSD Table – Large Volume Streaming Data System Matrix

Audio

Metadata

Transport Protocols and File Containers

Timing and Synchronization

Video NIIRS

Document Changes per MISP Version

Table of Contents

Changes since MISP 6.3 – Full Change Log in Appendix K iii

***FastPass* to Key Items** iii

Preface 1

MISB Documentation 1

1 Introduction 2

1.1 Motion Imagery Standards Board Mission 2
1.2 Motion Imagery Standards Profile Applicability to DoD/IC/NSG Communities 3
1.3 MISP Document Structure 3

2 Acronyms and Abbreviations 5

3 Terminology and Definitions 8

3.1 Motion Imagery 8
3.2 Electro Optical 8
3.3 Infrared 9
3.4 Multispectral/Hyperspectral (MSI/HSI) 9
3.5 STANDARD 9
3.6 PROFILE 9
3.7 RECOMMENDED PRACTICE 9
3.8 ENGINEERING GUIDELINE 10
3.9 Technical Reference Material 10
3.10 Motion Imagery System Matrix (MISM) 10
3.11 Infrared Motion Imagery System Matrix (IRSM) 10
3.12 Frame Rate 10
3.13 High Definition, Enhanced, and Standard Definition 11
3.14 Pixel Bit Depth 11
3.15 Situational Awareness 11

4 DoD/IC/NSG Motion Imagery Migration Objectives 11

4.1 General Implementation Notes and Document Philosophy 12
4.2 MISP COMPLIANCE: Definition 13

5 Overview of Current Motion Imagery Profile 14

5.1 MI types and content: Motion Imagery "Essence" 19
5.2 Audio 19
5.3 Metadata 19
5.4 Transport 20
5.5 Timing 20
5.6 Other Guidance and Support 20
5.7 Summary 20
5.8 MISB Compliant Standards for High Definition FMV 23
5.9 Future MI standards 24

6 Appendices 26

Appendix A Motion Imagery Modalities A-1

Electro-Optical Motion Imagery Systems A-2

A-1 Motion Imagery System Matrix - MISM A-3

A-1.1 RECOMMENDED PRACTICE 9720 - Motion Imagery System Matrix A-3
A-1.2 MISM Tables Glossary A-4
A-1.3 RECOMMENDED PRACTICE 9720a - MISM, Advanced High Definition Motion Imagery A-5
A-1.4 RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery A-7
A-1.5 RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery Technical Notes A-8
A-1.6 RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery A-9

A-1.7 RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery Technical Notes A-10
A-1.8 RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery A-11
A-1.9 RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery Technical Notes A-12
A-1.10 RECOMMENDED PRACTICE 9720e - MISM, Low Bandwidth Motion Imagery A-13
A-1.11 RECOMMENDED PRACTICE 9720e - MISM, Low Bandwidth Motion Imagery Technical Notes A-14
A-1.12 RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Definition Motion Imagery A-15
A-1.13 RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Motion Imagery Technical Notes A-16

A-2 Migration to Digital A-17

A-2.1 STANDARD 9709 - Use of Closed Captioning for Core Metadata Analog Video Encoding A-17
A-2.2 STANDARD 9719 - Analog Video Migration A-17

A-3 High Definition Motion Imagery A-18

A-3.1 STANDARD 9703 - Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing A-18
A-3.2 STANDARD 9710 - High Definition Television Systems (HDTV) A-18
A-3.3 STANDARD 9723 - Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems A-18

A-4 Enhanced Definition Motion Imagery A-21

A-4.1 STANDARD 9811 - Progressively Scanned Enhanced Definition Digital Motion Imagery A-21
A-4.2 STANDARD 0201 - Uncompressed Enhanced Motion Imagery Baseband Signal Transport A-21
A-4.3 STANDARD 0202 - Compressed Enhanced Definition Advanced Television (ATV) and Associated Motion Imagery Systems A-21
A-4.4 SMPTE 292M, Television - Bit-Serial Digital Interface for High-Definition Television Systems A-21

A-5 Standard Definition Motion Imagery A-22

A-5.1 STANDARD 9601 - Standard Definition Digital Motion Imagery, Compression Systems A-22
A-5.2 STANDARD 9702 - Standard Definition Digital Motion Imagery Sampling Structure A-22
A-5.3 STANDARD 9703 - Digital Motion Imagery Uncompressed Baseband Signal Transport and Processing A-22
A-5.4 STANDARD 9704 - Digital Motion Imagery, Compression Conversions A-23
A-5.5 STANDARD 9705 - Standard Definition Digital Motion Imagery, Format Conversions A-23
A-5.6 STANDARD 9707 - Standard Definition Digital Motion Imagery Tape Recorder, Digital Motion Imagery Servers, and Similar Systems Input / Output Protocol A-24
A-5.7 STANDARD 9803 - Serial Data Transport Interface A-24
A-5.8 STANDARD 9901 - Fiber Optic Interfaces Uncompressed Baseband Signal Transport and Processing .. A-24
A-5.9 RECOMMENDED PRACTICE 9902 - Authorized Limited Applications of DV Format Video A-25

A-6 Low Spatial/Temporal Motion Imagery A-26

A-6.1 STANDARD 9706 - Motion Imagery Still Frames A-26

A-7 Compression Guidelines A-26

A-7.1 ENGINEERING GUIDELINE 0802 - H.264/AVC Coding and Multiplexing A-26
A-7.2 ENGINEERING GUIDELINE 0904 - H.264 Bandwidth/Latency/Quality Tradeoffs A-26

A-8 Motion Imagery Tape Formats A-26

A-8.1 RECOMMENDED PRACTICE 9721 - Motion Imagery Tape Formats A-26

Infrared Motion Imagery Systems A-27

A-9 Infrared Motion Imagery Systems A-28

A-9.1 RECOMMENDED PRACTICE 0401 - Infrared Motion Imagery System Matrix A-28
A-9.2 IRSM Tables Glossary A-28
A-9.3 RECOMMENDED PRACTICE 0401a - Infrared System Matrix, Very Low Definition IR A-30
A-9.4 RECOMMENDED PRACTICE 0401b - Infrared System Matrix, Low Definition IR A-31
A-9.5 RECOMMENDED PRACTICE 0401c - Infrared System Matrix, Medium Definition IR A-32
A-9.6 RECOMMENDED PRACTICE 0401d - Infrared System Matrix, High Definition IR A-33

A-9.7 RECOMMENDED PRACTICE 0401e - Infrared System Matrix, Very High Definition IR A-34
A-9.8 STUDY 0401f - Infrared System Matrix, Super High Definition IR A-35
A-9.9 RECOMMENDED PRACTICE 0402 - Infrared Image Capture A-36
A-9.10 RECOMMENDED PRACTICE 0403 - Digital Representation and Source Interface Formats for Infrared Motion Imagery Mapped into 1280 x 720 Format Bit-Serial Digital Interface A-36
A-9.11 STANDARD 0404 - Compression for Infrared Motion Imagery A-36

LVSD Motion Imagery Systems A-37

A-10 Large Volume Streaming Data Motion Imagery A-38

A-10.1 MISM Tables Glossary A-39
A-10.2 RECOMMENDED PRACTICE 1004 – Motion Imagery System Matrix, LVSD A-40
A-10.3 RECOMMENDED PRACTICE 0606 - Authorized Use of JPEG 2000 for Large Volume Streaming Data Imagery A-41
A-10.4 RECOMMENDED PRACTICE 0705 - LVSD Compression Profile A-41
A-10.5 RECOMMENDED PRACTICE 0811 - JPIP Profile (Client/Server Functions) A-41

Appendix B Audio B-1

B-1 Audio B-2

B-1.1 ENGINEERING GUIDELINE 1001 - Audio Encoding in MPEG-2 TS B-2

Appendix C Metadata C-1

C-1 Metadata: Classes and Rules C-2

C-1.1 STANDARD 9711 - Intelligence Motion Imagery Index, Geospatial Metadata C-2
C-1.2 STANDARD 9712 - Intelligence Motion Imagery Index, Content Description Metadata (Dynamic Metadata Dictionary Structure and Contents) C-3
C-1.3 STANDARD 9713 - Data Encoding Using Key-Length-Value C-3
C-1.4 STANDARD 9716 - Packing KLV Packets into SMPTE 291 Ancillary Data Packets C-3
C-1.5 RECOMMENDED PRACTICE 9717 - Packing KLV Packets into MPEG-2 Systems Streams C-3
C-1.6 STANDARD 9718 - Packing KLV Packets into AES3 Serial Digital Audio Streams C-4
C-1.7 RECOMMENDED PRACTICE 0101 - Use of MPEG-2 System Streams in Digital Motion Imagery Systems C-4
C-1.8 STANDARD 0102 - Security Metadata Universal Set for Digital Motion Imagery C-4
C-1.9 RECOMMENDED PRACTICE 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery C-5
C-1.10 ENGINEERING GUIDELINE 0104 - Basic Predator KLV Metadata C-5
C-1.11 STANDARD 0107 - Bit and Byte Order for Metadata in Motion Imagery Files and Streams C-5
C-1.12 STANDARD 0601 - UAS Datalink Local Metadata Set C-5
C-1.13 NATO STANAG 4609, Edition 3, and 4586 Metadata Set (informative) C-5
C-1.14 RECOMMENDED PRACTICE 0602 - Annotation Universal Metadata Set C-8
C-1.15 ENGINEERING GUIDELINE 0607 - MISB Metadata Registry and Processes C-8
C-1.16 RECOMMENDED PRACTICE 0608 - Motion Imagery Identifier C-8
C-1.17 RECOMMENDED PRACTICE 0701 - Common Metadata Structure C-8
C-1.18 ENGINEERING GUIDELINE 0801 - Photogrammetry Metadata Set C-9
C-1.19 ENGINEERING GUIDELINE 0805 - Cursor on Target C-9
C-1.20 ENGINEERING GUIDELINE 0806 - Remote Video Terminal Local Data Set C-9
C-1.21 STANDARD 0807 MISB DoD/IC/NSG KLV Metadata Registry C-9
C-1.22 RECOMMENDED PRACTICE 0808 - Ancillary Text Data Sets C-9
C-1.23 ENGINEERING GUIDELINE 0809 - KLV Representation of Meteorological Data C-10
C-1.24 ENGINEERING GUIDELINE 0810 - Profile 2: KLV for LVSD Applications C-10
C-1.25 STANDARD 0902 - MISB Motion Imagery Sensor Minimum Metadata Set C-10
C-1.26 STANDARD 0903 - Video Moving Target Indicator Local Data Set C-10
C-1.27 ENGINEERING GUIDELINE 1002 - Range Image Metadata Set C-10
C-1.28 ENGINEERING GUIDELINE 1108 – Video Interpretability and Quality Keys C-11

C-1.29 RECOMMENDED PRACTICE 1201 – Floating Point to Integer Mapping C-11
C-1.30 RECOMMENDED PRACTICE 1204 – Motion Imagery Identification System (MIIS) C-11

Appendix D Transport Protocols and File Containers D-1

D-1 Transport Protocols and File Containers D-2

D-1.1 STANDARD 9701 - MPEG-2 Transport Stream D-2
D-1.2 Xon2 ..... D-2
D-1.3 RECOMMENDED PRACTICE 0106 - Advanced Authoring Format D-3
D-1.4 RECOMMENDED PRACTICE 0108 - Material Exchange Format D-3
D-1.5 STANDARD 0301 - MISB Profile for Aerial Surveillance and Photogrammetry Applications D-3
D-1.6 ENGINEERING GUIDELINE 0803 - Delivery of Low Bandwidth Motion Imagery D-4
D-1.7 RECOMMENDED PRACTICE 0804 - Real-Time Protocol for Full Motion Video D-4
D-1.8 ENGINEERING GUIDELINE 0812 - Clipping of Streaming Video into Files D-4
D-1.9 ENGINEERING GUIDELINE 0813 - Integration of Motion Imagery into the Coalition Shared Database D-4

Appendix E Timing and Synchronization E-1

E-1 Timing and Synchronization E-2

E-1.1 STANDARD 9708 - Imbedded Time Reference for Motion Imagery Systems E-2
E-1.2 STANDARD 9714 - Time Code Embedding E-2
E-1.3 STANDARD 9715 - Time Reference Synchronization E-2
E-1.4 STANDARD 0604 - Time Stamping and Transport of Compressed Motion Imagery and Metadata E-3
E-1.5 STANDARD 0603 - CommonTime Reference for Digital Motion Imagery Using Coordinated Universal Time (UTC) E-3
E-1.6 STANDARD 0605 - Inserting Time Stamps and Metadata in High Definition Uncompressed Video E-3

Appendix F Video NIIRS F-1

F-1 Motion Imagery Quality Metrics F-2

F-1.1 RECOMMENDED PRACTICE 0901 - Video NIIRS F-2
F-1.2 ENGINEERING GUIDELINE 1203 – Video Interpretability and Quality Measurement and Prediction F-2
F-1.3 ENGINEERING GUIDELINE 1205 – Video Test Sequences F-2

Appendix G Interoperability Profiles G-3

Appendix H Technical Reference Material H-3

H-1 Technical Reference Material H-4

H-1.1 TRM 07A Low Bandwidth Motion Imagery - Technologies H-4
H-1.2 TRM 0909 Constructing a MISP Compliant File H-4
H-1.3 TRM 1003 Forward Error Correction for Motion Imagery over IP H-4
H-1.4 TRM 1006 Key-Length-Value (KLV) Users Guide H-4
H-1.5 TRM 1007 Surfing the MISP H-4
H-1.6 TRM 1012 H.264 Study for Mobile Devices H-4

Appendix I References and Bibliography I-1

Appendix J MISP Versions J-1

Appendix K Revision Record K-1

List of Tables

Table 1-1: Organizational Layout of the MISP ---- 4
Table 5-1: Summary of MISB Standards (STD), Interoperability Profiles, Recommended Practices (RP), and Engineering Guidelines (EG) ---- 14

Table A-1: Motion Imagery System (Spatial /Temporal) Matrix-Levels (MISM-L) ---- A-3
Table A-2: Advanced High Definition Motion Imagery (Study 9720a) ---- A-5
Table A-3: High Definition Motion Imagery (Recommended Practice 9720b) ---- A-7
Table A-4: Enhanced Definition Motion Imagery (Recommended Practice 9720c) ---- A-9
Table A-5: Standard Definition Motion Imagery (Recommended Practice 9720d) ---- A-11
Table A-6: Low Bandwidth Motion Imagery (Recommended Practice 9720e) ---- A-13
Table A-7: Very Low Temporal Motion Imagery (Recommended Practice 9720f) ---- A-15
Table A-8: Infrared Motion Imagery System Matrix-Level ---- A-29
Table A-9: Very Low Definition Infrared Motion Imagery (Recommended Practice 0401a) ---- A-30
Table A-10: Low Definition Infrared Motion Imagery (Recommended Practice 0401b) ---- A-31
Table A-11: Medium Definition Infrared Motion Imagery (Recommended Practice 0401c) ---- A-32
Table A-12: High Definition Infrared Motion Imagery (Recommended Practice 0401d) ---- A-33
Table A-13: Very High Definition Infrared Motion Imagery (Recommended Practice 0401e) ---- A-34
Table A-14: Super High Definition Infrared Motion Imagery (Study 0401f) ---- A-35
Table A-15: LVSD Dissemination for BSA MISM Levels, EO Sensor ---- A-40
Table C-1: MISB Standard 0601.2 KLV Metadata Elements ---- C-6
Table J-1: Document Changes per MISP Version Released ---- J-2

List of Figures

Figure 5-1: Standards, Recommended Practices, Engineering Guidelines for Electro-Optical ---- 21
Figure 5-2: Standards, Recommended Practices, Engineering Guidelines for Infrared ---- 22
Figure 5-3: Standards, Recommended Practices, Engineering Guidelines for LVSD ---- 23
Figure 5-4: Current Standardization Work of the MISB ---- 25

Preface

This document summarizes the Motion Imagery Standards Profile (MISP) work to-date by the Department of Defense/ Intelligence Community/National System for Geospatial Intelligence (DoD/IC/NSG) Motion Imagery Standards Board (MISB).

MISB Documentation

MISB Public Web Site: http://www.gwg.nga.mil/misb/
MISB Private Web Site: http://www.gwg.nga.mil/protected/misb/

1 Introduction

In accordance with Department Of Defense Directive Number 5105.60 (29 July 2009), which established the National Geospatial-Intelligence Agency (NGA); and whereas: *"NGA shall support U.S. national security objectives by providing timely, relevant, and accurate geospatial intelligence (GEOINT) to the Department of Defense, the Intelligence Community (IC), and other U.S. Government (USG) departments and agencies; conducting other intelligence-related activities essential for U.S. national security; providing GEOINT for safety of navigation information; preparing and distributing maps, charts, books, and geodetic products; designing, developing, operating, and maintaining systems related to the processing and dissemination of GEOINT; and providing GEOINT in support of the combat objectives of the Armed Forces of the United States.";* and whereas NGA shall: *"Serve as the DoD Lead for GEOINT standards and prescribe, mandate, and enforce standards and architectures related to GEOINT and GEOINT tasking, collection, processing, exploitation, and international geospatial information for the DoD Components and for the non-DoD elements of the IC,…"* to include:

> *"Serve as the DoD Lead for GEOINT standards and prescribe, mandate, and enforce standards and architectures related to GEOINT and GEOINT tasking, collection, processing, exploitation, and international geospatial information for the DoD Components and for the non-DoD elements of the IC…"*
>
> *"Standards for end-to-end architectures and embedded interfaces related to GEOINT"*
>
> *"Technical guidance and direction to the DoD Components and other components of the NSG regarding standardization and interoperability of systems requiring, exploiting, and/or disseminating GEOINT"*

The Motion Imagery Standards Board (MISB) is hereby designated as the organization, under the auspices of the National Center for Geospatial Intelligence Standards (NCGIS) Geospatial-Intelligence Standards Working Group (GWG) of the Information Technology Standards Committee (ITSC), to formulate, review and recommend standards for motion imagery, associated metadata, audio and other related systems for use within the Department of Defense / Intelligence Community / National System for Geospatial-Intelligence (DoD/IC/NSG). The MISB will formulate and make recommendations to the NCGIS on all proposed motion imagery, associated metadata, audio, and other related systems standards for compliance with the technical goals of the DoD IT Standards Registry (DISR), and NSG Technical Architecture (NTA). The MISB will therefore monitor and participate in changes to, and the implementation of, related motion imagery, metadata, audio, and associated systems standards in national and international arenas for impacts to DoD/IC/NSG Systems.

1.1 Motion Imagery Standards Board Mission

Whereas, motion imagery has been recognized by the DoD/IC/NSG as a fundamentally important source of imagery intelligence, and whereas; improved battle-space/intelligence-space awareness using motion imagery sensors has been identified as a key technology area; the mission of the MISB is to ensure the development, application and implementation of standards that maintain interoperability and quality for motion imagery, associated metadata, audio and other related systems in the DoD/IC/NSG. The MISB will monitor and participate in the

development of and changes to adopted standards and assess their impacts on systems and DoD/IC/NSG architectures through community input and discussion. Additionally, the MISB will participate in the North Atlantic Treaty Organization (NATO) Standards Agreement (STANAG) process for coalition force interoperability, and participate in US and international standards bodies to monitor, advocate, and represent DoD/IC/NSG interests for motion imagery, associated metadata, audio, and related systems to support global interoperability and protect image and information quality.

This DoD/IC/NSG Motion Imagery Standards Profile (MISP) is a direct expression of the MISB mission and serves as the master baseline standards document prepared and managed by the MISB. The DISR, NTA, and NATO reference the MISB yielding seamless international interoperability for coalition force operations. All DoD/IC/NSG organizations that use motion imagery technologies are encouraged to participate in MISB activities and represent their specific requirements and issues.

1.2 Motion Imagery Standards Profile Applicability to DoD/IC/NSG Communities

The MISP is applicable to all DoD/IC/NSG motion imagery systems that are subject to the DoD IT Standards Registry (DISR) and the NSG Technical Architecture. All new motion imagery systems are required to be compliant with provisions of the MISP as soon as practical. All analog motion imagery systems are legacy systems as of 12 June 1997. In accordance with the MISP, all new systems are required to be based on digital motion imagery technology.

Note that by reference here, other classes, communities and users of motion imagery systems (Video Teleconference Systems and Video Telemedicine) are specifically excluded from the mandatory requirements of the MISP. However, when any of these other classes of motion imagery systems are used for motion imagery data dissemination then the requirements and provisions of the MISP apply.

These and future to-be-defined motion imagery communities are encouraged to review the applicability of the standards given in the MISP and if deemed practical, implement MISP standards and recommended practices to foster broader interoperability across the entire DoD/IC/NSG/Federal spectrum. These separate communities are specifically invited to join the DoD/IC/NSG MISB and merge their requirements into the ongoing development of the DoD/IC/NSG MISP document.

1.3 MISP Document Structure

Material applicable to the entire MISP document, including definitions, DoD/IC/NSG migration objectives, and MISP compliance is contained in the body of this document. Various Appendices supply information pertaining to specific topics, and these are organized as shown in Table 1-1.

The MISP points to several documents as normative references. These documents fall into the categories of Industry Standards that are the due-process standards followed by commercial vendors and developers; and MISB documents specifically developed for motion imagery applications when there are no industry standards to meet specific DoD/IC/NSG needs.

Main Body	MISB Mission, MISP Applicability to DoD/IC/NSG, Acronyms, DoD/IC/NSG Migration Objectives, MISP Compliance Definition
Appendix A	Motion Imagery Modalities: Electro-Optical, Infrared, LVSD. MISM Tables, HD, ED, SD, Compression Guidelines, Tape Formats, IR, LVSD
Appendix B	Audio
Appendix C	Metadata: Classes and Rules
Appendix D	Transport Protocols and File Containers
Appendix E	Timing and Synchronization
Appendix F	Video NIIRS
Appendix G	Interoperability Profiles
Appendix H	Technical Reference Material
Appendix I	References and Bibliography
Appendix J	MISP Versions & Corresponding Documents
Appendix K	Revision Record

Table 1-1: Organizational Layout of the MISP

2 Acronyms and Abbreviations

A	
AES3	Audio Engineering Society 3
ANSI	American National Standards Institute
AAF	Advanced Authoring Format
ATM	Asynchronous Transfer Mode
ATSC	Advanced Television Systems Committee
ATV	Advanced Television
AVI	Audio/Video Interleaved
B	
BIIF	Basic Image Interchange Format
BNC	British National Connector
C	
CCI	Command and Control Interface
CDL	Common Data Link
CFR	Code of Federal Regulations
CIF	Common Image Format (352x288)
COT	Cursor on Target
COTS	Commercial Off-The-Shelf
D	
DVB-T	Digital Video Broadcast - Terrestrial
DISR	DoD Information Technology Standards Registry
DoD	Department of Defense
DV	Digital Video
DVB	Digital Video Broadcasting
DVD	Digital Versatile Disk; Digital Video Disk
D-VHS	Digital VHS
D-VITC	Digital VITC
E	
EBU	European Broadcast Union
ED	Enhanced Definition
EG	Engineering Guideline
EIA	Electronic Industries Association
EO	Electro-optical
ETR	European Telecommunications Report
ETS	European Telecommunications Standard
F	
FCC	Federal Communications Commission
FMV	Full Motion Video
FOV	Field Of View
FPS	Frames Per Second
G	
GB	Gigabyte
Gb	Gigabits

GFE	Government Furnished Equipment
GPS	Global Positioning System
H	
HD	High Definition
HDTV	High Definition Television
HL	High level
Hz	Hertz
I	
IC	Intelligence Community
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IOC	Initial Operational Capability
IPL	Image Product Library
IR	Infrared
ISDN	Integrated Services Digital Network
ISMC	International Standards Management Committee
ISO	International Standards Organization
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union – Radiocommunications
J	
JPEG	Joint Photographic Experts Group
JPIP	JPEG 2000 Interactive Protocol
K	
Kb/s	Kilobits per second
KB/s	Kilobytes per second
KLV	Key-Length-Value
L	
LTC	Longitudinal Time Code
LVSD	Large Volume Streaming Data
M	
Mb/s	Megabits per second
MB/s	Megabytes per second
MIL-STD	Military Standard
MIPO	Motion Imagery Program Office
MISM	Motion Imagery Systems Matrix
MISM-L	Motion Imagery Systems Matrix - Level
MJD	Modified Julian Date
ML	Main Level
MP	Main Profile
MPEG	Moving Pictures Experts Group
MTI	Moving Target Indicator
N	
NATO	North Atlantic Treaty Organization
NIIRS	National Imagery Interpretation Rating Scale
NSIF	NATO Secondary Imagery Format
NTA	NSG Technical Architecture

NTSC	National Television Standards Committee
O	
OC-3	Fiber Optic Communications Standard (155 Mbps)
OC-12	Fiber Optic Communications Standard (655 Mbps)
P	
PAL	Phase Alternate Line
p	Progressive
POTS	Plain Old Telephone Service
Q	
QSIF	Quarter SIF (176 x 120 Pixels)
R	
RFC	Request for Change
RP	Recommended Practice
RTCP	Real Time Control Protocol
RTSP	Real Time Streaming Protocol
RTP	Real Time Protocol
S	
s	seconds
SD	Standard Definition
SDI	Serial Digital Interface
SDTI	Serial Data Transport Interface
SECAM	System Electronique Couleur Avec Mémoire
SIF	Standard Image Format (352x240 pixels)
SMPTE	Society of Motion Picture and Television Engineers
STANAG	(NATO) Standardization Agreement
S-VHS	Super Vertical Helical Scan
T	
T-1	Telecommunications Link Standards (1.5 Mbps)
T-3	Telecommunications Link Standards (45 Mbps)
TBD	To Be Defined
TS	MPEG-2 Transport Stream
U	
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
UTC	Universal Time Code Coordinated
V	
VHS	Vertical Helical Scan
VISP	Video Imagery Standards Profile
VITC	Vertical Interval Time Code
VWG	Video Working Group
W	
WALF	Wide Area Large Format (LVSD Preferred)
X	
Y	
Y2K	Year 2000
Z	

3 Terminology and Definitions

In the broadest context of imagery applications, the major divisions are:

STILL Imagery / MOTION Imagery

This document addresses applications associated with **MOTION Imagery**.

3.1 Motion Imagery

Motion Imagery is defined as imagery [a likeness or representation of any natural or man-made feature or related object or activity] utilizing sequential or continuous streams of images that enable observation of the dynamic, (temporal), behavior of objects within the scene. Motion Imagery temporal rates—nominally expressed in frames per second—must be sufficient to characterize the desired dynamic phenomena. Motion Imagery is further defined as including metadata and nominally beginning at frame rates of 1 Hz (1 frame per second) within a common field of regard. Full Motion Video (FMV) falls within the context of these standards.

Within the division of MOTION Imagery, the following domains are currently specified:

1) Electro Optical (including video)
2) Infrared (including low-light video)
3) Multispectral (MSI) / Hyperspectral (HSI)

3.2 Electro Optical

Electro-Optical motion imagery technologies, such as video, are defined by standards developed by the International Organization for Standards (ISO), International Telecommunication Union (ITU), Society of Motion Picture and Television Engineers (SMPTE), European Broadcasters Union (EBU), etc. Television is defined by Government Transmission Regulations such as NTSC, PAL, SECAM, and FCC 4th Report and Order. These standards and regulations are reviewed, adopted and profiled for DoD/IC/NSG applications by designated DoD/IC/NSG standards bodies such as the MISB. The requirements and or limitations of transmission regulations, typically specified for civilian (general public) applications, are not necessarily applicable for DoD/IC/NSG applications.

Motion Imagery systems, when defined as electro-optical motion imagery whose formats are governed by national and international standards, are divided into four (4) categories:

1. *Motion Imagery Systems* (used to create, process, manipulate, exploit, store, archive, and disseminate Motion Imagery), both for real-time and other end-user wide area product distribution, in support to imaging applications, including (but not limited to) Intelligence, Surveillance, and Reconnaissance (ISR), Exploitation, and all other critical, warfighter-supporting motion imagery-based systems not specifically defined below.
2. *Video Teleconference Systems* provide real-time visual interchange between remote locations typically in support of meetings.
3. *Video Telemedicine Systems* provide real-time visual interchange between remote locations in biomedical applications including fiber optic and video teleconferencing.

4. *Video Support Services* enable end-user applications associated with motion imagery (video)-based training, newsgathering or other non-critical functions that do not directly support the warfighter. This includes traditional studio and field video productions, which are not associated with DoD warfighter operations.

3.3 Infrared

The infrared region is typically defined as electromagnetic radiation ranging from just below 1 micron to approximately 14 microns. This region of the electromagnetic spectrum includes the near or short-wave, mid-wave, and long-wave bands. This document presents new standards for infrared systems. As new standards are completed, they will be promulgated within future versions of the MISP.

3.4 Multispectral/Hyperspectral (MSI/HSI)

Multispectral/Hyperspectral sensors collect information as a set of 'images'. Each image represents a range of the electromagnetic spectrum and is also known as a spectral band. These 'images' are then combined and form a three-dimensional Hyperspectral cube for processing and analysis. Standards for motion imagery MSI or HSI systems are not yet available.

3.5 STANDARD

Where the MISP term STANDARD is used, the MISP item (chosen by specific MISB adoption, and approved by the NCGIS), mandates binding technical implementation policy, and as such, should be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government.

For point of clarification, in commercial practice many identified standards (notably those from SMPTE) are “voluntary” standards, where equipment manufacturers and users are free to choose to comply or to not comply with the standard. Standards, as represented in this MISP are not considered voluntary for DoD/IC/NSG users and systems; they are mandatory.

3.6 PROFILE

Where the MISP term PROFILE is used, the MISP item documents an extension to a STANDARD developed or specified to meet DoD/IC/NSG unique mission requirements not normally covered by commercial standards. MISP PROFILES (chosen by specific MISB adoption, and approved by the NCGIS) mandate binding technical implementation policy, and as such, should be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government.

3.7 RECOMMENDED PRACTICE

Where the MISP term RECOMMENDED PRACTICE is used, the MISP item documents a recommended implementation or practice that further clarifies the implementation of a STANDARD or PROFILE in order to insure interoperability across DoD/IC/NSG systems. Recommended Practices chosen by specific MISB adoption should be a technical implementation policy, and as such, may be identified in Government procurement actions as a mandatory compliance item for vendor offerings to be accepted by the Government.

3.8 ENGINEERING GUIDELINE

Where the MISP term ENGINEERING GUIDELINE is used, the MISP item documents a recommended implementation or practice that represents good engineering principles and therefore, should be implemented if possible.

3.9 Technical Reference Material

Where the MISP term TECHNICAL REFERENCE MATERIAL (TRM) is used, the MISP item documents information collected from research, technical exchange meetings, or study that does not result in a Standard, Recommended Practice, or Engineering Guideline, but contributes to further understanding of the topic that may prove useful in the application of said MISB documentation.

3.10 Motion Imagery System Matrix (MISM)

The Motion Imagery System Matrix (MISM) identifies the supported compression profiles and levels for a given spatial resolution/temporal frame rate and subsequent data rates for Electro-Optical imagery as directed by Recommended Practice (RP) 9720.

3.11 Infrared Motion Imagery System Matrix (IRSM)

The Infrared Motion Imagery System Matrix (IRSM) identifies the supported compression profiles and levels for a given spatial resolution/temporal frame rate and subsequent data rates for Infrared imagery as directed by Recommended Practice (RP) 0401.

3.12 Frame Rate

The following scanning frame rate annotations are used throughout all of the MISP profiles:

60p	=	60 FPS (frames per second), progressive scan
60p/1.001	=	59.94 FPS (NTSC-compatible frame rate), progressive scan
50p	=	50 FPS, progressive scan
30p	=	30 FPS, progressive scan
30p/1.001	=	29.97 FPS (NTSC-compatible frame rate), progressive scan
25p	=	25 FPS, progressive scan
24p	=	24 FPS, progressive scan
24p/1.001	=	23.98 FPS (NTSC-compatible frame rate), progressive scan
30i	=	30 FPS, interlaced scan at 60 fields per sec Note: many commercial documents use the term 60i to mean 30i
30i/1.001	=	29.97 FPS (NTSC-compatible frame rate), interlaced scan at 59.94 fields per sec Note: frame rate associated with “television” in the United States
25i	=	25 FPS, interlaced scan at 50 fields per sec
24i	=	24 FPS, interlaced scan at 48 fields per sec
24i/1.001	=	23.98 FPS (NTSC-compatible frame rate), interlaced scan at 47.96 fields per sec

For Infrared motion imagery, frame rates of 25, 30, 50, and 60 are preferred; lower and higher frame rates are allowed and tolerance in the system should provide for 1/1.001 of 30 Hz and 1/1.001 of 60 Hz.

3.13 High Definition, Enhanced, and Standard Definition

The following scanning format definitions are used throughout all MISP profiles:

High Definition (HD):	spatial resolution *at or greater than* 1280x720 pixels; progressive scan; temporal rates *at or greater than* 24 FPS
Enhanced Definition (ED):	spatial resolution *of at least* 720x480 pixels; progressive scan; temporal rates *at or greater than* 24 FPS
Standard Definition (SD):	spatial resolution of 720x576 or 720x480 pixels; interlaced scan; temporal rates *from* 24 *to* 60 FPS

Standard definition systems shall be replaced by progressively captured enhanced or high definition systems as soon as practical. It is DoD/IC/NSG policy to migrate to all progressive scanning formats. However, many existing DoD/IC/NSG motion imagery imaging systems are Standard Definition interlaced systems, which can be used until the end of their practical service life. Such existing systems must be replaced with progressive systems.

Infrared (IR) motion imagery is defined in a similar manner to that above. The spatial resolution classes of IR include: 160x120, 320x240, 640x480 (including 640x512, 720x480, 720x512, and 720x576), 1024x720 (including 1280x720 and 1024x1024), 1920x1080, and 2048x2048 all progressive scan. Interlaced scan IR systems are to be treated as legacy and shall be replaced with progressive systems at the end of their service lives.

3.14 Pixel Bit Depth

Pixel bit depths (amplitude quantization) of 8 bits are common in electro-optical motion imagery although critical viewing suggests that 10 and 12 bits are preferred. Infrared motion imagery typically has higher bit depths such as 12 and 14 bits, which are preferred.

3.15 Situational Awareness

Situational Awareness is the human perception of the elements of the operational environment in the context of forces, space and time, the comprehension of their meaning, and the projection of their status in the near future.

A Situational Awareness Product is a concise, transportable summary of the state of friendly and enemy elements conveyed through information such as full-motion video (FMV), imagery, or other data that can contribute to the development of Situational Awareness either locally or at some distant node.

4 DoD/IC/NSG Motion Imagery Migration Objectives

DoD/IC/NSG user communities have diverse mission requirements and will select diverse motion imagery systems, across a range of capabilities, to meet system performance objectives. This section outlines the desired end-state of DoD/IC/NSG motion imagery capabilities. Not all users will require a migration to the highest possible spatial and temporal resolutions, but all

users should be aware of the target end-objectives for motion imagery capabilities for the DoD/IC/NSG as described below:

1) For all motion imagery systems to move to all digital, progressive scan, and square pixels; move to higher spatial, temporal, and spectral resolutions as technology enables.
2) Standard Definition, analog interlace is considered legacy and obsolete. Within analog families, component processing (R/G/B, Y/R-Y/B-Y, and Y/C) is preferred over composite (such as NTSC and PAL).
3) Standard Definition, digital interlace, using serial digital interfaces (SDI) is a logical and economical upgrade from analog interlace systems. However, with a minimal cost differential between Standard Definition digital interlace and Enhanced Definition digital progressive a migration to Enhanced Definition is strongly advised.
4) Enhanced Definition, digital progressive provides the best combination of improved spatial and temporal resolution capabilities at minimal increased costs as compared to digital interlace. However, 480 and 576 progressive systems do not have square pixels and cannot properly deliver a 16:9 aspect ratio. Enhanced Definition may be suitable when high definition spatial and temporal resolutions, or a 16:9 aspect ratio is not required.
5) High Definition, progressive scan is the desired upgrade for DoD/IC/NSG motion imagery systems. Both 1280x720x(50p)60p and 1920x1080x(50p)60p are anticipated to become common formats in current and future imagery systems. Communities may consider use of 1920x1080x24p/25p/30p in applications that do not require high temporal rates (such as studio production, training, etc.). The anticipated dynamic geo-political landscape and military battlespace environment envisioned by Joint Vision 2010 requires a trade space of maximal spatial and temporal resolution, thus 1280x720x(50)60p or 1920x1080x(25)30p will remain the objective architecture end-goal.

4.1 General Implementation Notes and Document Philosophy

It is the intent of the MISP to give users a consolidated, clear and concise view of the standards they will need to build and operate motion imagery systems. The MISP includes guidance on uncompressed, compressed, and related motion imagery sampling structures; motion imagery time standards, motion imagery metadata standards, interconnections, and common language descriptions of motion imagery system parameters. All the technology within the MISP is based on commercially available (or very near term available) open standards systems and components.

No single commercial motion imagery standard will provide all the guidance necessary to build interoperable systems for use across the diverse missions of DoD/IC/NSG. Therefore, the MISP is a collection of standards and practices founded on commercial standards that can best offer interoperable service to DoD/IC/NSG users. Think of the MISP as a specific technology (motion imagery) domain document that defines the concepts needed in building interoperable, end-to-end motion imagery systems based on commercial motion imagery technology. A specific example is MPEG-2, where the commercial MPEG-2 standard defines an extremely flexible technology, but does not guarantee interoperability. By carefully selecting “nominal” values from the ranges of choices within a standard, standards management groups and users can better shape interoperability for their classes of applications.

For standards to be effective some regimen of compliance must be established. For DoD/IC/NSG standards to achieve interoperability objectives, systems procured for the DoD/IC/NSG must have JITC (Joint Interoperability Test Command) certification to warrant that the systems are compliant with applicable standards, and that the systems perform as advertised.

Over many years, organizations such as SMPTE and ISO have worked to standardize motion imagery systems—primarily targeted at broadcast video— to facilitate interoperability to meet high quality production capability. Such standardization has given broadcasters and production centers confidence that products from multiple vendors would function together. There are proprietary vendor products that claim "standard" status based on market share, but such proprietary products do not presently meet DoD/IC/NSG guidelines for adoption as approved standards.

Therefore, the MISP seeks industry standards and guidance that further interoperability from Digital Cinema quality through low bandwidth Internet quality imagery. DoD users that adopt proprietary compression, file packaging, or transport systems are cautioned that such systems may not be supported by DoD/IC/NSG, and that the interoperability of such systems cannot be assured.

4.2 MISP COMPLIANCE: Definition

Motion Imagery Standards Profile (MISP) compliance is based upon compliance to a specified approved version of the MISP (e.g. MISP Version (V) 4.4, MISP V4.5, etc.). The motion imagery system supplier specifies the MISP version for which it is seeking compliance along with four qualifications:

1. The MISM (Motion Imagery System Matrix)-Level(s) that the motion imagery compression is to operate within (across)
2. The metadata STD/RP/EG implemented
3. The transport/file format STD/RP/EG for transport/storage of the motion imagery
4. The timing/synchronization STD/RP/EG implemented

MISM levels are as defined per the MISP version specified by the system supplier. All signals tested are assumed digital. Supported video compression includes MPEG-2, MPEG-4 Part 10 (i.e. AVC or H.264) and motion JPEG 2000. Metadata is tested for compliance to the specified version of the MISP and respective STDs/RPs/EGs. MISP compliant systems shall produce metadata elements from Standard 0601 or EG 0104 (legacy systems only), optionally using metadata keys from MISB Standard 0807, SMPTE RP 210, and other MISB RPs/EGs of their choice. The minimum metadata set for Standard 0601 is given by Standard 0902. In addition, Security metadata shall comply with MISB Standard 0102. Supported transport and file formats include MPEG-2 Transport Stream (TS), Real Time Protocol (RTP), Material Exchange Format (MXF) and Advanced Authoring Format (AAF). Furthermore, if the motion imagery system uses MXF/AAF it shall comply with Standard 0301. Draft RPs/EGs will not be tested until approved by the MISB. When security metadata is carried within the MPEG-2 Transport Stream it shall be inserted into only one of the two carriage mechanisms available: the synchronous stream method identified in [16] or the asynchronous stream method identified in [61].

(18 Sep 08 - approved)(11 Dec 08 - approved)(3 Sep 09 - approved)(3 Dec 09 - approved)(30 Sep - approved)(27 Jan 11 - approved)

A MISP-compliant file/stream must have the following three components with timing/synchronization implicit in the metadata and/or media container:

1. **Motion Imagery** – uncompressed or compressed (the essence)
2. **Metadata** – Key Length Value format (mission and security data)
3. **Media Container** – approved package that carries MI, metadata, or both. In a MPEG-2 transport stream (TS) both MI and metadata must be present. In Real-Time Transport Protocol (RTP), MI and metadata are independently carried as separate streams with appropriate timing that associate the individual media streams.

5 Overview of Current Motion Imagery Profile

The MISP consists of five basic parts: there are four core bodies of standards, engineering guidelines, and recommended practices plus there is a set of supporting documents. The Profiles, Recommended Practices and Studies of this document are included to expressly focus DoD/IC/NSG uses of commercial standards to better manage and support mission interoperability. Table 5-1 summarizes the Standards, Interoperability Profiles and Recommended Practices for DoD/IC/NSG Implementations, and Motion System Recommended Practices forming the basis of this Motion Imagery Standards Profile document. However, Table 5-1 shall not be used in lieu of the detailed descriptions of this document.

Table 5-1: Summary of MISB Standards (STD), Interoperability Profiles, Recommended Practices (RP), and Engineering Guidelines (EG)

Item		Formal Standard Tailored by MISP	Name/Purpose
STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES and ENGINEERING GUIDELINES for DoD/IC/NSG Implementations			
Electro-Optical Motion Imagery Systems			
RP 9720	Motion Imagery System Descriptions	Motion Imagery System Matrix (MISM)	
RP 9720a	Advanced High Definition Motion Imagery	MISM Levels 12-14 (study)	
RP 9720b	High Definition Motion Imagery	MISM Levels 9-11	
RP 9720c	Enhanced Definition Motion Imagery	MISM Levels 6-8	
RP 9720d	Standard Definition Motion Imagery	MISM Levels 3-5	
RP 9720e	Low Spatial/Temporal Motion Imagery	MISM Levels 1-2	
RP 9720f	Very Low Temporal Motion Imagery	MISM Level 0	
Migration to Digital			
STD 9709	Use of Closed Captioning for Core Metadata Analog Video Encoding	EIA-608[6] 47 CFR 15.119 [EIA-708 for HDTV][7]	Recommended Practice for Line 21
STD 9719	Analog Video Migration	ANSI/SMPTE 170M [27] ITU-R BT.601 [23]	Analog video 4:2:2 Component Digital video
Electro-Optical Interface, Sampling Structure, Compression			
High Definition Motion Imagery			
STD 9703	Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing	SMPTE 292M [31]	Serial Digital Interface (SDI) Bit-Serial Interface

Item		Formal Standard Tailored by MISP	Name/Purpose
STD 9710	High Definition Television Systems (HDTV)	SMPTE 274M [29] SMPTE 292M [31] SMPTE 296M [34] SMPTE 295M [33]	1920x1080 HDTV and Interface Bit-Serial Interface 1280x720 HDTV and Interface 1920x1080 50 Hz HDTV and Interface
STD 9723	Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems	ISO/IEC 13818 - 1,2,3,4 [16-19] ITU-T Rec. H.264 [65]	MPEG-2 MP@HL H.264/AVC
Enhanced Definition Motion Imagery			
STD 9811	Progressively Scanned Enhanced Definition Digital Motion Imagery	ITU-R BT.1358 [44] SMPTE 292M [31] SMPTE 349M [62]	Progressive Scan EDTV Serial Interface
STD 0201	Uncompressed Enhanced Motion Imagery Baseband Signal Transport	SMPTE 394M [111]	Passing SD, ED through SMPTE 292M HD interface
STD 0202	Compressed Enhanced Definition Advanced Television (ATV) and Associated Motion Imagery Systems	ISO/IEC 13818 - 1,2,3,4 [16-19] ITU-T Rec. H.264 [65]	MPEG-2 MP@HL H.264/AVC
SMPTE 292M	Bit-Serial Digital Interface for High-Definition Television Systems	SMPTE 292M [31]	Uncompressed baseband signal transport
Standard Definition Motion Imagery			
STD 9601	Standard Definition Digital Motion Imagery, Compression Systems	ISO/IEC 13818-1,2,3,4 [16-19] ITU-T Rec. H.264 [65]	MPEG-2 MP@ML H.264/AVC
STD 9702	Standard Definition Digital Motion Imagery Sampling Structure	ITU-R BT.601[23]	4:2:2 Component Digital Video
STD 9703	Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing	SMPTE 259M [28] SMPTE 292M [31]	Serial Digital Interface (SDI)
STD 9704	Digital Motion Imagery, Compression Conversions	ITU-R BT.601 [23] SMPTE 259M [28]	4:2:2 Component Digital video Serial Digital Interface (SDI)
STD 9705	Standard Definition Digital Motion Imagery, Format Conversions	ITU-R BT.601 [23] SMPTE 259M [28]	4:2:2 Component Digital video Serial Digital Interface (SDI)
STD 9707	Standard Definition Digital Motion Imagery Tape Recorder, Digital Motion Imagery Server, and Similar Systems Input/Output Protocol	SMPTE 259M [28] IEEE 1394[13]	Serial Digital Interface (SDI) HP Serial Bus
STD 9803	Serial Data Transport Interface	SMPTE 305M [36]	SDTI
STD 9901	Fiber Optic Interfaces Uncompressed Baseband Signal Transport and Processing	SMPTE 297M [35] SMPTE 259M [28]	Fiber Optic Standard Connector Types
RP 9902	Authorized Limited Application of DV Format Video	DV Format IEEE 1394 [13]	DV Format Video HP Serial Bus
Low Spatial/Temporal Motion Imagery			
STD 9706	Video Image Still Frames	MIL STD 2500C [25]	Video Still Specification
Compression Guidelines			
EG 0802	H.264 Coding and Multiplexing	ITU-T Rec. H.264 [65] ISO/IEC 13818-1 [16] IETF RFC 3984 [124]	For all digital formats
EG 0904	H.264 Bandwidth/Quality/Latency Tradeoffs	ITU-T Rec. H.264 [65]	HD formats for limited BW channels
Motion Imagery Tape Formats			
RP 9721	Motion Imagery Tape Formats	SMPTE 342M [54]	
Infrared Motion Imagery Systems			
RP 0401	Motion Imagery System Descriptions	Infrared Motion Imagery System Matrix (IRSM)	

Item		Formal Standard Tailored by MISP	Name/Purpose
RP 0401a	Infrared System Matrix, Very Low Definition IR	IRSM Levels 1-3	
RP 0401b	Infrared System Matrix, Low Definition IR	IRSM Levels 4-6	
RP 0401c	Infrared System Matrix, Medium Definition IR	IRSM Levels 7-9	
RP 0401d	Infrared System Matrix, High Definition IR	IRSM Levels 10-12	
RP 0401e	Infrared System Matrix, Very High Definition IR	IRSM Levels 13-15	
RP 0401f	Infrared System Matrix, Super High Definition IR	IRSM Level 16-18 (study)	
Infrared Interface, Sampling Structure, Compression			
RP 0403	Digital Representation and Source Interface Formats for Infrared Motion Imagery Mapped into 1280 x 720 Format Bit-Serial Digital Interface	SMPTE 352M [125] SMPTE 274M [29] SMPTE 291M [30] SMPTE 372M 67]	Mapping to SDI
STD 0404	Compression for Infrared Imagery	SMPTE 292M [31] ITU-T Rec. H.264 [65] ISO/IEC 15444 [72-74]	Bit mapping for optimal compression
RP 0402	Infrared Image Capture		Sampling structures
LVSD Systems			
RP 0606	Authorized Use of JPEG 2000 or Motion JPEG 2000 for Large Volume Streaming Data Imagery	ISO/IEC 15444 [72-75] (various parts)	More detail on format and metadata is required
RP 0705	LVSD Compression Profile	ISO/IEC BIIF Profile BPJ2K01.01 [89]	Superset of current J2K profiles
RP 1004	Motion Imagery System Matrix, LVSD	MISM Levels 9-1	
Audio			
EG 1001	Audio Encoding in MPEG-2 TS	ISO 11172-3[116] ISO 13818-3[18] ISO 13818-7 [117]	Audio Compression Standards
Metadata			
STD 9711	Intelligence Motion Imagery Index, Geospatial Metadata	Core Motion Imagery Metadata Profile	Core Metadata V 1.0, 14 Mar 97
STD 9712	Intelligence Motion Imagery Index, Content Description Metadata (Dynamic Metadata Dictionary Structure and Contents)	SMPTE 335M [39] SMPTE RP210 [42] SMPTE EG 37 [43]	Metadata Dictionary Structure Metadata Dictionary Contents Dictionary Node Structure
STD 9713	Data Encoding Using Key-Length-Value (KLV)	SMPTE 336M [40]	KLV Protocol
STD 0102	Security Metadata Universal Set for Digital Motion Imagery	CAPCO Authorized Classification and Control Markings Register	
STD 0601	UAS Datalink Local Metadata Set	SMPTE 336M [40] SMPTE RP210 [42] IEEE 1003 [142]	Bit-efficient, extensible SMPTE KLV Local Metadata Set for a wireless communications link (Datalink)
STD 0807	DoD/IC/NSG Motion Imagery Metadata Registry		Metadata Registry
STD 0902	MISB Motion Imagery Sensor Minimum Metadata Set	SMPTE 336M [40]	Direction on the encoding of the MIS-MMS for transmission from analog systems while supporting a migration path towards digital motion imagery systems
RP 9717	Packing KLV Packets into MPEG-2 Systems Streams	ISO/IEC 13818-1,2,3,4 [16-19] SMPTE RP 217 [61]	MPEG-2 Metadata Encoding

Item		Formal Standard Tailored by MISP	Name/Purpose
RP 0602	Annotation Universal Metadata Set	ISO/IEC 13818-1 [16] ISO/IEC 10918-1 [71] ISO/IEC 15948 [140] SMPTE 335M [41] SMPTE 336M [40] SMPTE RP 210 [42]	Annotation
RP 0608	Motion Imagery Identifier	ISO/IEC 8601 [141] SMPTE 336M [40] SMPTE 330M [126] IETF RFC 4122 [134]	Format and encoding of the Motion Imagery Identifier (MIID). defines the Motion Imagery Stream Identifier (MI_Stream_ID)
RP 0701	Common Metadata Structure	SMPTE 336M [40] IETF RFC 4122 [134]	Organization of the sensor/platform data into a hierarchy of KLV Packs and Local Sets that reduces the bandwidth to transmit the data
RP 0808	Ancillary Text Metadata Sets		
EG 0104	Basic Predator KLV Metadata	SMPTE 336M [40]	KLV Protocol
STD 0107	Bit and Byte Order for Metadata in Motion Imagery Files and Streams		big-endian
EG 0607	Metadata Registry and Processes	SMPTE 335M [39] SMPTE RP210 [42]	Metadata Dictionary Structure Metadata Dictionary Contents
EG 0801	Photogrammetry Metadata Set	ISO/IEC 8601 [141] SMPTE 336M [40] SMPTE RP 210 [42]	Photogrammetry Metadata
EG 0805	Cursor on Target conversion for KLV Metadata		CoT
EG 0806	Remote Video Terminal Local Data Set	ISO/IEC 13818-1 [16] SMPTE 336M [40] SMPTE RP 210 [42]	RVT
EG 0809	KLV Representation of Meteorological Data		Meteorological Metadata
EG 0810	Profile 2: KLV for LVSD Applications		KLV metadata for LVSD
STD 0903	Video Moving Target Indicator Local Data Set	SMPTE 336M [40] SMPTE RP 210 [42] ISO/IEC 13818-1 [16]	Provide VMTI metadata to downstream clients
EG 1002	Range Image Metadata Set	SMPTE 336M [40] SMPTE RP 210 [42]	SPI-3D LADAR sensor metadata
Transport Protocols and File Containers			
STD 9701	MPEG-2 Transport Stream	ISO/IEC 13818-1[16]	Xon2
STD 9716	Packing KLV Packets into SMPTE 291 Ancillary Data Packets	SMPTE 291M [30] SMPTE RP 214 [63]	SDI Bit-Serial Interface Metadata Encoding
STD 9718	Packing KLV Packets into AES3 Serial Digital Audio Streams	SMPTE 337M [127] SMPTE 339M [128] SMPTE 355M [41]	AES-3 Metadata Encoding
STD 0301	MISB Profile for Aerial Surveillance and Photogrammetry Applications (ASPA)	ISO/IEC 13818-1 [16] SMPTE 335M [41] SMPTE 336M [40] SMPTE 377M-1 [46] SMPTE 381M [50] SMPTE 395M [129] SMPTE 400M [130] SMPTE RP 210 [42] SMPTE RP 217 [61] SMPTE RP 224 [133] SMPTE EG 42 [49]	ASPA Profile

Item		Formal Standard Tailored by MISP	Name/Purpose
STD 0604	Time Stamping and Transport of Compressed Motion Imagery and Metadata	ISO/IEC 13818-1[16]	See "Timing and Synchronization"
RP 0101	Use of MPEG-2 System Streams in Digital Motion Imagery Systems	ISO/IEC 13818-1[16]	MPEG-2
RP 0106	Advanced Authoring Format	SMPTE 377-1 [46]	AAF
RP 0108	Material Exchange Format	SMPTE 378M [47] SMPTE 379M [48] SMPTE 381M [50] SMPTE 380M [51] SMPTE 391M [112]	MXF
RP 0804	Real Time Protocol for Full Motion Video	IETF RFC 3550 [90] IETF RFC 3551 [135] ISO/IEC 13818-2 [17] ITU-T Rec. H.264 [65] SMPTE 336M [40]	RTP
RP 0811	JPIP Profile (Client/Server Functions)	ISO/IEC 15444-1,2,9 [72, 73,75] IETF RFC 793 [136] IETF RFC 2045 [137] IETF RFC 2046 [138] IETF RFC 2616 [139]	JPIP
EG 0803	Delivery of Low Bandwidth Motion Imagery	IETF RFC 3350 [90], RFC 2326 [91]	
EG 0812	Clipping of Streaming Video into Files		Clipping
EG 0813	Integration of Motion Imagery into the Coalition Shared Database	Technically identical to NATO RP 0803	FMV in CSD
Timing and Synchronization			
STD 9708	Embedded Time Reference for Video Systems	SMPTE 12M [26] SMPTE 309M [37]	SMPTE Time Code MJD
STD 9714	Time Code Embedding	ITU-R BT.601 [23] SMPTE 259M [28] SMPTE 292M [31] SMPTE 309M [37]	D-VITC SMPTE Ancillary Time Code SMPTE Ancillary Time Code MJD
STD 9715	Time Reference Synchronization	SMPTE 12M [26]	Time Code synchronized to GPS
STD 0604	Time Stamping and Transport of Compressed Motion Imagery and Metadata	ISO/IEC 13818-1,2[16, 17] ITU-T Rec. H.264 [65] SMPTE 12M [26] SMPTE 309M [37] SMPTE 328M [131] SMPTE RP 217 [61]	Timing and Carriage of MI and Metadata in MPEG-2 TS
RP 0103	Timing Reconciliation Universal Metadata Set		Deprecated May 2009
STD 0603	Common Time Reference for Digital Motion Imagery using Coordinated Universal Time (UTC)	GPS Standard Positioning Specification, Jun 2, 2005 Assistant Secretary of Defense for Command, Control, Communications and Intelligence, "Global Positioning Standard Positioning Service Performance Standard," Sections 1.4, 1.4.2, A-1.3.2.3, A2.4	

Item		Formal Standard Tailored by MISP	Name/Purpose
STD 0605	Inserting Time Stamps and Metadata in High Definition Uncompressed Video	SMPTE 12M [26] SMPTE 259M [28] SMPTE 274M [29] SMPTE 291M [30] SMPTE 292M [32] SMPTE 296M [34] SMPTE 336M [40] SMPTE 352M [125] SMPTE 424M [86] SMPTE 425M [132] SMPTE RP 214 [63]	SMPTE Time Code Metadata Dictionary Contents Packing KLV Encoded Metadata and Data Essence into SMPTE 291M Ancillary Data Packets
Video NIIRS			
RP 0901	Video-NIIRS		MI Quality Metric Scale

5.1 MI types and content: Motion Imagery "Essence"

Differences within the characteristics of motion imagery of differing types legislates that different standards, EGs, and RPs be brought to bear depending on the imagery context. The MISP subdivides the Motion Imagery domain across the several discriminators described in Section 2, including:

- Spectral characteristics (EO, IR, MSI/HSI)
- Format Definition (Advanced HD, HD, ED, SD, Low Bandwidth/Temporal, LVSD)

Appendix A: *Motion Imagery Modalities* organizes the motion imagery types under the purview of the MISB into a set of levels. These levels are subsequently used as reference definitions that allow individual MISP standards for Metadata, Transport, and Timing to be applied to the appropriate motion imagery type.

For instance, MISP defines standards for compressing motion imagery, but compression algorithms may perform differently depending on the characteristics of the imagery being compressed. The MISP levels are used to define different standard compression algorithms for different types of motion imagery (notably JPEG2000 instead of H.264 for some types of Large Volume Streaming – LVSD – imagery)

5.2 Audio

Appendix B: *Audio* describes the MISP standards, guidelines, and practices governing audio compression formats.

5.3 Metadata

In order to effectively exploit collected motion imagery, it is critical that metadata be associated with the imagery that describes:

- The platform and sensor context of the imaging collection
- The geospatial environment of the imagery
- The security level of the imagery
- (Potentially) the contents of the imaged scene

Appendix C: *Metadata* describes the MISP standards, guidelines, and practices governing the required and recommended elements of the metadata associates with motion imagery. These generally apply across the levels of motion imagery described in Appendix A.

5.4 Transport

To effectively move collected motion imagery and have it be decodable at the receiving end of the transmission, standardized methods to encode motion imagery and associated information for transport must be defined and enforced. This is the role of the transport protocol and files container standards, EGs, and RPs adopted by the MISP. Considerations addressed include:

- Delivery of low bandwidth motion imagery
- Real time data delivery
- Integration into Coalition shared databases

Appendix D: *Transport Protocols and File Containers* describes the MISP standards, guidelines, and practices governing the transport of motion imagery and associated information across communication channels and file systems. These generally apply across the levels of motion imagery described in Appendix A.

5.5 Timing

Collection of motion imagery occurs in mission contexts in which the time of events and activities observed in the imagery, the timing of responses to the imagery, and/or the temporal relationships of imagery events, and activities may be critical. Considerations include:

- Time Stamp definitions
- Time Reference Synchronization
- Time code embedding

Appendix E: *Timing and Synchronization*: the MISP standards, guidelines, and practices governing the timing associated with motion imagery and associated information. These generally apply across the levels of motion imagery described in Appendix A.

5.6 Other Guidance and Support

Several additional topics are addressed by the MISB to ensure full support of motion imagery resources in the mission environment and in the standards definition process. The MISP therefore contains a set of additional standards, EGs, RPs, Studies, and other documents that cover necessary areas. These currently include:

- Video NIIRS (Appendix F)
- Interoperability Profiles (Appendix G)
- Technical Reference Material (Appendix H)
- References (Appendix I)
- MISP Versions (Appendix J)
- Revision Record (Appendix K)

5.7 Summary

Figure 5-1 to 5-3 provide a breakdown of the MISP standards, RP's, and EG's for the image modalities of Electro-Optical, Infrared, and LVSD respectively.

Figure 5-1: Standards, Recommended Practices, Engineering Guidelines for Electro-Optical

Electro-Optical Motion Imagery		
Advanced High Definition	≥ 1920 ≥ 1080p 48 - 120 L14 - L12	pixels lines Hz MISM
High Definition (HD) STD 9710, RP 9720b	1280 -1920 720 - 1080p 24 - 60 L11 - L9	pixels lines Hz MISM
Enhanced Definition STD 9811, RP 9720c	640 - 960 480 - 576p 24 - 60 L8 - L6	pixels lines Hz MISM
Standard Definition STD 9702, 9705, 9719, RP 9720d	640 - 720 480 - 576i 24 - 60 L5 - L3	pixels lines Hz MISM
Low Bandwidth MI RP 9720e	640 - 720 480 - 576i 24 - 30 L2.2 - L1.0	pixels lines Hz MISM
Very Low Temporal MI RP 9720f	720 - 1920 480 - 1080 Still - 2 L0	pixels lines Hz MISM

Compression
Uncompressed
H.264/AVC STD 9701 (SD) STD 9723 (HD) STD 0202 (ED)
MPEG-2 STD 9601, 9701 (SD) STD 9704 Conversions STD 9723 (HD) STD 0202 (ED)
Video NIIRS RP 0901

File/Transport
MPEG-2 TS STD 9701
SDI HD, SD STD 9703
Tape Servers STD 9707
KLV in SMPTE 291 STD 9716
KLV in AES3 STD 9718
SDI Interface STD 9803
Fiber Optic STD 9901
SDI ED STD 0201
ASPA STD 0301
MI/Metadata Transport STD 0604
KLV in MPEG2 TS RP 9717
Tape Formats RP 9721
DV Format RP 9902
MPEG-2 Systems RP 0101
AAF RP 0106
MXF RP 0108
RTP RP 0804
Low BW Video EG 0803
STANAG 4559 Model EG 0813

Timing & Synchronization		
Imbedded Time Ref STD 9708	**Time Stamping** STD 0604	
Time Code Embedding STD 9714		**Common Time Ref** STD 0603
Time Synchronization STD 9715		**Inserting Time Code** STD 0605

Metadata		
Closed Captioning STD 9709	**Annotation Set** RP 0602	**Predator UAS Set** EG 0104
Geospatial Metadata STD 9711	**MI Identifier** RP 0608	**MISB Registry** EG 0607
Content Description STD 9712	**CMS: Structure** RP 0701	**Photogrammetry** EG 0801
KLV Data Encoding STD 9713	**VMTI LDS** STD 0903	**CoT** EG 0805
Security Set STD 0102	**Range Image Set** EG 1002	**RVT Local Set** EG 0806
Bit / Byte Order STD 0107		**Meteorological** EG 0809
UAS Local Set STD 0601	**Audio Encoding** EG 1001	**LVSD Applications** EG 0810
Metadata Dictionary STD 0807		
Minimum Set STD 0902		

Figure 5-2: Standards, Recommended Practices, Engineering Guidelines for Infrared

Infrared Motion Imagery		
Super High Definition	2048 - 3840 1152 - 2160 25 - 60 L18 - L16	pixels lines Hz IRSM
Very High Definition RP 0401e	1920 -2048 1080 - 1152 25 - 60 L15 - L13	pixels lines Hz IRSM
High Definition RP 0401d	1024 - 1280 720 - 1024 25 - 60 L12 - L10	pixels lines Hz IRSM
Medium Definition RP 0401c	640 - 720 480 - 576 25 - 60 L9 - L7	pixels lines Hz IRSM
Low Definition RP 0401b	320 - 360 240 - 288 25 - 60 L6 - L4	pixels lines Hz IRSM
Very Low Definition RP 0401a	160 - 180 120 - 144 25 - 60 L3 - L1	pixels lines Hz IRSM

Compression
Capture RP 0402
H.264/AVC STD 0404
MPEG-2 STD 0404

File/Transport
MPEG-2 TS STD 9701
Serial Interface RP 0403
KLV in SMPTE 291 STD 9716
KLV in AES3 STD 9718
ASPA STD 0301
MI/Metadata Transport STD 0604
KLV in MPEG2 TS RP 9717
MPEG-2 Systems RP 0101
AAF RP 0106
MXF RP 01087
RTP RP 0804
Low BW Video EG 0803

Timing & Synchronization		
Imbedded Time Ref STD 9708	**Time Stamping** STD 0604	
Time Code Embedding STD 9714		**Common Time Ref** STD 0603
Time Synchronization STD 9715		**Inserting Time Code** STD 0605

Metadata		
	Annotation Set RP 0602	**Predator UAS Set** EG 0104
Geospatial Metadata STD 9711	**MI Identifier** RP 0608	**MISB Registry** EG 0607
Content Description STD 9712	**CMS: Structure** RP 0701	**Photogrammetry** EG 0801
KLV Data Encoding STD 9713		**CoT** EG 0805
Security Set STD 0102		**RVT Local Set** EG 0806
Bit / Byte Order STD 0107		**Meteorological** EG 0809
UAS Local Set STD 0601	**Audio Encoding** EG 1001	
Metadata Dictionary STD 0807		
Minimum Set STD 0902		

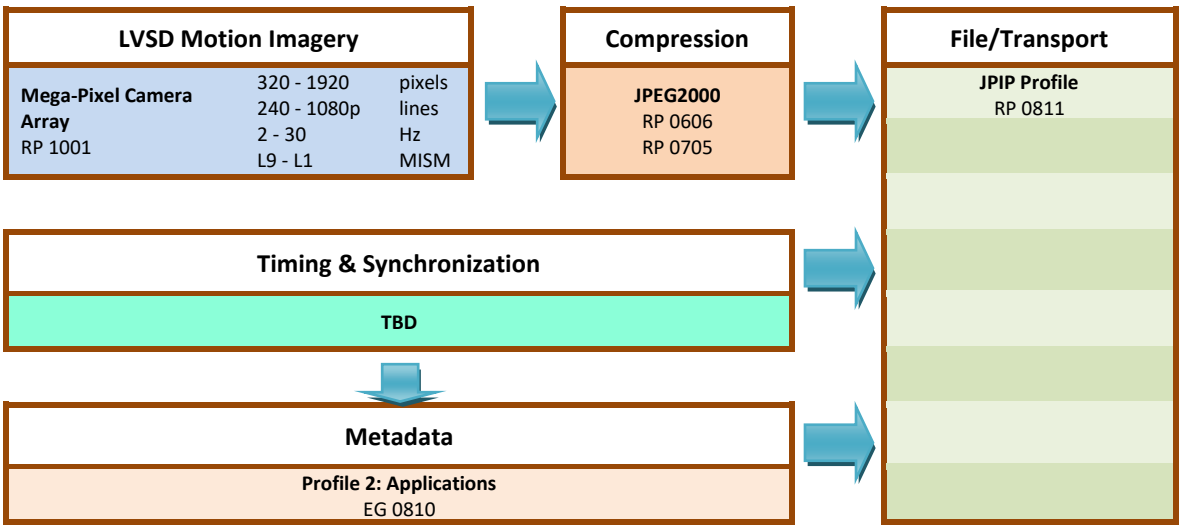

Figure 5-3: **Standards, Recommended Practices, Engineering Guidelines for LVSD**

5.8 MISB Compliant Standards for High Definition FMV

DoD FMV systems must comply with the mandated standards specified in the DoD/IC/NSG Motion Imagery Standards Profile (MISP). If applicable for coalition warfighter (NATO) operations, FMV systems shall also comply with Edition 3 of NATO STANAG 4609 and Allied Engineering Document Publication, AEDP-8 Edition 3. STANAG 4609 and AEDP-8 Edition 3 are equivalent to MISP 5.1. Copies of the MISP and STANAG can be found at www.gwg.nga.mil/misb.

All MISP and all STANAG 4609 compliant electro-optical (EO) MI systems shall decode all MPEG-2 transport streams with MPEG-2 compressed data types (Standard Definition, Enhanced Definition, High Definition) up to and including Level 9M, and all H.264 compressed data types up to and including Level 9H; however, each system may choose to ORIGINATE one, two or both data types. The Motion Imagery System Matrix (MISM) defines the supported Levels for EO directed by Recommended Practice (RP) 9720.

Similarly, all MISP and all STANAG compliant Infrared (IR) MI systems shall decode all MPEG-2 transport streams with MPEG-2 compressed data types up to and including Level 8M, and all H.264 compressed data types up to and including Level 8H; however, each system may choose to ORIGINATE one, two or both data types. The Infrared MI System Matrix (IRSM) defines the supported Levels for IR directed by Recommended Practice (RP) 0401.

Currently, no standards are defined for Multispectral or Hyperspectral imagery.

Highlights of the mandated standards in the MISP include:

For HD Sensors and Interface:

- MISB STANDARD 9710 (SMPTE 296M (720p HD); SMPTE 274M (1080p HD); Progressive only, no interlace)

- MISB STANDARD 9710 (SMPTE 292M)

For HD Compression:

- MISB STANDARD 9723 (ITU-T Rec. H.264 Main Profile at Level 4.0 Format; ISO/IEC 13818-1 (MPEG-2 Systems))

For Metadata:

- MISB STANDARD 0807 and MISB STANDARD 9712 (SMPTE 335M - KLV metadata)
- SMPTE RECOMMENDED PRACTICE 210 and SMPTE EG 37 (identify metadata elements encoded in digital motion imagery)
- MISB STANDARD 9713 (SMPTE 336M (KLV protocol))
- MISB STANDARD 0102 (Security Metadata Set)
- MISB STANDARD 0107
- MISB STANDARD 0601 (bit-efficient extensible SMPTE KLV Local Metadata Set, and a Minimum Metadata Set)

For Transport Protocol:

- MISB STANDARD 9723 (ISO/IEC 13818-1 (MPEG-2 Systems))
- MISB STANDARD 9701
- MISB STANDARD 9703
- MISB RECOMMENDED PRACTICE 9717
- MISB RECOMMENDED PRACTICE 0101

For Time Reference and Synchronization:

- MISB STANDARD 9708
- MISB STANDARD 9715
- MISB STANDARD 0604 (synchronous/asynchronous metadata carriage)
- MISB STANDARD 0603
- MISB STANDARD 0605

5.9 Future MI standards

Figure 5-4 graphically illustrates that the standardization of motion imagery continues as a work in process in some areas. This section describes the on-going activities that generate new potential standards, protocols, guidelines, and practices for inclusion in MISP. Anyone with a stake in the success of this area, ideas about what things are needed to help make motion imagery systems more interoperable, and the know-how to help turn these ideas into standards, etc., is welcome to participate.

The MISB works through a set of working groups that are responsible for developing the documents that make up the MISP. The current working groups are:

Advanced Compression Working Group (ACWG): Serves to identify and recommend commercially standardized motion imagery compression technologies for the DoD and the Intelligence Community.

Advanced Motion Imagery Working Group (AMIWG): Addresses advanced motion imagery as a key enabling technology and supports the development of advanced motion imagery

standards, Recommended Practices (RP) and Engineering Guidelines (EG) for advanced motion imagery collection, processing, exploitation, display and dissemination.

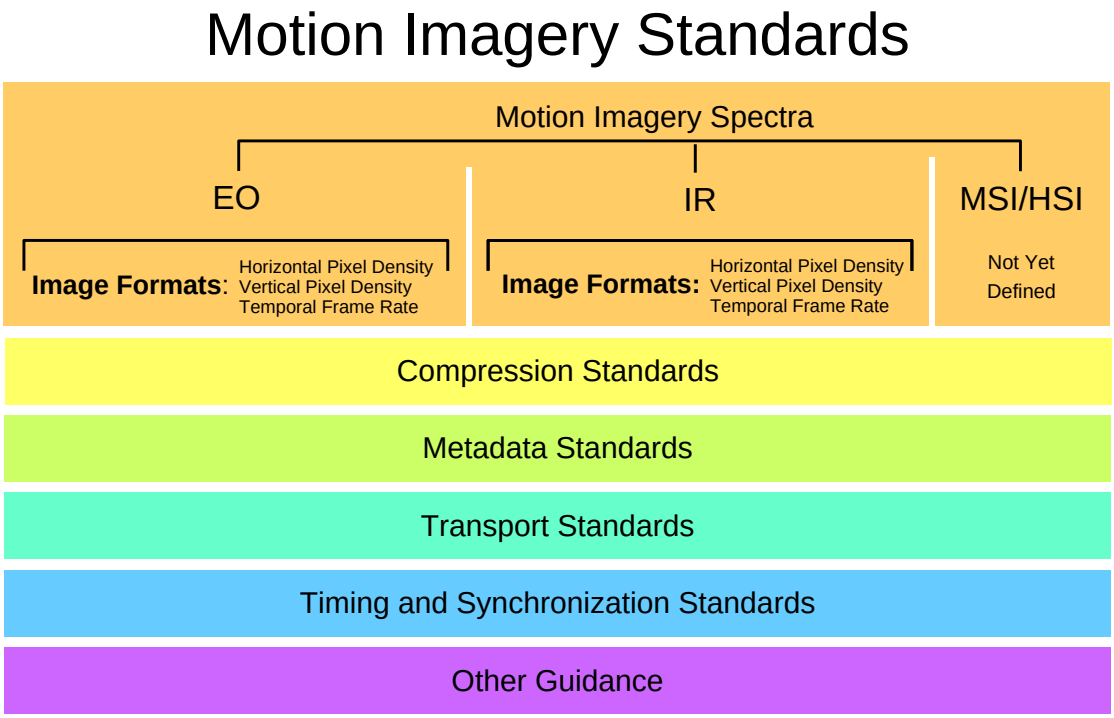

Figure 5-4: Current Standardization Work of the MISB

Format Working Group (FWG): Provides direction and leadership in the development of RPs and EGs for utilizing commercially available technologies and protocols to ensure suitability to and compliance with Community requirements

Interoperability Working Group (IWG): Develops and mediates RPs and EGs to help ensure interoperability of motion imagery systems and products in commercial and Government arenas for the DoD and Intelligence Communities.

Interpretability, Quality, and Metrics Working Group (IQMWG): The principal focus within the MISB for specific interpretability, quality and metrics (IQM) related issues.

Infrared Working Group (IRWG): Develops Standards and RPs that support infrared motion imagery collection, processing, exploitation and dissemination

Metadata Working Group (MWG): Develops RPs and EGs that foster metadata harmonization among motion imagery systems, leading to easily accessed, accurate motion imagery data that can be exploited by a wide range of users

Motion Imagery Tradecraft Working Group (MITWG): A collaborative government/industry working group focused on the challenges of collection, storing, retrieving,

processing and analyzing large volumes of motion imagery for the development of intelligence and for the support of military operations.

6 Appendices

Appendix A	**Motion Imagery Modalities** List of Standards, Interoperability Profiles, Recommended Practices, and Engineering Guidelines for DoD/IC/NSG Implementations for Electro Optical, Infrared, and LVSD Motion Imagery systems
Appendix B	**Audio** List of Audio Standards, Recommended Practices, and Engineering Guidelines for DoD/IC/NSG Implementations
Appendix C	**Metadata** List of Metadata Standards, Recommended Practices, and Engineering Guidelines for DoD/IC/NSG Implementations
Appendix D	**Transport Protocols and File Containers** List of Transport protocol and file container Standards, Recommended Practices, and Engineering Guidelines for DoD/IC/NSG Implementations
Appendix E	**Timing and Synchronization** List of timing and synchronization Standards, Recommended Practices, and Engineering Guidelines for DoD/IC/NSG Implementations
Appendix F	**Video NIIRS** List of Video NIIRS Standards, Recommended Practices, and Engineering Guidelines for DoD/IC/NSG Implementations
Appendix G	**Interoperability Profiles** List of Motion Imagery Interoperability Profiles for DoD/IC/NSG Implementations
Appendix H	**Technical Reference Material** Documents that provide additional informational implementation material on particular topics
Appendix I	**References and Bibliography**
Appendix J	**MISP Versions** Indicates Standards, Recommended Practices, and Engineering Guidelines that have been added or changed at identified MISP versions
Appendix K	**Revision Record** Record of changes to versions of the MISP

Appendix A Motion Imagery Modalities

Electro-Optical Motion Imagery Systems

Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSG Implementations

A-1 Motion Imagery System Matrix - MISM

All MISP compliant systems shall decode all MPEG-2 transport streams with MPEG-2 compressed data types (Standard Definition, Enhanced Definition, High Definition) up to and including Level 9M and all H.264 compressed data types up to and including Level 9H, but each system may choose to ORIGINATE one, two or all data types. Level 9 is defined in the Motion Imagery System Matrix (MISM) as found below. Likewise, all relevant Infrared MI systems shall decode all MPEG-2 transport streams with MPEG-2 compressed data types up to and including Level 8M and all H.264 compressed data types up to and including Level 8H, but each system may choose to ORIGINATE either compression type at whatever level it chooses. The levels of the Visible Motion Imagery System Matrix are found in RP 9720 below and those of the IR System Matrix are found in RP 0401.

A-1.1 RECOMMENDED PRACTICE 9720 - Motion Imagery System Matrix

The MISB Recommended Practice 9720 defines a "Motion Imagery Systems (Spatial and Temporal) Matrix" (MISM) for the simple identification of broad categories of Motion Imagery Systems. The matrix consists of "Levels" (MISM L0 to MISM L14, where MISM L14 defines the highest spatial and temporal resolution systems) that provide a common reference language to describe the fundamental technical capabilities of DoD/IC/NSG motion imagery systems. The Motion Imagery Systems Matrix includes technical specifications and related notes.

A Motion Imagery System Matrix - Level should only be applied to a single processing node of the end-to-end motion imagery chain, with the overall system specification equaling, at best case, the lowest motion imagery system processing node specification.

The MISM (RP 9720) is divided into six spatial/temporal bands as shown in Table A-1. The detailed tables for each RP and their accompanying Technical Notes provide technical specifications on the general performance of each MISM-L level. Please note that the technical parameters of the MISM-L sub-divisions are evaluated for adoption by the MISB.

RP	MISM-L	Description
9720a	14 - 12	Advanced High Definition Motion Imagery
9720b	11 - 9	High Definition Motion Imagery
9720c	8 - 6	Enhanced Definition Motion Imagery
9720d	5 - 3	Standard Definition Motion Imagery
9720e	2.2 - 1.0	Low Spatial/Temporal Definition Motion Imagery
9720f	0	Low Temporal Definition Motion Imagery

Table A-1: Motion Imagery System (Spatial /Temporal) Matrix-Levels (MISM-L)

(VWG, 10 July 1997 - adopted)(ISMC, 26 September 1997 - approved)(VWG, 8 June 1999, language revised and recommended to GSMC-ISMC for approval)(GSMC-ISMC, 12 August 1999 - approved)(27 July 2000 - editorial changes)(10 July 2006 - 9720e changes)(3 September 2009 - approved)

A-1.2 MISM Tables Glossary

Acquisition

Systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance.

Archiving

Storing or saving motion imagery to a data repository

Compression Ratio

Normal ranges specified. Uncompressed means no compression applied; TBD means To Be Determined.

Compression Profile Abbreviations

MP – Main Profile

HP – High Profile

Hi10P – High 10 Profile

Distribution

Motion Imagery that is disseminated to end users for display or consumption

Format

A still image is defined by its pixel density in the horizontal and vertical orientations. Motion imagery adds a third dimension called temporal. The three dimensions of H, V, and T define an images format.

Generation Resiliency

Rated as High for multiple generations of decompression/compression without artifacts; Medium for fewer generations (perhaps only one); and Low for no generations beyond first encoding.

Mezzanine Compression

A level of compression that preserves quality better than the compression levels typically used for final encoding. This allows the video to be processed and edited without degrading the final result.

Processing

Algorithms applied to the motion imagery that may be affected by artifacts introduced through compression. Such algorithms may also inadvertently contribute additional artifacts. Ideally, processing is best done on uncompressed, mezzanine, or high-quality compressed imagery.

A-1.3 RECOMMENDED PRACTICE 9720a - MISM, Advanced High Definition Motion Imagery

System Level	MISM		
	L14	L13	L12
Common Description/ Intended Application	Advanced High Definition (AHD) / Acquisition	Advanced HD / Processing / Archiving	Advanced HD / Distribution
System Attributes: Spatial Definition	Very High	Very High	Very High
System Attributes: Temporal Definition	Very High	Very High	Very High
System Attributes: Generation Resiliency	High	Medium	Low
Applicable Standard (Note: Other Profiles / Practices may apply)	TBD	TBD	TBD
Horizontal Resolution (Nominal)	≥ 1920	≥ 1920	≥ 1920
Vertical Resolution (Nominal)	≥ 1080p	≥ 1080p	≥ 1080p
Bit Depth (bits) (Nominal)	8 or 10 or 12	8 or 10 or 12	8 or 10 or 12
Frame Rate (FPS)	48 - 120	48 - 120	48 - 120
Compression Ratio (Nominal)	uncompressed	TBD	TBD
Data Rate (Nominal)	3 - 4 Gb/s	TBD	TBD
Data Rate Range	TBD	TBD	TBD
Candidate Transport Channel	OC-96-192	TBD	TBD
Allowed Transport Protocols	TBD	TBD	TBD
Preferred Transport Protocols	TBD	TBD	TBD

Table A-2: Advanced High Definition Motion Imagery (Study 9720a)

STUDY 9720a - MISM, Advanced High Definition Motion Imagery
Technical Notes

MISM-L14 Motion Imagery System Matrix Level 14 (MISM L14), Uncompressed Advanced High Definition Motion Imagery, is defined as including the following specific acquisition formats:

Resolution	Frame Rate	Aspect Ratio
1920 x 1080	60p, 50p	16:9
2048 x 1080	48p	1.896
1998 x 1080	48p	1.85
2048 x 858	48p	2.39

Note: PROGRESSIVE SCAN is required for advanced high definition DoD/IC/NSG Motion Imagery **acquisition** applications.

MISM-L13 Motion Imagery System Matrix Level 13 (MISM L13), Mezzanine Compression Advanced High Definition Motion Imagery is defined as any HD format of MISM-L14 using mild compression. MISM L13 is intended to describe Advanced HD signals that use mild compression to **process and transport** Advanced HD signals.

MISM-L12 Motion Imagery System Matrix Level 12 (MISM L12) is defined as any HD format of MISM L14/13 that is highly compressed for end-user (final link) **transport** delivery.

Note: While various pixel bit depths may be allowed under the standard, greater bit depths are preferred. For example, if allowed to choose 12-bit, 10-bit or 8-bits the 12-bit implementation is preferred.

(Recommend for study 8 June 1999)(27 July 2000 - editorially revised)(29 April 2005 - approved)(13 December 2007 approved)

A-1.4 RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery

System Level	MISM				
	L11	L10M	L10H	L9M	L9H
Common Description/ Intended Application	High Definition / Acquisition	High Definition / Processing / Archiving		High Definition / Distribution	
System Attributes: Spatial Definition	High	High		High	
System Attributes: Temporal Definition	Medium - High	Medium - High		Medium - High	
System Attributes: Generation Resiliency	High	Medium		Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 296M [34] Progressive modes of SMPTE 274M [29] SMPTE 295M [33] SMPTE 292M [31]	SMPTE 296M [34] Progressive modes of SMPTE 274M [29] SMPTE 295M [33] MPEG-2 MP@HL	SMPTE 296M [34] Progressive modes of SMPTE 274M [29] SMPTE 295M [33] H.264 MP@L4.1(8b) H.264 HP@L4.1 (8b) H.264 Hi10P@L4.1 (10b)	SMPTE 296M [34] Progressive modes of SMPTE 274M [29] SMPTE 295M [33] MPEG-2 MP@HL	SMPTE 296M [34], Progressive modes of SMPTE 274M [29] SMPTE 295M [33] H.264MP@L3.2 (720) H.264 MP@L4.0 H.264 HP@L4.0
Horizontal Resolution (Nominal)	1280 - 1920	1280 -1920		1280 - 1920	
Vertical Resolution (Nominal)	720p - 1080p	720p - 1080p		720p - 1080p	
Bit Depth (bits) (Nominal)	8 or 10	8	8 or 10	8	
Frame Rate (FPS)	24 - 60	24 - 60 (720p) 24 - 30 (1080p)		24 - 60 (720p) 24 - 30 (1080p)	
Compression Ratio (Nominal)	uncompressed	10:1	20:1	50:1	110:1
Data Rate (Nominal)	1.485 Gb/s	80 Mb/s	40 Mb/s	14 Mb/s	6 Mb/s
Data Rate Range	0.36 - 2.4 Gb/s	34 - 100 Mb/s	17 - 50 Mb/s	10 - 25 Mb/s	4.5 - 12 Mb/s (see EG 0904)
Candidate Transport Channel	SMPTE 292M [31] OC-48	SDI, E3, T3, OC-12	T3	TCDL, Half to Full T3, ATM	TCDL
Allowed Transport Protocols	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF
Preferred Transport Protocols	MXF Xon2	MXF Xon2	MXF Xon2	MXF Xon2	MXF Xon2

Table A-3: High Definition Motion Imagery (Recommended Practice 9720b)

A-1.5 RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery Technical Notes

MISM-L11 Motion Imagery System Matrix Level 11 (MISM L11), Uncompressed High Definition Motion Imagery, is defined as including the following specific acquisition formats:

Resolution	Frame Rate	Aspect Ratio
1920 x 1080	30p, 25p, 24p	16:9
1280 x 720	60p, 50p, 30p, 25p, 24p	16:9

Note 1: Only PROGRESSIVE SCAN formats are authorized for high definition DoD/IC/NSG Motion Imagery **acquisition** applications

Note 2: Two systems are not recommended: 1920x1080i30 (60 fields-per-second interlaced) and 1920x1080i25 (50 fields-per-second interlaced), but may be considered for end-user display systems in non-critical applications.

MISM-L10 Motion Imagery System Matrix Level 10 (MISM L10), Mezzanine Compression High Definition Motion Imagery is defined as any HD format of MISM L11 using mild compression to **transport** and **process** HD signals using, for example, a SMPTE 259M serial data interface (SDI). Note that H.264 can deliver a lower data rate at the equivalent motion image quality over MPEG-2. H.264 MISM-L4.1 can be used for data rates to 50 Mb/s. The H.264 High profile is recommended for 10- and 12- bit motion imagery.

MISM-L9 Motion Imagery System Matrix-Level 9 (MISM L9) is defined as any HD format of MISM L11/10 that is highly compressed to end-user (final link) **transport** delivery, such as the ATV transport delivery system in the US. MISM L9 may also include other transport delivery systems used by US Treaty partners. Note that H.264 can deliver a lower data rate at the equivalent motion image quality over MPEG-2. H.264 MISM L4.0 can be used for data rates up to 20 Mb/s. The H.264 High profile is recommended for 10- and 12- bit motion imagery.

Note 3: When the bandwidth of a delivery system does not support the compressed data rate, use MISB EG 0904 as a guide to optimize the image format and data rate for the given channel bandwidth.

Note: While various pixel bit depths may be allowed under the standard, greater bit depths are preferred. For example, if allowed to choose 12-bit, 10-bit or 8-bits the 12-bit implementation is preferred.

(VWG, 25 February 1998 - approved as amended)(ISMC, 6 March 1998 - approved)(VWG, 8 June 1999, language revised and recommended to GSMC-ISMC for Approval)(GSMC-ISMC -12 August 1999 - approved)(MISB, 27 July 2000 - MISB Standard recommended and editorially revised)(20 November 2003 - approved)(9 December 2004 - MISB approved)(13 December 2007 - approved)(3 September 2009 - approved)

A-1.6 RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery

System Level	MISM				
	L8	L7M	L7H	L6M	L6H
Common Description/ Intended Application	Enhanced Definition (ED) / Acquisition	Enhance Definition / Processing / Archiving		Enhanced Definition / Distribution	
System Attributes: Spatial Definition	Enhanced	Enhanced		Enhanced	
System Attributes: Temporal Definition	Medium - High	Medium - High		Medium - High	
System Attributes: Generation Resiliency	High	Medium		Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	ITU-R BT.1358 [44] SMPTE 294M [32]	ITU-R BT.1358 [44] SMPTE 294M [32] MPEG-2 MP@HL	ITU-R BT.1358 [44] SMPTE 294M [32] H.264 MP@L3 (L3.1 > 30 FPS)	ITU-R BT.1358 [44] SMPTE 294M [32] MPEG-2 MP@HL	ITU-R BT.1358 [44] SMPTE 294M [32] H.264 MP@L3 (L3.1 > 30 FPS)
Horizontal Resolution (Nominal)	640 - 1024	640 - 1024	640 - 1024	640 - 1024	640 - 1024
Vertical Resolution (Nominal)	480p - 576p	480p - 576p	480p - 576p	480p - 576p	480p - 576p
Bit Depth (bits) (Nominal)	8 or 10	8	8	8	8
Frame Rate (FPS)	24 - 60	24 - 60	24 - 60	24 - 60	24 - 60
Compression Ratio (Nominal)	uncompressed	10:1	20 :1	50:1	110 :1
Data Rate (Nominal)	360 Mb/s	25 Mb/s	12 Mb/s	5 Mb/s	2 Mb/s
Data Rate Range	135 - 540 Mb/s	10 - 50 Mb/s	5 - 14 Mb/s	2 - 10 Mb/s	1 - 5 Mb/s (see EG 0904)
Candidate Transport Channel	SDI, OC-12	T3, ATM	T3, ATM	GBS, ATM	GBS, ATM
Allowed Transport Protocols	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF
Preferred Transport Protocols	MXF Xon2	MXF Xon2	MXF Xon2	MXF Xon2	MXF Xon2

Table A-4: Enhanced Definition Motion Imagery (Recommended Practice 9720c)

A-1.7 RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery Technical Notes

MISM-L8 Motion Imagery System Matrix-Level 8 (MISM-L8), Uncompressed Enhanced Definition Motion Imagery, is defined as digital progressive 480-line and 576-line **acquisition** formats at 24 to 60 frames per second.

Note 1: MISM-L8 can be considered to yield a good combination of improved spatial and temporal resolution capabilities at minimal increased costs as compared to today's broadcast quality digital interlace (ITU-R BT.601 [23]) systems.

MISM-L7 Motion Imagery System Matrix-Level 7 (MISM L7), Mezzanine Compression Enhanced Definition Motion Imagery is defined as any ED format of MISM-L8 using mild compression. Note that H.264 can deliver a lower data rate at the equivalent motion image quality over MPEG-2. H.264 MISM L3.0 can be used for frame rates up to 30 Hz. H.264 MISM L3.1 must be used for frame rates above 30 Hz.

MISM-L6 Motion Imagery System Matrix Level 6 (MISM L6) is defined as any ED format of MISM L8/7 that is highly compressed to end-user (final link) **transport** delivery systems. MISM L6 includes transport delivery systems used by US Treaty partners. Note that H.264 can deliver a lower data rate at the equivalent motion image quality over MPEG-2. H.264 MISM L3.0 can be used for frame rates up to 30 Hz. H.264 MISM L3.1 must be used for frame rates above 30 Hz.

Note 2: When the bandwidth of a delivery system does not support the compressed data rate, use MISB EG 0904 as a guide to optimize the image format and data rate for the given channel bandwidth.

Note 3: MISM-L6 has the advantages of: progressive scan, bandwidth efficiency, higher vertical resolution, and lack of interlaced artifacts compared to standard definition television (MISM L3 - MISM L5).

(VWG, 25 February 1998 - approved as amended)(ISMC, 6 March 1998 - approved)(VWG, 8 June 1999, language revised and recommended to GSMC-ISMC for approval)(GSMC-ISMC, 12 August 1999 - approved)(27 July 2000 - editorially revised)(20 November 2003 - approved)(8 April 2004 - MISB approved)(13 December 2007 - approved)(3 September 2009 - approved)

A-1.8 RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery

System Level	MISM				
	L5	L4M	L4H	L3M	L3H
Common Description/ Intended Application	Standard Definition / Acquisition	Standard Definition / Processing / Archiving		Standard Definition / Distribution	
System Attributes: Spatial Definition	Standard	Standard		Standard	
System Attributes: Temporal Definition	Standard	Standard		Standard	
System Attributes: Generation Resiliency	High	Medium		Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	ITU-R BT.601 [23] SMPTE 259M [28] (4:2:2)	MPEG-2 MP@ML	H.264 MP@L3	MPEG-2 MP@ML	H.264MP@L3
Horizontal Resolution (Nominal)	640 - 720	640 - 720	640 - 720	640 - 720	640 - 720
Vertical Resolution (Nominal)	480i - 576i	480i - 576i	480i - 576i	480i - 576i	480i - 576i
Bit Depth (bits) (Nominal)	8 or 10	8	8	8	8
Frame Rate (FPS)	24 - 60	24 - 30	24 - 30	24 - 30	24 - 30
Compression Ratio (Nominal)	1:1(uncompressed) to 2.5:1	5.5:1 - 10:1	10 - 20:1	40:1	83:1
Data Rate (Nominal)	270 Mb/s	15 Mb/s	8 Mb/s	4 Mb/s	2 Mb/s
Data Rate Range	270 - 360 Mb/s	10 - 30 Mb/s	5 - 10 Mb/s	2 - 10 Mb/s	1.0 - 5 Mb/s
Candidate Transport Channel	SDI, OC-12	Half to Full T3, TCDL, ATM	Half to Full T3, TCDL, ATM	GBS, T2, ATM, DVD	GBS, T2, ATM, DVD
Allowed Transport Protocols	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF	Xon2 MXF/AAF
Preferred Transport Protocols	MXF Xon2	MXF Xon2	MXF Xon2	MXF Xon2	MXF Xon2

Table A-5: Standard Definition Motion Imagery (Recommended Practice 9720d)

A-1.9 RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery Technical Notes

MISM-L5 Motion Imagery System Matrix-Level 5 (MISM-L5), Uncompressed Standard Definition Motion Imagery, is defined as uncompressed, 4:2:2 digital interlace motion imagery, including 720x 480 (to 576) x 24-60 or ITU-R BT.601 [23] (4:2:2) Component Video. Note that while both 10 bit and 8 bit implementations are allowed under MISM L5, 10 bit implementations are preferred. Note that storage systems (such as some digital motion imagery tape formats) that use bit-serial interface 4:2:2 input/output protocols but use 2.5:1 (near lossless) internal compression will be considered as meeting MISM L5. Furthermore, all primary routing and distribution hardware systems must comply with SMPTE 259M [28] Level C and D (270/360 Mb/s) implementations to meet MISM L5. Users are cautioned that true uncompressed processing may be required for the most demanding MISM L5 applications.

MISM-L4 Digital MPEG-2 compressed motion imagery, with no more than 10:1 compression and H.264 with no more than 20:1 compression defines MISM L4. Note that 10:1 compression compliant MPEG-2 Main Profile @ Main Level based systems meet MISM L4 and 20:1 compression compliant H.264.

MISM-L3 Digital 4:2:0, MPEG-2 compressed motion imagery, with no more than 28:1 compression, and H.264 compressed motion imagery with no more than 56:1 compression. Note that both these systems are anticipated to meet MISM L3.

(VWG, 10 July 1997 - adopted)(ISMC, 26 September 1997 - approved)(VWG, 19 Nov 1997 - approved as amended) (VWG, 25 February 1998 - approved as amended)(ISMC, 6 March 1998 - approved)(VWG, 8 June 1999, language revised and recommended to GSMC-ISMC for approval)(GSMC-ISMC, 12 August 1999 - approved)(27 July 2000 - editorially Revised)(12 June 2003 - edited to reflect MP@ML)(8 April 2004 - approved)(13 December 2007-approved)(3 September 2009 - approved)

A-1.10 RECOMMENDED PRACTICE 9720e - MISM, Low Bandwidth Motion Imagery

System Level	MISM							
	L2.2H	L2.1H	L2.1M	L2.0M	L1.3H	L1.2H	L1.1H	L1.0H
Common Description/ Intended Application	Medium / Distribution	Low-Medium / Distribution		Low / Distribution	Low / Distribution	Very Low / Distribution	Very Low / Distribution	Lowest / Distribution
System Attributes: Spatial Definition	Medium	Low - Medium		Low	Low	Low	Low	Very Low
System Attributes: Temporal Definition	Medium	Medium		Medium	Medium	Low	Very Low	Low
System Attributes: Generation Resiliency	Low	Low		Very Low	Very Low	Very Low	Very Low	Lowest
Applicable Standard (Note: Other Profiles /Practices may apply)	H.264 L2.2	H.264 L2.1	MPEG2 MP@ML	MPEG-1	H.264 L1.3	H.264 L1.2	H.264 L1.1	H.264 L1.0
Horizontal Resolution (Nominal)	640 - 720	320 - 352		320 - 352		320 - 352		160 - 176
Vertical Resolution (Nominal)	480 - 576	480 - 576		480 - 576	240 - 288p	240 - 288p		120 - 144p
Bit Depth (bits) (Nominal)	8	8		8		8		8
Frame Rate (FPS)	24 - 30	24 - 30		24 - 30		12 - 15	6 - 7	12 - 15
Compression Ratio (Nominal)	110:1	83:1	55:1	83:1	83:1	83:1	83:1	166:1
Data Rate (Nominal)	1.5 Mb/s	1.0 Mb/s	1.5 Mb/s	1.0 Mb/s	512 Kb/s	256 Kb/s	128 Kb/s	32 Kb/s
Data Rate Range (Kbits/s)	1,024 -1,500	768 - 1,024	1,024 - 1,500	768 - 1,024	384 - 768	192 - 384	56 - 192	< 56
Candidate Transport Channel (Nominal	T1/ E1	T1/ E1		T1/ E1	Partial T1/E1	Wireless	Wireless	Wireless
Allowed Transport Protocols	Xon2	Xon2		Xon2	Xon2 RTP/RTSP	Xon2 RTP/RTSP	Xon2 RTP/RTSP	Xon2 RTP/RTSP
Recommended Transport Protocols	Xon2	Xon2		Xon2	RTP/RTSP	RTP/RTSP	RTP/RTSP	RTP/RTSP

Table A-6: Low Bandwidth Motion Imagery (Recommended Practice 9720e)

A-1.11 RECOMMENDED PRACTICE 9720e - MISM, Low Bandwidth Motion Imagery Technical Notes

MISM-L2.2 *and below* Recommended Practice 9720e is defined for use in low bandwidth situations where the objective is situational awareness and a compromise in image quality can be tolerated. Some situational awareness scenarios, such as following a person running in a forest, may yield poor results using RP 9720e: in this case the user should operate at a higher MISM level. Baseline, Main, or High Profile of ITU-T Rec. H.264 [65] can be used for RP 9720e.

MISM-L2 Includes H.264 MISM L2.1 and MISM L2.2. Digital MPEG-2 (half-horizontal resolution using Adaptive Field/Frame techniques) or MPEG-1 compressed video using SIF image resolution decimation at 25-30 FPS temporal rate can be used for MISM L2. MISM L2.0 using MPEG-1 is included for legacy purposes. H.264 will provide image quality equal to MPEG-2 at less than half the data rate. Therefore, the preferred compression method for MISM L2.1 and MISM L2.2 is H.264, which will yield higher quality motion imagery at these data rates. The following data rates are recommended for H.264:

- 1,024 - 1,500 kb/s: MISM L2.2; full resolution; 24-30 FPS
- 768 - 1,024 kb/s: MISM L2.1; half-horizontal resolution; 24-30 FPS

MISM-L1 H.264 is expected to meet the requirements for MISM-L1. Digital MPEG-2 (4:2:0, using Adaptive Field Frame techniques) and MPEG-1 at SIF resolutions are not usable at these data rates. The following data rates are recommended for H.264:

- 384 - 768 kb/s: MISM L1.3 at CIF[1], SIF[2] or QVGA[3] resolution and 24-30 fps
- 192 - 384 kb/s: MISM L1.2 at CIF, SIF, or QVGA resolution and approximately 12-15 fps
- 56 - 192 kb/s: MISM L1.1 at CIF, SIF, or QVGA resolution and approximately 6-7 fps
- Less than 56 kb/s: MISM L1.0 at QCIF[4], QSIF[5], or QQVGA[6] resolution and 5-15 fps

(VWG, 26 March 1997 - approved for study)(27 July 2000 - editorially revised)(21 November 2002 - added H.264)(12 June 2003 - H.264 adopted)(20 November 2003 - approved)(29 April 2005 - approved)(25 August 2005 - amended - MISM approved)(13 December 2007 - approved)(3 September 2009 - approved)

---

[1] 352 x 288
[2] 352 x 240
[3] 320 x 240
[4] 176 x 144
[5] 176 x 120
[6] 160 x 120

A-1.12 RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Definition Motion Imagery

System Level	MISM
	L0
Common Description/ Intended Application	Very Low Temporal Motion Imagery /
System Attributes: Spatial Definition	High
System Attributes: Temporal Definition	Very Low
System Attributes: Generation Resiliency	Variable
Applicable Standard (Note: Other Profiles / Practices may apply)	NITF
Horizontal Resolution (Nominal)	720 - 1920
Vertical Resolution (Nominal)	480 - 1080
Bit Depth (bits) (Nominal)	8 or 10 or12
Frame Rate (FPS)	Still - 2 FPS
Compression Ratio (Nominal)	10:1
Data Rate (Nominal)	256 Kb/s
Data Rate Range	56 - 512 Kb/s
Candidate Transport Channel	Non Real Time POTS, ISDN

Table A-7: Very Low Temporal Motion Imagery (Recommended Practice 9720f)

A-1.13 RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Motion Imagery Technical Notes

MISM-L0 Low temporal rate motion imagery based on digital video sources using full MISM L11/8/5 spatial resolution, but having very limited temporal resolution (on the order of stills to 1 or 2 FPS). At these low temporal rates, the imagery is no longer considered to be video (thus the motion imagery nomenclature). MISM L0 is intended to describe applications where the most severe bandwidth limitations preclude delivery of true motion video. For these very low bandwidth applications, systems should deliver full spatial resolution, but may need to severely decimate temporal data down to still frames (and delivering such frames in non-real-time, based on the data rate capacity of the delivery channel). For the specific cases of still imagery derived from video sources, such imagery shall be formatted to conform to NITF standards (see PROFILE 9706 - Video Image Still Frames).

(VWG, 26 March 1997 - approved for study)(VWG, 25 February 1998 - approved as amended)(ISMC, 6 March 1998 - approved)(27 July 2000 - editorially revised)

A-2 Migration to Digital

A-2.1 STANDARD 9709 - Use of Closed Captioning for Core Metadata Analog Video Encoding

CEA-608-B [6] (Data Services), commonly known as closed captioning, shall be the DoD/IC/NSG STANDARD for legacy system analog video, vertical interval metadata encoding using video line 21. Per DoD direction, DoD and other applicable systems using closed captioning shall separate the line 21 data from the analog video, convert into a digital signal, and encrypt it.

Note that any such analog video system data encoding is to be considered for legacy analog systems and may also be implemented by new systems for redundancy. New systems shall also conform to all applicable digital motion imagery, audio, and metadata protocols specified in the MISP.

MISP Standard 9711 shall be the basis for Geospatial metadata descriptions for DoD/IC/NSG systems using Closed Captioning (until replaced by future Motion Imagery Standards Profiles).

MISP Standard 9714 shall be the basis for time references for analog video vertical interval data. Therefore, MISB Standard 9709 implementations should not be burdened with duplicate time reference data.

Furthermore, to facilitate universal inter-operability, DoD/IC/NSG users are encouraged to submit recommended implementations for analog closed captioning systems for consideration and inclusion in this Motion Imagery Standards Profile document by the MISB as numbered Recommended Practices.

(VWG, 16 Jan 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(3 September 2009 - approved)

A-2.2 STANDARD 9719 - Analog Video Migration

All DoD/IC/NSG motion imagery production systems that currently use SMPTE 170M [27] analog video waveforms (also known as RS-170A) <u>should convert</u> to ITU-R BT.601 [23] component (4:2:2) digital sampling structure as soon as practical.

Furthermore, all new digital baseband motion imagery system production sampling structures shall conform to ITU-R BT.601 component (4:2:2) sampling structures.

Furthermore, unique mission systems with legacy analog video waveforms <u>should convert</u> such analog video waveforms to ITU-R BT.601 component (4:2:2) sampling structures as soon as possible in the signal processing chain, with no processing node backwards conversions to analog waveforms allowed.

In addition, systems shall output the original video <u>without burned-in metadata</u>. This requirement also applies to digital systems.

(VWG, 26 March 1997 - approved for study)(VWG, 19 November 1997 - approved) (15 May 2008 - approved)

A-3 High Definition Motion Imagery

A-3.1 STANDARD 9703 - Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing

SMPTE 292M [31] high definition (1.5 Gb/s Bit-Serial Interface) and SMPTE 424M [86] (3 Gb/s) shall be the uncompressed baseband signal transport and processing DoD/IC/NSG STANDARD for digital motion imagery, audio and metadata origination, system interface, production / analysis center processing and manipulation.

Note:The "Connector Type" specification given in SMPTE 259M [28], Section 4, or 292M recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSG users, such physical connections and cable types can be Recommended Practices, not Standards. (Flexibility to use connectors other than BNC is given to accommodate operational directives, which do not allow BNC connectors in aircraft systems.)

(VWG, 26 March 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised) (GSMC-ISMC, 6 March 1998 - approved)(VWG, 8 June 1999 - language editorially revised)(GSMC-ISMC, 12 August 1999 - approved as amended)

A-3.2 STANDARD 9710 - High Definition Television Systems (HDTV)

SMPTE Standard 296M [34] shall define the DoD/IC/NSG STANDARD motion imagery sampling structure for progressively scanned digital high definition systems based on 720 vertical scanning lines. The standard incorporates multiple frame rates such as 24, 25 and 50 Hz. The parallel connector interface defined for SMPTE 296M shall not be used if bit-serial interfaces are available. The color components are specified in SMPTE 296M. Note that the color specification for high definition is not the same as that for standard definition.

SMPTE 292M [31] shall define the DoD/IC/NSG STANDARD for bit-serial interfaces for high definition television systems, including by specific reference SMPTE 296M.

SMPTE 274M [29] (progressive only) shall define the DoD/IC/NSG STANDARD motion imagery sampling structures for progressively scanned digital high definition systems based on 1080 vertical scanning lines.

Note: Only progressive scan shall be used for origination of high definition motion imagery for DoD/IC/NSG applications.

(VWG, 25 February 1998 - approved) (ISMC, 6 March 1998 - approved) (MISB, 27 July 2000 - submitted)(02 November 2000 GSMC-ISMC approved)(MISB, 7 February 2001- SMPTE 296M-2001 adopted; 01 March 2001 GSMC-ISMC approved)(MISB, 9 December 2004 - added progressive only)

A-3.3 STANDARD 9723 - Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems

ISO/IEC 13818-1 [16] (Systems), 2 [17] (Video) (commonly known as MPEG-2) "High Level," which defines a broad family of high definition video compression capabilities, shall be the DoD/IC/NSG STANDARD for compressed high definition advanced television and motion imagery, with the following PROFILE specifications:

> The MPEG-2, Main Profile (4:2:0) High Level (MP@HL), shall be the high definition motion imagery compression PROFILE for DoD/IC/NSG origination, acquisition,

production, manipulation, exploitation, and end-user motion imagery product distribution, including real-time wide area transmissions.

Originators may also output ITU-T Rec. H.264 [65] (Baseline, Main, or High Profiles). Decoders shall support ITU-T Rec. H.264 [65] (Baseline, Main, and High Profiles). See A-1 for decoder requirements. See RP 9720b for further guidance.

Receivers for use in other world regions will need to consider terrestrial broadcast standards for that area. Furthermore, to promote universal interoperability, DoD/IC/NSG high definition advanced television and motion imagery RECEIVING systems must be able to decode, process and display all the diverse sampling structures and temporal rates within the MPEG-2 High Level profiles specified above, where the systems may either display the received signal in its native format or the signals may be re-formatted to the highest common progressive format supported by the system. The following specific motion imagery sampling formats and temporal rates are noted as a mandatory sub-set under the broader MPEG-2 High Level receiver umbrella:

Resolution	**Frame Rate**	**Aspect Ratio**
1920 x 1080	30p, 30p/1.001, 30i, 30i/1.001, 25p, 25i, 24p	16:9
1280 x 720	60p, 60p/1.001, 50p, 30p, 30p/1.001, 25p, 24p	16:9
720 x 576	50p, 25p, 25i, 24p	16:9 or 4:3
720 x 480 (483)	60p, 60p/1.001, 30p, 30p/1.001, 30i, 30i/1.001, 24p, 24p/1.001	16:9 or 4:3
640 x 480	60p, 60p/1.001, 30p, 30p/1.001, 24p, 24p/1.001	4:3

Note 1: For future enhancement and migration options, the following additional formats should be decoded by DoD/IC/NSG MP@HL receiving systems, where the systems may either display the received signal in its native format or the signals may be re-formatted to the highest common progressive format supported by the display (See SMPTE 274 [29]):

Resolution	**Frame Rate**	**Aspect Ratio**
1920 x 1080	60p, 60p/1.001, 50p	16:9

Furthermore, DoD/IC/NSG high definition advanced television and motion imagery **ORIGINATION, ACQUISITION, PRODUCTION, MANIPULATION**, and or **PROCESSING** systems must generate at least one of the following sampling formats and its associated temporal rates:

For High Definition applications:

Resolution	**Frame Rate**	**Aspect Ratio**
1280 x 720	60p, 50p, 30p, 25p, 24p	16:9
1920 x 1080	30p, 25p, 24p	16:9

Note 2: For future enhancement and migration options, 1080 progressive scan formats (50p/60p) are included as future objectives for high definition motion imagery applications, when more commercially available. Therefore, 1080 50p/60p systems are not yet mandated. The MISB will continue to periodically evaluate the availability of 1080 progressive scan format systems for future consideration.

Note 3: Dual mode interlaced and progressive scan systems are authorized under this MISP profile, if for DoD/IC/NSG applications, 1) only the progressive scan mode shall be used and 2) if the progressive scan mode is derived from a native progressive capture and is not derived from an interlaced image capture.

For Standard Definition applications:

Resolution	**Frame Rate**	**Aspect Ratio**
720 x 576	50p, 25p, 25i, 24p	16:9 or 4:3
720 x 480 (483)	60p, 30p, 30i, 30i/1.001, 24p	16:9 or 4:3
640 x 480	60p, 50p, 30p, 25p, 24p	4:3

Note 4: 720 horizontal pixels are the standard width for DoD/IC/NSG standard and enhanced definition program origination and processing. DoD/IC/NSG systems shall not originate or process imagery content using 704 horizontal pixels.

(VWG, 25 February 1998 - approved as amended)(ISMC, 6 March 1998 - approved)

A-4 Enhanced Definition Motion Imagery

A-4.1 STANDARD 9811 - Progressively Scanned Enhanced Definition Digital Motion Imagery

ITU-R BT.1358 [44] shall define the DoD/IC/NSG STANDARD motion imagery sampling structure for progressively scanned, digital enhanced definition motion imagery systems. Parallel connector interfaces shall not be used if bit-serial interfaces are available.

Furthermore, while both 10 bit and 8 bit implementations are allowed under the standard, 10 bit implementations are preferred.

(VWG, 25 February 1998 - approved)(ISMC, 6 March 1998 - approved)(MISB, 24 May 2001, BT.1358 replaces SMPTE 293M)(21 November 2002 - revised)

A-4.2 STANDARD 0201 - Uncompressed Enhanced Motion Imagery Baseband Signal Transport

SMPTE 349M [62] “Transport of Alternate Source Image Formats through SMPTE 292M” defines the uncompressed baseband signal transport of 525-line interlaced, 525-line progressive, 625-line interlaced, and 625-line progressive scan source formats through SMPTE 292M, the bit-serial digital interface for high-definition television systems.

(21 November 2002 - adopted)

A-4.3 STANDARD 0202 - Compressed Enhanced Definition Advanced Television (ATV) and Associated Motion Imagery Systems

If compression is needed, ISO/IEC 13818-1 [16] (Systems), -2 [17] (Video) (commonly known as MPEG-2) “High Level,” which defines a broad family of enhanced and high definition video compression capabilities, shall be the DoD/IC/NSG STANDARD for compressed enhanced definition motion imagery, with the following PROFILE specification:

> The MPEG-2, Main Profile High Level (MP@HL) shall be the enhanced definition motion imagery compression PROFILE for DoD/IC/NSG origination, acquisition, production, manipulation, exploitation, distribution and archiving.

Originators may also output ITU-T Rec. H.264 [65] (Baseline, Main, or High Profiles). Decoders shall support ITU-T Rec. H.264 [65] (Baseline, Main, and High Profiles). See A-1 for decoder requirements. See RP 9720c for further guidance.

A-4.4 SMPTE 292M, Television - Bit-Serial Digital Interface for High-Definition Television Systems

SMPTE 292M [31] is the DoD/IC/NSG STANDARD for Enhanced Definition digital motion imagery, audio and metadata bit serial interface for origination, system interface, production/analysis center processing and manipulation.

(21 November 2002 - adopted)

A-5 Standard Definition Motion Imagery

A-5.1 STANDARD 9601 - Standard Definition Digital Motion Imagery, Compression Systems

The 1996 the Video Working Group adopted MPEG-2 as the approved motion imagery compression format, which is hereby superseded by a more detailed specification:

ISO/IEC 13818-1, 2, 3, 4 [16-19] (commonly known as MPEG-2) shall be the DoD/IC/NSG STANDARD for all standard definition compressed motion imagery, with the following PROFILE specifications:

> The "MPEG-2, Main Profile @ Main Level" (MP @ ML) shall be the standard definition motion imagery compression PROFILE for DoD/IC/NSG origination, acquisition, production, manipulation, exploitation, and end-user motion imagery product distribution, including real-time wide area transmissions.

ITU-T Rec. H.264 [65] shall be the standard for applications constrained by low bandwidth channels (typically less than 1 Mb/s that may not be adequately supported by MPEG-2). The MISP also allows the use of H.264 for higher bandwidth applications. See Motion Imagery System Recommended Practice 9720 and A-1 for guidelines on the use of MPEG-2 and H.264.

Note: See Motion Imagery System Recommended Practice 9902 for guidelines concerning other digital motion imagery compression formats (such as DV).

(ISMC, 6 March 1998 - approved)(VWG, 21 January 1999 - language editorially revised)(GSMC-ISMC, 12 August 1999 - approved as amended)(21 November-revised)(12 June 2003 - approved ITU-T Rec. H.264 for low bandwidth applications)(3 September 2009 - approved)

A-5.2 STANDARD 9702 - Standard Definition Digital Motion Imagery Sampling Structure

ITU-R BT.601[23] Component (4:2:2) Digital Video shall be the DoD/IC/NSG STANDARD sampling structure for baseband (uncompressed) standard definition motion imagery signals. The color components are specified in the above document. Note that the color specification for standard definition is not the same as that for high definition.

Furthermore, while both 10 bit and 8 bit implementations are allowed under the standard, 10 bit implementations are preferred.

(VWG, 26 March 1997 - adopted as amended)(ISMC, 12 June 1997 – approved)(VWG, 25 February 1998 - language editorially revised)(ISMC, 6 March 1998 - approved)

A-5.3 STANDARD 9703 - Digital Motion Imagery Uncompressed Baseband Signal Transport and Processing

SMPTE 259M [28] (4:2:2) standard definition (270-360 Mb/s Serial Digital Interface - SDI) and SMPTE 292M [31] high definition (1.5 Gb/s Bit-Serial Interface) shall be the uncompressed baseband signal transport and processing DoD/IC/NSG STANDARDS for digital motion imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

Furthermore, all DoD/IC/NSG standard definition primary routing and distribution motion imagery hardware systems must comply with SMPTE 259M Levels C and D (270/360 Mb/s)

implementations (270/360 Mb/s data rates allow routing and distribution systems to pass both 4:3 and 16:9 aspect ratio digital motion imagery signals).

Furthermore, within SDI or bit-serial interfaces, one AES3 audio channel (one stereo pair) shall be reserved for mission audio (such as narration); one AES3 audio channel (one stereo pair) shall be reserved for mission metadata encoding.

Furthermore, as much ancillary data (separate from the AES3 requirements above) as possible shall be reserved for metadata encoding.

Furthermore, bit-serial interfaces shall be the DoD/IC/NSG STANDARD protocol for compression system input signals and decompression system outputs when further processing is required.

Note:The "Connector Type" specification given in SMPTE 259M, Section 4, or 292M recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSG users, such physical connections and cable types can be Recommended Practices, not Standards. (Flexibility to use connectors other than BNC is given to accommodate operational directives, which do not allow BNC connectors in aircraft systems.)

(VWG, 26 March 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised)(GSMC-ISMC, 6 March 1998 - approved)(VWG, 8 June 1999 - language editorially revised)(GSMC-ISMC, 12 August 1999 - approved as amended)(20 November 2003 - approved)

A-5.4 STANDARD 9704 - Digital Motion Imagery, Compression Conversions

ITU-R BT.601 [23] shall be the transitional sampling structure, compression conversion and processing DoD/IC/NSG STANDARD for standard definition digital motion imagery, audio and metadata, where the input compressed motion imagery stream shall be uncompressed into ITU-R BT.601 component (4:2:2) baseband video sampling structure (within bit-serial interface input/output signal processing equipment) and then shall be re-compressed into the target compression format.

Note 1: For guidelines on use of multiple compression-conversion cycles see Motion Imagery System Recommended Practice 9720.

Note 2: The "Connector Type" specification given in SMPTE 259M [28], Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSG users, such physical connections and cable types can be Recommended Practices, not Standards.

(VWG, 26 March 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised)(GSMC-ISMC, 6 March 1998 - approved)

A-5.5 STANDARD 9705 - Standard Definition Digital Motion Imagery, Format Conversions

ITU-R BT.601 [23] shall be the transitional sampling structure, format conversion and processing DoD/IC/NSG STANDARD for standard definition digital motion imagery, audio and metadata, where the input video format is converted into ITU-R BT.601 component (4:2:2) baseband video (within bit-serial interface input/output signal processing equipment) and is then re-formatted into target formats (such as 625-line component systems).

Note 1: The "Connector Type" specification given in SMPTE 259M [28], Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSG users, such physical connections and cable types can be Recommended Practices, not Standards.

Note 2: This format conversion is intended to facilitate equipment interoperability between 525i30 (American) and 625i25 (NATO and Treaty Partner) motion imagery systems, where the SDI bit-serial interface has been designed for common digital motion imagery parameters wherever practical.

(VWG, 16 Jan 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised)(ISMC, 6 March 1998 - approved)

A-5.6 STANDARD 9707 - Standard Definition Digital Motion Imagery Tape Recorder, Digital Motion Imagery Servers, and Similar Systems Input / Output Protocol

SMPTE 259M [28] shall be the DoD/IC/NSG STANDARD motion imagery input/output protocol for standard definition digital videotape recorder, digital motion imagery servers, and similar systems.

Note 1: The "Connector Type" specification given in SMPTE 259M, Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSG users, such physical connections and cable types can be Recommended Practices, not Standards.

Furthermore, "fiber channel" input/output protocols may be considered for digital motion imagery tape recorders, digital motion imagery servers, and similar systems provided such systems also have bit-serial interfaces available.

Furthermore, IEEE 1394 [14] input/output protocols may be considered for digital motion imagery sensors, tape recorders, servers, and similar systems. In particular, IIDC 1394-based Digital Camera Specification Version 1.31 Format_0 Mode_3 may be considered for 640x480 YUV, Format_1 Mode_0 may be considered for 800x600 YUV and Format_0 Mode_6 for 640x480 IR. See Study 0501.

Note 2: IEEE 1394 defines a transport channel upon which multiple motion imagery (and other signal) sampling structures may be delivered. Systems that use the IEEE 1394 interface (such as "DV" format tape recorders) may not produce motion imagery sampling structures that meet the standards profiled in this MISP document. Users are cautioned to verify the video sampling structure delivered by any device that claims digital video delivery via IEEE 1394 interfaces.

(VWG, 26 March 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised)(ISMC, 6 March 1998 - approved)

A-5.7 STANDARD 9803 - Serial Data Transport Interface

SMPTE 305M [36], *Serial Data Transport Interface (SDTI)*, shall define the DoD/IC/NSG Standard for data stream used to transport packetized data within a studio/production center environment. The data packets and synchronizing signals are compatible with SMPTE 259M [28].

(MISB, 7 February 2001 - SMPTE 305.2M-2000 adopted; 01 March 2001 GSMC-ISMC approved)

A-5.8 STANDARD 9901 - Fiber Optic Interfaces Uncompressed Baseband Signal Transport and Processing

SMPTE 297M [35] shall be the fiber optic uncompressed standard definition (270-360 Mb/s Serial Digital Interface for baseband signal transport and processing DoD/IC/NSG STANDARD for digital motion imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

Furthermore, all DoD/IC/NSG standard definition primary routing and distribution motion imagery hardware systems must comply with SMPTE 259M [28] Levels C and D (270/360 Mb/s) implementations (270 /360 Mb/s data rates allow routing and distribution systems to pass both 4:3 and 16:9 aspect ratio digital motion imagery signals).

Furthermore, within SDI or bit-serial interfaces, one AES3 audio channel (one stereo pair) shall be reserved for mission audio (such as narration); one AES3 audio channel (one stereo pair) shall be reserved for mission metadata encoding.

Furthermore, at least 6 Mb/s of ancillary data (separate from the AES3 requirements above) shall be reserved for metadata encoding.

Furthermore, bit-serial interfaces shall be the DoD/IC/NSG STANDARD protocol for compression system input signals and decompression system outputs when further processing is required.

(VWG, 26 March 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised)(ISMC, 6 March 1998 - approved)

A-5.9 RECOMMENDED PRACTICE 9902 - Authorized Limited Applications of DV Format Video

The MISB Recommended Practice 9902 authorizes the DV video format for specialized DoD/IC/NSG applications requiring the use of consumer-grade palm-sized camcorders to meet limited, low profile (covert) mission requirements, provided that: 1) No less than first generation DV footage will be directly digitally transferred into computer processing systems using IEEE 1394 interfaces; 2) Such motion imagery DV clips will not be forwarded nor interfaced to any DoD/IC/NSG communications nodes for subsequent processing.

Affordable devices are now commercially available to convert from the DV format to MISP approved digital formats for distribution and exploitation. Thus, DV-originated motion imagery that meets the above criteria may be distributed when it is converted to an approved digital format such as MPEG-2.

(VWG, 21 January 1999 - adopted; VWG, 8 June 1999 - language revised)(VWG, 8 June 1999, recommended to GSMC-ISMC for approval)(GSMC-ISMC, 12 August 1999 - approved)

A-6 Low Spatial/Temporal Motion Imagery

A-6.1 STANDARD 9706 - Motion Imagery Still Frames

The National Imagery Transmission Format (NITF 2.1) shall be the DoD/IC/NSG STANDARD for digital still images that have been extracted from video image sequences. Once an image has been captured for individual still image processing, exploitation and dissemination; the image is no longer considered to be video and is therefore not subject to this Motion Imagery Standards Profile (but must meet all NITF 2.1 image standards).

Furthermore, still images should be extracted from full resolution bit-serial interface video streams, with direct conversion and storage into NITF image formats (using no transitional analog processing steps).

Furthermore, still images may be directly extracted from MPEG-2 digital files provided there are no transitional analog processing steps.

(VWG, 16 Jan 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised)(GSMC-ISMC, 6 March 1998 - approved as amended)

A-7 Compression Guidelines

A-7.1 ENGINEERING GUIDELINE 0802 - H.264/AVC Coding and Multiplexing

The MISB Engineering Guideline 0802 [93] provides recommendations and guidelines for the creation of H.264/AVC motion imagery that maintains the interoperability and quality for motion imagery within the US Department of Defense / Intelligence Community / National System for Geospatial-Intelligence (DoD/IC/NSG) community. The document covers the creation of H.264/AVC motion imagery for: 1) video exploitation and dissemination 2) operator-in-the-loop operations, and 3) low bandwidth users. The scope of this document includes the structure of the video encoding, information included with the video, and properties of the transport layer used to carry the video.

(14 May 2009 - approved) (30 September 2010 - approved)

A-7.2 ENGINEERING GUIDELINE 0904 - H.264 Bandwidth/Latency/Quality Tradeoffs

The MISB Engineering Guideline 0904 [107] addresses tradeoffs in bandwidth, latency and image quality of H.264 encoding to meet channel limitations in bandwidth. It is based on image formats and data rates found in the MISP.

(3 September 2009 - approved)

A-8 Motion Imagery Tape Formats

A-8.1 RECOMMENDED PRACTICE 9721 - Motion Imagery Tape Formats

Recommended Practice 9721 [123] defines the Motion Imagery System Practices and tape MISM levels L11-L0 for DoD/IC/NSG motion imagery tape formats.

Infrared Motion Imagery Systems

Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSG Implementations

A-9 Infrared Motion Imagery Systems

Infrared (IR) motion imagery is defined as being in the spectral wavelengths from 1 to 14 um. Standards and Recommended Practices for IR are like those in the motion imagery standards levels (MISL) for the electro-optical (EO) or visible spectrum. This section enumerates the standards, recommended practices, interoperability profiles, and engineering guidelines specifically designed for IR. Collectively this range of standards shall also be referred herein as "infrared" or "IR." It is beneficial for IR to use motion imagery standards whenever possible to achieve the advantage of the higher volume, lower cost motion imagery product availability, utilize the same or similar modules for IR and EO motion imagery, and aid in fused products.

For Infrared motion imagery, frame rates of 25, 30, 50, and 60 are preferred, but lower and higher frame rates are allowed and tolerance in the system should allow for 1/1.001 of 30 Hz and 1/1.001 of 60 Hz. The resolution classes of IR are 160x120, 320x240, 640x480 (including 640x512, 720x480, 720x512, and 720x576), 1024x720 (including 1280x720 and 1024x1024), 1920x1080, and 2048x2048 progressively scanned. *Interlaced scanning IR systems are to be treated as legacy systems and shall be replaced with progressive systems at the end of their service lives*. Infrared motion imagery typically has greater bit depths such as 12 and 14 bits, which are preferred.

A-9.1 RECOMMENDED PRACTICE 0401 - Infrared Motion Imagery System Matrix

The MISB Recommended Practice 0401 defines an Infrared (IR) Motion Imagery Systems Matrix" (IRSM) for the simple identification of broad categories of IR Motion Imagery Systems. The intent of the IRSM is to give user communities an easy to use, common shorthand reference language to describe the fundamental technical capabilities of DoD/IC/NSG IR motion imagery systems. The IRSM is like the MISM, but is listed in order of increasing resolution. The tables refer to <u>progressive</u> capture of IR imagery. *Interlace is sometimes used in legacy systems but must be replaced at the end of useful life with progressive systems*.

The IRSM (RP 0401) has six general bands as defined in Table A-8 and the accompanying Technical Notes provide detailed technical specifications of the general performance of each IRSM-L level. The levels may be further identified as **M** for MPEG-2 compression and **H** for H.264 compression.

A-9.2 IRSM Tables Glossary

Acquisition

Systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance.

Archiving

Storing or saving motion imagery to a data repository

Compression Ratio

Normal ranges specified. Uncompressed means no compression applied; TBD means To Be Determined.

Distribution

Motion Imagery that is disseminated to end users for display or consumption

Format

A still image is defined by its pixel density in the horizontal and vertical orientations. Motion imagery adds a third dimension called temporal. The three dimensions of H, V, and T define an images format.

Generation Resiliency

Rated as High for multiple generations of decompression/compression without artifacts; Medium for fewer generations (perhaps only one); and Low for no generations beyond first encoding.

Processing

Algorithms applied to the motion imagery that may be affected by artifacts introduced through compression. Such algorithms may also inadvertently contribute additional artifacts. Ideally, processing is best done on uncompressed, mezzanine, or high-quality compressed imagery.

RP	IRSM-L	Description
0401a	1	Very Low Definition IR – Distribution Compression
	2	Very Low Definition IR – Mild Compression
	3	Very Low Definition IR – No Compression
0401b	4	Low Definition IR – Distribution Compression
	5	Low Definition IR – Mild Compression
	6	Low Definition IR – No Compression
0401c	7	Medium Definition IR – Distribution Compression
	8	Medium Definition IR – Mild Compression
	9	Medium Definition IR – No Compression
0401d	10	High Definition IR – Distribution Compression
	11	High Definition IR – Mild Compression
	12	High Definition IR – No Compression
0401e	13	Very High Definition IR – Distribution Compression
	14	Very High Definition IR – Mild Compression
	15	Very High Definition IR – Low Compression
0401f (Study)	16	Super High Definition IR – Distribution Compression
	17	Super High Definition IR – Mild Compression

Table A-8: Infrared Motion Imagery System Matrix-Level

A-9.3 RECOMMENDED PRACTICE 0401a - Infrared System Matrix, Very Low Definition IR

System Level	IRSM-L		
	L3	L2H	L1H
Common Description/ Intended Application	Low Definition / Acquisition	Low Definition / Processing / Archiving	Low Definition / Distribution
System Attributes: Spatial Definition	Very Low	Very Low	Very Low
System Attributes: Temporal Definition	Standard	Standard	Standard
System Attributes: Generation Resiliency	High	Medium	Low
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 259M [28] or 292M [31]	H.264 MP@L1.3	H.264 MP@L1.2
Horizontal Resolution (Nominal)	160 - 180	160 - 180	160 - 180
Vertical Resolution (Nominal)	120 - 144	120 - 144	120 - 144
Bit Depth (bits) (Nominal)	8 - 14	8	8
Frame Rate (FPS)	25 - 60	25 - 60	15 - 30
Compression Ratio (Nominal)	uncompressed	20:1	120:1
Data Rate (Nominal)	8 Mb/s	403 Kb/s	67 Kb/s
Data Rate Range	6.7 - 22 Mb/s	336 - 1090 Kb/s	34 - 91 Kb/s
Candidate Transport Channel (Nominal Rates)	Partial T3, TCDL, ATM	Partial T1, TCDL, ATM	Partial T1, Wireless

Table A-9: Very Low Definition Infrared Motion Imagery (Recommended Practice 0401a)

(26 August 2004 - adopted)(3 December 2009 - approved)

A-9.4 RECOMMENDED PRACTICE 0401b - Infrared System Matrix, Low Definition IR

System Level	IRSM-L		
	L6	L5H	L4H
Common Description/ Intended Application	Low Definition / Acquisition	Low Definition / Processing / Archiving	Low Definition / Distribution
System Attributes: Spatial Definition	Low	Low	Low
System Attributes: Temporal Definition	Standard	Standard	Standard
System Attributes: Generation Resiliency	High	Medium	Low
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 259M [28] or 292M [31]	H.264 MP@L2.2 H.264 HP4@L2.2	H.264MP@L1.3 H.264 HP4@L1.3
Horizontal Resolution (Nominal)	320 - 360	320 - 360	320 - 360
Vertical Resolution (Nominal)	240 - 288	240 - 288	240 - 288
Bit Depth (bits) (Nominal)	8 - 14	8 8 - 14	8 8 - 14
Frame Rate (FPS)	25 - 60	25 - 30	15 - 30
Compression Ratio (Nominal)	uncompressed	20:1	120:1
Data Rate (Nominal)	32 Mb/s	1.5 Mb/s	269 Kb/s
Data Rate Range	27 - 87 Mb/s	1.3 - 2.2 Mb/s	134 - 363 Kb/s
Candidate Transport Channel (Nominal Rates)	T3, TCDL, ATM	T1, TCDL, ATM	Partial T1, Wireless

Table A-10: Low Definition Infrared Motion Imagery (Recommended Practice 0401b)

Note about bit depths: While multiple bit depths are allowed, higher bit depths are preferred. For example, if 12-bit, 10-bit and 8-bit implementations are allowed under the standard, 12-bit implementations are preferred.

(26 August 2004 - adopted)(3 December 2009 - approved)

A-9.5 RECOMMENDED PRACTICE 0401c - Infrared System Matrix, Medium Definition IR

System Level	IRSM-L				
	L9	L8M	L8H	L7M	L7H
Common Description/ Intended Application	Medium Definition / Acquisition	Medium Definition / Processing / Archiving		Medium Definition / Distribution	
System Attributes: Spatial Definition	Medium	Medium		Medium	
System Attributes: Temporal Definition	Standard	Standard		Standard	
System Attributes: Generation Resiliency	High	Medium		Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 292M [31]	MPEG-2 MP@ML	H.264 HP4@L3.1 H.264 MP@L3.1	MPEG-2 MP@ML	H.264 HP4@L3 (L3.1 > 30 FPS) H.264 MP@L3 (L3.1 > 30 FPS)
Horizontal Resolution (Nominal)	640 - 720	640 - 720		640 - 720	
Vertical Resolution (Nominal)	480 - 576	480 - 576		480 - 576	
Bit Depth (bits) (Nominal)	8 - 14	8	8 - 14 8	8	8 - 14 8
Frame Rate (FPS)	25 - 60	25 - 60		25 - 60	
Compression Ratio (Nominal)	uncompressed	10:1	20:1	45:1	120:1
Data Rate (Nominal)	129 Mb/s	13 Mb/s	6.4 Mb/s	2.9 Mb/s	1.1 Mb/s
Data Rate Range	108 - 364 Mb/s	2.1 - 35 Mb/s	5.4 - 14 Mb/s	0.47 - 7 Mb/s	0.9 - 2.9 Mb/s
Candidate Transport Channel (Nominal Rates)	SDI, OC-12	Half to Full T3, TCDL, ATM	Half T3, TCDL, ATM	GBS, T2, ATM, DVD	GBS, 2xT1, ATM, DVD

Table A-11: Medium Definition Infrared Motion Imagery (Recommended Practice 0401c)

Note about bit depths: While multiple bit depths are allowed, higher bit depths are preferred. For example, if 12-bit, 10-bit and 8-bit implementations are allowed under the standard, 12-bit implementations are preferred.

(26 August 2004 - adopted)(3 December 2009 - approved)

A-9.6 RECOMMENDED PRACTICE 0401d - Infrared System Matrix, High Definition IR

System Level	IRSM-L				
	L12	L11M	L11H	L10M	L10H
Common Description/ Intended Application	High Definition / Acquisition	High Definition / Processing / Archiving		High Definition / Distribution	
System Attributes: Spatial Definition	High	High		High	
System Attributes: Temporal Definition	Standard	Standard		Standard	
System Attributes: Generation Resiliency	High	Medium		Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 292M [31]	MPEG-2 MP@ML, MP@HL (>30FPS)	H.264 HP4@L4.2 H.264 MP@L4.2	MPEG-2 MP@ML, MP@HL (>30 FPS)	H.264HP4@L3.2 H.264MP@L3.2
Horizontal Resolution (Nominal)	1024 - 1280	1024 - 1280		1024 - 1280	
Vertical Resolution (Nominal)	720 - 1024	720 - 1024		720 - 1024	
Bit Depth (bits) (Nominal)	8 - 14	8	8 - 14 8	8	8 - 14 8
Frame Rate (FPS)	25 - 60	25 - 60		25 - 60	
Compression Ratio (Nominal)	uncompressed	10:1	20:1	45:1	120:1
Data Rate (Nominal)	440 Mb/s	44 Mb/s	22 Mb/s	9.8 Mb/s	3.7 Mb/s
Data Rate Range	258 - 1,100 Mb/s	26 - 110 Mb/s	12.9 - 55 Mb/s	5.7 - 24 Mb/s	2.2 - 9.2 Mb/s
Candidate Transport Channel (Nominal Rates)	HD-SDI, OC-12, OC-48	T3, TCDL, ATM	Partial T3, TCDL, ATM	GBS, T2, ATM, DVD	GBS, T2, ATM, DVD

Table A-12: High Definition Infrared Motion Imagery (Recommended Practice 0401d)

Note about bit depths: While multiple bit depths are allowed, higher bit depths are preferred. For example, if 12-bit, 10-bit and 8-bit implementations are allowed under the standard, 12-bit implementations are preferred.

(26 August 2004 - adopted)(3 December 2009 - approved)

A-9.7 RECOMMENDED PRACTICE 0401e - Infrared System Matrix, Very High Definition IR

System Level	IRSM-L				
	L15	L14M	L14H	L13M	L13H
Common Description/ Intended Application	Very High Definition / Acquisition	Very High Definition / Processing / Archiving		Very High Definition / Distribution	
System Attributes: Spatial Definition	Very High	Very High		Very High	
System Attributes: Temporal Definition	Standard	Standard		Standard	
System Attributes: Generation Resiliency	High	Medium		Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 292M [31] (≤30FPS) SMPTE 372M [67]	MPEG-2 MP@ML	H.264 HP4@L4.2	MPEG-2 MP@ML	H.264 HP4@L4.2
Horizontal Resolution (Nominal)	1920 - 2048	1920 - 2048		1920 - 2048	
Vertical Resolution (Nominal)	1080 - 1152	1080 - 1152		1080 - 1152	
Bit Depth (bits) (Nominal)	8 - 14	8	8 - 14	8	8 - 14
Frame Rate (FPS)	25 - 60	25 - 60		25 - 60	
Compression Ratio (Nominal)	uncompressed	10:1	20:1	45:1	120:1
Data Rate (Nominal)	871 Mb/s	87.1 Mb/s	43.5 Mb/s	19.4 Mb/s	7.3 Mb/s
Data Rate Range	726 - 1982 Mb/s	73 - 198 Mb/s	36 - 99 Mb/s	16 - 44 Mb/s	6 - 16.5 Mb/s
Candidate Transport Channel (Nominal Rates)	OC-48	T3, CDL, ATM	T3, CDL, ATM	GBS, T3, ATM, DVD	GBS, Partial T3

Table A-13: Very High Definition Infrared Motion Imagery (Recommended Practice 0401e)

Note about bit depths: While multiple bit depths are allowed, higher bit depths are preferred. For example, if 12-bit, 10-bit and 8-bit implementations are allowed under the standard, 12-bit implementations are preferred.

(26 August 2004 - adopted)(9 December 2004 - added proposed Digital Cinema resolutions)(3 December 2009 - approved)

A-9.8 STUDY 0401f - Infrared System Matrix, Super High Definition IR

System Level	IRSM-L		
	L18	L17H	L16H
Common Description/ Intended Application	Super High Definition / Acquisition	Super High Definition / Processing / Archiving	Super High Definition / Distribution
System Attributes: Spatial Definition	Super High	Super High	Super High
System Attributes: Temporal Definition	Standard	Standard	Standard
System Attributes: Generation Resiliency	High	Medium	Low
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 292M [31] SMPTE 372M [46]	H.264 HP4@L5.1	H.264 HP4@L5.1
Horizontal Resolution (Nominal)	2048 - 3840	2048 - 3840	2048 - 3840
Vertical Resolution (Nominal)	1152 - 2160	1152 - 2160	1152 - 2160
Bit Depth (bits) (Nominal)	8 - 14	8 - 14	8 - 14
Frame Rate (FPS)	25 - 60	25 - 60	25 - 60
Compression Ratio (Nominal)	uncompressed	20:1	120:1
Data Rate (Nominal)	1762 Mb/s	88 Mb/s	14.7 Mb/s
Data Rate Range	825 - 6967 Mb/s	41 - 348 Mb/s	6.9 - 58 Mb/s
Candidate Transport Channel (Nominal Rates)	OC-48, OC-192	T3, CDL, ATM	TCDL, T3, ATM

Table A-14: Super High Definition Infrared Motion Imagery (Study 0401f)

Note about bit depths: While multiple bit depths are allowed, higher bit depths are preferred. For example, if 12-bit, 10-bit and 8-bit implementations are allowed under the standard, 12-bit implementations are preferred.

(26 August 2004 - adopted)(3 December 2009 - approved)

A-9.9 RECOMMENDED PRACTICE 0402 - Infrared Image Capture

The MISB Recommended Practice 0402 [113] is the DoD/IC/NSG STANDARD IR sampling structure for progressively scanned, infrared motion imagery systems for resolutions of 640x480, 720x480, and 1280x720 at 60 Hz and 720x576 and 1280x720 at 50 Hz. The resolution classes of IR are 160x120, 320x240, 640x480 (including 640x512, 720x480, 720x512 and 720x576), 1024x720 (including 1280x720 and 1024x1024), 1920x1080, and 2048x2048 progressively scanned. Interlaced scanning IR systems are to be treated as legacy systems and shall be replaced with progressive systems at the end of their service lives. Furthermore, while 8-, 10-, 12-, 14-bit and 16-bit implementations are allowed under the standard, at least 12 bits are preferred. For Infrared motion imagery, frame rates of 25, 30, 50, and 60 are preferred, but lower and higher frame rates are allowed and tolerance should be in the system to allow 1/1.001 of 30 Hz and 1/1.001 of 60 Hz.

(26 August 2004 - adopted)(9 December 2004 - added 16 bit)(11 May 2006 - adopted)(10 August 2006 - adopted)

A-9.10 RECOMMENDED PRACTICE 0403 - Digital Representation and Source Interface Formats for Infrared Motion Imagery Mapped into 1280 x 720 Format Bit-Serial Digital Interface

The MISB Recommended Practice 0403 [109] is to be used for mapping digital infrared motion imagery parallel data from an IR source into a SMPTE 292M [31] compatible serial digital interface. Two methods are described for formatting the infrared imagery. The first method pre-formats the imagery such that it is pre-scaled, pseudo-colored, and prepared for display without further modification. The second method is geared toward retaining the original pixel values and therefore the full source dynamic range, up to 16-bits, of the infrared imagery.

This process maps various progressive 60Hz/50Hz infrared image formats into a progressive 60Hz/50Hz format based on a 1280x720 image lattice. Supported infrared formats covered by this document are 640x480, 640x512, 720x480, 1280x720, and 1024x1024, all at 60Hz and 720x576 and 1280x720 at 50Hz. When utilizing the 1024x1024 image format, clipping will occur in the vertical frame dimension, resulting in a 1024x720 format. The IR source format mapping of 1920x1080 is addressed in the Annex A and is beyond scope of this document.

(26 August 2004 - adopted)(11 May 2006 - adopted)(3 December 2009 - approved)

A-9.11 STANDARD 0404 - Compression for Infrared Motion Imagery

The MISB Standard 0404 [110] shall be the DoD/IC/NSG STANDARD for compressed infrared motion imagery, and addresses unique issues that pertain to optimizing the quality and utility of data that are acquired with infrared imaging systems. While infrared imaging systems routinely provide 14-bit dynamic range pixels, many UAS systems are limited to eight or ten bits. State of the art compression algorithms, including JPEG2000 and H.264, now support monochrome compression at 14-bits. This advancement allows for the retention of dynamic range information that is traditionally lost when utilizing eight or ten bit streaming systems.

(26 August 2004 - adopted)(9 December 2004 - Added H.264 FRExt)(11 May 2006 - adopted)(3 September 2009 - approved)(3 December 2009 - approved)

LVSD Motion Imagery Systems

Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSG Implementations

A-10 Large Volume Streaming Data Motion Imagery

The Motion Imagery System Matrix (MISM) levels were created to address traditional Full Motion Video (FMV) sensors. Typically, FMV sensors have frame rates in the 24-60 Hz range and may be temporally sub-sampled down to 5-15 Hz to meet low bandwidth constraints. Higher temporal frame rates and higher frame pixel counts (mistakenly referred to higher spatial resolution) typically go hand-in-hand. For example, High Definition (HD) sensors will operate at 25-60 Hz. These traits are reflected in the MISM tables. Also, most FMV sensors operate only at 8 bits per color channel (except IR sensors) and the MPEG-2 compression algorithm (ISO/IEC 13818-2) is itself limited to 8 bits per color channel video.

Current LVSD sensors, while similar in some respects to traditional FMV sensors, possess fundamentally different characteristics from their FMV counterparts. LVSD sensors typically have very high frame pixel counts (or high spatial resolution) and moderate-to-low video frame rates. LVSD sensors produce on the order of 100×10^6 up to 2×10^9 pixels per frame. For comparison, a 1920x1080 HD video sensor produces approximately 2×10^6 pixels per frame. There are no commercially available video codec's (MPEG-2 or H.264) that can handle frame sizes larger than 1920x1080. This may change soon as the ISO MPEG committee develops 4K profiles (approximately 8×10^6 pixels per frame) for Ultra Definition/Digital Cinema applications. However, even a 4K profile falls short of the frame sizes generated by LVSD sensors. Furthermore, the MPEG standards provide no mechanism for tiling large video frames so that they might be compressed as smaller independent sub-tiles within a larger video frame. For these reasons, any motion imagery delivered off of a LVSD platform will be a smaller sub-window into a much larger video frame.

LVSD motion imagery is currently limited to 1-15 Hz video frame rates with many sensors running at approximately 2 Hz. These lower frame rates can have profound impacts on compression algorithm performance and may necessitate different compression parameter settings than those currently recommended for FMV sensors. The motion compensation models in MPEG-2 and H.264 may not accommodate such coarse temporal frame rates. Furthermore, LVSD collections exhibit significant global scene motion, including perspective changes that generate parallax and scene rotation. Neither type of motion is covered by MPEG's local block-based translation motion model. The low temporal frame rate and different types of scene motion reduce the benefits of MPEG's inter-frame encoding capabilities. For this reason and others, most LVSD systems are employing JPEG 2000 (ISO/IEC 15444-1 [72]) compression for intra-frame compression of their motion imagery.

Finally, LVSD systems collect visible (EO) and infrared (IR) motion imagery at bit-depths up to 14 bits per color channel. Future multispectral (MS) and hyperspectral (HS) sensors will collect at bit-depths of 16 bits per channel and higher. MPEG-2 is limited to 8 bits per color channel and H.264 can process 14 bits/color channel but only in its High 4:4:4 profile with Fidelity Range Extensions (FRExt). There are few commercial implementations of the H.264 High 4:4:4 profile with FRExt. To disseminate EO or IR LVSD motion imagery off a platform to a remote viewing terminal will require the use of the H.264 High 4:4:4 profile with FRExt or the imagery must be mapped down to 8 bits/color channel. Even if a FRExt capable H.264 encoder is available, it is highly unlikely that the RVT will be incapable of displaying anything beyond 8 bits/color channel. LVSD systems will therefore need to provide a histogram mapping from their native high bit-depth imagery down to 8 bits per color channel for dissemination off the platform (10 and 12 bit per channel H.264 High profiles exist and may be an option as well).

The MISB has conducted a compression study for IR in conjunction with White Sands Missile Range (WSMR) focused on recommendations for the compression and bit-depth scaling of 14 bit IR imagery. The study considered MPEG-2, H.264 and JPEG 2000 encoding along with applying 14 bit to 8 bit scaling techniques at various points in the processing chain. The MISB STANDARD 0404 fully explains the tradeoffs in performing scaling. Implementers must realize that one single scaling technique may not suffice for all imaging conditions, exploitation CONOPS and sensor type (EO vs. IR). LVSD systems will most likely have to provide operator selected scaling algorithms or dynamic scaling algorithms that adjust based upon scene dynamic range and sensor characteristics.

Delivery of MPEG-2 or H.264 encoded sub-windows to remote viewing terminals (RVT or OSRVT) will necessitate transcoding from JPEG 2000. Table A-14 defines MISM levels for an EO LVSD sensor to support such encoded sub-windows. Three levels are given assuming both MPEG-2 and H.264 compression. In determining the data rates, it has been assumed that the sensor is a 4:2:0 color sensor. This leads to 1.5 times as many data values as there are color pixels in the resulting image. In other words, a YCbCr color space is assumed with 2x2 sub-sampling of the chrominance bands. If the sensor is monochromatic (4:0:0) or is supporting some other luminance/chrominance format (4:2:2 or 4:4:4), the bitrates must be adjusted accordingly. Note also that other chrominance formats (4:2:2 or 4:4:4) may necessitate usage of a higher profile than that specified in the table. For example, 4:2:2 is only allowed within the High Profile (HP) of MPEG-2 and the Hi422P and Hi444PP profiles of H.264. Monochrome (4:0:0) color space is only allowed in High Profiles (HiP, Hi10P, Hi422P, Hi444P) of H.264.

A-10.1 MISM Tables Glossary

Acquisition

Systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance.

Archiving

Storing or saving motion imagery to a data repository

Compression Ratio

Normal ranges specified. Uncompressed means no compression applied; TBD means To Be Determined.

Distribution

Motion Imagery that is disseminated to end users for display or consumption

Format

A still image is defined by its pixel density in the horizontal (H) and vertical (V) orientations. Motion imagery adds a third dimension called temporal (T).

Generation Resiliency

Rated as High for multiple generations of decompression/compression without artifacts; Medium for fewer generations (perhaps only one); and Low for no generations beyond first encoding.

Processing

Algorithms applied to the motion imagery that may be affected by artifacts introduced through compression. Such algorithms may also inadvertently contribute additional artifacts. Ideally, processing is best done on uncompressed, mezzanine, or high-quality compressed imagery

A-10.2 RECOMMENDED PRACTICE 1004 – Motion Imagery System Matrix, LVSD

System Level	MISM					
	L9.0M	L9.0H	L3.0M	L3.0H	L1.0M	L1.0H
Common Description/ Intended Application	High Definition / Distribution	High Definition / Distribution	Standard Definition / Distribution	Standard Definition / Distribution	Very Low / Distribution	Very Low / Distribution
System Attributes: Spatial Definition	High	High	Standard	Standard	Low	Low
System Attributes: Temporal Definition	Medium - High	Medium - High	Medium - Low	Medium - Low	Low	Low
System Attributes: Generation Resiliency	Low	Low	Low	Low	Very Low	Very Low
Applicable Standard (Note: Other Profiles /Practices may apply)	MPEG-2 MP@HL	H.264 MP@L3.1 (720) MP@L4.0 HP@L4.0 For 10 bits Hi10P@L4.0 Hi422P@L4.0 For 12 bits Hi444PP@L4.0	MPEG-2 MP@H-14 MP@HL	H.264 MP@L2.2 (480) MP@L3.0 (480) MP@L3.1 HP@L3.1 For 10 bits Hi10P@L3.1 Hi422P@L3.1 For 12 bits Hi444PP@L3.1	MPEG-2 MP@ML	H.264 MP@L1.2 (320) MP@L2.0 (320) MP@L2.2 HP@L2.2 For 10 bits Hi10P@L2.2 Hi422P@L2.2 For 12 bits Hi444PP@L2.2
Horizontal Resolution (Nominal)	1280 - 1920	1280 - 1920	640 - 960	640 - 960	320 - 540	320 - 540
Vertical Resolution (Nominal)	720p - 1080p	720p - 1080p	480p – 720p	480p – 720p	240p - 416p	240p - 416p
Bit Depth (bits) (Nominal)	8§	8§ - 12*	8§	8§ - 12*	8§	8§ - 12*
Frame Rate (FPS)	10 - 30	10 - 30	2 - 10	2 - 10	2 - 5	2 - 5
Compression Ratio (Maximum Nominal)	62:1	180:1	33:1	83:1	35:1	100:1
Data Rate (Maximum Nominal)	12.0 Mb/s	6.0 Mb/s	2.5 Mb/s	1.5 Mb/s	384 Kb/s	192 Kb/s
Data Rate Range (Kbits/s)	1,338 -15,050	461 - 7,776	168 - 3,142	70 - 1,873	39 - 481	14 - 252
Candidate Transport Channel (Nominal Rates)	?	CDL BR-10.71B (10 Mb/sec)	CDL BR-10.71B (10 Mb/sec)	CDL BR-10.71B (10 Mb/sec)	CDL BR-10.71B (10 Mb/sec)	CDL BR-10.71B (10 Mb/sec)
Allowed Transport Protocols	Xon2	Xon2	Xon2	Xon2	Xon2 RTP/RTSP	Xon2 RTP/RTSP
Recommended Transport Protocols	Xon2	Xon2	Xon2	Xon2	RTP/RTSP	RTP/RTSP

Notes: § If original source data is greater than 8 bits per pixel per band, the data must be scaled prior to compression.
* If original source data is greater than 12 bits per pixel per band, the data must be scaled prior to compression.

Table A-15: LVSD Dissemination for BSA MISM Levels, EO Sensor

A-10.3 RECOMMENDED PRACTICE 0606 - Authorized Use of JPEG 2000 for Large Volume Streaming Data Imagery

JPEG 2000 (ISO/IEC 15444 [72-75] in various Parts) uses a wavelet-based compression method and associated file formats with high versatility and scalability. The JPEG 2000 standard allows for region-of-interest encoding and feature scalability, and is an emerging commercial technology used in digital cinema and other large image applications.

New motion imagery sensors for use in Large Volume Streaming Data (LVSD) (also referred to as Wide Area Large Format (WALF)) applications are composed of arrays of individual digital cameras that result in composite imagery frames containing hundreds of millions of pixels (megapixels) produced at rates of one frame per second or greater. JPEG 2000 has extensible features that can accommodate these frame sizes and frame rates and is authorized for use when standards-based compression and file transport are required for system interoperability.

A-10.4 RECOMMENDED PRACTICE 0705 - LVSD Compression Profile

The encoding of LVSD motion data is limited to baseline JPEG DCT (ISO/IEC 10918-1: Digital compression and coding of continuous-tone still images requirements and guidelines) and JPEG 2000 Part 1: Image Coding System (ISO/IEC 15444-1 [72]). The BIIF Profile BPJ2K01.01 [89] document, defines a new JPEG 2000 compression profile, LPJE (LVSD Preferred JPEG 2000 Encoding). LVSD systems that utilize JPEG 2000 frame-based compression are required to conform to this profile. The LPJE profile is a superset of current JPEG 2000 profiles (NPJE and EPJE defined in BPJ2K01.01) as well as the profile defined in STANAG 7023.

The recommended compression for LVSD (Large Volume Streaming Data as referred to by the NATO community), is enumerated in Recommended Practice 0705 [88], which is a profile in ISO/IEC BIIF Profile BPJ2K01.10 [89]. When the compression profile is approved by ISO, RP 0705 will simply refer to the profile of the ISO standard. Note: JPEG 2000 is the preferred encoder for LVSD applications, but because of current hardware limitations JPEG DCT is also accepted for simple frame-by-frame data compression.

Further investigation is required to define a more detailed profile and best practice guide for LVSD motion imagery encoding. It is also expected that a profile will be required of JPEG 2000 Part 9: JPIP (ISO/IEC 15444-9 [75]: Interactive tools, APIs and protocols) to facilitate the scalability and functionality of the JPEG 2000 standard.

Additional work is needed within the MISB to define metadata carriage and precision time stamping practices. The MISB will investigate and document recommendations on the use of formats and metadata carriage including possible solutions of MISP with KLV, MXF (SMPTE 377M 46]), JPEG 2000 File Format (ISO/IEC 15444-1: Image coding system [72] and 15444-2: Extensions [73]), Motion JPEG 2000 File Format (ISO/IEC 15444-3: Motion JPEG 2000 [74] and 15444-12: ISO Base Media File Format [76]). The ASPA Profile for LVSD is contained is contained in MISB STANDARD 0301 [66].

(MISB, 11 May 2006 - adopted as amended)(13 September 2007- approved)(18 September 2008 - approved)

A-10.5 RECOMMENDED PRACTICE 0811 - JPIP Profile (Client/Server Functions)

The MISB Recommended Practice 0811 [102] defines the JPEG 2000 Interactive Protocol (JPIP) Profile for client/server interaction. It defines the expected behavior for client/server interactions for the delivery of JPEG 2000 compressed imagery within the context of the JPIP protocol.

(14 May 2009 - approved)

Appendix B Audio

Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSG Implementations

B-1 Audio

B-1.1 ENGINEERING GUIDELINE 1001 - Audio Encoding in MPEG-2 TS

Engineering Guideline (EG) 1001 provides guidelines for the use of external audio standards, for transport and archival storage of audio, particularly recorded speech, together with video in an MPEG-2 transport stream.

(20 May 2010 - MISB approved)

Appendix C Metadata

Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSG Implementations

C-1 Metadata: Classes and Rules

MISB Statement on POSIX Microseconds Key: The POSIX Microseconds Key in SMPTE RP 210 (06.0E.2B.34.01.01.01.03.07.02.01.01.01.05.00.00) (Line 1786 in RP 210v11) contains the following descriptive statement: "Bitwise mapping of 64-bit timecode into 8 bytes, lsb first." SMPTE 210.12 reverses this statement and says this key shall be implemented in a big-endian fashion. The MISP shall use SMPTE 210.12.

The Vertical Field of View Key used in Annex F (Basic Predator KLV Metadata) of STANAG 4609 AEDP-8 Edition 3 is 06 0E 2B 34 01 01 01 02 04 20 02 01 01 0A 01 00, but the same Key in MISB EG 0104.5 is 06 0E 2B 34 01 01 01 07 04 20 02 01 01 0A 01 00. SMPTE RP 210 v 6 represents this key with the value "03" in the eighth byte.

i. This discrepancy is in byte 8, the Version Number of the key.

ii. SMPTE guidance is that byte 8 of a Key has no impact on the uniqueness of the key. The two key values above, differing only in byte 8, represent the same key.

iii. Given the SMPTE guidance, KLV parsers should, in general, IGNORE byte 8 of a key in all cases.

C-1.1 STANDARD 9711 - Intelligence Motion Imagery Index, Geospatial Metadata

The VWG Metadata Sub-Group, "Core Video Metadata Profile," Version 1.0, 14 March 1997 is the DoD/IC/NSG RECOMMENDED PRACTICE for analog video intelligence Geospatial Metadata. This RP for legacy analog video was developed to capture and transmit metadata over analog video services to take advantage of existing metadata previously only available in telemetry. The intention is that when analog motion imagery systems are replaced by digital systems that they will use the more extensible Metadata Dictionary and Encoding described by STANDARDS 9713, 9716-9718.)

(VWG, 26 March 1997 - adopted)(ISMC, 12 June 1997 - approved)(VWG, 8 June 1999 - language editorially revised)(GSMC-ISMC, 12 August 1999 - approved as amended)

Note 1: This Profile has been nominated by the MISB for candidate harmonization with the SMPTE "Metadata Dictionary" Standard

Note 2: DoD/IC/NSG users may begin system development activities using this Core Geospatial Metadata, with the understanding that metadata parameters may change depending on negotiations and coordination with SMPTE and commercial video equipment manufacturers. The expectation is that the Geospatial metadata forms the initial core of the DoD/IC/NSG requirement set for the broader digital "Motion Imagery Metadata Dictionary" Standard, and once part of the broader standard, will provide significantly enhanced applicability and broad, universal interoperability with commercial index, archive, and Geospatial motion imagery systems. The new SMPTE standard should provide a single standard for both DoD/IC/NSG and commercial systems.

(VWG, 16 January 1997 - approved for study)

Note 3: The Core Video Metadata Profile elements are incorporated in the extensive "Metadata Dictionary and Encoding" (Version 1.0) document. However, it is expected that the analog Core Motion Imagery Metadata Profile will continue if legacy analog motion imagery systems are still fielded.

(VWG, 8 June 1999 - language editorially revised)

C-1.2 STANDARD 9712 - Intelligence Motion Imagery Index, Content Description Metadata (Dynamic Metadata Dictionary Structure and Contents)

SMPTE 335M [39], Metadata Dictionary Structure, SMPTE RP210 [42], SMPTE Metadata Dictionary Contents, and SMPTE EG37 [43], Node Structure for the SMPTE Metadata Dictionary, formerly known as the Intelligence Video Index (Video Metadata Dictionary), comprise the DoD/IC/NSG STANDARD for the definition and identification of metadata elements encoded in digital motion imagery products.

All new DoD/IC/NSG motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into uncompressed digital motion imagery bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 16 Jan. 1997 - approved for study; VWG, 19 November 1997- language revised)(VWG, 8 June 1999 - language revised)(VWG, 20 October 1999 - adopted; recommended to GSMC-ISMC for approval)(24 February 2000 - GSMC-ISMC approval)(MISB, 27 July 2000 - SMPTE Standard Recommended)(02 November 2000 GSMC-ISMC approved)(MISB, 24 May 2001, replaced 210.2 by 210.3)(20 November 2003 replaced 210.3 by 210.8)(9 December 2005 replaced 210.8 by 210.9)(3 September 2009 replaced 210.9 with 210.12)

C-1.3 STANDARD 9713 - Data Encoding Using Key-Length-Value

SMPTE 336M [40], Data Encoding Protocol Using Key-Length-Value, is the DoD/IC/NSG STANDARD protocol for encoding data essence and metadata (such as 9712) into Motion Imagery streams, files, and associated systems.

(VWG, 16 Jan. 1997 - approved for study; VWG, 19 November 1997- language revised)(VWG, 8 June 1999 - language revised)(VWG, 20 October 1999 - adopted; recommended to GSMC-ISMC for approval)(24 February 2000 - GSMC-ISMC approval)(MISB, 27 July 2000 - SMPTE Standard recommended)(02 November 2000 GSMC-ISMC approved)

C-1.4 STANDARD 9716 - Packing KLV Packets into SMPTE 291 Ancillary Data Packets

SMPTE RP 214 [63], “Packing KLV Encoded Metadata and Data Essence into SMPTE 291M Ancillary Data Packets” is the DoD/IC/NSG STANDARD for the encoding of metadata elements into Serial Digital Interface (SDI) SMPTE 291M [30] ancillary data packets.

All new DoD/IC/NSG motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into uncompressed digital motion imagery bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - approved for study, VWG, 19 November 1997- language revised)(VWG, 8 June 1999 - language revised)(VWG, 20 October 1999 - adopted; recommended to GSMC-ISMC for approval) (24 February 2000 - GSMC-ISMC approval)

C-1.5 RECOMMENDED PRACTICE 9717 - Packing KLV Packets into MPEG-2 Systems Streams

Metadata shall be encoded consistent with MISB Standard 0604 [81].

ISO/IEC 13818-1:2000/AMD 1: 2003: "Information technology -- Generic coding of moving pictures and associated audio information: Systems, AMENDMENT 1: Carriage of metadata over ISO/IEC 13818-1 streams," which has been incorporated into ISO/IEC 13818-1:2007 [16], is mandatory for the synchronous transport of metadata.

SMPTE RP 217 [61], Non-synchronized Mapping of KLV Packets into MPEG-2 System Streams, is a Recommend Practice for the non-synchronous encoding of metadata elements into MPEG-2 Systems Streams.

Note: To be MISP compliant, KLV metadata in the Transport Stream must be identified by the registered format_identifier 0x4B4C5641 ("KLVA"). SMPTE RP 217-2001 states that 0x4B4C5641 is the format_identifier to be used for the Transport Stream.

All new DoD/IC/NSG motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into compressed digital motion imagery bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - approved for study, VWG, 19 November 1997- language revised)(VWG, 8 June 1999 - language revised)(VWG, 20 October 1999 - adopted; recommended to GSMC-ISMC for approval)(24 February 2000 - GSMC-ISMC approved)(MISB, 11 October 2001 - submitted for approval)(revised 29 November 2001 for GSMC/ISMC approval)(3 September 2009 - approved)

C-1.6 STANDARD 9718 - Packing KLV Packets into AES3 Serial Digital Audio Streams

SMPTE 355M [41] Format for Non-PCM Audio, SMPTE 337 [68] Format for Non-PCM Audio and Data in an AES3 Serial Digital Audio Interface, and SMPTE 339 [69] Format for Non-PCM Audio and data in AES3-Generic Data Types are the DoD/IC/NSG STANDARDs for the encoding of metadata elements into AES3 data streams.

(VWG, 26 March 1997 - approved for study, VWG, 19 November 1997- language revised)(VWG, 8 June 1999 - language revised) (VWG, 20 October 1999 - adopted; recommended to GSMC-ISMC for Approval)(24 February 2000 - GSMC-ISMC approval)(MISB, 27 July 2000 - SMPTE RP recommended)(02 November 2000 GSMC-ISMC approved)(29 April 2005 - approved)

C-1.7 RECOMMENDED PRACTICE 0101 - Use of MPEG-2 System Streams in Digital Motion Imagery Systems

The MISB Recommended Practice 0101 [55] defines use of MPEG-2 system streams in motion imagery systems.

(7 February 2001 - adopted; 01 March 2001 GSMC-ISMC approved)

C-1.8 STANDARD 0102 - Security Metadata Universal Set for Digital Motion Imagery

The MISB Standard 0102 [56] shall be the standard for use of security metadata in MPEG-2 digital motion imagery applications.

(7 February 2001 - adopted; 01 March 2001 GSMC-ISMC approved)(20 November 2003 - approved)(10 August 2006 - updated - MISB adopted)(13 December 2007 - updated –MISB adopted)(15 May 2008 - adopted) (18 September 2008 - approved)(14 May 2009 - approved)(3 September 2009 - approved)(20 May 2010 - approved) (30 September 2010 - approved)

C-1.9 RECOMMENDED PRACTICE 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery

This Recommended Practice (RP) has been deprecated.

(MISB, 24 May 2001 - approved)(14 May 2009 - deprecated)

C-1.10 ENGINEERING GUIDELINE 0104 - Basic Predator KLV Metadata

The MISB Engineering Guideline 0104 [57] defines the basic and geospatially adjusted Predator UAS (Unmanned Aircraft System) metadata to be encoded into a standard SMPTE KLV Metadata Universal Metadata Sets. This EG provides direction on the creation of a standard metadata sets for reliable exchange of Predator closed caption (CC) data among digital motion imagery systems.

The scope of this EG is strictly limited to metadata that originates as closed caption metadata in analog video from the Predator UAS. Analog video and closed caption metadata are legacy systems, which shall be updated to all-digital sensors and information infrastructures as soon as practical. This EG facilitates that transition only and does not constitute an approved end-system implementation.

(MISB, 24 May 2001 - submitted for approval)(20 November 2003 - approved)(8 April 2004 - approved)(10 August 2006 - approved)(14 December 2006 - approved)(18 September 2008 - approved)

C-1.11 STANDARD 0107 - Bit and Byte Order for Metadata in Motion Imagery Files and Streams

The MISB Standard 0107 [58] defines the selection of big-endian for bit and Byte order (msb-first and MSB-first). This is applicable only to KLV metadata encoding. Bit and Byte order of essence is not affected.

(MISB, 11 October 2001 - submitted for approval)(9 June 2011 - approved)

C-1.12 STANDARD 0601 - UAS Datalink Local Metadata Set

The MISB Standard 0601 [77] defines the bit-efficient, extensible SMPTE KLV Local Metadata Set designed for transmission through a wireless communications link (Datalink).

This standard provides direction on the creation of a standard KLV Local Data Set for a reliable, bandwidth-efficient exchange of metadata among digital motion imagery systems on UAS platforms. The standard also provides a mapping to EG 104 [57] and Predator Exploitation Support Data (ESD) for continued support of existing metadata systems.

(14 May 2009 - approved)(12 January 2006 - approved) (14 June 2007- approved)(13 December 2007- approved)(15 May 2008 - approved)(18 September 2008 - approved)(14 May 2009 - approved)(3 December 2009 - approved)(20 May 2010 - approved)

C-1.13 NATO STANAG 4609, Edition 3, and 4586 Metadata Set (informative)

The following paragraphs and Table C-1 reflects the KLV metadata implementation that was agreed to by STANAG 4586 on UAS and STANAG 4609 for digital motion imagery. This section contains information regarding common metadata parameters which should be used by a STANAG 4586 compliant Unmanned Air Vehicle Control System (UCS). Table C-1 provides the comprehensive list of metadata elements from MISB Standard 0601.2, UAS Datalink Local Metadata Set, which has been adopted by many existing UAV systems.

An ‘X’ in the first column indicates that the particular element should be implemented in a STANAG 4586 compliant UCS in order to enhance imagery exploitation for that system, and is required for Edition 3 of STANAG 4609 compliance. If the particular element is implemented in a STANAG 4586 compliant UCS, then it shall be applicable to the UCS interface specified in the second column of the table: the Command and Control Interface (CCI) only, or both the CCI and Data Link Interface (DLI) as defined in STANAG 4586. Refer to STANAG 4586 for actual mapping of these elements to the DLI. Refer to MISB Standard 0902 for the MISP-compliant motion imagery sensor minimum metadata set.

Table C-1: MISB Standard 0601.2 KLV Metadata Elements

Mandatory Elements [2]	DLI / CCI [3]	UAS LDSKey[1]	Name [1]
X	Co	1	Checksum
X	D&C	2	UNIX Time Stamp
X	Co	3	Mission ID
	Co	4	Platform Tail Number
X	D&C	5	Platform Heading Angle
X	D&C	6	Platform Pitch Angle
X	D&C	7	Platform Roll Angle
	Co	8	Platform True Airspeed
	Co	9	Platform Indicated Airspeed
X	Co	10	Platform Designation
X	D&C	11	Image Source Sensor
X	Co	12	Image Coordinate System
X	D&C	13	Sensor Latitude
X	D&C	14	Sensor Longitude
X	D&C	15	Sensor True Altitude
X	D&C	16	Sensor Horizontal Field of View
X	D&C	17	Sensor Vertical Field of View
X	D&C	18	Sensor Relative Azimuth Angle
X	D&C	19	Sensor Relative Elevation Angle
X	D&C	20	Sensor Relative Roll Angle
X	Co	21	Slant Range
X	Co	22	Target Width
X	Co	23	Frame Center Latitude
X	Co	24	Frame Center Longitude
X	Co	25	Frame Center Elevation
	Co	26	Offset Corner Latitude Point 1
	Co	27	Offset Corner Longitude Point 1
	Co	28	Offset Corner Latitude Point 2
	Co	29	Offset Corner Longitude Point 2
	Co	30	Offset Corner Latitude Point 3
	Co	31	Offset Corner Longitude Point 3

Mandatory Elements [2]	DLI / CCI [3]	UAS LDSKey[1]	Name [1]
	Co	32	Offset Corner Latitude Point 4
	Co	33	Offset Corner Longitude Point 4
	D&C	34	Icing Detected
	Co	35	Wind Direction
	Co	36	Wind Speed
	D&C	37	Static Pressure
	D&C	38	Density Altitude
	D&C	39	Outside Air Temperature
	Co	40	Target Location Latitude
	Co	41	Target Location Longitude
	Co	42	Target Location Elevation
	Co	43	Target Track Gate Width
	Co	44	Target Track Gate Height
	Co	45	Target Error Estimate - CE90
	Co	46	Target Error Estimate - LE90
	Co	47	Generic Flag Data 01
X	Co	48	Security Local Metadata Set
	D&C	49	Differential Pressure
	D&C	50	Platform Angle of Attack
	D&C	51	Platform Vertical Speed
	D&C	52	Platform Sideslip Angle
	Co	53	Airfield Barometric Pressure
	Co	54	Airfield Elevation
	Co	55	Relative Humidity
	D&C	56	Platform Ground Speed
	Co	57	Ground Range
	D&C	58	Platform Fuel Remaining
	Co	59	Platform Call Sign
	Co	60	Weapon Load
	Co	61	Weapon Fired
	Co	62	Laser PRF Code
	Co	63	Sensor Field of View Name
	D&C	64	Platform Magnetic Heading
X	D&C	65	UAS LDS Version Number
	Co	66	Target Location Covariance Matrix
	D&C	67	Alternate Platform Latitude
	D&C	68	Alternate Platform Longitude
	D&C	69	Alternate Platform Altitude
	D&C	70	Alternate Platform Name
	D&C	71	Alternate Platform Heading
	Co	72	Event Start Time - UTC
	Co	73	«LDS_Name» Conversion

Table notes:

1. The element name and tag refers to MISB Standard 0601 UAS Datalink Local Metadata Set.
2. Elements marked with an 'X' are to be included in a STANAG 4586 UCS as an extended list of elements, oriented for image exploitation.
3. (Co): The element shall be available at the CCI only.
   (D&C): The element shall be available at the DLI and the CCI.

(11 December 2008 - approved)(14 May 2009 - approved)(3 December 2009 - approved)

C-1.14 RECOMMENDED PRACTICE 0602 - Annotation Universal Metadata Set

The MISB Recommended Practice 0602 [78] documents the basic SMPTE KLV metadata sets used to encode Video Annotation data associated within a motion imagery data stream. This RP provides direction on the creation of "Annotation" KLV metadata to allow for the creation, dissemination, and display of visual cues to enhance the exploitation of MISP-compliant motion imagery data.

(12 January 2006 - approved)(14 June 2007 - approved)(14 May 2009 - approved)

C-1.15 ENGINEERING GUIDELINE 0607 - MISB Metadata Registry and Processes

The MISB Engineering Guideline 0607 [79] provides guidelines for the structure of the MISB Metadata Registry and administrative practices for requesting, assigning, approving, and managing metadata identifiers (KLV keys) and operation of an on-line registry database. The registry contains information about Universal Label (UL) metadata identifiers reserved for private use by motion imagery systems in the Department of Defense (DoD), Intelligence Community (IC), and National System for Geospatial-Intelligence (NSG).

(11 May 2006 - adopted)(18 September 2008 - approved number change from EG 0602 to EG 0607)

C-1.16 RECOMMENDED PRACTICE 0608 - Motion Imagery Identifier

The MISB Recommended Practice 0608 [83] defines the format and encoding of the Motion Imagery Identifier (MIID) required by segments of the National System for Geospatial-Intelligence (NSG). This RP also defines the Motion Imagery Stream Identifier (MI_Stream_ID) used to uniquely identify streams of motion imagery from their source and to be included in the MIID.

(14 December 2006 - adopted)(Updated 14 June 2007- adopted) (13 December 2007- approved) (30 September 2010 - approved)

C-1.17 RECOMMENDED PRACTICE 0701 - Common Metadata Structure

The MISB Recommended Practice 0701 [84] defines the Structure of the Common Metadata System (CMS). The CMS is a list of metadata items embedded in KLV data structures that can be used across any sensor/platform and motion imagery system. RP 0702, to follow, describes the Content definition. RP 0701 describes how to organize the sensor/platform data into a hierarchy of KLV Packs and Local Sets that reduces the bandwidth needed to transmit the data. This RP also defines the required data elements but all other data elements (Content elements) are defined in companion document RP0702.

(14 June 2007 - approved)

C-1.18 ENGINEERING GUIDELINE 0801 - Photogrammetry Metadata Set

The MISB Engineering Guideline 0801 [92] provides the KLV metadata and metadata structures necessary for the dissemination of data for the photogrammetric exploitation of motion imagery. The metadata structures are designed to allow for flexible, bit-efficient packaging of the necessary data. This document concerns itself solely with the metadata and metadata structures specific to photogrammetry; metadata necessary for the primary exploitation of the motion imagery (including such elements as mission number, sensor type, platform type, etc.) and security metadata are not addressed in this Engineering Guideline.

(18 September 2008 - approved)(14 May 2009 - approved)(3 December 2009 - approved)(30 September 2010 - approved)

C-1.19 ENGINEERING GUIDELINE 0805 - Cursor on Target

The MISB Engineering Guideline 0805 [96] defines the metadata items used for fields in Cursor on Target (CoT) Situational Awareness (SA) messages. Two CoT message conversions from MISB-standard Key Length Value (KLV) metadata sets are described in this document – Platform Position and Sensor Point of Interest (SPI). Conversions from both MISB EG 0601 [77] UAS Datalink Local Data Set and MISB EG 0104 [57] Predator Universal Metadata Set are included here. The intent is to provide a method of generating CoT messages either in real time or later from motion imagery files and the results should be the same in either case.

(18 September 2008 - approved)

C-1.20 ENGINEERING GUIDELINE 0806 - Remote Video Terminal Local Data Set

The MISB Engineering Guideline 0806 [97] defines the Remote Video Terminal (RVT) Local Data Set (LDS), lays out the relationship between the RVT LDS and other relevant Standards, and gives implementation guidance for the RVT LDS.

(18 September 2008 - approved)(11 December 2008 - approved)(14 May 2009 - approved)(3 September 2009 - approved)

C-1.21 STANDARD 0807 MISB DoD/IC/NSG KLV Metadata Registry

The MISB Standard 0807 [98] defines the KLV elements and the conventions of their use within the DoD/IC/NSG community. The registry is maintained by the Motion Imagery Standards Board as registered private data in accordance with SMPTE 335M [39].

(18 September 2008 - approved)(14 May 2009 - approved) (3 September 2009 - approved)(3 December 2009)(20 May 2010 - approved)(30 September 2010 - approved)

C-1.22 RECOMMENDED PRACTICE 0808 - Ancillary Text Data Sets

The MISB Recommended Practice 0808 [99] documents the basic SMPTE KLV metadata sets used to encode text data associated with a motion imagery data stream. This RP provides direction on the creation of KLV metadata to allow for the creation, dissemination, and display of supplemental text to enhance the exploitation of MISP compliant motion imagery data. The inclusion of descriptive text within a video clip will support new search capabilities, as well as providing valuable context information about video data.

(14 May 2009 - approved)

C-1.23 ENGINEERING GUIDELINE 0809 - KLV Representation of Meteorological Data

The MISB Engineering Guideline 0809 [100] defines KLV metadata elements to convey meteorological information and a metadata construct for the efficient expression of these KLV elements. Fundamental to almost all Advanced Geospatial Intelligence techniques is the characterization of the atmosphere between an observed object/activity and the sensor that records it. This EG provides both the language with which to describe the atmosphere and the mechanisms to convey that knowledge.

(11 December 2008 - approved)

C-1.24 ENGINEERING GUIDELINE 0810 - Profile 2: KLV for LVSD Applications

The MISB Engineering Guideline 0810 [101] describes the metadata elements and metadata structures necessary to support the characterization of LVSD/WALF data, especially for photogrammetry applications.

(14 May 2009 - approved)(30 September 2010 - approved)

C-1.25 STANDARD 0902 - MISB Motion Imagery Sensor Minimum Metadata Set

(Formally called STANDARD 0902 – MISB Minimum Metadata Set)

MISB Standard 0902 [105] is the standard, which specifies the minimum metadata required for MISP compliance. This Standard provides direction on the encoding of the MIS-MMS for transmission from analog systems while supporting a migration path towards digital motion imagery systems.

(14 May 2009 - approved)(3 December 2009 - approved)(20 May 2010 - approved)

C-1.26 STANDARD 0903 - Video Moving Target Indicator Local Data Set

MISB Standard 0903 [106] defines a Local Data Set (LDS) that may be used to deliver Video Moving Target Indicator (VMTI) metadata in accordance with SMPTE (Society of Motion Picture Television Engineers) 336M [40]. This RP also lays out the relationship between the VMTI LDS and other relevant Standards, and gives implementation guidance for the VMTI LDS.

The intent is to provide VMTI metadata to downstream clients for populating Situational Awareness and Common Operating Pictures, generating VMTI overlays on video players and for input to tracking and data fusion systems (e.g. STANAG 4676 compliant systems). In the interests of data efficiency, the VMTI LDS only includes elements relevant to VMTI systems and that are not available in any other Universal or Local data set.

(3 September 2009 - approved)(27 January 2011 – approved)

C-1.27 ENGINEERING GUIDELINE 1002 - Range Image Metadata Set

This Engineering Guideline [115] presents the KLV metadata format and structure necessary for the dissemination of an array of range data collected from the Standoff Precision Identification in Three-Dimensions (SPI-3D) LADAR sensor. This sensor collects its range data in a unique way, where an array of ranges (*i.e.* a range image) is collected with accuracy information for each range (*i.e*. accuracy image). Another unique characteristic of this sensor is that it collects data

through the same physical aperture as a visible or infrared (depending on the mode of the sensor) sensor, which provides identical perspective geometry to the collected range image. In the absence of accompanying Motion Imagery, LADAR data sets should not use this EG.

(20 May 2010 - MISB approved)(30 September 2010 - approved)

C-1.28 ENGINEERING GUIDELINE 1108 – Video Interpretability and Quality Keys

This Engineering Guideline [143] defines the metadata keys necessary to express motion imagery interpretability and quality (IQ) in the transport stream. IQ metadata enables downstream clients for gauging proper operation of video collection and dissemination systems and can be used to direct automatic exploitation software.

C-1.29 RECOMMENDED PRACTICE 1201 – Floating Point to Integer Mapping

This standard describes the method for mapping floating point values to integer values and the reverse, mapping integer values back to their original floating point value to within an acceptable precision. There are many ways of optimizing the transmission of floating point values from one system to another; the purpose of this standard is to provide a single method which can be used for all floating-point ranges and valid precisions. This standard provides a method for a forward and reverse linear mapping of a specified range of floating point values to a specified integer range of values based on the number of bytes desired to be used for the integer value. Additionally, it provides a set of special values which can be used to transmit non-numerical "signals" to a receiving system.

C-1.30 RECOMMENDED PRACTICE 1204 – Motion Imagery Identification System (MIIS)

This recommended practice [145] defines the required identification elements that shall be inserted into motion imagery streams or files, where in the motion imagery data flow (i.e. from source to user) the insertions should happen and the insertion techniques, formats and locations within streams and files. MIIS provides metadata to be able to identify whether two streams are from the same source and to be able to distinguish two streams from the same source. RP 1204 is intended to supersede RP 0608. A stream may contain both RP 0608 and RP 1204. RP 1204 will be a recommended practice for a trial period, after which it will be promoted to a Standard, be referenced by STD 0902, and become mandatory.

Appendix D Transport Protocols and File Containers

Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSG Implementations

D-1 Transport Protocols and File Containers

D-1.1 STANDARD 9701 - MPEG-2 Transport Stream

The MISB Standard 9701 mandates the use of ISO/IEC 13818-1 [16] (MPEG-2) transport stream and the Xon2 implementation for MPEG-2 and H.264 motion imagery. X defines existing or future video compression technologies and on2 refers to the use of MPEG-2 transport streams and files. The DoD has successfully deployed "2on2" payloads, using standards compliant MPEG-2 compressed video elementary streams, audio elementary streams, and SMPTE KLV encoded metadata as MPEG-2 private data streams in support of UAS operations. Building on this baseline capability, "Xon2" provides a migration path to inject improved compressions technologies, which will yield improved image quality and/or reduced bandwidths. H.264 can be carried over the MPEG-2 transport streams using ITU-T Rec. H.222.0 [64].

The use of multiple programs is allowed in MPEG-2 transport streams. Video, audio, and metadata elementary streams which are gen-locked or otherwise on the same time base, and are intended to be kept/used together, shall be carried in a single program within a transport stream.

All User Datagram Protocol (UDP) datagrams encapsulating single program MPEG-2 Transport Stream (TS) packets shall contain an integer number of TS packets. Each UDP datagram may contain a different integer number of TS packets.

It is highly recommended that the maximum integer number of TS packets encapsulated in a UDP datagram be selected to maximize throughput, minimize fragmentation, and minimize errors or losses. For example, in an IP/Ethernet network with a Maximum Transmission Unit (MTU) of 1500 the recommended maximum number would be seven (7) TS packets. It is also recommended that where fragmentation is allowed by the underlying networks that UDP datagrams be allowed to fragment if the underlying network layers reconstruct the UDP datagram to its original whole prior to any extraction of TS packets. In IP networks this appears to be the standard.

(18 September 2008 - approved)(3 September 2009 - approved)(20 May 2010 - approved)

D-1.2 Xon2

"Xon2" is the name of the DoD activity to support the "seamless" rollout of advanced video compression technologies without disrupting current and future operations and systems. "X" defines existing or future video compression technologies and "on2" refers to the use of MPEG-2 transport streams and files. The DoD has already successfully deployed "2on2" payloads, using standards compliant MPEG-2 compressed video elementary streams, audio elementary streams, and SMPTE KLV encoded metadata as MPEG-2 private data streams in support of UAS operations. Building on this baseline "2on2" capability, "Xon2" will provide a migration path to inject improved compressions technologies, which will yield improved image quality and/or reduced bandwidths. Several systems anticipate near term fielding of "Xon2" using advanced video compression technologies, such as H.264 ("264on2"). H.264 can be carried over the MPEG-2 transport streams using ITU-T Rec. H.222.0 [64].

(21 November 2002 - adopted)(8 April 2004 - approved)

D-1.3 RECOMMENDED PRACTICE 0106 - Advanced Authoring Format

The Advanced Authoring Format, including AAF Container Specification v1.0.1, 2004, AAF Object Specification, v1.1, 2005-04-08, AAF Stored Format Specification, v1.0.1, 2004-07-12, and AAF Edit Protocol, 2005-04-08 is recommended for DoD/IC/NSG use, but is not mandated for the exchange of motion imagery and metadata files for collaboration of production work in progress among analysts; storage of work in progress for access by multiple users; and permanent archive of all contributions to a finished work. AAF is recommended but not yet mandated, in anticipation of mandating SMPTE 377-1 MXF and SMPTE 377-2 MXF KXS, given that MXF KXS standardizes all AAF functionality in KLV.

(MISB, 24 May 2001 - submitted for approval) (21 November 2002 - adopted) (12 June 2003-MISB approved changing from authorized to recommended) (20 November 2003 - approved)(20 May 2010 - approved)

D-1.4 RECOMMENDED PRACTICE 0108 - Material Exchange Format

The MISB Recommended Practice 0108 is recommended for DoD/IC/NSG use, but is not mandated for interchange of motion imagery for single programs, finished material between an archive and user and distribution of tailored sections of a finished work to satisfy a user's specific request.

In applications, where digital video files need to be exchanged, real-time or not, between collection platforms, users and data-bases with random access to the motion imagery based on metadata indexing, the Material Exchange Format (MXF), SMPTE 377M, can be used. This format makes use of the sampling, compression and metadata rules and provides advanced features for easy access and exchange over communication networks.

As MXF covers many options and application domains, the present standard restricts as follows the applicable MXF possibilities to a minimum level mandated to achieve interoperability between the implementing entities:

Only operational patterns 1a (OP-1a) and 1b (OP-1b) as per SMPTE 378M [47] and 391M [112], respectively, will be used for file exchange.

The essence will be wrapped frame by frame using the generic container as per SMPTE 379M [48] and SMPTE 381M [50].

From the complete list of metadata sets and properties given by SMPTE 380M, the participating parties will be required to interpret only a minimum profile (derived from ASPA Profile). It must be noted that it is a design rule of MXF players to accept dark (unknown) data which obviously will not be interpreted.

The dynamic metadata will be interleaved with the body.

(MISB, 24 May 2001 - submitted for approval)(12 June 2003-MISB approved changing from authorized to recommended)(amended 25 August 2005)(13 December 2007 - approved)

D-1.5 STANDARD 0301 - MISB Profile for Aerial Surveillance and Photogrammetry Applications

The MISB Standard 0301 [66] governs Aerial Surveillance and Photogrammetry Applications (ASPA) when using the Advanced Authoring Format (AAF) and/or the Material eXchange Format (MXF). The profile constrains the contents of AAF and MXF files to those in accordance with the Motion Imagery Standards Profile (MISP). The ASPA Profile addresses specific operational needs and forms the basis of MXF and AAF developments. The

STANDARD version 0301.5 includes Large Volume Streaming Data (LVSD). On and before 9 April 2008, this document was Recommended Practice 0301.

(18 September 2008 - approved)(14 May 2009 - approved)(20 May 2010 - approved)

D-1.6 ENGINEERING GUIDELINE 0803 - Delivery of Low Bandwidth Motion Imagery

The MISB Engineering Guideline 0803 [94] offers suggested methods for creating and distributing Motion Imagery over low bandwidth channels. Typical exploitation quality motion imagery is generated at MISP MISM level 3 and greater. The motion imagery produced at these levels can exceed the bandwidth of the network delivering motion imagery to users at the edges. To meet network constraints motion imagery asset tradeoffs are required; the imagery may need to be reduced in spatial resolution, temporal rate, or fidelity. In some cases, a combination of reductions is necessary. Alternative measures to meet bandwidth constraints include reducing the quantity of metadata, and transcoding the imagery using different compression.

(18 September 2008 - approved)

D-1.7 RECOMMENDED PRACTICE 0804 - Real-Time Protocol for Full Motion Video

The MISB Recommended Practice 0804 [95] documents the standards profile for packaging and delivering Full Motion Imagery (FMV) data over the Real-Time Protocol (RTP). This RP provides direction on the packetization and streaming of video and metadata using RTP to support diverse IP based networks. The scope of this RP is limited to delivery of Full Motion Video (FMV) products and is not intended to replace any other approved standards for other uses; rather it is intended to complement those standards.

(18 September 2008 - approved)(14 May 2009 - approved)(20 May 2010 - approved)(30 September 2010 - approved)

D-1.8 ENGINEERING GUIDELINE 0812 - Clipping of Streaming Video into Files

The MISB Engineering Guideline 0812 has been incorporated in EG 0813.

(11 December 2008 - approved)(14 May 2009 - approved)

D-1.9 ENGINEERING GUIDELINE 0813 - Integration of Motion Imagery into the Coalition Shared Database

The MISB Engineering Guideline 0813 [103] describes the necessary conditions for integration of motion imagery products into the Coalition Shared Database (CSD). It is technically identical to NATO RP 0803.

(11 December 2008 - approved)

Appendix E Timing and Synchronization

Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSG Implementations

E-1 Timing and Synchronization

E-1.1 STANDARD 9708 - Imbedded Time Reference for Motion Imagery Systems

MISB Standard 0603 [80], Standard 0604 [81], and Standard 0605 [82] shall be the DoD/IC/NSG standards for time annotation and imbedded time references for motion imagery systems.

Furthermore, within SMPTE 12M [26], commonly known as SMPTE time code, the Drop Frame Time Code shall be used for 60/1.001, 30/1.001, 24/1.001 frames per second (FPS) systems. Non-Drop Frame Time Code shall be used for 60, 50, 30, 25, and 24 FPS systems.

SMPTE 309M [37] shall be the DoD/IC/NSG Standard for precision time and date imbedding into SMPTE 12M time code data streams.

Furthermore, within SMPTE 309M, DoD/IC/NSG users will use the Modified Julian Date (MJD) (Y2K compliant) date encoding format and Universal Coordinated Time (UTC) as the time zone format.

(VWG, 26 March 1997 - adopted as amended)(ISMC, 12 June 1997 - approved)(VWG, 25 February 1998 - language editorially revised)(ISMC, 6 March 1998 - approved)(MISB, 10 August 2006 - approved)(18 September 2008 - approved)

E-1.2 STANDARD 9714 - Time Code Embedding

Digital Vertical Interval Time Code (D-VITC) shall be embedded on digital video line 14 of all ITU-R BT.601 [23] Component (4:2:2) and bit-serial interface systems. Users may implement LTC for internal processing (such as in tape recorders) provided D-VITC is always forwarded to the next processing element on digital video line 14.

Furthermore, SMPTE Ancillary Time Code (embedded in the bit-serial interface Ancillary data space) may be used instead of D-VITC, provided such time code data is part of other metadata delivered by the ancillary data stream.

Date and Time Zone information defined by SMPTE 309M [37] shall be used to achieve Year 2000 (Y2K) compliance by all DoD/IC/NSG systems.

(VWG, 26 March 1997 - approved for study; VWG, 19 November 1997- language revised)(VWG, 8 June 1999 - study completed; recommended to GSMC-ISMC for approval)(GSMC-ISMC, 12 August 1999 - approved)

E-1.3 STANDARD 9715 - Time Reference Synchronization

Universal coordinated time (UTC, also known as “Zulu”), clock signals shall be used as the universal time reference for DoD/IC/NSG SMPTE 12M [26] time code systems, allowing systems using time code to accurately depict the actual Zulu time of day of motion imagery acquisition/collection/operations.

Furthermore, when DoD/IC/NSG “original video acquisition” motion imagery sequences are used as sources for editing onto new “edit master” sequences, the “edit master” sequence may have a new, continuous time code track. The time code for the new sequence should reflect the “document date” of the new motion imagery product.

Furthermore, Standard RP 0603 [80], “Common Time Reference for Digital Motion Imagery Using Coordinated Universal Time (UTC)” provides a global common reference frequency and

absolute timing for digital motion imagery collected from multiple sensors in different locations, multiple sensors on the same platform, and single sensor configurations requiring precise correlation of video and metadata.

(VWG, 19 November 1997, adopted as amended)(VWG, 25 February 1998 - language revised)(ISMC, 6 March 1998 – approved)(MISB, 11 May 2006, adopted as amended)

E-1.4 STANDARD 0604 - Time Stamping and Transport of Compressed Motion Imagery and Metadata

The MISB Standard 0604 [81] defines the standard for time stamping compressed digital motion imagery.

(10 August 2006 - draft for review)(14 June 2007- approved)(18 September 2008 - approved)(9 June 2011 - approved)

E-1.5 STANDARD 0603 - CommonTime Reference for Digital Motion Imagery Using Coordinated Universal Time (UTC)

The MISB Standard 0603 [80] defines setting and using common UTC time reference for digital motion imagery.

(10 August 2006 - adopted)(9 June 2011 - approved)

E-1.6 STANDARD 0605 - Inserting Time Stamps and Metadata in High Definition Uncompressed Video

The MISB Standard 0605 [82] defines time stamping of uncompressed digital motion imagery.

(10August 2006 - adopted)(13 September 2007- approved)(15 May 2008 - approved)(9 June 2011 - approved)

Appendix F Video NIIRS

F-1 Motion Imagery Quality Metrics

F-1.1 RECOMMENDED PRACTICE 0901 - Video NIIRS

The MISB Recommended Practice 0901[104] defines a Video National Imagery Interpretability Rating Scale (Video NIIRS) for the human/visual rating of motion imagery quality (interpretability). The intent of the Video NIIRS is to provide a common frame of reference for the subjective rating of the intelligence potential of motion/video clips. The Video NIIRS consists of calibrated criteria sets that are designed to provide repeatable statistical agreement of analyst ratings across a population. The Video NIIRS provides criteria sets for seven orders of battle and ten quality levels. Orders of battle include air forces, ground forces, missiles, naval forces, electronics, culture, and security. The quality levels are integer based and range from zero to nine depicting increased spatial and temporal resolution with each ascending level. The document also provides an explanation of the scale's construct and instructions for its use in rating video quality and its employment in scientific studies and evaluations.

(3 December 2009 - approved)

F-1.2 ENGINEERING GUIDELINE 1203 – Video Interpretability and Quality Measurement and Prediction

This Engineering Guideline [146] defines an automated algorithmic means to computer Video NIIRS without a reference. Methods other than EG 1203 should be considered when reference imagery is available. When using the method defined in EG 1203 to populate EG 1108 metadata, the interpretability and quality method key within EG 1108 must be set to the major version number of the EG 1203 document, currently 2.

F-1.3 ENGINEERING GUIDELINE 1205 – Video Test Sequences

EG 1205 [147] provides a file and metadata nomenclature for injected motion imagery test sequences. Video test sequences are injected prior to compression, and data transmission. The calibration clips are meant to be used in operational system to test end-to-end operations; however, they can also be used in a laboratory setting as a standard benchmark. Metadata signaling the presence of a test sequence is defined.

Appendix G Interoperability Profiles

This Appendix removed

Appendix H Technical Reference Material

H-1 Technical Reference Material

H-1.1 TRM 07A Low Bandwidth Motion Imagery - Technologies

TRM 07A provides information on technologies relevant to the delivery of motion video, audio, and metadata to users whose information channel is characterized as low bandwidth consistent with the MISP MISM Levels L2, L1, and L0. This document does not mandate or recommend instantiations of technologies; other MISB documents exist for that purpose. Rather, this document is a survey of pertinent technologies to video over low-bandwidth channels, and should serve as an informative guide when implementing low-bandwidth motion imagery systems. It indicates where MISB approved technologies are appropriate, and provides an aid in appreciating tradeoffs and current industry practices.

H-1.2 TRM 0909 Constructing a MISP Compliant File

TRM 0909 provides guidance on how to construct an example MISP (Motion Imagery Standards Profile) compliant file/stream using technologies approved by the Motion Imagery Standards Board. *It is intended as informative only and is not exhaustive in covering all possible combinations and technologies approved under the MISP. The material here is directly related to Electro-Optical and Infrared imagery and not Large Volume Streaming Data (LVSD).*

H-1.3 TRM 1003 Forward Error Correction for Motion Imagery over IP

Internet Protocol (IP) was never intended to carry real-time signals such as video. Advances in protocols like RTP are specifically designed for real-time signal delivery over IP; however, quality of service is still not guaranteed. IP data integrity is subject to the path taken where various disparate networks may be traversed and numerous router types encountered. Depending on network traffic data packets may be discarded because of congestion, reshuffled in arrival because of the different paths an IP packet may take, or delayed beyond their useful lifetime. Forward Error Correction (FEC) methods afford detection and correction of certain errors in data transmission, and so provide powerful tools in ensuring a certain level of data delivery. This document serves to illuminate the challenges in choosing a FEC method.

H-1.4 TRM 1006 Key-Length-Value (KLV) Users Guide

This document outlines the rules, parsing, and structures for KLV usage.

H-1.5 TRM 1007 Surfing the MISP

This document provides an overview of the functions of the MISB, and identifies Standards, Recommended Practices, and Engineering Guidelines in abbreviated form.

H-1.6 TRM 1012 H.264 Study for Mobile Devices

FMV to the tactical edge—considered as that to a disadvantaged user— is generally labeled as providing Situational Awareness (SA) FMV. SA FMV can be of various data rates, levels of quality, and provided using different delivery vehicles to meet the constraints of channel bandwidth, channel type (wired/wireless), and client device. Understanding of the H.264 compression profiles, structures and features across this wide variation in usage should prove valuable guidance.

Appendix I References and Bibliography

1. ATSC Doc. A/53, *Advanced Television Standard*, 16 Sep 1995
2. Code of Federal Regulations, Title 47, Chapter 1, Part 15, Section 119 (47CFR15.119), *Closed Caption Decoder Requirements for Television Receivers*, Revised 1 Oct 1998
3. DoD Directive 5105.60, *National Geospatial-Intelligence Agency (NGA)* Jul 29, 2009
4. *DoD Joint Technical Architecture (JTA)*, Version 4.0, 2 Apr 2001
5. EIA, *Recommended Practice for Advanced Television Closed Captioning*, R-4.3 subcommittee, draft, Jul 1, 1994
6. EIA/CEA-608-B, *Recommended Practice for Line 21 Data Service*, Oct 2000
7. EIA/CEA-708-B, *Digital Television (DTV) Closed Captioning*, Dec 1999
8. A005r5, *Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)*, 2009
9. ETSI TS 101 162, *Digital broadcasting systems for television, sound, and data services: Allocation of Service Info. (SI) codes for Digital Broadcasting (DVB) systems*, 2009
10. ETSI EN 300 468, *Digital broadcasting systems for television, sound, and data services: Specification for Service Information (SI) in Digital Video Broadcasting (DVB) systems*, 2009
11. ETSI EN 300 743, *Digital Video Broadcasting (DVB); DVB subtitling*, 2006
12. FCC Fourth Report and Order, *Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service*; Adopted 24 December 1996 (Released 27 Dec 1996)
13. IEEE STD 1394, *Standard for a High Performance Serial Bus – Firewire:* 2008
14. IEEE 1394A-2000, *superseded by IEEE STD 1394:2008*
15. IEEE 1394B-2002, *superseded by IEEE STD 1394:2008*
16. ISO/IEC 13818-1, *Information technology - Generic coding of moving pictures and associated audio information, Part 1: Systems*, 2007 (also known as MPEG-2 Systems)
17. ISO/IEC 13818-2, *Information technology - Generic coding of moving pictures and associated audio information, Part 2: Video*, 2000 (aka MPEG-2 Video)
18. ISO/IEC 13818-3, *Information technology - Generic coding of moving pictures and associated audio information, Part 3: Audio*, 1998 (aka MPEG-2 Audio)
19. ISO/IEC 13818-4, *Information technology - Generic coding of moving pictures and associated audio information, Part 4: Compliance Testing*, 2004 (aka MPEG-2 Compliance)
20. ISO/IEC 13818-6, *Information technology - Generic coding of moving pictures and associated audio information, Part 6: Extension for Digital Storage Media Command and Control*, 1998 (aka MPEG-2 DSM-CC)
21. ISO/IEC 13818-9, *Information technology - Generic coding of moving pictures and associated audio information, Part 9: Real-time Interface Specification*, 1996 (aka MPEG-2 RTI)
22. ISO/IEC 14496-2, *Coding of audio-visual objects, Part 2: Visual*, 2004 (also known as MPEG-4)
23. ITU-R BT.601-6, *Studio encoding parameters for digital television for standard 4:3 and wide-screen 16:9 aspect ratios*, 2007
24. ITU-R BT.1208-1, *Video coding for digital terrestrial television broadcasting*, 10/97
25. MIL-STD-2500C, *National Imagery Transmission Format Version 2.1 for the National Imagery Transmission Format Standard*, 1 May 2006
26. SMPTE ST 12M-1:2008, *Television, Audio and Film - Time and Control Code*
27. SMPTE ST 170:2004, *Television - Composite Analog Video Signal - NTSC for Studio Applications*
28. SMPTE ST 259:2008, *Television - 10-Bit 4:2:2 Composite and 4 fsc Composite Digital Signals - Serial Digital Interface*
29. SMPTE ST 274:2008, *Television - 1920 x 1080 Scanning and Interface*
30. SMPTE ST 291:2006, *Television - Ancillary Data Packet and Space Formatting*

31. SMPTE ST 292:2008, *Television - Bit-Serial Digital Interface for High-Definition Television Systems*
32. SMPTE ST 294:2001, *Television - 720 x 483 Active Line at 59.94-Hz Progressive Scan Production - Bit-Serial Digital Interfaces*
33. SMPTE ST 295:2008, *Television - 1920 x 1080 50-Hz - Scanning and Interface*
34. SMPTE ST 296:2001, *Television - 1280 x 720 Progressive Image Sample Structure - Analog and Digital Representation and Analog Interface*
35. SMPTE ST 297:2006, *Television - Serial Digital Fiber Transmission System for ANSI/SMPTE 259M Signals*
36. SMPTE ST 305:2005, *Serial Data Transport Interface (SDTI)*
37. SMPTE ST 309:1999, *Transmission of Date and Time Zone Information in Binary Groups of Time and Control Code*
38. *NSG Technical Architecture*, Revision A, 26 Jan 1999
39. SMPTE ST 335:2001, *Metadata Dictionary Structure*
40. SMPTE ST 336:2007, *Data Encoding Protocol Using Key-Length-Value*
41. SMPTE ST 355:2001, *Format for Non-PCM Audio and Data in AES3 - KLV Data Type*
42. SMPTE RP210.10:2007, Metadata Dictionary Registry of Metadata Element Descriptions
43. SMPTE EG37:2001, *Node Structure for the SMPTE Metadata Dictionary*
44. ITU-R BT.1358-1, *Studio Parameters of 525 and 625 Line Progressive Scan Television Systems*, 2007
45. SMPTE EG 41:2004, *Material Exchange Format (MXF) Engineering Guideline (Informative)*
46. SMPTE ST 377-1:2009, *Material Exchange Format (MXF) File Format Specification (Standard)*
47. SMPTE ST 378:2004, *Material Exchange Format (MXF) Operational pattern 1A (Single Item, Single Package)*
48. SMPTE ST 379-1:2009, *Material Exchange Format (MXF) MXF Generic Container*
49. SMPTE EG 42:2004, *Material Exchange Format (MXF) MXF Descriptive Metadata*
50. SMPTE ST 381:2005, *Material Exchange Format (MXF) Mapping MPEG streams into the MXF Generic Container (Dynamic)*
51. SMPTE ST 380:2004, *Material Exchange Format (MXF) Descriptive Metadata Scheme-1 (Standard, Dynamic)*
52. SMPTE ST 393:2004, *Material Exchange Format (MXF) Operational Pattern 2b (Play-List Items, Ganged Packages)*
53. Advanced Authoring Format Object Specification, V 1.1, 2005-04-08, http://www.amwa.tv/downloads/specifications/aafobjectspec-v1.1.pdf
54. SMPTE ST 342:2004, *HD-D5 Compressed Video 1080i and 720p Systems - Encoding process and Data Format*
55. MISB RP 0101.1, *Use of MPEG-2 System Streams in Digital Motion Imagery Systems*, 27 Jan 2011
56. MISB STANDARD 0102.9, *Security Metadata Universal and Local Sets for Digital Motion Imagery*, 30 Sep 2010
57. MISB EG 0104.5, *Predator UAV Basic Universal Metadata Set*, 14 Dec 2006
58. MISB STANDARD 0107.1, *Bit and Byte Order for Metadata in Motion Imagery Files and Streams*, 9 Jun 2011
59. ISO/IEC 13818-1:2000/AMD 1: 2003, revised by ISO/IEC 13818-1:2007
60. ISO/IEC 13818-1:2000/AMD 3: 2004, revised by ISO/IEC 13818-1:2007
61. SMPTE RP 217:2001, *Non-synchronized Mapping of KLV Packets into MPEG-2 System Streams*
62. SMPTE ST 349:2001, *Transport of Alternate Source Image Formats though SMPTE 292M*

63. SMPTE RP 214:2002, *Packing KLV Encoded Metadata and Data Essence into SMPTE 291M Ancillary Data Packets*
64. ITU-T Rec. H.222.0 (05/06), *Generic coding of moving pictures and associated audio information: Systems*
65. ITU-T Rec. H.264 *Advanced Video Coding for Generic Audio Visual Services*, 03/2009. (ISO/IEC 14496-10:2009)
66. MISB STANDARD 0301.5, *MISB Profile for Aerial Surveillance and Photogrammetry Applications (ASPA)*, Version 1.5, 20 May 2010
67. SMPTE ST 372:2009, *Dual Link 292M Interface for 1920 x 1080 Picture Raster*
68. SMPTE ST 337:2008 *Format for Non-PCM Audio and Data in an AES3 Serial Digital Audio Interface*
69. SMPTE ST 339:2008 *Format for Non-PCM Audio and data in AES3-Generic Data Type*
70. IIDC 1394-based Digital Camera Specification, Version 1.31, 1394 Trade Association, 2003
71. ISO/IEC 10918-1:1994, Information technology - *Digital compression and coding of continuous-tone still images: Requirements and guidelines*
72. ISO/IEC 15444-1:2004, Information technology - *JPEG 2000 image coding system: Core coding system*
73. ISO/IEC 15444-2:2004, Information technology - *JPEG 2000 image coding system: Extensions*
74. ISO/IEC 15444-3:2007, Information technology - *JPEG 2000 image coding system - Part 3: Motion JPEG 2000*
75. ISO/IEC 15444-9:2005, Information technology - *JPEG 2000 image coding system - Part 3: Interactive protocols and APIs*
76. ISO/IEC 15444-12:2008, Information technology - *JPEG 2000 image coding system - Part 12: ISO base media file format*
77. MISB STANDARD 0601.5, *UAS Datalink Local Metadata Set*, 6 Oct 2011
78. MISB RP 0602.2, *Annotation Universal Metadata Set*, 14 May 2009
79. MISB EG 0607, *MISB Metadata Registry and Processes*, 18 Sep 2008
80. MISB STANDARD 0603.1, *Common Time Reference for Digital Motion Imagery using Coordinated Universal Time (UTC)*, 9 Jun 2011
81. MISB STANDARD 0604.2, *Time Stamping and Transport of Compressed Motion Imagery and Metadata*, 9 Jun 2011
82. MISB STANDARD 0605.3, *Inserting Time Code and Metadata in High Definition Uncompressed Video*, 9 Jun 2011
83. MISB RP 0608.2, *Motion Imagery Identification*, 30 Sep 2010
84. MISB RP 0701, *Common Metadata System - Structure*, 6 Aug 2007
85. SMPTE ST 422:2006, *Material Exchange Format - Mapping JPEG 2000 Codestreams into MXF Generic Container*
86. SMPTE ST 424:2006, *3 Gb/s Signal/Data Serial Interface*
87. SMPTE ST 435-1,2,3:2009, *10 Gb/s Serial Signal Data Interface*
88. MISB RP 0705.2, *LVSD Compression Profile*, 18 Sep 2008
89. ISO/IEC BIIF Profile BPJ2K01.10, *BIIF Profile of JPEG 2000 Version 01.10*, 15 Apr 2009
90. IETF RFC 3550 *RTP: A Transport Protocol for Real-Time Applications*, 2003
91. IETF RFC 2326 *Real Time Streaming Protocol (RTSP)*, 1998
92. MISB EG 0801.3, *Profile 1: Photogrammetry Metadata Set for Digital Motion Imagery*, 6 Oct 2011
93. MISB EG 0802.1, *H.264/AVC Coding and Multiplexing*, 30 Sep 2010

94. MISB EG 0803, *Delivery of Low Bandwidth Motion Imagery*, 24 Apr 2008
95. MISB RP 0804.3, *Real-Time Protocol for Full Motion Video*, 30 Sep 2010
96. MISB EG 0805, *Cursor on Target (CoT) conversion for Key-Length-Value (KLV) Metadata*, 18 Sep 2008
97. MISB EG 0806.3, *Remote Video Terminal Local Data Set*, 3 Sep 2009
98. MISB STANDARD 0807.10, *MISB DoD/IC/NSG KLV Metadata Registry*, Oct 2012
99. MISB RP 0808, *Ancillary Text Metadata Sets*, 14 May 2009
100. MISB EG 0809, *KLV Representation of Meteorological Data*, 9 Dec 2008
101. MISB EG 0810.2, *Profile 2: KLV Metadata for LVSD Applications*, 30 Sep 2010
102. MISB RP 0811, *JPIP Profile (Client/Server Functions)*, 14 May 2009
103. MISB EG 0813, *Integration of Motion Imagery into the Coalition Shared Database*, 11 Dec 2008
104. MISB RP 0901.1, *Video-National Imagery Interpretability Rating Scale*, 4 Oct 2012
105. MISB STANDARD 0902.1, *Motion Imagery Sensor Minimum Metadata Set*, 9 Jun 2010
106. MISB STANDARD 0903.3, *Video Moving Target Indicator and Track Metadata Local Data Set*, 5 October 2012
107. MISB EG 0904, *H.264 Bandwidth/ Quality/ Latency Tradeoffs*, 3 Sep 2009
108. USIP reference removed
109. MISB RP 0403.1, *Digital Representation and Source Interface formats for Infrared Motion Imagery mapped into 1280 x 720 format Bit-Serial Digital Interface*, Feb 2010
110. MISB STANDARD 0404, *Compression for Infrared Motion Imagery*, 3 Dec 2009
111. SMPTE ST 394:2006, *Material Exchange Format (MXF) - System Scheme 1 for the MXF Generic Container*
112. SMPTE ST 391:2004**,** *Material Exchange Format (MXF) – Operational Pattern 1b (Single Item, Ganged Packages)*
113. MISB RP 0402.5, *Infrared Motion Imagery Capture*, Aug 2006
114. MISB EG 1001, *Audio Encoding in MPEG-2 Transport Stream*, 20 May 2010
115. MISB EG 1002, *Profile 3: Range Image Metadata Set*, 20 May 2010
116. ISO 11172-3:1993, *Information technology - Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbit/s - Part 3: Audio*, 1 Aug 1993
117. ISO 13818-7:2004, *Information technology - Generic coding of moving pictures and associated audio information - Part 7: Advanced Audio Coding (AAC)*, 15 Oct 2007
118. MISB TRM 07A Low Bandwidth Motion Imagery - Technologies, 16 Jun 2008
119. TRM 0909.3 Constructing a MISP Compliant File, 11 Apr 2011
120. TRM 1003 Forward Error Correction for Motion Imagery over IP, 16 Mar 2010
121. TRM 1006 Key-Length-Value (KLV) Users Guide, 20 May 2010
122. TRM 1007 Surfing the MISP, May 2010
123. MISB RP 9721, Motion Imagery Tape Formats
124. IETF RFC 3984, *RTP Payload Format for H.264 Video*, Feb 2005
125. SMPTE ST 352:2010, Video *Payload Identification Codes for Serial Digital Interfaces*
126. SMPTE ST 330:2004, *Unique Material Identifier (UMID)*
127. SMPTE ST 337:2008, *Format for Non-PCM Audio and Data in AES3 Serial Digital Audio Interface*
128. SMPTE ST 339:2008, *Format for Non-PCM Audio and Data in AES3 – Generic Data Types*
129. SMPTE ST 395:2003, *Television – Metadata Groups Registry Structure*
130. SMPTE ST 400:2004, *Television – SMPTE Labels Structure*

131. SMPTE ST 328:2000, *Television – MPEG-2 Video Elementary Stream Editing Information*
132. SMPTE ST 425:2008, *3 Gb/s Signal/Data Serial Interface – Source Image Format Mapping*
133. SMPTE RP 224 v10:2009, *SMPTE Labels Register*
134. IETF RFC 4122, A *Universally Unique IDentifier (UUID) URN Namespace*, Jul 2005
135. IETF RFC 3551, *RTP Profile for Audio and Video Conferences with Minimal Control*, Jul 2003
136. IETF RFC 793, *TRANSMISSION CONTROL PROTOCOL*, Sep 1981
137. IETF RFC 2045, *Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies*, Nov 1996
138. IETF RFC 2046, *Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types*, Nov 1996
139. IETF RFC 2616, *Hypertext Transfer Protocol -- HTTP/1.1*, Jun 1999
140. ISO/IEC 15948:2004, *Computer graphics and image processing -- Portable Network Graphics (PNG): Functional specification*
141. ISO.IEC 8601:2004, *Data elements and interchange formats -- Information interchange -- Representation of dates and times*
142. IEEE 1003.1, *Information Technology--Portable Operating System Interface (POSIX)*, 2004
143. MISB EG 1108.1, *Video Interpretability and Quality Keys*, 1 Oct 2012
144. MISB RP 1201, *Floating Point to Integer Mapping*, 29 Feb 2012
145. MISB RP 1204, *Motion Imagery Identification System (MIIS)*, 7 Jun 2012
146. MISB EG 1203.2, *Video Interpretability and Quality Measurement*, 4 Oct 1012
147. MISB EG 1205, *Video Test Sequences*, 4 Oct 2012

Appendix J MISP Versions

Approved Versions of Standards, Recommended Practices, Engineering Guidelines and Interoperability Profiles that meet MISP Compliance per MISP Version

Table J-1 reflects all related document versions for a particular version of the MISP. Additional editorial changes to text within a particular version of the MISP and other materials can be found in Appendix K. Only versions of the MISP that can be classified as meeting MISP Compliance for certification by the JITC are listed here.

Table J-1: Document Changes per MISP Version Released

MISP Version	Approved Standards, Recommended Practices, Engineering Guidelines, and Interoperability Profiles
4.4	RP 0102.4 RP 0705.1
4.5	All EO MPEG2/H.264 MI systems must decode up to/including MISM L9 All IR MPEG2/H.264 MI systems must decode up to/including IRSM L8 RP 0102.5 RP 0301.3
5.0	STD 9701 restated text STD 0102.5 (promoted from RP) STD 0601.2 (promoted from RP) STD 0604 (promoted from RP) STD 0807 RP 0804 RP 0705.2 EG 0803 EG 0805 EG 0806 EG 0602 changed to EG 0607
5.1	STD 0807.1 EG 806.1 EG 0809 EG 0812
5.2	STD 0102.6 STD 0301.4 STD 0601.3 STD 0807.2 RP 0103 deprecated RP 0804.1 RP 0602.2 RP 0808 RP 0811 EG 0802 EG 0806.2 EG 0810 EG 0813 EG 0902 EG 0801.1 IP 0905
5.3	STD 0102.7 STD 0604.1 STD 0807.3 EG 0806.3 EG 0903 EG 0904

MISP Version	Approved Standards, Recommended Practices, Engineering Guidelines, and Interoperability Profiles
5.4	STD 0404 STD 0601.4 (not approved; under review and revision) STD 0807.4 STD 0902.1 RP 0403.1 EG 0801.2
5.5	STD 0102.8 STD 0301.5 STD 0601.4 (error: previously listed as version 5) STD 0807.5 RP 0804.2 RP 1004 EG 1001 EG 1002 TRM 1003
6.0	STD 0102.9 STD 0807.6 RP 0608.2 RP 0804.3 EG 0801.3 (not approved; under review and revision) EG 0810.2 TRM 0909.1 TRM 1007 TRM 1012
6.1	STD 0807.7 RP 0101.1 TRM 0909.2
6.2	STD 0107.1 STD 0603.1 STD 0604.2 STD 0605.3 RP 0903.2 TRM 0909.3
6.3	STD 0601.5 STD 0807.8 RP 1201 EG 0801.3 EG 1108
6.4	STD 0903.3 STD 0807.10 RP 0901.1 RP 1204 EG 1108.1 EG 1203.2 EG 1205

Appendix K Revision Record

Date on Document	Version Number	Revision Record: Notes/Status
16 Jan 1997	0.96	Version 0.96 – First VWG VISP document under configuration control. 16 Jan 97 document plus 30-day provisional adoption items. Submitted to VWG and adopted with agreed changes on 26 Mar 97.
26 Mar 1997	0.97	Final baseline version as adopted by VWG (includes agreed changes from 26 Mar 97). Submitted to ISMC for approval. Approved by ISMC on 12 Jun 97 with agreed minor changes.
12 Jun 1997	1.00	Final ISMC approved baseline version (includes agreed minor changes from 12 Jun 97).
26 Sep 1997	1.10	Incorporates the following changes approved by the ISMC on 26 Sep 1997: V97-001 – Video Systems Matrix update - Section 4.0 - RP 9720 V97-002 - Change of document title to: "Video Imagery Standards Profile" (Includes editorial changes and reorganization to align with other DoD/IC/NSG standards documents)
19 Nov 1997	1.20	Incorporates the following changes approved by the VWG on 19 Nov 1997: V98-001 - Updates to and adoptions of Standard 9715 (Time Reference Synchronization), Updates to and adoptions of Standard 9723 (Advanced Television). Updates to and adoption of Video Systems Matrix RP 9720a (HD).
7 Jan 1998	1.21	Returns Standard 9723 (Advanced Television) to Emerging status and RP 9720a (HD) to Study status pending formal GSMC-ISMC approval; incorporates Explanatory/editorial changes. Note that 1.21 is the reference baseline for JTA 2.0
25 Feb 1998	1.22	Incorporates revisions to 1.2 (based on 60 days Comments Period); incorporates explanatory/editorial changes. Incorporates changes from 25 Feb VWG.
6 Mar 1998	1.3	GSMC-ISMC Approved as Amended.
8 Jun 1999	1.4	Incorporates the following changes provisionally approved by the VWG on 20 Jan 1999 and with language revised by VWG on 8 June 1999: 1. Addition of a DoD/IC/NSG Video Imagery Migration Objective section to Chapter 1. 2. Movement of 9714, Time Code Embedding, from Study to Standard status. 3. Temporary suspension of a portion of 9723 (FCC Fourth Report and Order). 4. Revision of Metadata Studies 9712, 9713, 9716, 9717, 9718 to reflect recent changes in draft SMPTE standards. 5. New Studies 9903, 9904, 9905 for NITF wrapper for motion imagery, MPEG-2 PS sub-header, and Concise KLV Encoding. 6. Extensive revision of Recommended Practice 9720 to include addition of Enhanced Definition as a new VSM band with other VSM definitions changed accordingly. Note that the inclusion of this new definition required an extensive re-write of the VSM concept. Therefore, the new VSM scale will hereafter be annotated as VSM Revision 1 (VSM r1). 7. Movement of 9902 from Study to Recommended Practice 9902 status, authorizing limited applications of DV format video 8. Explanatory/editorial changes: a. Added Table of Contents b. Expanded References c. Added Glossary of Acronyms
12 Aug 1999	1.4	GSMC-ISMC Approved
20 Oct 1999	1.5	20 October meeting of VWG approved and recommended to GSMC-ISMC the movement of Metadata Studies 9712, 9713, 9716, 9717, 9718 to STANDARDS status; new Study 9906 on Segmentation and Re-assembly of KLV Packets; identification of relevant VWG documents for metadata standards; update to VISP version chronology; editorial changes.
24 Feb 2000	1.5	GSMC-ISMC Approved.
27 Jul 2000	1.6	1. Presented at the Motion Imagery Standards Board Meeting. Incorporates the

Date on Document	Version Number	Revision Record: Notes/Status
		following changes: 2. Editorial changes related to the change from VWG to MISB 3. Adoption of SMPTE Standards and Recommended Practices for Metadata Dictionary and KLV encoding protocol 4. Adoption of MISB Standard 001-720P to update to multiple frame rates including 24, 25 and 50 Hz
02 Nov 2000	1.6	GSMC-ISMC Approved.
7 Feb 2001	1.7	Approved by the Motion Imagery Standards Board. Incorporates the following changes: 1. Editorial changes in terminology from video to motion imagery 2. Acceptance of SMPTE 305.2M-2000, Serial Data Transport Interface; Movement of 9803 from Study status. 3. Acceptance of SMPTE 296M-2001, 1280 x 720 Progressive Image Sample Structure; Replaces the identical MISB Standard 0001-720P, which has been rescinded. 4. Acceptance, upon 30-day review, of RP – 0101, MPEG-2 System Streams 5. Acceptance, upon 30-day review, of RP – 0102, Security Metadata Universal Set; 6. Acceptance of four items for Study; 0103 - Timing Reconciliation; 0104 - Predator Engineering Guideline for Closed Captioning; 0105 - Unmanned Vehicle Metadata Sets; 0106 – Advanced File Formats *(direct request to GSMC/ISMC)* 7. Cancelled Study items 9905 and 9906
1 Mar 2001	1.7	GSMC-ISMC Approved.
24 May 2001	1.8	Submitted to the Motion Imagery Board for approval on 24 May 2001. Substantive changes are: 1. ITU-R BT.1358 replaces SMPTE 293M as the Enhanced Definition Standard 2. Adopts RP 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery 3. Adopts Engineering Guideline 0104 - Basic Predator KLV Metadata 4. Adopts RP 0106 on Advanced Authoring Format 5. Adopts RP 0107 on Material Exchange Format (Oct 2011 – renumber to 0108) 6. Updates to SMPTE RP210.3 metadata dictionary from RP210.2
11 Oct 2001	2.0	Submitted on 11 October 2001 to the Motion Imagery Board for provisional 30-day approval. Substantive changes are: 1. Editorially revised to be NATO friendly 2. ISO/IEC 13818-1, *Information technology - Generic coding of moving pictures and associated audio information*, Part 1: Systems, 2000 (also known as MPEG-2 Systems), includes amendments and replaces 13818-1, 1995 including Amendment 1: Registration Procedure for Copyright Identifier, Amend. 2: Registration of Private Data, and Draft Amendment 3: DSM-CC and Private Data. ISO/IEC 13818-2, Information technology - Generic coding of moving pictures and associated audio information, Part 2: Video, 2000 (also known as MPEG-2 Video), includes amendments and replaces 13818-2, 1995 including Amendment 1: Registration Procedure for Copyright Identifier, Amendment 2: 4:2:2 Profile, Amendment 3: Multi-view Profile, and Draft Amendment 4: ITU-T Extension Code Assignment. Adopt RP on Bit and Byte Order. Adopt MPEG-2 Amendment for Synchronization of Metadata. Adopt the revised Metadata RPs. Adopt Study on Scathe View Metadata.
20 Nov 2003	2.3	Approved by MISB. If no objection in 30 days from this date, 2.3 will be the

Date on Document	Version Number	Revision Record: Notes/Status
		approved MISP. 1. Recommended the AAF Profile ASPA 0.7 for Aerial Surveillance and Photogrammetry Applications 2. Updated commercial standards references 3. Updated MISP RP 0102.1 to 0102.2 4. Updated MISP EG 0104.1 to 0104.2 5. Added 3 studies 6. Updated data rates for various motion imagery standards levels 7. Added guidance for the use of H.264 for low bit rate applications
8 Apr 2004	2.4	Approved by MISB. If no objection in 30 days from this date, MISP 2.4 will be the approved MISP. 1. Updated Infrared 2. Update AAF Profile ASPA 0.7 to 0.8 3. Allowed the use of H.264 for Standard Definition and Enhanced Definition Motion Imagery 4. Added data rates for H.264 5. Updated EG 0104.2 to 0104.3 6. Added one study 7. Updated references
26 Aug 2004	3.0	Approved by MISB. If no objection in 60 days from this date, MISP 3.0 will be the approved MISP. 1. Added Section 3 on Infrared Standards 2. Added Study on Infrared Standards 3. Modified recommended practice tables 4. Updated references 5. Modified line for embedding Vertical Interval Time Code 6. Editorial changes
9 Dec 2004	3.1	Approved by MISB. If no objection in 60 days from this date, MISP 3.1 will be the approved MISP. 1. SMPTE 210.8 to SMPTE 210.9 2. ASPA 0.8.2 to ASPA 0.8.3 3. MISP STD 0403 Serial Interface STD for IR 4. H.264 for High Definition Motion Imagery 5. Added 16 bit and H.264 for IR
29 Apr 2005	3.2	Approved by MISB. If no objection in 60 days from this date, MISP 3.2 will be the approved MISP. 1. New MISM Levels for situational awareness 2. Changes to MISM Levels for High Definition and Advanced High Definition 3. Revisions to metadata via AES-3
25 Aug 2005	3.3	Approved by MISB. If no objection in 60 days from this date, MISP 3.3 will be the approved MISP. 1. New MISM Levels for situational awareness 2. Engineering Guideline EG 0104.4, “Predator UAV Basic Universal Metadata Set” was updated 3. Recommended modes for IEEE 1394 4. Added three studies
Jan 2006	3.4	Approved by MISB. If no objection in 60 days from this date, MISP 3.3 will be the approved MISP. 1. Engineering Guideline 0601 – UAV Datalink Local Metadata Set 2. Recommended Practice 0602 – Annotation Universal Metadata Set 3. STUDY 0601 – Study and Propose Compression Methods for Advanced High Definition Motion Imagery Levels L12 and L13

Date on Document	Version Number	Revision Record: Notes/Status
		4. STUDY 0602 – Study and Propose Methods for Time Stamping of Metadata and Motion Imagery for reliable Synchronization 5. STUDY 0603 – MISB Metadata Registry 6. STUDY 0604 – Cursor-on-Target (CoT)
May 2006	3.5	Approved by MISB. If no objection in 60 days from this date, MISP 3.3 will be the approved MISP. 1. Recommended Practice 0606 – Authorized Use of JPEG 2000 or Motion JPEG 2000 for Wide Area Large Format Motion Imagery 2. Engineering Guideline 0602 – MISB Metadata Registry 3. STANDARD 0403 – Digital Representation and Source Interface Formats for Infrared Motion Imagery Mapped into 1280 x 720 Format Bit-Serial Digital Interface (added IEEE 1394 input/output protocols, specifically IIDC 1394-based Digital Camera Specification Version 1.31 Format_0 Mode_6 may be used for 640x480 IR. See Study 0501) 4. Changed references to ITU-T Rec. H.264/ AMD1: 2004, Advanced Video Coding Fidelity Range Extensions, expanded to include the new High 4:4:4 Profile 5. STUDY 0605 – Encoder Tradeoff study
10 Aug 2006	4.0	Approved by MISB. If no objection in 60 days from this date, MISP 4.0 will be the approved MISP. 1. Draft RP 0603 on Common Time Reference for Digital Motion Imagery using Coordinated Universal Time (UTC) 2. Draft RP 0605 on Inserting Time Code and Metadata in High Definition Uncompressed Video 3. Draft RP 0402 on Infrared Motion Image Capture 4. Draft RP 0608 on Motion Imagery ID 5. Draft Update of RP 0102 on Security Metadata 6. Changed UAV to UAS
14 Dec 2006	4.1	Approved by MISB. If no objection in 60 days from this date, MISP 4.1 will be the approved MISP. 1. RP 0604 – Time Stamping of Compressed Motion Imagery; changed formal standard to ISO/IEC 13818-1:2000/AMD 1: 200 2. Changed RECOMMENDED PRACTICE 0102.3 to 102.4 3. Noted in Engineering Guideline 0104 that an error in obliquity angle in this document will be corrected in the next version. 4. Engineering Guideline (EG) 0104.4 updated to 104.5 5. RP 0608 Motion Imagery Identifier Added 6. Added STUDY 0606 on Motion Imagery Metadata Only Formats and Distribution Standards 7. Updated References
14 Jun 2007	4.2	Approved by MISB. If no objection in 60 days from this date, MISP 4.2 will be the approved MISP. 1. EG 0601 – UAS Datalink Local Metadata Set: updated to 0601.1 and mapping to EG 104.5 and issued for 30-day approval 2. RP 102.3 – Security Metadata Universal Set for Digital Motion Imagery issued for 30-day approval 3. RP 0602 – Annotation Universal Metadata Set: updated to 0602.1 and issued for 30-day approval 4. RP 0604 – Time Stamping of Compressed Motion Imagery: 30-day approval. 5. RP 0608 – Motion Imagery Identifier: updated to RP 0608.1 6. RP 0701 – Common Metadata Structure: added and MISB posted for information.

Date on Document	Version Number	Revision Record: Notes/Status
		7. Added language for IR resolutions and frame rates. 8. RP 0405 – Metadata for IR: deleted 9. Added Dr. Kasner to contact list 10. Updated Web Site
13 Sep 2007	4.3	Approved by MISB. If no objection in 60 days from this date, MISP 4.3 will be the approved MISP. 1. Updated RP 0102.2 to RP 0102.3 2. Updated RP 0301 to RP 0301.2 3. Updated EG 0601 to EG 0601.1 4. Updated RP 0605 to RP 0605.1 5. Updated RP 0608 to RP 0608.1 6. Added RP 0705 on WALFLVSD compression 7. Added Study 0701 on high bit-depth Infrared compression. 8. References updated.
13 Dec 2007	4.4	Approved by MISB. If no objection in 30 days from this date, MISP 4.4 will be the approved MISP. 1. Updated RP 0102.3 to RP 0102.4 2. Updated RP 0301.2 to RP 0301.3 3. Updated RP 0705 to 0705.1 4. Editorial changes to RP 0601.1 5. Changes to RP 0608.1 6. Added Study 0702 on ISO Based Media Format 7. References updated.
15 May 2008	4.5	Approved by MISB. If no objection in 30 days from this date, MISP 4.5 will be the approved MISP. 1. New definition for Motion Imagery and Full Motion Video (FMV) 2. Definition for Situational Awareness added 3. Requirement that all MPEG2 MI systems decode up to/including level 9, and that all H.264 MI systems decode up to/including level 9 4. Requirement that all IR MI MPEG2 systems decode up to/including level 8, and that all H.264 IR MI systems decode up to/including level 8. 5. MISM levels identified as M for MPEG2 and H for H.264 6. L10 and L9 limits on frame rates added 7. Video must be output without burned-in metadata 8. RP 0102.5 the new reference document for Security Metadata Universal Set 9. Informative section added: UAS STANAG 4586 KLV Metadata Implementation 10. STUDY 9809 Audio Interchange added 11. STUDY 0802 on Minimum Metadata for Situational Awareness added 12. RP 0301.3 13. RP 0705.1 14. RP 0605.2
18 Sep 2008	5.0	Approved by MISB. If no objection in 30 days from this date, MISP 5.0 will be the approved MISP. 1. RP 0604, 0102, 0301 changed to Standards 2. Updated EG 0601.1 to Standard 0601.2 3. Added EG 0803 Delivery of Low Bandwidth Motion Imagery 4. Added RP 0804 Real Time Protocol 5. Added RP 0705.2 LVSD Compression Profile 6. Changed EG 0602 to EG 0607 MISB Metadata Registry & Processes 7. Added EG 0801 Photogrammetry Metadata Set 8. Added EG 0805 CoT 9. Added EG 0806 Remote Video Terminal Local Data Set

Date on Document	Version Number	Revision Record: Notes/Status
		10. Added STANDARD 0807 MISB DoD/IC/NSG KLV Metadata Registry 11. Restated STANDARD 9701 MPEG2 Transport Stream in the File Formats Section
11 Dec 2008	5.1	If no objection in 30 days from this date, MISP 5.1, which includes a minimum metadata set for standard 0601, will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. A new EG 0812 on clipping of motion imagery 2. A new EG 0813 on placing motion imagery in the coalition shared database 3. A new EG 0809 on KLV representation of meteorological data 4. A revision to EG 0806.1 on Remote Video Terminal 5. Editorial revision to RP 0705.2 6. Added keys to the KLV standards dictionary 0807.1 Also, released for review and comment 1. A revision to RP 0602.1 on annotation 2. RP 0808 on chat 3. EG 0810 on KLV for LVSD 4. RP 0811 on JPIP
14 May 2009	5.2	If no objection in 30 days from this date, MISP 5.2 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. RP 0808 2. RP 0811 3. EG 0802 4. EG 0810 5. EG 0813 6. EG 0902 7. IP 0905 The following documents were revised (incremented version) 1. STD 0102.6 2. STD 0301.4 3. STD 0601.3 4. STD 0807.2 5. RP 0602.2 6. RP 0804.1 7. EG 0801.1 8. EG 0806.2 Also released for review and comment 1. Draft EG 0903 2. Draft EG 0904 The following other actions were taken: 1. RP 0103 was deprecated 2. RP 9720c was updated 3. Statement on progressive scan ED/HD replacing SD 4. Added: use of the POSIX Microsecond Key 5. Reference to MIL-STD-2500B updated to 2500C 6. References updated
03 Sept 2009	5.3	If no objection in 30 days from this date, MISP 5.3 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. EG 0903 2. EG 0904 The following documents were revised (incremented version) 1. STD 0102.7 2. STD 0807.3 3. EG 0806.3

Date on Document	Version Number	Revision Record: Notes/Status
		4. STD 0604 Also released for review and comment: 1. IETF Draft RTP Payload for KLV Encoded Data 2. STD 0404 3. STD 0403 (converted and continued as RP 0403.1) 4. MISB Compliant Standards for High Definition FMV The following other actions were taken: ▪ Clarification on MISP Compliance Definition ▪ Revised RP 9720b, RP 9720c, RP 9720d, RP 9720e ▪ RP 9709 – Line 21 encryption ▪ RP 9717 consistent with STD 0604 ▪ STD 9701 use of multiple programs in a MPEG-2 TS ▪ Use of the SMPTE 210.12 for POSIX Microsecond Time code ▪ References updated
3 Dec 2009	5.4	If no objection in 30 days from this date, MISP 5.4 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. STD 0601.4 (not approved; under revision) 2. EG 0801.2 3. STD 0807.4 4. RP 0403.1 5. STD 0404 6. STD 0902.1 Also released for review and comment: 1. IBMF Whitepaper v1 2. RP 0906 3. RP 0907 4. MISB Compliant Stream v3 5. Text for MISP CBR/VBR The following other actions were taken: 1. Clarification on MISP Compliance Definition 2. Revised values in the IR MISM tables to reflect the outcome of the IR Compression Study 3. References updated
20 May 2010	5.5	If no objection in 30 days from this date, MISP 5.5 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. STD 0102.8 2. STD 0301.5 3. STD 0601.4 (error: previously listed as version 5) 4. STD 0807.5 5. RP 0804.2 6. RP 1004 7. EG 1001 8. EG 1002 9. TRM 1003 The following other actions were taken: 1. Usage of Transport Stream STD 9701 2. Addition of RP 1004 - LVSD MISM table 3. Revised table labels 4. References updated 5. STD 0601.5 under revision
30 Sep 2010	6.0	If no objection in 30 days from this date, MISP 5.5 will be the approved MISP. Also approved with a 30-day comment period are the following: 1. STD 0102.9

Date on Document	Version Number	Revision Record: Notes/Status
		2. STD 0807.6 3. RP 0804.3 4. RP 0608.2 5. EG 0802.1 6. EG 0801.3 (not approved; under review and revision) 7. TRM 0909.1 8. TRM 1012 The following other actions were taken: 9. EG 1001 posted for review and comments 10. STD 0601.4 new date added 11. STD 0604 Title change The following other actions were taken: STD 0902 inclusion in MISP Compliance definition
27 Jan 2011	6.1	If no objection in 30 days from this date, MISP 6.1 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. RP 0101.1 2. RP 0903.2 (not approved; under review and revision; completed) 3. TRM 0909.2 The following other actions were taken: 4. Revise MISP 6.1 for LVSD 5. Revise STD 0604 for carriage of metadata 6. Fixed numeric error in RP 0605 (editorial change) 7. Post RP 0608.2 for review and comment 8. Post TRM 1013 for review and comment
9 Jun 2011	6.2	If no objection in 30 days from this date, MISP 6.2 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. STD 0107.1 2. STD 0603.1 3. STD 0604.2 4. STD 0605.3 The following other actions were taken: 5. TRM 0909.3 published
6 Oct 2011	6.3	If no objection in 30 days from this date, MISP 6.3 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. STD 0601.5 2. EG 0801.3 3. STD 0807.8 4. EG 1108 5. RP 1201 The following other actions were taken: 6. RP 0107 renumbered to RP 0108 7. STD 0403 changed to RP 0403 (partially done earlier) 8. STD 0402 superseded by RP 0402
4 Oct 2012	6.4	If no objection in 30 days from this date, MISP 6.4 will be the approved MISP. Also, approved with a 30-day comment period are the following: 1. STD 0807.10 MISB KLV Metadata Dictionary 2. RP 1204 Motion Imagery Identification System 3. EG 1108.1 Video Interpretability and Quality Keys 4. EG 1203.2 Video Interpretability and Quality Measurement and Prediction 5. EG 1205 Video Test Sequences 6. RP 0901.1 Video National Imagery Interpretability Rating Scale 7. STD 0903.3 VMTI (from RP 0903.2) The following other actions were taken:

Date on Document	Version Number	Revision Record: Notes/Status
		8. RP 1101 in review and comment 9. Draft EG 0801.4 in review and comment 10. Draft EG 1202 in review and comment 11. Draft EG 1107 in review and comment 12. Draft EG 1208 in review and comment 13. Draft EG 1206.1 in review and comment 14. Draft STD 1207 in review and comment 15. Draft RP 1102.1 in review and comment