Motion Imagery Standards Board **Engineering Guideline** **Integration of Motion Imagery into the STANAG 4559 Data Model**	**MISB EG 0813** **11 December 2008**

Scope

This document is technically identical to NATO EG0803 in draft Edition 3 of AEDP-8.

References

[1] ISO/IEC 13818-1:2007 Information technology – Generic coding of moving pictures and associated audio information: Systems
[2] SMPTE 336M-2007, Data Encoding Protocol Using Key-Length-Value
[3] SMPTE RP210.11-2008, Metadata Dictionary
[4] NATO EG0803 – Engineering Guideline to Facilitate Integration of Motion Imagery Products into the STANAG 4559 DATA MODEL
[5] MISB Standard 0601.2 – UAS Datalink Local Metadata Set
[6] STANAG 4609 – NATO Digital Motion Imagery Format
[7] STANAG 4559 – NATO Standard ISR Library Interface (NSILI)
[8] MISB RP0102.5 – Security Metadata Universal and Local Sets for Digital Motion Imagery
[9] MISB RP0701 – Common Metadata System: Structure

1 Introduction

This Engineering Guideline describes the necessary conditions for integration of motion imagery products into the STANAG 4559 Data Model (DM) and Interface, which is based on the MAJIIC Coalition Shared Database (CSD). The proposed approach covers both File products (clips) and Streaming products with a maximum of similarity in the approach for both types.

This EG proposes a schema that will address two challenges when integrating a 4609-compliant stream into the STANAG 4559 DM:

1) STANAG 4609 allows for numerous data elements, which may have more than one key registered in RP210 possibly used to represent data in a given implementation. For example, a time stamp can be represented by at least five different keys. This EG facilitates integration with the STANAG 4559 DM taking into consideration the possible disparate sources of KLV information.
2) The fielded solutions streaming KLV metadata are expected to evolve from exclusive uses of 16 byte Universal SMPTE keys, to MISB Standard 0601[5], and possibly MISB CMS [9] in the near future. This EG proposes a method that considers these evolutions and allows STANAG 4559 DM integration independent of the KLV encoding scheme.

MAJIIC IDD 2.06 presents well-defined attributes for the STANAG 4559 DM to use when integrating ISR products specifically for STANAG 4609 products. This EG facilitates integration of a generically compliant 4609 products, which can use any of the keys in RP210.10[3]. It does this by identifying, from all these possible keys, how the MAJIIC IDD attributes can be populated. Figure 1 presents the objective of this EG with STANAG 4559 DM attributes against elements present in the STANAG 4609 KLV stream.

Registry names of element that have to be in KLV Elementary Stream
Image Source Device
Episode Number
FC Lat&Long + Smart on ingestor
Security Classification
Release Instructions
User Defined Time Stamp
FC Lat&Long
Device designation
Platform designation
Source Organization
Elements that have to be video Elementary Stream
Video size (pixels)
Frame Rate
Video Encoding
Stream bit rate
category of sensor
Video Encoding

?

STANAG 4559 DM Entity.Attribute
NSIL_COMMON.source
NSIL_COMMON.identifierMission
NSIL_COVERAGE.spatialCountryCode
NSIL_METADATASECURITY.classification
NSIL_METADATASECURITY.releasability
NSIL_COVERAGE.spatialGeographicReferenceBox
NSIL_CARD.publisher
NSIL_VIDEO.frameResolution
NSIL_VIDEO.frameRate
NSIL_VIDEO.encodingScheme
NSIL_VIDEO.averageBitRate
NSIL_VIDEO.category
NSIL_VIDEO.MISMLevel
NSIL_VIDEO.metadataEncodingScheme
NSIL_STREAM.sourceURL
NSIL_STREAM.format
NSIL_STREAM.creator
NSIL_STREAM.dateTimeDeclared
NSIL_STREAM.formatVersion
NSIL_STREAM.programID

Figure 1: Objective: Mapping KLV to STANAG 4559 DM

The object of this Engineering Guideline is to facilitate the integration of 4609 products into the STANAG 4559 DM by producing a mapping from all compliant keys to STANAG 4559 DM attributes, while including all considerations above.

In addition, this EG considers the possibility of using a relatively simple application, which could be collocated on a host computer that has most of its CPU resources already allocated to CPU-intensive tasks such as real-time processing and display of STANAG 4609 stream to an operator. This EG conceptually enables using one single host to receive a 4609 stream, allow exploitation of this stream, record files in real-time, and host a STANAG 4559 DM. This requires a schema that will:

- Use processes already performed on the host computer
- Require minimal additional I/O operations
- Require minimal additional use of memory
- Run in lower priority than critical real time processes as needed

2 Producing the information for STANAG 4559

2.1 Concepts

The approach brought forward by this EG is based on three elementary concepts as follow:

- Definition of elements composing "*generic header information*"
- Generation of the "*generic header information*" from multiple KLV metadata element and encoding scheme
- Simple Clipping Procedure to write a 4609 Stream into files

These concepts are defined in the following sub sections.

2.1.1 Concept 1: Definition of a "*generic header information*" element

Produce the necessary information from the 4609 elements, both KLV and video parameters, to populate the STANAG 4559 DM attributes for Stream and File products. For this EG, this necessary information will be called the "*generic header information*" and should comprise the elements listed in Table 1 for clips or Table 2 for Streams. A possible format to contain this information could be an XML document, which could be easily processed by the '*ingestor'.* This EG focuses on the necessary information required and deliberately does not detail a specific schema to convey the information to leave a maximum flexibility in going from STANAG 4609 to STANAG 4559.

2.1.2 Concept 2: Generation of the "*generic header information*" from multiple KLV metadata elements and encoding scheme

Each element composing the *generic header information* can be sourced from several different KLV elements in the 4609 stream. Table 3 describes all the possible mappings, as one-to-many relationships for each element of the *generic header information*. This concept does not describe how to calculate each field but provides all possible keys from which the information may be derived. For each element, there may be more than one key that is registered in RP210. For example, a time stamp can be represented by at least five different keys.

2.1.3 Concept 3: Simple Clipping Procedure to write a STANAG 4609 Stream into files

This concept presents a low-overhead approach for the creation of motion imagery clip files from an MPEG-2 transport stream with asynchronous metadata. Additional maturation is needed before applying this EG to H.264 video or transport streams with synchronous metadata.

The Simple Clipping concept is founded on five key principles, with an additional consideration:

<u>Key Principle 1:</u> The first MPEG2 TS packet of the clip should be the Program Association Table (PAT).

<u>Key Principle 2</u>: The second MPEG2 TS packet of the clip should be the Program Mapping Table (PMT).

<u>Key Principle 3:</u> All Packetized Elementary Stream (PES) packets should be complete. This applies to all types of PES (video, audio, private, etc.) packets. In particular,

a. Each PES should be complete at the beginning of the clip file, and
b. Each PES should be complete at the end of the clip file.

c. For elementary streams containing MPEG-2 video, the first PES packet in the clip should start with a sequence_header followed by an Intra Coded Picture (I-frame).

Key Principle 4: The clip should absolutely preserve the stream sequence, except in the case it conflicts with Key Principles 1, 2, and 3 above.

Key Principle 5: The recorded clip should have at least 2 PCR packets.

A worked example is illustrated in Figure 2. The black diamond markers specify the desired clip boundaries. The placement of each TS packet (into clip N, or clip N+1) is based upon the desired clip boundaries, and the key principles.

At the beginning of the clip file:

The first packet of clip N is a PAT. The second packet of clip N is a PMT. The PAT and PMT should be the most recent PAT and PMT in the stream. For each PES present in the stream, the first TS packet in the clip has a payload_unit_start_indicator (PUSI=1). In other words, the first TS packet in the clip starts a complete PES packet for its specific Elementary Stream.

At the end of the clip file:

The next clip (N+1) begins with a PAT-PMT doublet. Once the marker for the end of clip 1 is reached, the first TS packets sought are the next (downstream) PAT and then the next PMT packet. These PAT and PMT packets are used for clip N+1. Once these PAT and PMT packets are found, the next (downstream) TS packets sought are, for each PES, the next packet with PUSI=1. From that point the previous TS packets of that PES complete the packet in Clip N. All following TS packets of this Elementary Stream are part of clip N+1. After the last PES is complete clip N is finished. In continuous clipping, all TS packets identified above as part of clip N+1 constitute the start of the next clip file.

Looking downstream and preserving every packet:

The clipping schema presented above is based on looking downstream, and it preserves every TS packet. The clipping procedure could also be performed looking backward (upstream) from the PAT-PMT in the stream; however, this would demand constant and high memory usage. Rejecting incomplete packets would alleviate the memory usage in this case.

This concept minimizes both the memory usage and the number of I/O operations. It preserves each TS packet of the stream, in order, and ensures only whole PES packets will be present in clip files.

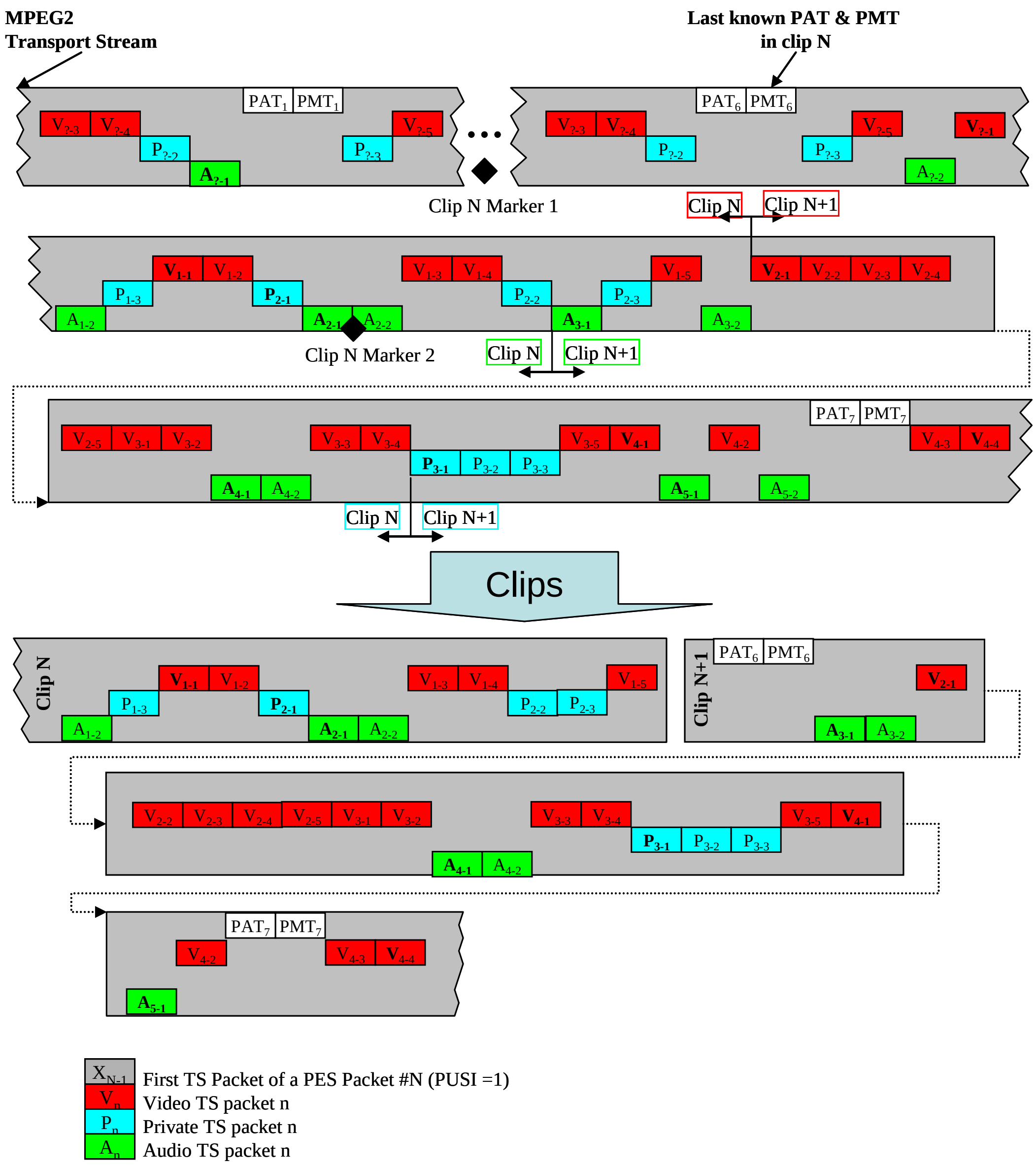

Figure 2: Illustrated example of clip boundary decisions

.

2.2 Process for Clips

Concepts introduced in the previous section are used. Each step is described in detail below.

2.2.1 First Clip

1) Connect to the stream if not already connected
2) Identify the start of the clip with Marker 1
3) Perform the clipping at the beginning of the files in accordance with the aforementioned key principles
4) Obtain the User Timestamp from the first KLV packet for element 6 of Table 2
5) In parallel:

a. Obtain *once* necessary data from the KLV as described in Concept 2 of Section 2.1 to produce elements 1, 2, 4, 5, 9 and 10 of Table 2, as they become available in the KLV stream;

b. *Frequently* monitor the stream for the Frame Center Latitude and Longitude; from this information preserve the extreme values for the duration of the clip.

Note 1: *Frequently* could mean every second. The Bounding Rectangle STANAG 4559 DM Attribute is not meant to be extremely accurate, but rather to generally describe the coverage of the clip and allow searches. With that in mind a reasonable number for frequency of monitoring FC Lat & Long should be selected depending on the dynamics of the system.

Note 2: If possible apply logic to filter out instances where the FC is looking too close to the horizon, and where the reported bounding rectangle would see its usefulness decreased. Possibilities include:

- For a depression angle corresponding to an FC less than 20 degrees, use for LAT and LON information one of the four corners coordinates that passes the same criteria;
- If FC *and* all corners are too close to the horizon as per the 20 degree criteria, disregard this instance; and
- If the FC is located too close to the horizon and corner information is not available or cannot be derived from the KLV, disregard this instance.

If similar logic becomes mandatory in a future version of this EG, Table 2 will have to include possible sources (a one-to-many relationship) of corner information in the KLV metadata.

6) If clipping is to be done at fixed time intervals in a continuous mode, keep track of the time by using the User Timestamp from the KLV.
7) Once the Marker 2 reached, indicating the end of the first clip, format the end of clip1 and the beginning of clip 2 in accordance with EG 0802.
8) Produce elements 7 and 8 of Table 2.
9) Using the information gathered during the duration of the clip, generate the *generic header information* as per Concepts 1 and 2 of section 2.1.

2.2.2 Subsequent Clips in a continuous clipping process

1) The beginning of the file was formatted in the process of the previous packet at step 7 above (in the process of closing the files for the first clip) or step 5 below (for subsequent clips).
2) Obtain the User Timestamp from the first KLV packet for element 6 of Table 2.
3) In parallel:

a. Obtain *once* necessary data from the KLV as described in Concept 3 of section 2.1 to produce elements 1, 2, 4, 5, and 8 of Table 2, as they come available in the KLV stream. Ensure these values have not changed from the last clips.

b. *Frequently* monitor the stream for the Frame Center Latitude and Longitude. From this information preserve the extreme values for the duration of the clip.

4) If clipping is to be done at fixed time intervals in a continuous mode keep track of the time in using the User Timestamp from the KLV.
5) Once the Marker 2 reached, indicating the end of the first clip, format the end of clip1 and the beginning of clip 2 in accordance with the clipping principles.
6) Produce elements 7 and 8 of Table 2.
7) Generate the *generic header information* as per Concepts 1 and 2 of Section 2.1, as was done for the clip 1.

2.3 Process for Streams

Concepts introduced in the Section 2.1 are used to generate the *generic header information* for a stream. Each step is described in details below:

1) Connect to the stream if not already connected
2) Obtain values for elements 1,2, and 7 through 20, which will all remain constant for the life of the stream
3) Use the stream for the Frame Center Latitude and Longitude and corners or Field of View parameter to determine a representative Georeference Bounding Box. The logic as for clips from Section 2.2 to filter out instances when the FC is looking too close to the horizon.
4) Produce the *generic header information* as often as required, for example every minute or every five seconds

2.4 Limiting I/O operations and memory usage

Clipping Concept presented in EG 0802 minimizes the memory usage. If in parallel there is a process for parsing the KLV, for example to display the product to a user, it would save CPU if this process could be leveraged to find the information required to generate the *generic header information*.

Table 1: Clips – Mapping between suggested *generic header information* and the STANAG 4559 DM attributes

STANAG 4559 DM Entity.Attribute	*El #*	*generic header information* (suggested elements)
NSIL_COMMON.source	1	= Sensor Identification
NSIL_COMMON.identifierMission	2	= Mission Identification
NSIL_COVERAGE.spatialCountryCode	3	
NSIL_METADATASECURITY.classification	4	= Security Classification
NSIL_METADATASECURITY.releasability	5	= Release Instructions
NSIL_COVERAGE.temporalStart	6	= Clip Start Time (UTC)
NSIL_COVERAGE.temporalEnd	7	= Clip End Time (UTC)
NSIL_COVERAGE.spatialGeographicReferenceBox	8	= Georeferenced_Bounding_Rectangle
NSIL_CARD.publisher	9	= Source Organization
NSIL_FILE.creator	10	= Platform designation (see context)
NSIL_VIDEO.frameResolution	11	= (1) Video size (pixels)
NSIL_VIDEO.frameRate	12	= (1) Frame Rate

NSIL_VIDEO.encodingScheme	13	= (1) Video Encoding
NSIL_VIDEO.averageBitRate	14	= (1) Stream bit rate
NSIL_VIDEO.category	15	= (1) category of sensor
NSIL_VIDEO.MISMLevel	16	= (1) based on resolution, bandwidth, etc as per STANAG 4609
NSIL_VIDEO.metadataEncodingScheme	17	= Metadata Encoding present in the PMT information

Table Footnotes:
(1) Data not present in KLV but retrievable from the video PES
(2) To know if a STANAG 4559 DM attribute is optional or mandatory refer to the STANAG 4559 Documentation

Table 2: Streams – Mapping between suggested *generic header information* and the STANAG 4559 DM attributes

STANAG 4559 DM Entity.Attribute	***El #***	***generic header information* (suggested elements)**
NSIL_COMMON.source	1	= Sensor Identification
NSIL_COMMON.identifierMission	2	= Mission Identification
NSIL_COVERAGE.spatialCountryCode	3	
NSIL_METADATASECURITY.classification	4	= Security Classification
NSIL_METADATASECURITY.releasability	5	= Release Instructions
NSIL_COVERAGE.spatialGeographicReferenceBox	6	= Georeferenced_Bounding_Rectangle
NSIL_CARD.publisher	7	= Source Organization
NSIL_VIDEO.frameResolution	8	= (1) Video size (pixels)
NSIL_VIDEO.frameRate	9	= (1) Frame Rate
NSIL_VIDEO.encodingScheme	10	= (1) Video Encoding
NSIL_VIDEO.averageBitRate	11	= (1) Stream bit rate
NSIL_VIDEO.category	12	= (1) category of sensor
NSIL_VIDEO.MISMLevel	13	= (1) based on resolution, bandwidth, etc as per STANAG 4609
NSIL_VIDEO.metadataEncodingScheme	14	= Video Encoding present in the PMT information
NSIL_STREAM.sourceURL	15	= (1) Stream Connection Information
NSIL_STREAM.format	16	= STANAG 4609
NSIL_STREAM.creator	17	= Platform designation (see context)
NSIL_STREAM.dateTimeDeclared	18	= user time stamp
NSIL_STREAM.formatVersion	19	= Edition of the STANAG 4609
NSIL_STREAM.programID	20	= Program ID (from the PAT)

Table Footnotes:
(1) Data not present in KLV but retrievable from the video PES
(2) To know if a STANAG 4559 DM attribute is optional or mandatory refer to the STANAG 4559 Documentation

Table 3: Possible 4609 compliant KLV element required to produce the *generic header information* (one-to-many)

	generic header information **element name**		**Defining Document (3)**	**Key**
1	Sensor Identification		RP210.10[3]	0x060E2B3401010101010420010201010000
			RP210.10	0x060E2B3401010101090420010201010100
			STD0601[5]	0d11
			RP0701-702 (CMS)[9]	TBD
2	Mission Identification		RP210.10	0x060E2B3401010101010105050000000000
			RP210.10	0x060E2B3401010101030105050100000000
			STD0601	0d03
			RP0701-702 (CMS)	TBD
3	Security Classification		RP210.10	0x060E2B3401010101030208020100000000
			RP210.10	0x060E2B3401010101090208020101000000
			STD0601(RP102.5)	0d48 (0d01)
			RP0701-702 (CMS)	TBD
4	Release Instructions		RP210.10	0x060E2B3401010101030701200102090000
			STD0601 (RP102.5)	0d48 (0d06)
			RP0701-702 (CMS)	TBD
5 & 6	Clip Start time (UTC) (1) & Clip End time (UTC)		RP210.10	0x060E2B3401010101010702010101010000
			RP210.10+309M&331M	0x060E2B3401010101010702010101030000
			RP210.10+12M&331M	0x060E2B3401010101010702010101040000
			RP210.10	0x060E2B3401010101030702010101050000
			STD0601	0d02
			RP0701-702 (CMS)	TBD
7	Bounding_Rectangle	Lat	RP210.10	0x060E2B3401010101010701020103020000
			RP210.10	0x060E2B3401010101030701020103020200
			RP210.10+330M	0x060E2B3401010101010701020103030000
			STD0601	0d23
			RP0701-702 (CMS)	TBD
		Lon	RP210.10	0x060E2B3401010101010701020103040000
			RP210.10	0x060E2B3401010101030701020103040200
			RP210.10+330M	0x060E2B3401010101010701020103050000
			STD0601	0d24
			RP0701-702 (CMS)	TBD
		Lat&Lon	RP210.10	0x060E2B3401010101010701020103060000
		Image Coord System	RP210.10	0x060E2B3401010101010701010100000000
			STD0601	0d12
			RP0701-702 (CMS)	TBD
8	Platform Designation		RP210.10	0x060E2B3401010101030101210100000000
			RP210.10	0x060E2B3401010101090101210101000000
			RP210.10	0x060E2B3401010101010101200100000000[3]
			STD0601	0d10
			RP0701-702 (CMS)	TBD
9	Source Organization		RP210.10	0x060E2B3401010101010101200100000000[3]
			STD0601	0d10
			RP0701-702 (CMS)	TBD

Table footnotes:

(1) Event Start Date and Time – UTC and Video Clip Duration element of the *generic header information* refers to the beginning of the clip and therefore uses the *Timestamp* of the first KLV packet encountered in the clip It does uses the *Event Start Date and Time – UTC* key that can possibly be used in the stream.
(2) Short version of SMPTE references are used, where 330M corresponds to SMTPE 330M. Similar references are made for 12M, 309M and 331M
(3) Some 4609 implementations may use ‘Device Designation’ to identify the platform. That’s a misuse since ‘Device’ refers to the sensor.

Table 4: STANAG 4559 DM DESCRIPTION OF THE ATTRIBUTES

STANAG 4559 DM Attribute	*generic header information* related elements	Description (MAJIIC IDD 206)
source	Image Source Device	References to **assets** (e.g. platform IDs) from which the tagged data asset is derived. Sources may be derived partially or wholly; it is recommended that an identifier (such as a string or number from a formal identification system) be used as a reference. For multiple sources these shall be separated by BCS Comma (could happen for container files like AAF, MXF and NSIF). 'Source' is different from 'creator' in that the 'source' entity is the provider of the data content, while the 'creator' is the entity responsible for assembling the data (provided by "sources") into a file. Note: Examples of assets are 'EO Nose', 'EO Zoom (DLTV)', 'EO Spotter', 'IR Mitsubishi PtSi Model 500', 'IR InSb Amber Model TBT', 'LYNX SAR Imagery', ' NADIA DLTV '
identifierMission	Episode Number	An alphanumeric identifier that identifies the mission (e.g. a reconnaissance mission) under which the product was collected/generated. As an example, for products collected by sensors on an aircraft, the mission identifier should be the 'Mission Number' from the Air Tasking Order (ATO).
classification	Security Classification	NATO Security markings which determine the physical security given to the information in storage and transmission, its circulation, destruction and the personnel security clearance required for access as required by [C-M(2002)49]
releasability	Release Instructions	An additional marking to further limit the dissemination of classified information in accordance with [C-M (2002)49]. Values include one or more three-character country codes as found in STANAG 1059 edition 9 separated by a single BCS Comma (code 0x2C). Default value should be NATO. Note: Although STANAG 1059v9 includes the 'XXN' entry for NATO, the full 'NATO' name shall be used to indicate NATO releasability to avoid any confusion from established and common used terms.
temporalStart	Event Start Date and Time - UTC	Start time of a period for the content of the dataset (start time of content acquisition). For products capturing a single instant in time, start time and end time will be equal ((or the end time could be omitted).
temporalEnd	temporalStart + Video Clip Duration	End time of a period for the content of the dataset (end time of content acquisition). For products capturing a single instant in time, start time and end time will be equal (or the end time could be omitted).
spatialGeographicReferenceBox	Bounding_Rectangle	Geographic location of the dataset In WGS-84 reference system, and using decimal degrees. The first coordinate represents the most North-Western corner, the second the most South-Eastern corner. The x-value in a UCOS: Coordinate2D struct represents the longitude, the y-value represents the latitude.
publisher	Source Organization	The name of the **organization** responsible for making the resource (product) available in an IPL. By doing so, the publisher enables the discovery of that resource by a requestor entity (client). Examples of organizations are 'CJTF', 'LCC', 'ACC' etc.
creator	Platform Designation	An entity primarily responsible for making the content of the resource. Creator is responsible for the intellectual or creative content of the resource. With raw sensor products, a creator is the **unit** that runs the sensor. With exploited products, it is the **exploitation station**, with an Information Request (IR) it an IR Management system/service. Note: Examples of unit running the sensor or exploitation station: 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'IgnatER', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc.